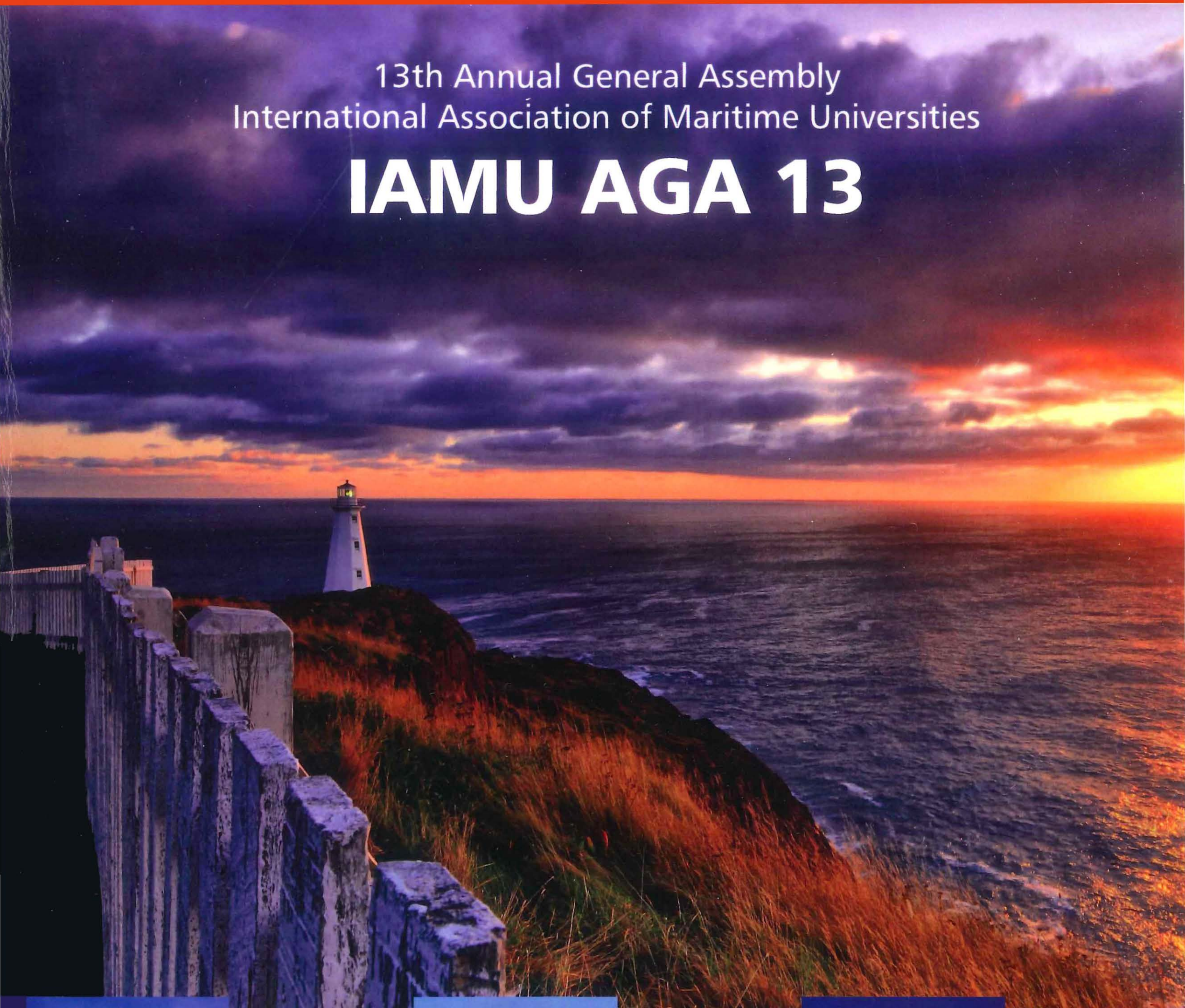
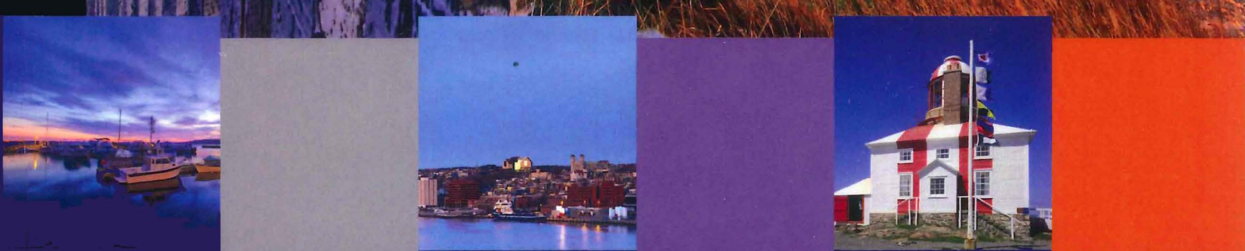
13th Annual General Assembly
International Association of Maritime Universities

IAMU AGA 13





Expanding Frontiers

Challenges and Opportunities in Maritime Education and Training

Fisheries and Marine Institute of Memorial University of Newfoundland
October 15-17, 2012

13th Annual General Assembly

International Association of Maritime Universities

IAMU AGA 13

Expanding Frontiers

Challenges and Opportunities in Maritime Education and Training

Editor(s):

Robert Mercer

John Cross

Christopher McCulloch

Fisheries and Marine Institute of Memorial University of Newfoundland

October 15-17, 2012

Dear IAMU Members and Colleagues

The Fisheries and Marine Institute of Memorial University (Marine Institute) is honored to host the 13th Annual General Assembly (AGA 13) of the International Association of Maritime Universities (IAMU) in St. John's, Newfoundland and Labrador (NL), Canada from October 15 – 17, 2012.

The IAMU membership represents the leading Maritime Education and Training Institutions in the world and we are pleased to welcome you to this year's annual meeting to exchange ideas and decide on our collective future. We are proud to be the largest marine institute in Canada and considered to be North America's most comprehensive institute dedicated to education, training, applied research and industrial support for ocean industries.

This year marks the 100 anniversary of the sinking of the Titanic which resulted in the establishment of the global maritime regulatory frameworks and regulations under which we all operate. This year also coincides with the introduction of the Manila Amendments to STCW, and this will have an impact on Maritime Education and Training (MET) and possibly change the way we provide service to the global shipping industry. Additionally, due to our proximity to the Titanic's resting spot and to the harsh North Atlantic Ocean our theme for the AGA 13 Conference is:

Expanding Frontiers

Challenges and Opportunities in Maritime Education and Training

Many IAMU members are involved in research, training, and education on many 'frontiers' and some of the frontiers that will be explored at the AGA 13 will be situational awareness; recruitment and retention of seafarers; distance education and technology; participation of women in the marine industry; and the new STCW standards.

We will have over 30 presentations and 5 project presentations during the AGA13 and I encourage all of you to take this opportunity to share your thoughts and ideas with your IAMU colleagues from all over the world.

The past, present and future of our city and our province revolves around the ocean and I look forward to sharing it with you at AGA13.

Mr. Glenn Blackwood

Chair of the AGA13 Local Executive Committee

Vice-President, Memorial University (Marine Institute)

Organization of the IAMU

Honorary Chair

Mr. Yohei Sasakawa
(Chairperson of The Nippon Foundation)

International Executive Board

Prof. Cornel Panait, Ph.D. , Chair
(Constanta Maritime University)

Valeriy L. Mikheev, Ph.D. in law
(Admiral Makarov State Maritime Academy)

Capt. Irakli Sharabidze
(Batumi Maritime University)

Mr. Glenn Blackwood
(Fisheries and Marine Institute of Memorial University of Newfoundland)

Dr. Han-il Park
(Korea Maritime University)

RADM Richard G. Gurnon
(Massachusetts Maritime Academy)

Captain (N) Prof. Dr. Boyan Mednikarov
(Nikola Y. Vaptsarov Naval Academy)

Prof.Dr. Luong Cong Nho
(Vietnam Maritime University)

Dr. Björn Kjerfve
(World Maritime University)

Mr. Mitsuyuki Unno
(The Nippon Foundation)

Mr. Hideaki Uematsu
(IAMU Secretary)

Secretary's Office

Mr.Hideaki Uematsu, Secretary

Mr. Hidemasa Tagami , Vice-Secretary

Ms.Etsuko Komatsu, Coordinator

Expanding Frontiers

Challenges and Opportunities in Maritime Education and Training

Editor(s)

Robert Mercer

John Cross

Christopher McCulloch

Fisheries and Marine Institute of Memorial University of Newfoundland

AGA 13
Expanding Frontiers - Challenges and Opportunities in Maritime Education and Training

Editor(s):
Robert Mercer
John Cross
Christopher McCulloch

Published by:
The Fisheries and Marine Institute of Memorial University of Newfoundland
Local Executive Committee of IAMU AGA 13.

The texts of the papers in this volume were set individually by the authors or under their supervision. Only corrections pertaining to the style and/or formatting of the text may have been carried out by the editors.

ISBN 978-0-88901-439-8

Contents

How to overcome the 'Culture of Compliance'?

Captain Quentin N Cox
Senior Lecturer, Warsash Maritime Academy, Southampton Solent University, Newtwon Road, Warsash, Southampton, UK SO31 9ZL
Quentin.cox@solent.ac.uk

Abstract: For too long many of the less reputable shipping operators have tainted the industry with standards that are on the regulatory borderline. The approach appears to be that the regulatory standard of operation represents the very zenith of operational standards and that any additional effort to rise above such a level is effort, time and money wasted. The company culture is one of nothing more than compliance with regulations. For the reputable operators, their own company policy standards vastly exceed those required by regulation. Moreover, standards in terms of operational procedures and hardware, are often driven up by charterers' requirements, again often way above mere regulatory standards. Changes in regulations rarely affect the reputable operators, many of whom will anticipate legislative changes and enshrine them in their own operational practices long before any legislation amendment is implemented. Changes in regulations are generally aimed at the non-conformers, who persistently manage to find a way to harm themselves and the environment, whichever regulations are in place at the time. Very often, incidents occur not because the company has failed to train its staff, especially when such training is mandatory but simply where training has been ineffective or not put into practice. So what are our options? If the training is failing, perhaps that is the area which needs attention. What could motivate ships' staff to the extent that they carried out their duties not just safely but efficiently and cost effectively? How could the knowledge and skills imparted by the training become implemented more efficiently? The paper discusses, through argument and counter argument, possible options to ensure what has been trained will be implemented in the working arena. Training of company staff is often interpreted as a box-ticking exercise, so it is time to rid the industry of this mentality.
Keywords; Training, Education, Human Factors, Legislation, Innovation, Technology in Teaching and Learning.

1. Define the 'Culture of Compliance'.

There is a very specific meaning of the phrase 'Culture of Compliance' within the context of this paper. There is an apparent prevailing attitude amongst certain shipping staff that compliance with minimum legislative standards alone will be sufficient for their company to succeed commercially. Many observers may rejoice in the knowledge that their colleagues are willing to make enough effort to comply with regulations, yet the attainment of this level alone will not enable an operator to compete commercially.

Perhaps a more focused title would be to refer to the culture of regulatory compliance. The implication is that a commercial operator will not succeed by regulatory compliance alone; they require safe, efficient and cost effective operations. Those qualities do not result from mere regulatory adherence. Yet ship safety inspectors, such as Port State or Flag State or even Classification Society, are looking only for legislative and regulatory compliance. So perhaps the perception of ship and company staff is that a standard of performance aligned with these requirements is sufficient to continue trading. After all, a ship and ship company (in all contexts of the term) will not be prosecuted or detained if all rules and regulations are followed.

So why would a workforce choose to put in any extra effort, above and beyond that required to follow the rules? I am basing these comments and suggestion on pure speculation, yet it is abundantly clear that there are institutional cultures within the shipping industry that appear to exist on such philosophies. It is not necessary to identify a series of culprits within this paper as one only has to read the trade press, even intermittently, to notice the multitude of shipping related incidents that result from a lack of, or error in, judgement during a navigational or operational procedure. Most would appear to have been following all the rules, but perhaps not recommendations and best practice. It is not the intent of this paper to launch into a diatribe about risk management but the incidents to which I refer are very rarely attributable to the misjudgement of one individual alone. More often than not, managerial and supervisory responsibilities are open to question.

2. How can an operator establish a desired level of performance above and beyond what is required by regulations?

Neither is it the intent of this paper to preach business management and to recite mantras generally found in MBA (Master of Business Administration) material but the business world is full of advice of how to bring the best out of a workforce. There is no lack of application of these principles to shipping and indeed the esteemed InterManager includes the following paragraph in its mission statement to emphasise the point;

> "InterManager is committed to improving transparency and governance in the shipping world and ensuring high standards are maintained throughout the shipmanagement sector" (InterManager)[1].

The organisation may appear to be a highly business-oriented enterprise but amongst its aims is to link the performance of individuals who make up the work force with the commercial performance of their employers. Moreover, the impetus is to encourage high standards in both.

Usage of terms such as Key Performance Indicators (KPI) may sound like pretentious management speak to the hardened seafarer but these are the very ideas which encourage and enable working standards and performance to be raised.

I am a former hardened seafarer myself and I have often, in the past, made the cynical observation that safety and profit are mutually exclusive objectives. One can only be achieved at the expense of the other, or so it is tempting to believe. The fact is that in commercial shipping, lucrative charter parties can be attracted by ships and their staff demonstrating qualities significantly above those required for mere regulatory compliance alone. So maybe safety and commercial success are not so far apart after all. Maybe one can lead to another. Maybe it is this idea that appears such an anathema to the less scrupulous shipping enterprises and their staff.

Maybe the shipping industry collectively should be more motivated into research of this area. As has been noted as recently as 2007;

> "Although there have been numerous studies examining general quality management practices and implementation, industry-specific studies on quality management practices and factors that influence their success in the shipping industry are rather few" (Cheng and Choy 2007)[2].

It would be wrong to be judgmental when considering the plethora of shipping incidents peppering the pages of the trade press, since we never really know all the pertinent details of any reported incident. However, one wonders how much notice of quality standards and performance enhancing regimes has been taken by the outfits featuring in such sobering press articles.

Of course there is no absolute necessity for any employer to subscribe to any quality management administration managers. There is a mandatory requirement to demonstrate a workable safety management system (SMS). During my time working as an auditor I came to the conclusion that many quality management accreditations simply indicated the company possessed a quality system. It didn't indicate whether the system was of any practical value. To a degree, the advent of the ISM Code requiring a SMS is a great deal more effective. Nonetheless, one does wonder if the SMS on the ships featured in the casualty lists were followed comprehensively.

3. What motivates operators and operatives?

The two areas maritime regulation tends to focus upon most rigidly are safety and pollution, though the scope of requirement has spread gradually. The ability to demonstrate adherence to these regulations is not purely for the purposes of passing mandatory inspections, though we can often be forgiven for thinking as such. For example, why would a ship prepare or rehearse for an inspection or vetting? Are they trying to reach a peak of presentation? Or is the inspection meant to provide a snap shot of a sort of plateau, a consistent standard of operation?

Regulations declare themselves to be 'minimum standards'. Take a look at chapter 17 of the IBC Code for chemical tankers [3]. What is the title of the chapter? Summary of *Minimum* Requirements. Is it reasonable to expect higher standards, or are the minimum standards too high for some?

Does it occur to operators and operatives that establishing a culture of good practice might possibly be for their own benefit? Ask the surviving victims of the *Doola 3* or the *Edirne* on 15th January, the same weekend as a certain other higher profile navigational incident. Ask the survivors from the hot work incident on the *Prem Diva* 6 days earlier, or the *Stolt Valor* on 15th March 2012, or the *Royal Diamond 7* on 24th March 2012, as reported in the 30th March 2012 edition of *Trade Winds* [4]. Do they feel the adherence to regulations and demonstration of good practice are for inspections, or that there are additional benefits in following them? I am not for one moment suggesting recommended guidelines were neglected in any of these reported incidents and it would be very foolhardy to suggest as much, particularly in the light of the fact that investigations have yet to be concluded. However, I am trying to make the point that it would be equally foolhardy for any seafarer or ship manager to be complacent and to think that the days of shipping accidents are over.

Guidelines exist for a purpose. Even the most reputable operators can be caught out, as recently evidenced. Following guidelines will not guarantee safety but it will certainly reduce the chances of incident. Published guidelines, often endorsed by advisory bodies, are usually accepted as carrying as much weight as an article of legislation by marine prosecutors; they are an *Accepted Code of Practice.* Deviation from such practice would likely be regarded as failing to exercise a due standard of care, as described by Russo, 1999 [5].

So what about pollution avoidance? Once again staff may actually have a conscience about the environment and would choose to protect it, despite apparent commercially attractive alternatives not to. Yet the incentive to being awarded lucrative commercial contracts will be based on a sound track record of pollution free operation.

Again, during my auditing and consulting days of the mid-1990s, one of my obligations was to sit with the Master of a tanker named, at the time, the *Sea River Mediterranean* and ask if his ship had recently been involved in any pollution incidents – and to do so with a straight face. Mercifully, the Master in question was aware of my obligation and treated my question with sensitivity, where he might have been tempted otherwise. In response to his explanation; "not since March 1989" I, in turn, resisted the temptation to ask, "Can you just run that incident past me again, Captain, what happened then?"

It may seem amusing upon reflection, yet this one incident, arguably the most infamous tanker incident on record, has led to so much development of quality and safety management procedures. The main objective of investigating these incidents is to ensure they don't happen again.

An example of more tangible incentives on offer is provided by Exmar Ship Management, with their retention mantra "we pay you stay" (2007) [6]. This inferred more than simply remuneration but a more comprehensive employment package incorporating what they considered favourable terms and conditions.

"How are we finding and developing officers? Exmar 'we pay, you stay' 2007"

I recall an experience of mine, as a tanker training course lecturer with two commercial ship vetting inspectors. We were discussing the minor contrast between the International Safety Guide for Oil Tankers and Terminals (ISGOTT) [7] and the International Chamber of Shipping Tanker Safety Guide for Chemicals [8] for tank washing in a non-inerted condition. The discussion became heated when they started to argue about the contention of *minimum* standards. Despite the increasing tension, the result was a very thought provoking argument. What was revealed was the fact that many different tanker companies approached the task in a number of different ways. The technicalities of different tank washing regimes is not the theme of this paper but the fact that such a frequent and routine tanker operation can be approached so arbitrarily may be of concern. This is not to advocate strict consistency between the various tanker codes or indeed otherwise. However, it is of interest that two recent course attendees, whose profession is based on scrutinising observation of tanker practice, should report such diversity. Only the more reputable tanker operators would have invited these vetting inspectors on board, so they provided an interesting insight into current practice.

So, on the basis of what has been reported, is it fair to say changes in regulations or the introduction of new regulations are made largely to motivate the less reputable operators?

4. "It takes a major disaster to change the regulations".

How many times have we heard this lament? I recall hearing this most recently on one of those patronising 'investigative journalism' type programmes on UK television in the wake of the *Costa Concordia* incident in January 2102 (Channel 4, 2012) [9] . Well, despite this having become a standard response to such events, I assert that a professional operator does not need regulations in order to execute a professional service. If the mentality of the operator is to achieve a reliable standard, in terms of safety, prevention of pollution and cost efficiency, then of what significance are regulations to such an operator? They know they are meeting all applicable regulations but their motivation is not the existence of regulations alone. Their motivation is to compete in a commercial industry by providing a better 'experience' for their customers than their competitors. Regulatory compliance is the *very least* standard expected by their customers. This is what I mean by breaking away from what I term the *culture of compliance.*

This is the basis of what commercial vetting programs are aiming to achieve and perhaps why they have been so prominent in commercial shipping, especially the tanker trade. It is no bad thing either, though the way vetting inspections have evolved has become rather contorted, in that chartering companies do not seem to trust one another's reports. However, the premise is a very simple and a very reliable one. It is purely an attempt to find evidence of sound professional practice, where attention to detail is taken to ensure the customer has faith in the service for which they are paying. Once again, regulatory requirement is the very least acceptable, not the most. Customers expect to be provided with evidence that their investment is being protected by knowledgeable and trustworthy professionals. They are looking for evidence of good practice, not simply regulatory compliance alone. That is why their ship inspection questionnaires are so long and detailed.

It is not difficult to find reputable and commercially successful shipping operators. Neither is it difficult to understand how they have built and protected their reputation.

Why are they successful? Possibly because they do not pander to the very *culture of compliance* to which I refer but seek ever increasing standards of operation, which are not covered or required by regulation. These are the companies who see that safety and commercial success actually go hand in hand, in that one is likely to follow the other.

I am constantly being asked about vetting requirements which cannot be found in regulations. My response is usually to the effect that indeed, such requirements will not be found within applicable regulations but the presence of an item or a procedure is re-assuring to the customer. They will have more faith in the client to protect their investment. That is what increasingly high levels of good practice will yield.

Investment in hardware is one matter, such as an oil tanker having a vapour return manifold. This is not required by MARPOL Annex VI, since it governs ship requirements rather than terminal requirements. If the ship never visits one of the few oil terminals which actually possess a vapour return facility, what's the point of the regulations insisting on the ship having one? Nearly all commercially competitive operators have installed such a manifold, so that they will become more attractive to lucrative charter parties.

However, the yield from good practice, where training is implemented is another matter and one worth considering further.

5. What theories and practices are there to ensure training is effective?

So if an employer provides motivational incentive for operatives to work to a professional standard and yet this standard does not always seem to prevail, then what else can we examine? The training programme is another area that warrants a look. For decades, corporate management has been pondering how to make training more effective, no matter what and how much training has been delivered.

Consider the term *training evaluation* and one is likely at some stage to come across the theories of Donald Kirkpatrick, which were first published in a series of articles in 1959 in the *Journal of American Society of Training Directors*. He revisited and updated his theories into a 1976 publication *Training and Development Handbook* [10], which is more commonly quoted these days. Unsurprisingly, being of such a vintage, many other academics have revisited these theories and have come up with some feedback. For example, Salas and Canon-Bowers assert that;

> "However, recent work has either expanded it or pointed out weaknesses, such as the need to develop more diagnostic measures" (2001)[11].

Kirkpatrick's original ideas are based on four levels of evaluation; reaction, learning, behaviour and results. Furthermore, one of the very few books published regarding Crew Resource Management training (Kanki et al 2010) and even more rarely, a short passage of this training in the shipping industry has additional observations.

Within this publication Shuffler et al (2010) [12] describe Kirkpatrick's approach as the most common and most simplistic. Later, it cites Kraiger et al (1993) [13] as taking Kirkpatrick's model;

> "a step further by detailing the outcomes (skill based, cognitive, affective) that must be evaluated after training". This model takes a multidimensional approach that is designed to provide a more comprehensive view of outcomes to what is being learned" (Kraiger et al 1993).

So there is no absence of theory relating to how training may be successfully implemented. Several corporate assessments are also illustrated in this publication but it is perhaps a little worrying that shipping companies, unlike their counterparts in for example, the aviation industry, do not apparently seek to promulgate their findings in this area so prominently. It appears a little perverse that employers should spend millions on training their staff, yet there is very little evidence to indicate how satisfied those that pay are seeing the training implemented. Is it possible the employers see mandatory training as little more than a tick box exercise? As Houghton ((2012) asserts with regard to such mandatory training;

> "...one unintended consequence is that they actually give average-performing organisations an excuse for not doing anything substantive". "...everyone assumes the programme is just fine. After all - the boxes are being ticked!" (Hougton 2012)[14]

So maybe I am not the only one who suspects as much.

6. What monitoring mechanisms are in use?

This is the tricky question to answer, as alluded to in the previous paragraph. At this stage we can only look at the existing techniques with which the industry is already familiar. Over and above the *minimum* - not *maximum*- regulatory requirements, there are many voluntary schemes which enable an operating establishment to assess themselves. Examples of these are the ship inspection report scheme (SIRE) and the Tanker Management and Self Assessment scheme. They are described by their originators as;

> "The Tanker Management and Self Assessment (TMSA) programme provides ship operators with a means to improve and measure their own management systems. The programme encourages ship operators to assess their safety management systems against listed performance indicators. The results of these assessments can then be used to develop an improvement plan, using the stages of attainment described in the programme, to achieve safety and environmental excellence" [15].

Commercial vetting mechanisms, as mentioned earlier, also serve a purpose but there is a theme developing within this list of examples. It does still appear that tankers and tanker terminals have set a trend, which has not been wholeheartedly embraced by other sectors of the shipping industry. Danger is not the exclusive realm of tankers.

Recent events have highlighted the hazards associated with passenger liners and dry bulk carriers, according to a paper presented to the IMO Maritime Safety Committee, [16] have an even worse safety record than those of tankers.

Thankfully, there are now many more guidelines available for cargo ships other than tankers, as indicated by the IMO, as well as various P&I clubs. So there is no shortage of suitable guidance easily available for operators to establish and maintain sound operating practice.

7. Conclusion

The fundamental thrust of this paper is to motivate operators away from and to a higher level than simply a culture of regulatory compliance. This level is cited by regulators' own descriptions as a minimal level, at which a commercial operator will simply pass its mandatory inspections. It is a level which will not guarantee commercial success and customers of such operators will very soon indicate to operators who maintain such a mentality. More simply, there will not be any commercial customers.

The paper advocates an approach which treats regulation as an indication of the bare minimum, in terms of operational standard, and furthermore, one which encourages aspiration to higher standards. These higher standards can be identified through participation in voluntary self-assessment schemes and following advice given by institutions dedicated to the prevention of incidents, such as P&I clubs, most of whom produce excellent incident avoiding literature. Incident avoidance can be striven for through a number of activities, not just by learning from previous incidents but by adhering to voluntary guidance and by implementing mandatory and non-mandatory training. Fellow high risk industries such as aviation, the offshore industry, medicine and the nuclear industry have all applied and encouraged self-monitoring research. It is time the shipping industry followed suit on a much larger scale than has been hitherto evidenced.

References

[1] Intermanager. (2012) Promoting Excellence in Ship Management, Who are we? [Online] Available: http://www.intermanager.org [Accessed 17th April 2012]

[2] Cheng, E. & Choy, P. (2007) Measuring success factors of quality management in the shipping industry. Maritime Economics & Logistics, 2007, 9, (pp.234–253) Palgrave Macmillan Ltd.

[3] International Maritime Organisation (2007) International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code) Chapter17.

[4] Corbett, A. (2012) Fourth balst rocks chem-tank sector. Trade Winds. The International Shipping Newspaper. 23 (13). March 30th 2012.pp. 46-47.

[5] Russo, T. (1999) Criminal Liability in Maritime Accidents. DRI Admiralty and Maritime Law: Freehill Hogan & Mahar LLP. Selected Topics, pp. 43-56, 1999. [Online] Available: http://www.freehill.com/articles/crimliab_maritime.cfm [Accessed 17th April 2012]

[6] Jungbluth, R. (2007) How are we finding and developing officers? Staff Development of the LNG Ship. [Online] Available: http://www.thedigitalship.com/powerpoints/ath07/Rene%20Jungbluth,%20Exmar%20-%20crewing.pdf [Accessed 17th April 2012]

[7] International Safety Guide for Oil Tankers and Terminals (2006) 5th Edition. Shipboard Operations. Witherby. London. p.191.

[8] Tanker Safety Guide (Chemicals) (2002). Cargo Tank Washing and Cleaning. International Chamber of Shipping. London. p.73.

[9] Disasters at sea; Why Ships Sink (2012) TV, Channel 4 (UK), 1st April 2012, 2000 hrs [Online] Available: [http://www.channel4.com/programmes/disasters-at-sea-why-ships-sink/4od#3311813] [Accessed 17th April 2012]

[10] Kirkpatrick D. L. (1959). 'Techniques for evaluating training programs.' *Journal of American Society of Training Directors*, 13 (3): pp21–26. [Online] Available: http://www.nwlink.com/~donclark/hrd/isd/kirkpatrick.html [Accessed 17th April 2012]

[11] Salas, E. & Cannon-Bowers J.A (2001) THE SCIENCE OF TRAINING: A Decade of Progress. Annual Review of Psychology. 2001. 52:pp.471–99

[12] Shuffler, M.L., Slas, E., & Xavier, L.F. (2010) The design, delivery and evaluation of crew resource management training in. Kanki, B., Helmreich, R. & Anca, J. eds. (2010) Crew Resource Management. Elsevier. Sandeigo. p.207

[13] Kraiger, K., Ford, J.K., & Salas, E. (1993) Application of cognitive, skill-based and effective theories of learning outcomes to new methods of training evaluation [Monograph]. Journal of Applied Psychology 78, pp.311-328 as cited in Kanki, B., Helmreich, R. & Anca, J. eds. (2010) Crew Resource Management. Elsevier. Sandeigo. p.207

[14] Houghton, C. (2012) Is leadership training a waste of money? Seaways, The International Journal of the Nautical Institute. January 2012. pp.15-16.

[15] Oil Companies International Marine Forum OCIMF (2008) Tanker Management Self Assessment. Working for a Safer Marine Environment; Welcome.[Online] Available: http://www.ocimf-tmsa.com/pagesMain/home/default.aspx [Accessed 17th April 2012]

[16] International Maritime Organisation (2001) Formal safety assessment fore-end watertight integrity MARITIME SAFETY COMMITTEE 74th session Agenda Item 5 BULK CARRIER SAFETY Submitted by the International Association of Classification Societies. [Online] Available: http://www.iacs.org.uk/document/public/Publications/Other_technical/PDF/FSA_Bulk_Carrier_Report_pdf424.PDF p.7 [Accessed 17th April 2012]

Modern multimedia learning tools in MET

Barsan, E.
P. Eng., Constantza Maritime University,
ebirsan@inbox.com

Muntean, C.
Assistant lecturer, drd., Constantza Maritime University,
codrut.muntean@gmail.com

Abstract: IT and modern technologies are an integral part of the learning process in any maritime university. Indeed, it is expected by the students, the ship owners and the shipping industry as a whole that the training of future maritime officers should be made up of such modern means. However, it is not only fashionable to use simulators and concepts like e-learning, but it is also a very effective way of training future maritime personnel, as well as retraining and improving the performances of the existing manpower in the industry. Thus it is not a problem of whether or not a maritime education center should have an educational program based on modern technologies, but rather how to optimize such a program. This abstract is about how we at Constanta Maritime University (CMU) are seeking to improve our approach to this relatively new but nonetheless highly important learning process in order to make it even more efficient. The main points of our interest are the simulators but we are also looking forward to improving the general presentation and content of our courses, and the realization of an internet based electronic university library with free public access. Of course we cannot upgrade the simulator ourselves, but we can improve the applications i.e. the content of the simulated scenarios and the way they are conceived.
Keywords: MET, multimedia, learning tools, maritime personnel, e-learning

1. Introduction

It can be said without being mistaken that the primary role and responsibility of maritime education and training centres is to provide the transport industry with qualified and competent manpower. These men and women are required to fill job positions ranging from sea-going to shore-based but no matter where they are actively involved, they have a crucial impact on keeping the shipping activity safe and the ocean's waters cleaner. We at the Constanta Maritime University (CMU) believe that this apparently simple idea is not just the IMO aim [1]. We say that this credo ingeniously hides a greater truth: a properly operated ship, with an adequately trained crew and with full shore based support, is an efficient one, because it rarely runs into dangers and has fewer incidents. Thus such a ship would be highly profitable, but we should not restrict ourselves only to ships, for this principle applies also to any commercial enterprise.

A very important question is how our students can accomplish such feats. The answer is almost straightforward: through continuous training. During the years they spend in universities as students, men and women acquire the skills and knowledge that gives them a chance of having a successful career in this challenging, competitive and highly dynamic maritime transport industry.

However the most important question is: How to best train our students? Of course, when speaking about the future mariners there is some help. Over the years the IMO has pondered on this question and, through the STCW convention, provides us with invaluable guidelines that cover the minimum requirements [2]. Ultimately, it leaves the responsibility of how to teach the students with the training centres. This brings us back to our question.

2. The conventional way

One possible answer is to look back and take note from what the traditional way of schooling has still to offer us. We must not think of the old ways as obsolete; indeed, what is considered traditional is in fact tried and tested. We take into account the traditional training, as conceived not so long ago by the seafaring nations who would take men on board and school them during voyages. It can be stipulated that this kind of training still exists today, in the form of the on board training program as some countries still practice it. These training programs rely on minimum background training or familiarization programs that give students a minimum degree of competency. They would then embark on board ships, where they would study both the theoretical and practical aspects of their future trade, and would return to their training centre for examinations, after which they would proceed to another voyage.

The down side of this kind of training is, in our point of view, the lack of standardized training. Where at the end of his or her education an individual would undergo a standardized test, one can never be sure that the cadet has covered the entire required curriculum [3]. Nevertheless it is a system that has good results and, among other good things, it allows students to experience life at sea from the early stages of their career and gives them the chance to determine whether or not it is truly their calling in life or not. However, this type of education requires a fairly large number of vessels and becomes even more practical when ship-owners become students' sponsors, as they search for high quality future employees.

Another way of training future maritime officers is through the educational system. The approach relies on a rigorous theoretical training program followed by a one-year training program at sea, as required by the STCW. Even if topics like basic and advanced mathematics, chemistry or others may seem to exist just to beef up the curricula, they truly have their just place in the harmonious development of any future maritime officer.

This approach is a more realistic approach in the context of the global crisis. Maritime transport is not an activity that is ever likely to cease and, as such, at any one time there will be a demand for qualified men and women to man ships. During crisis moments ship owners and operators will look for every opportunity to cut back on loses and will not hire new cadets until they are absolutely sure that there is still a future for their company in this competitive business.

But what about the modern ways of teaching? The modern school has embraced the idea of a modern technology to the point that the two are nearly inseparable. Emphasis is put on fast computers and simulators as well as Internet. This article is about how we at CMU are trying to bring the best it and the new technological advances have to give to our students.

3. Simulators

The most obvious and most welcomed intrusion in the maritime education process for IT is in the form of simulators. However, engine, bridge and economic simulators are not only a fashionable asset for an education centre, but also extremely effective. Apart from bringing the student one step closer to the realities of working with ship equipments, simulator training does much to improve the overall teaching experience. The students are more motivated and have a tendency to gather even more information on related topics than is offered to them in class.

Moreover, they have a chance to experience the capabilities and limitations of each of the pieces of equipment that is simulated. Also the student can experiment with the integrated bridge systems. This means he can learn how to gather information from multiple sources, how to identify errors and malfunction types, and how to react in case of an emergency or in case of an equipment failure.

Furthermore, during simulated scenarios with a high degree of difficulty the students learn about their own limitations, something that cannot be taught otherwise in a safe environment [4]. No matter what job they are training for, whether as part of a ship crew or as part of the shore based member of the company, they are going to find themselves as part of the team. Although this is may not be considered a direct benefit from using simulators, teamwork, leadership and communication are all skills that can be acquired, practiced, and perfected during simulator training.

However, it is not just a matter of just having the latest in simulator hardware and/or software. The exercises need to be relevant, with possible practical application in the future, and pertinent to the purpose of the syllabus. We have found out that students really appreciate exercises that are inspired from real life events, and are generally put off by exercises that are not well designed, or that happen to be farfetched. As a consequence we put a lot of effort into creating complex scenarios, and we are constantly looking for ideas for new ones. One such source for scenarios, especially for ship bridge simulators, is the analysis of past incidents or accidents. Although such a reactive approach is not a novelty, we believe that it ensures that our training programs are up to date and responsive to the ever-changing requirements the maritime transport industry [5].

Perhaps the most important aspect of the simulator training program is that the trainee has a chance to put into practice what he or she has learnt or is learning in their studies in a theoretical manner. To go even further, simulators are an important part of the educational process, because they reduce the gap between what is learnt at school and what is asked in the line of work. At first glance this may not seem like something important but there are some important implications. Firstly, it raises the proficiency of students in the task they are going to accomplish in the line of work even before they ever step in the working environment. Secondly, because great care is taken so that the simulated equipment or systems are as realistic as possible, trainees have a chance to learn how to operate them effectively. Thirdly, the simulators, more often than not, do not have just one system model but a variety. This means that proficiency is gained on a system type. Lastly, we at the CMU are confident that, because of what has been stated above, students that have been taught with the help of simulators have a much easier time to be integrated in a working collective [6], because they require training only on topics related to details of their jobs. Thus the person in charge of the training has a much easier job, and these students have a higher chance to be employed.

4. The influence of modern technologies on university courses.

Another way modern technologies have upgraded the pedagogical experience is in the manner in which information is passed on to the students. The traditional way of teaching, as many of us know, was that the teacher was at the heart of the system emitting the information, passing knowledge to the pupils who were the receivers. Of course, no one can argue that this method is completely ineffective, or that it may be completely obsolete, or that it shouldn't be used anymore. Indeed in many parts of the world it may be the only option for the teacher. However, with the advent of new technologies we can see that there are a few changes that have been made.

Because of the new communication technology being widely available and accessible to most of the population, the teaching experience has changed. Perhaps the most important technological advance is the use of the internet. Through the internet, information is easily accessible to anyone. It is just a matter of accessing the right source and even more important, learning how to process the information. It is at this point where we can say the role of the professor has changed; he is no longer the sole provider of knowledge, but rather he provides guidance for his students and helps them interpret their findings [7]. The teacher no longer has to dictate the information to the class room, he can present slide shows with the overhead projector and make arguments on the presented topic. Thus the entire teaching activity inside a class is transformed into a debate, because generally speaking it is allowed for a student to challenge what the teacher says and present arguments and documents to the discussion.

Of course, the information obtained from the world web can sometimes be questionable at best. This is why, at our university, we are trying to make most, if not all, courses available in electronic format. We are also envisioning the development of a public internet based library where all students, both domestic and foreign, have access to both our courses and related materials. This related material should include links to relevant sites and articles and freeware computer programs including basic simulators. Part of this has already been done with great success and much appreciation from the students. Furthermore, we are considering building up a data base of filmed courses, where professors are filmed in class while teaching, over the duration of the entire course. We consider that these "virtual classes" will have a greater learning value than some downloaded text files, because students are given a chance to listen how a professor argues his information and, in a manner of speaking, have a chance to be in the classroom [8].

Furthermore, we are building up a data base of information such as films of simulations or demonstrations to present the students on various topics.

As an alternative, we are also looking forward to the introduction of computer based training programs which are certainly not a novelty, and we do not believe them to exhaustively approach any topic. We consider them more of a schematic course but we cannot argue their value as a teaching aid, and their popularity with our students. This is why we are considering the development of such computer programs of our own, with the purpose of being related with the main courses with clear links where further information can be found.

This library we believe is especially invaluable for the students that are going on the high seas, and need to prepare for their exams on the return from their voyage, or find themselves in the position to require one particular piece of information relatively quickly.

Possibly a surprising way we use the World Wide Web is the university's internet forums which are incredibly popular with the students. Here students are able to discuss almost on any topic, and most appreciatively, have an informal contact with any professor. They have instant access to their scholastic situation as well as their parents, and learn how they have performed in recent or past examinations.

Furthermore, we believe that the way students are tested is slowly but steadily changing. Of course, at our university at least, the written test is the main form of examination. However standardised testing nowadays is also on Computer Based Testing (CBT). This type of examination is becoming increasingly popular because it generally takes a relatively low amount of time for the examination to occur, and it provides an almost instantaneous review of the student's performance. Such tests may include multiple choice answers, listening and comprehension of a text or a situation.

Where applicable, we are trying to implement simulator aided examinations. This is especially true in the case where the trainees have to demonstrate that they have acquired not only the knowledge but also a set of skills and abilities [9]. However time consuming, and despite the resources needed for such an enterprise… we feel that this should be the next step in student examination.

5. Conclusions

IT and modern technologies nowadays are an integral part of the learning process in any maritime university. Even though the STCW convention does not explicitly require that students shall be trained using modern means, any maritime educational program could not be considered complete without them.

Indeed it is expected by the students, the ship owners and the shipping industry as a whole that future maritime officers should have a thorough training. However it is not only fashionable to use simulators and concepts like e-learning, but it is also a very effective way of training future maritime personnel, as well as retraining and improving the performances of the existing manpower in the industry. In other words modern technology must be implemented in order to accomplish the feats required of a modern society.

Unfortunately, at IMO level when they talk about MET and implementation of the STCW Manila amendments, the discussions are focused mainly on the training of already certified seafarers [10]. This was the state of facts also in the meeting held in London at the beginning of May 2012 of the IMO Sub-Committee on STCW where the discussions were very active around the new content of ECDIS courses, about the redesign of CBT courses and modification of IMO model courses 7.01, 7.02 and 7.04 regarding the training of Masters, Chief Mates, Chief Engineers and Engineer Officers. We consider that the renewing process for these courses that will imply major updates and modifications to the content of theoretical training for maritime officers must start with the IMO model course 7.03 dedicated to OOW training. After completion of this model course we can start the renewal process for watch engineer officers and to continue with the modifications of model courses for the training of deck/engineer officers for managerial positions [11].

The presence of IAMU representatives at the IMO Sub-Committee on STW became a must, due to the importance of MET decisions that will be adopted in the next months [12]. Over there, the IAMU representatives are the only ones that truly represent the interest and point of view of maritime universities from the perspective of the academic level of training for the future maritime officers. The other representatives of national maritime authorities are still trying to impose curricula and education methods suitable mainly for the already certified seafarers.

We have to add one more thing regarding the participation of IAMU representatives at the IMO Maritime Safety subcommittees. The IAMU delegates must understand that they are sent there to represent IAMU and not the national maritime authority. Of course they have many friends among the national delegation, but sometimes it is possible that the interests of IAMU are opposite to the amendments proposed by their national authority and they have to express the maritime universities point of view.

Thus it is not a problem of whether or not a maritime education centre should have an educational program based on modern technologies, but rather how to optimize such a program.

References

[1] R. Hanzu-Pazara, E. Barsan, "Teaching techniques – modern bridges between lecturers and students", *7th WSEAS International Conference on Engineering Education,* Corfu Island, Greece, 2010, published in "Latest Trends on Engineering Education" pp. 176-181, ISSN: 1792-426X, ISBN: 978-960-474-202-8, Athens, Greece, 2010

[2] Anstey F., Dutton C., "Towards STCW 2012: An Analysis and Discussion on Selected Topics", *11th General Assambly of International Association of Maritime Universities* – Busan, Korea, 2010, published Technical Cooperation in MET, ISBN 978-89-5532-285-0, Pub. KMU, Busan, Korea, 2010

[3] Hanzu-Pazara R., Arsenie P., "New challenges in the maritime academics", 7th *WSEAS International Conference on Engineering Education,* Corfu Island, Greece, 2010, published in "Latest Trends on Engineering Education", pp 299-304, ISSN: 1792-426X, ISBN: 978-960-474-202-8, Athens, Greece, 2010

[4] Barsan E. , Muntean C., "Combined Complex Maritime Simulation Scenarios for Reducing Maritime Accidents Caused by Human Error", *3rd International Conference on Maritime and Naval Science and Engineering, Constantza Maritime Univ, Constantza, Romania,* 2010, Published in: Advances in Maritime and Naval Science And Engineering, **ISBN:** 978-960-474-222-6, **pages:** 89-93, **Publisher:** World Scientific And Engineering Acad & Soc, Athens, Greece, 2010

[5] Hair A., "Development of MET to Meet Future Industry Demands", *10th General Assambly of International Association of Maritime Universities* – St. Petersburg, Russia, published in MET trends in the XXI century, ISBN 978-5-9509-0046-4, Pub. Makarova, Russia, 2009

[6] Barsan E., Memet F., Stan L., "Particularities of the Maritime Higher Education System as Part of the Maritime Transport Engineering Studies", *7th WSEAS International Conference on Engineering Education,* Corfu Island, Greece, 2010, published in "Latest Trends on Engineering Education", pp 168-175, ISSN: 1792-426X, ISBN: 978-960-474-202-8, Athens, Greece, 2010

[7] Barsan E., Hanzu-Pazara R., Arsenie P., Grosan N., "E-Learning - A Step Forward in Academic Training", *6th International Seminar on the Quality Management in Higher Education, Tulcea, ROMANIA,* 2010, Published in: Quality Management in Higher Education, VOL 2 Pages: 349-352, Publisher: Univ Tech Gheorghe Asachi Iasi, Romania, 2010

[8] Hanzu-Pazara R, Barsan E, Arsenie P., "Applying of Innovative Teaching Methods In The Maritime Academic", *5th Balkan Region Conference on Engineering and Business Education/2nd International Conference on Engineering and Business Education,* 2009 Lucian Blaga Univ, Sibiu, Romania; Published in: **Balkan Regional Conference On Engineering And Business Education & ICEBE, Conference Proceedings** Pages: **687-690, 2009**

[9] Popescu C., Varsami A.E. – "The Place of Women in a Men's World from a Maritime University Perspective", *7th WSEAS International Conference on Engineering Education,*

Corfu Island, Greece, 2010, published in "Latest Trends on Engineering Education", pp 182-186, ISSN: 1792-426X, ISBN: 978-960-474-202-8, Athens, Greece, 2010

[10] Hanzu-Pazara R., Barsan E., Arsenie P., "The Impact of European and International Requirements on Romanian Maritime Training Curricula", *6th International Seminar on the Quality Management in Higher Education, Tulcea, Romania*, 2010, Published in: Quality Management in Higher Education, vol 2 pages: 427-430, Publisher: Univ Tech Gheorghe Asachi Iasi, Romania, 2010

[11] Barsan E., Muntean C., "Enhancing Maritime Officers Opportunities for Managerial Level Positions", *11th General Assambly of International Association of Maritime Universities* – Busan, Korea, 2010, published Technical Cooperation in MET, ISBN 978-89-5532-285-0, pag. 377-383, Pub. KMU, Busan, Korea, 2010

[12] Loginovsky V., "STCW 78 Manila Amendments and Some Risk Assesment Aspects, 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

A New Student-Centered Control Laboratory Using Matlab/Simulink

Ziqian Liu
Department of Engineering, SUNY Maritime College
zliu@sunymaritime.edu

Abstract: In order to well prepare our engineering students for the challenges presented by advanced technologies in the 21st century, a student-centered control laboratory has been developed recently in the State University of New York Maritime College for a senior control course. We adopted Windows XP based software, Matlab/Simulink, in our laboratory. With the goal to stimulate the enthusiasm of our students and tie closely theory and practice, a series of fourteen application projects were elaborated in the laboratory, which include the following design themes: ship control system, submarine depth control system, DC motor control system, machine tool control system, satellite Halo control system, space telescope control system, automotive power train control system, design of PID controllers, compact disc player control system, VTOL aircraft control system, space shuttle flight control system, satellite ground tracking antenna control system, etc. Through the above computer aided projects, students not only learned how to design, analyze and synthesize a control application system, but also strengthened their understanding of theoretical and abstract subjects in control theory.
Key Words: Control Laboratory, Matlab/Simulink, Computer Simulation, Electrical Engineering, Engineering Training, Maritime Education

1. Introduction

It is vital in engineering education for an instructor to let students grasp the relation between theory and application. In Electrical Engineering there are many topics that are heavily theoretical and abstract, and require intensive mathematical background. Hence it becomes particularly challenging for an EE instructor to help students build the bridge that leads from theory to application. The control course is a classic but also a difficult course in engineering education. Its traditional laboratory components usually are made up using analog devices to simulate control systems, which lack the emphasis on the soft side of intelligent control design skills. With the energy saving revolution in progress, the lab is playing a more important role in engineering curriculum. Since a control course mainly focuses on theoretical and abstract subjects, it is very challenging for an instructor to attract and keep our students' interest when teaching it. From a pedagogical point of view, computer simulation provides a hands-on tool for students to gain deep insights on both transient and steady-state responses for a control system, which often are not easily mastered through studying theory. In industry, modeling and simulation are widely used by engineers as a critical procedure to design a control system in order to save the cost of building a system prototype. Furthermore, computer-aided laboratory exercises can make students have accomplishment feelings and therefore can create more space for their creativities.

In order to well prepare our engineering students for the challenges presented by advanced technologies in the 21st century, a student-centered control laboratory has been developed recently in the State University of New York Maritime College for a senior control course. We adopted Windows XP-based software, Matlab/Simulink, in our laboratory. Matlab/Simulink is a powerful tool for efficiently and effectively developing sophisticated control systems in a wide range of applications. Its graphics and design methods are implemented by using high level, user-friendly functions. In our student-centered control laboratory, a series of fourteen application projects were elaborated. The themes of our lab projects include the following designs: ship control system, submarine depth control system, DC motor control system, machine tool control system, satellite Halo control system, space telescope control system, automotive power train control system, design of PID controllers, compact disc player control system, VTOL aircraft control system, space shuttle flight control system, satellite ground tracking antenna control system, etc. Through the above hands-on projects, students not only learned how to design, analyze and synthesize a control application system, but also strengthened their understanding of theoretical and abstract subjects in control theory. After we implemented the student-centered laboratory using Matlab/Simulink, students showed great enthusiasm towards the course throughout the whole semester. The results of student surveys demonstrate the effectiveness of our laboratory component in supporting student learning

With the feedback from students, we are confident that our newly developed laboratory made contributions in enhancing student intelligent control design skills on the soft side, which is highly demanded for a 21^{st} century and future engineer.

In the following sections, we will discuss some of our laboratory projects. In Section 2, we present the project of a submarine depth control system. In Section 3, we describe the design project of aircraft control system. In Section 4, we illustrate the design project of a space telescope control system. In Section 5, we show the project of PID controller design. Finally, we present some discussions in section 6.

2. Design of Submarine Depth Control System

2.1 Laboratory Description

To control the motion of a submarine is significantly different from the control of a surface ship, aircraft, or missile. This difference is primarily caused by the movement in the vertical plane because of the buoyancy effect. Therefore, it is interesting to consider the control of the depth of a submarine. The depth is measured by a pressure transducer. The equations describing the dynamics of a submarine can be obtained by using Newton's laws and the angles defined in the following Fig. 1 [1] [2]. To simplify the equations, we will assume that θ is a small angle and the velocity v is constant and equal to 25 ft/s. The state variables of the submarine, considering only vertical control, are $x_1 = \theta$, $x_2 = d\theta / dt$, and $x_3 = \alpha$, where α is the angle of attack. Thus the state vector differential equation for this system, when the submarine has an Albacore type hull, is

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ -0.0071 & -0.111 & 0.12 \\ 0 & 0.07 & -0.3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ -0.095 \\ 0.072 \end{bmatrix} u(t)$$

where $u(t) = \delta_s(t)$, the deflection of the stern plane.

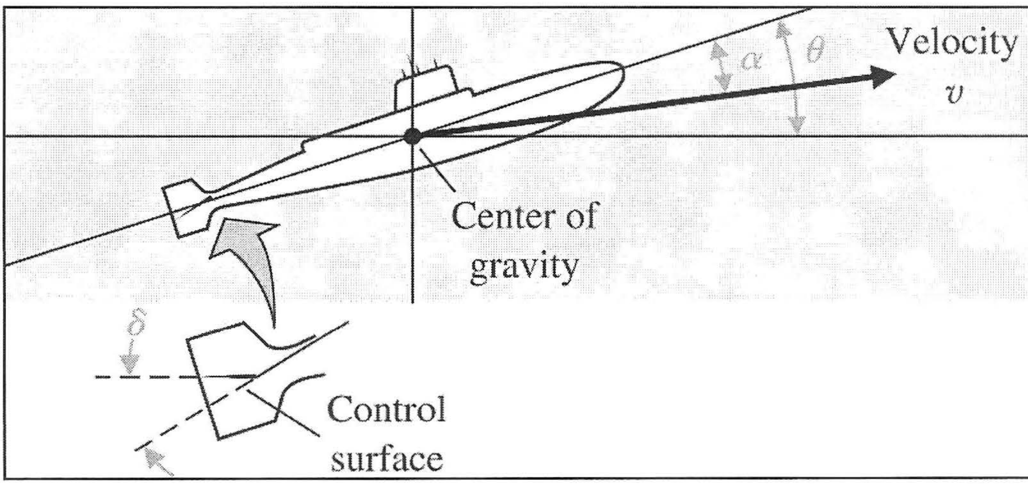


Figure 1. Submarine Depth Control

2.2 Laboratory Assignment

Using Matlab/Simulink:

(1.) To investigate the response of the system to a stern plane step command of $0.285°$ with the initial conditions equal to zero.

(2.) To determine whether the system is stable under the aforementioned conditions.

2.3 Explanation about this Laboratory

This project is designed to aid students in understanding and mastering the important concepts, and acquiring the corresponding skills as listed below:

- Understand the important role of state variable modeling in control system design.
- Know how to obtain the time responses for state variable models.
- Be familiar with the computer-aided control system design tool, Matlab/Simulink.
- Know how to determine the stability of a dynamic system.

2.4 Laboratory Graphic Results

The Matlab/Simulink graphic solution is given in the following Fig. 2, which shows the response of the state variables of the submarine system to a step change in the stern plane.

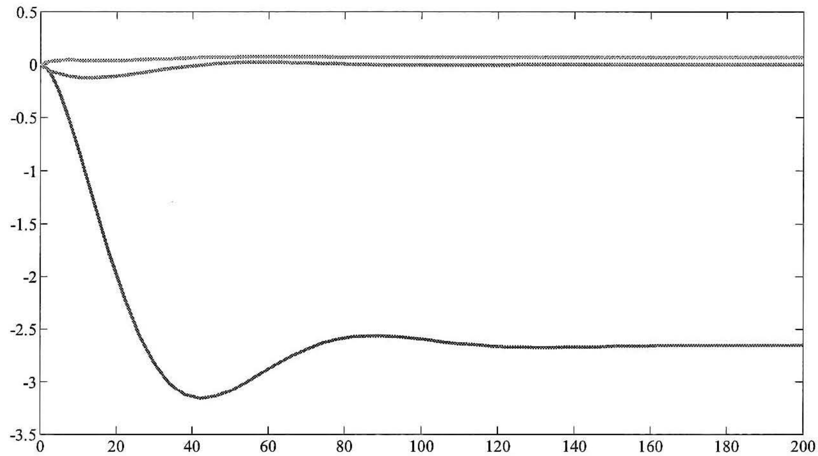


Figure 2. Response of the state variables of the submarine system

3. Design of Aircraft Control System

3.1 Laboratory Description

The objective of vertical takeoff and landing (VTOL) aircraft is to accomplish operation from a relatively small airport, while still performing like a normal aircraft in level flight. Therefore, the VTOL aircraft taking off in a way similar to an air missile (at the end) is certainly unstable. A control system using adjustable jets can control the vehicle. The dynamics of a jump-jet aircraft can be represented by an open-loop transfer function shown in Fig. 3.

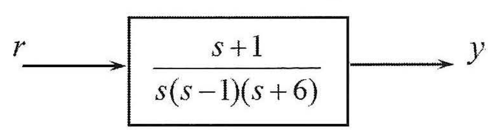


Figure 3. A jump-jet aircraft system

3.2 Laboratory Assignment

Part 1. For the open-loop control system described by the above block diagram, use Matlab/Simulink to plot unit step response of the system output $y(t)$

Part 2. Consider the closed loop control system shown in Fig. 4 [3]

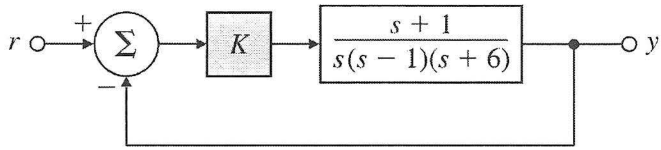


Figure 4. Closed loop control system

where K is the gain of the proportional controller. Use Matlab/Simulink to plot unit step response of the system output $y(t)$ for the following three cases:

Case 1: $K= 24$

Case 2: $K=12$

Case 3: $K=6$

and compare the differences among them.

Part 3. Compare the results in part 1 and part 2, what are your conclusions?

3.3 Explanation about this Laboratory

This project is designed to aid students in understanding and mastering the important concepts, and acquiring the corresponding skills as listed below:

- Understand the concept of stability and how important it is for a dynamic system.
- Know how to obtain the time responses for a closed loop control system.
- Be familiar with the computer-aided control system design tool, Matlab/Simulink.
- Be aware of constructing a feedback control to let an unstable system become a stable system.

3.4 Laboratory Graphic Results

The Matlab/Simulink graphic solutions are given in the following figures. Fig. 5 shows the response of the jump-jet for an open-loop control system, which is unstable. Fig. 6 shows the responses of the jump-jet for a closed-loop feedback control system under different control parameters.

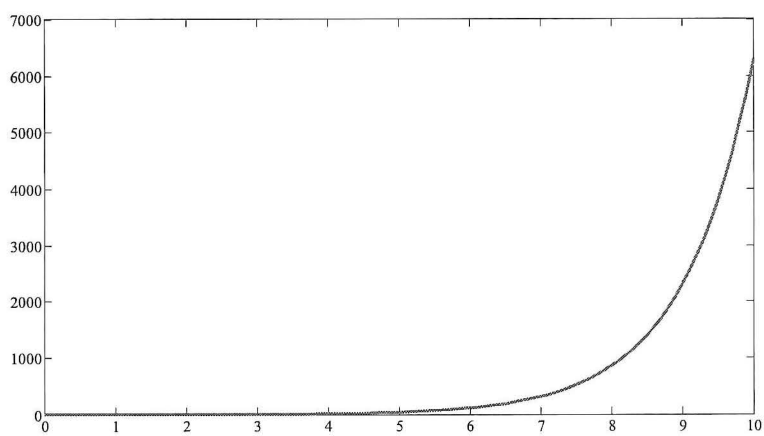


Figure 5. Response of jump-jet for open-loop control system

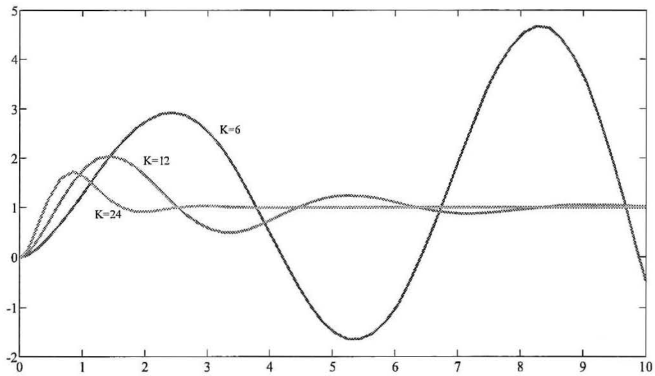


Figure 6. Responses of jump-jet for closed loop control system

4. Design of Space Telescope Control System

4.1 Laboratory Description

We consider a telescope operated in space but controlled from Earth. The goal is to manipulate and position the telescope to accurately point at a planet. The actuator chosen is a low-power actuator, and the model of the combined actuator and telescope is shown in Fig 7. The command signal is received from an Earth station with a delay of $\pi/16$ seconds. A sensor will measure the pointing direction of the telescope accurately. However, this measurement is relayed to Earth with a delay of seconds. Therefore, the control system is shown in Fig 8 [1] [4]. The controller is a PID controller.

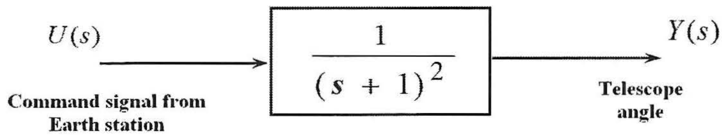


Figure 7. Model of a Low-Power Actuator and Telescope

4.2 Laboratory Assignment

Using Matlab/Simulink to plot the step responses of the control system under the following controllers:

(1.) $K_P = 0.022$, $K_I = 0.22$, and $K_D = 0$

(2.) $K_P = 0.8$, $K_I = 0.5$, and $K_D = 10^{-3}$

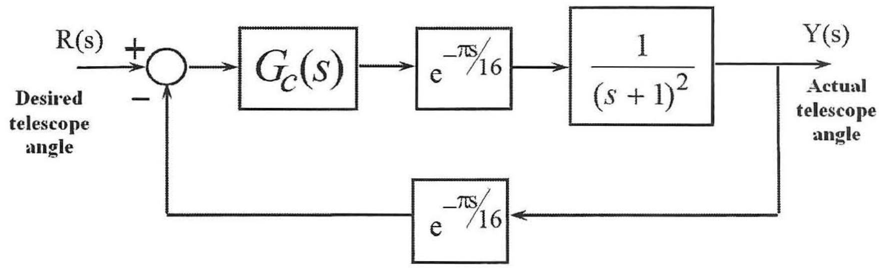


Figure 8. Feedback control system for the Space Telescope

4.3 Explanation about this Laboratory

This project is designed to aid students in understanding and mastering the important concepts, and acquiring the corresponding skills as listed below:

- Understand the important role of modeling in the control system design process.
- Be aware of the dynamic behavior of a time delayed control system.
- Understand the robust design, such as, a robust PID system.
- Know how to obtain transient responses by using computer-aided design tool.

4.4 Laboratory Graphic Results

The Matlab/Simulink graphic solutions are given in the following figures. Fig. 9 shows the time response for the following design parameters $K_P = 0.022$, $K_I = 0.22$, and $K_D = 0$. Fig. 10 shows the time responses for the following design parameters $K_P = 0.8$, $K_I = 0.5$, and $K_D = 10^{-3}$.

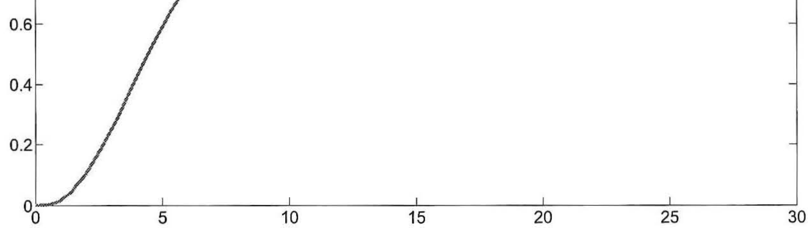


Figure 9. Time response for $K_P = 0.022$, $K_I = 0.22$, and $K_D = 0$.

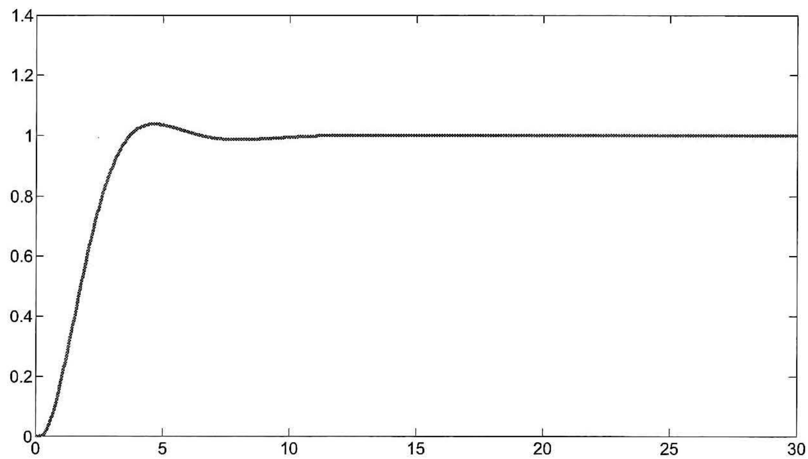


Figure 10. Time response for $K_P = 0.8$, $K_I = 0.5$, and $K_D = 10^{-3}$

5. Design of PID Controllers

5.1 Laboratory Description

The speed control of a high-speed train is represented by the system shown in Fig. 11. The transfer function of the train dynamics is shown in Fig. 12.

$$G(s) = \frac{1}{s^2 + 10s + 20}$$

5.2 Laboratory Assignment

Part A. For the open-loop system described by the following block diagram, assume that the input $r(t)$ is a unit step. (1) Compute the steady-state system output y_{ss}. (2) Find the steady-state error e_{ss}. (3) Make a plot for the system output $y(t)$ by using Matlab/Simulink.

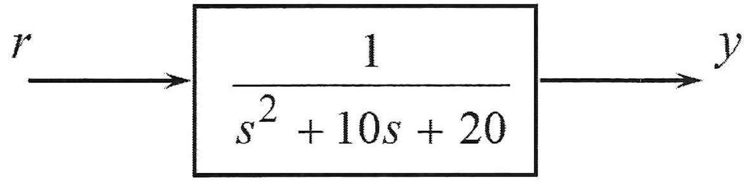


Figure 11. A high speed train system

Part B. Consider the closed loop control system shown below, where D(s) is a PID controller. Assume that the input $r(t)$ is a unit step. Determine the steady-state error and use Matlab/Simulink to plot the response of the system output $y(t)$ for each of the following cases:

(1.) Use **P** control, let $D(s) = K_p$, in which

(a) $K_p = 30$
(b) $K_p = 300$, and
(c) $K_p = 1000$

(2.) Use **PI** control, let $D(s) = K_P + \frac{K_I}{s}$

(a) $K_P = 300$ and $K_I = 10$
(b) $K_P = 300$ and $K_I = 100$ and
(c) $K_P = 300$ and $K_I = 100$

(3.) Use **PD** control, let $D(s) = K_P + K_D s$, in which

(a) $K_P = 300$ and $K_D = 10$
(b) $K_P = 300$ and $K_D = 500$, and
(c) $K_P = 300$ and $K_D = 1000$

(4.) Use **PID** control, let $D(s) = K_P + \frac{K_I}{s} + K_D s$, in which

(a) $K_P = 30$, $K_I = 10$ and $K_D = 10$
(b) $K_P = 300$, $K_I = 100$, and $K_D = 500$
(c) $K_P = 1000$, $K_I = 300$, and $K_D = 1000$

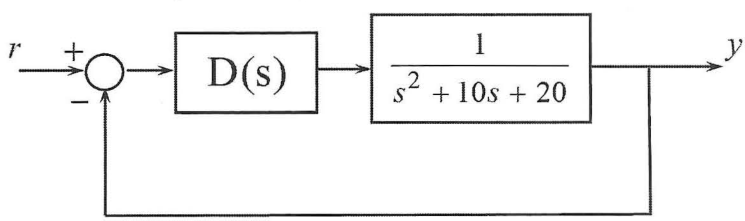


Figure 12. PID closed loop control system

Part C. Compare all results in Part A and Part B, what are your conclusions?

5.3 Explanation about this Laboratory

This project is designed to aid students in understanding and mastering the important concepts, and acquiring the corresponding skills as listed below:

- Be familiar with the PID controller, which is a key element of many feedback control systems widely used in industry today.
- Understand the differences between the transient response and the steady-state response for a dynamic system.
- Get a good sense of the advantages and disadvantages of PID feedback in the process of a control system design.
- Recognize the central role of the error signal in the design and analysis of a control system.
- Know how to obtain transient responses by using computer-aided design tool.

5.4 Laboratory Graphic Results

The Matlab/Simulink graphic solutions are given the following figures. Fig. 13 shows the responses of P control feedback system with Kp = 30, 300, and 1000. Fig. 14 shows the response of PID control feedback system with Kp = 30, Ki = 10, and Kd = 10.

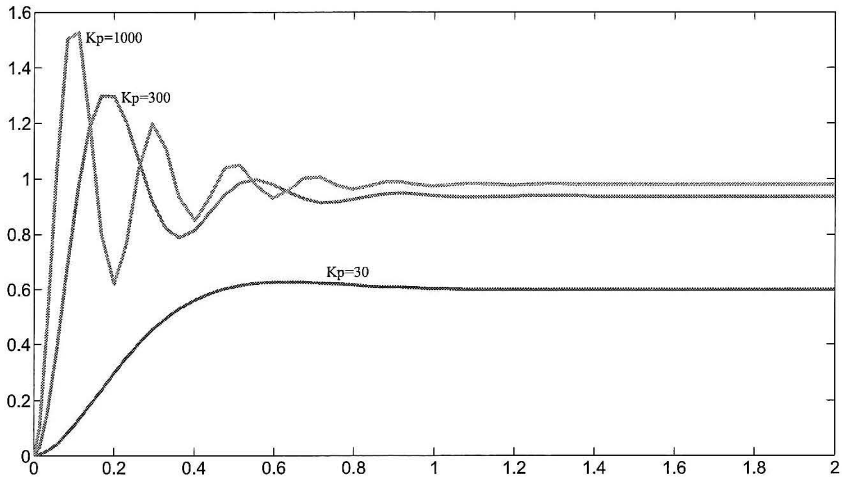


Figure 13. Responses of P control feedback system with Kp = 30, 300, and 1000

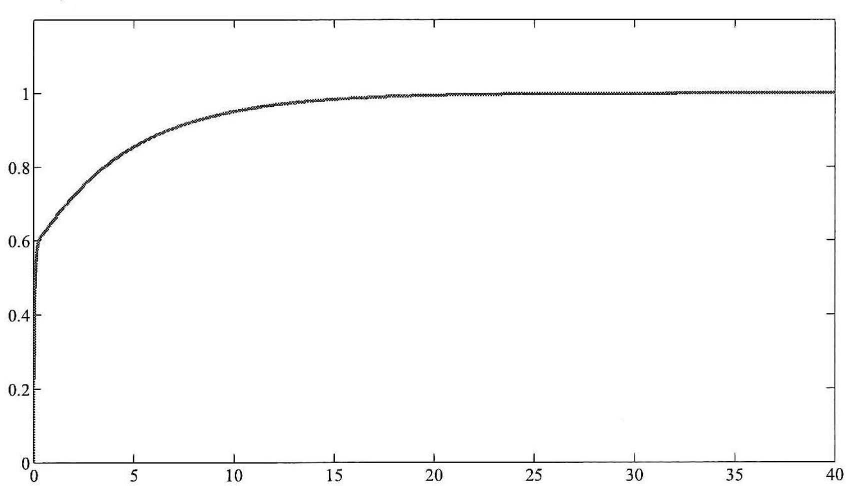


Figure 14. Response of PID control feedback system with Kp = 30, Ki = 10, and Kd = 10

6. Conclusions

In this paper, we presented the design of a series of application projects for a student-centered control laboratory using Matlab/Simulink in a senior control course. By asking students to do a soft-side computer aided laboratory and develop their own solutions for the laboratory projects, we give students opportunities to put theory into practice, which also keeps students' interest high. Furthermore, the laboratory exercises provide a sense of accomplishment to the students and allows room for their creativities.

References

[1] Dorf R. and Bishop R., "*Modern Control Systems*", 11th Edition, Pearson Prentice Hall, 2008.
[2] Liceaga-castro E and Vander G., "A submarine depth control system design", *International Journal of Control*, Vol. 61, No. 2, 1995, pp 279-308.
[3] Franklin G., Powell J., and Emami-Naeini A., "*Feedback Control of Dynamic Systems*", 6th Edition, Pearson Prentice Hall, 2010.
[4] Shoureshi R., "Intelligent control systems, are they for real?", *Journal of Dynamic Systems, measurement, and control*, Vol. 115 No. 2, 1993, pp 392-401.

ECDIS Training in China: from International to National

Chen, Yuli
Assistant professor, Shanghai Maritime University, ylchen@shmtu.edu.cn

Xiao, Yingjie
Professor, Shanghai Maritime University, yjxiao@shmtu.edu.cn

Abstract: Based on the instruction of the challenge of Electronic Chart Display and Information System training in China, this paper presents the actions taken or to be taken in the collaboration of China Maritime Safety Administration, the maritime education and training institutions and the shipping companies to transfer the international paper requirements into national adequate practice. This includes national legislation, performance standards of training classrooms and simulators, the competence of instructors and assessors. Future considerations to further improve the effectiveness of ECDIS training, such as the standardization and accreditation system of ECDIS simulators, the use of new ECDIS model course, the development of automatic assessment tools and the establishment of ECDIS training forum, are also proposed in the paper.
Keywords: STCW, ECDIS, training, examination, officer, student, simulator, instructor competence, China

1. Introduction

The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, as amended in 2010 (STCW 2010) mandates that any marine officer keeping a navigational watch on any International Convention on the Safety of Life at Sea (SOLAS Convention) vessel where an Electronic Chart Display and Information System (ECDIS) is fitted must be trained and certified as competent in the use of ECDIS to maintain safe navigation in the forthcoming years. ECDIS training has greatly challenged the institutions of maritime education and training (MET) in China, as more than 200,000 marine officers in addition to the 20,000 officer cadets graduated annually are required to receive this training during the transitional years as per the China Maritime Safety Administration (referred to as the Administration hereinafter) statistics[1]. Unlike any other new training program introduced into the MET industry, ECDIS training sees a more complicated process in terms of the training difference between officer and student, the consideration of acceptance of prior recommended training, and the performance standards of training classrooms and ad hoc ECDIS simulators. Some officers have already received and have been certified in ECDIS training from MET institutions based on the recommendation of the shipping industries before the STCW 2010 became effective. Will the Administration accredit this kind of training as effective, obsolete or compromising? How will the different training programs between officers who have working experience onboard and students who are totally fresh with the ship be implemented? How will we ensure that the instructor is competent to conduct the training? What are the performance standards of training classrooms and the ECDIS simulators?

2. National Legislation

In order to fully and effectively implement the STCW 2010, China's Ministry of Transport developed and issued the latest Code of Competence Examination and Certification for Seafarers serving on Sea-going Ships (referred to as the Code hereinafter) at the end of 2011. The Code has relatively general specifications dealing mainly with the authorization for government, the contents, category, issuance and endorsement requirements of the Certificate of Competence (COC), the seafarer rank and function, and the category and application of the competence examination etc. [2] Therefore, the detailed requirements regarding training courses such as ECDIS cannot be detected in the Code, but actually covered in the Implementation Rule for the Code, issued at the beginning of this year by the Administration which is the competent authority dealing with the maritime affairs and administration under the control of China Ministry of Transport. The Implementation Rule for the Code contains the specific requirements pertaining to the training time, theoretical examination subjects, practical assessment subjects, professional training subjects, special training subjects etc. based on the different seafarer rank and function, ship's tonnage/main engine power, and the trading area. The Administration also accordingly developed the syllabus for each training subject required[3]. However, the specifications of the Implementation Regulation for the Code are actually focusing on the new officer students after the STCW 2010 entered into force (referred to as new students hereinafter) rather than the current marine officers certificated by the STCW 95 (referred to as current officers hereinafter). Hence, the Administration further developed the Implementation Rule for the Transitional Regulations of the STCW 2010, which is the specific legislation dealing with the training and examination requirements for transferring the current officer's COC mandated by the STCW 95 into the new COC compliance with the STCW 2010[4]. The Three aforementioned legislations were all effective on 1st March 2012. ECDIS training and examination requirements are mainly contained in the two Implementation Rules.

2.1 Requirements for New Students

ECDIS training and examination requirements for new students enrolled by the MET institutions after STCW 2010 became effective shall fully comply with the requirements of the new STCW Code A and Code B. In China, the new students applying for the COC of third mate shall complete the ECDIS training and pass the examination. The exam method consists of theoretical and practical assessments. The theoretical knowledge is examined in the Navigation subject, but the practical knowledge is just examined as an assessment subject that is different from the professional training subjects that result in professional certificates being issued to trainees after completing successful training and examination. The relevant training syllabus mainly adopts the specifications and guidance regarding ECDIS mentioned in new STCW Code A and Code B. The overall training time is suggested to be 40 hours but actually dependent upon the individual MET institution. For the students who were enrolled before 1st March 2012 but graduated after this date, the Implementation Rule for Transitional Regulations of the STCW 2010 shall also be observed.

2.2 Requirements for Current Officers

Current officers holding the COC mandated by the STCW 95 which will become obsolete in 2017 shall complete the ECDIS training and examination during transitional period from 1st March 2012 to 31st December 2016 as one of compulsory conditions for applying the new COC. Current officers are classified into two categories. One is the officers who have never attended the ECDIS training and examination before, the other is the officers who have attended the ECDIS training that was recommended by the Administration and the shipping industry and who have obtained the relevant document of compliance before the STCW 2010 entered into force. For the first category, there is no doubt that these officers shall fully receive the ECDIS training and pass the exam required by the Administration. For the second category, the Administration adopts a compromising action. That is to say, whether the Administration accepts the previous ECDIS training outcome before the STCW 2010 entered into force conducted by certain MET institutions is mainly dependent upon whether the previous ECDIS training materials, such as syllabus, teaching plan, teaching handout etc. comply with the relevant requirements. The Administration will evaluate these kind of ECDIS training materials submitted by the MET institutions. If these training materials are considered to be fully in compliance with the new ECDIS training based on the Administration evaluation, the officers who have received this ECDIS training are approved to be exempt from the new ECDIS training progress, but new ECDIS exams are still required to be taken for these officers. Otherwise, the second category of officers shall fully re-attend the ECDIS training and exam. New ECDIS training time for current officers in the transitional period is only required to be 16 hours based on the considerations that current officers have the advantage of working experience as opposed to the new students.

3. Training Classroom

Unlike other training courses where the theoretical lectures are normally presented in the common classroom while the practical contents are exercised in the laboratory, the best and most effective ECDIS training method is well acknowledged to be demonstration, i.e. both theoretical and practical lectures are presented in the training classroom fitted with ECDIS simulators. Therefore, the performance of the ECDIS training classroom is of paramount importance for determining the training effectiveness.

3.1 General Requirements

The Administration requires that the ECDIS training shall be conducted in the specific-purpose training classroom.(Fig.1) The training classroom is required to fit not only the common devices of multimedia classroom, such as overhead projector, whiteboard, instructor station, microphones and speakers etc., but also sufficient training computers with installed ECDIS software referred to as the ECDIS simulator. Additionally, a set of real ECDIS equipment is required to be fitted in each classroom to complement the training which cannot be presented by using ECDIS simulators. Each trainee shall sit on an ECDIS training simulator and the maximum trainees shall be 40 in one training classroom under the control of at least 2 competent instructors.

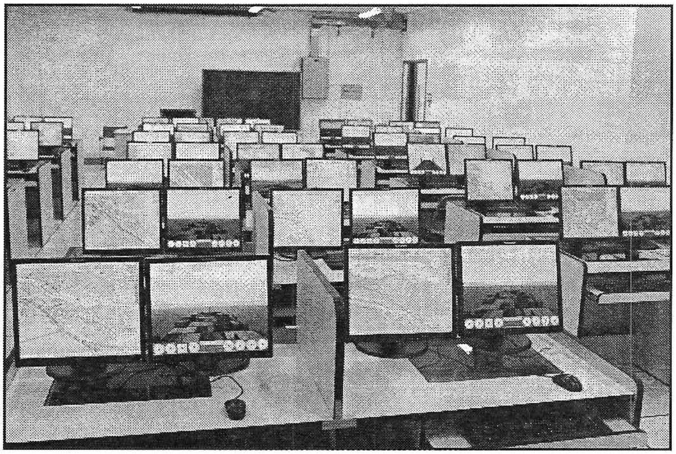


Figure 1. Layout of ECDIS training classroom

3.2 Simulator Requirements

There is no doubt that an ECDIS simulator based on the intranet structure plays an important role in training and examination. Hence the simulator used for ECDIS training and examination is required to be endorsed by the Administration in advance. Even though the Administration does not specify concrete regulations regarding the ECDIS training simulator performance, the simulator used is recommended to be accredited by the recognized organizations such as DNV. The performance standards of the ECDIS simulator consist of both hardware and software aspects. Some performances of ECDIS simulator are strongly recommended by the Administration. The simulator stations shall include an instructor workstation and student workstations. Each student workstation is comprised of two monitors, one main machine and one set of mouse and keyboard at least. One monitor is fixed to display the ECDIS picture, the other alternatively displays the 3-dimentional visual view and radar picture which is synchronized with the scenario displayed on the ECDIS screen as shown in Fig. 2.

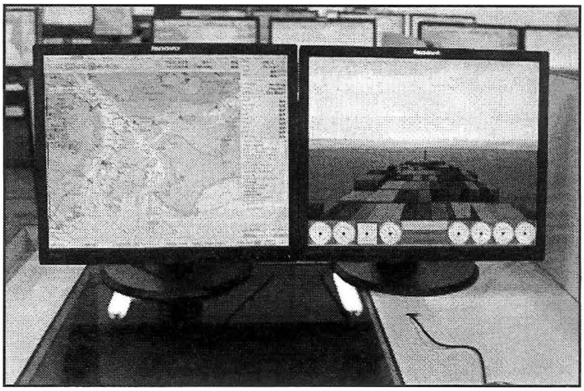


Figure 2. One student workstation with two displays

The student workstation ECDIS software shall at least comply with the requirements of the ECDIS onboard performance standard developed by International Maritime Organizational (IMO). The instructor workstation including multi displays shall be able to control and monitor all student workstations via the intranet communication and the specialized software (see Fig. 3 and Fig. 4). The instructor workstation can design different scenarios and distribute them to all or certain student workstations. The student workstations can see each other on the ECDIS simulator screen under the control of the instructor workstation.

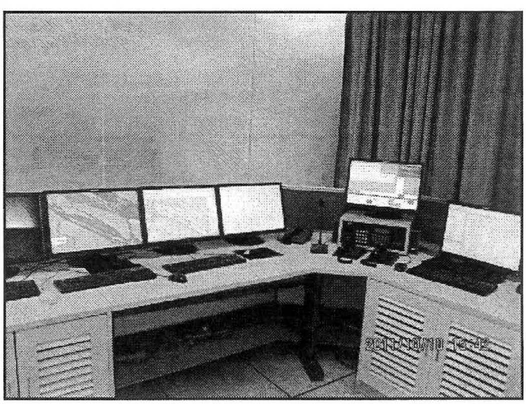


Figure 3. Layout of instructor workstation

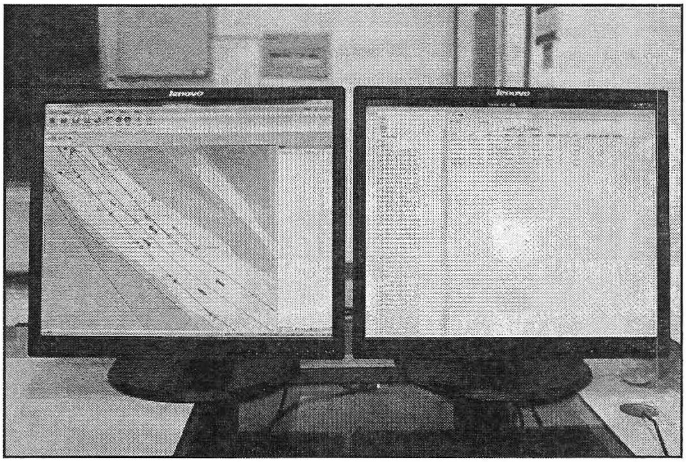


Figure 4. Control software of instructor workstation

4. Competence of Instructor and Assessor

As an ECDIS course is primarily a technical course designed to teach proper operation of an ECDIS, unlike other training courses the instructor competence is rather difficult to define so that it deserved lengthy discussions in the validation of revised ECDIS model course on the IMO's Subcommittee on Standards of Training and Watchkeeping 43 Session (STW 43) held from 30th April to 4th May 2012[5]. The Administration requires that the instructor shall have adequate sea-going experience, certificate qualification and have successfully completed a type-approved ECDIS course. The instructor shall have at least one level of COC higher than the trainees on the course. The instructor shall successfully complete the ECDIS training course organized and endorsed by the Administration before conducting the ECDIS training for trainees. As far as assessor competence is concerned, the assessor shall be an instructor other than the instructor of the trainees to be assessed.

5. Future Considerations

It is widely recognized that ECDIS is an important system to maintain navigational safety of ships in future. Nevertheless, there is no mature, effective and successful ECDIS training and exam experience for reference since mandatory requirements came into effect. There are no doubts that many issues regarding ECDIS training still need to be researched and practiced both internationally and nationally. The following proposed considerations to further improve the effectiveness of ECDIS training in China shall be put on the top agenda by the Administration in future. The Administration shall further consider whether the standardization and accreditation system of ECDIS simulator are applicable based on the overall evaluation of effectiveness of the current ECDIS simulators. A new ECDIS model course has already been validated by IMO in the STW 43 Session [5]. As this new model course is so comprehensive compared to the previous version including the introductions of exercise and assessment cases, the Administration shall research and experiment with this model course so as to adopt it into ECDIS training in

China as appropriately as possible. In order to make the assessment more efficient, effective and objective, the Administration shall work hard with other organizations to develop automatic assessment tools by using computer programs. Also, the Administration shall encourage and support the MET institutions and the shipping companies to jointly establish an ECDIS training forum in order to provide timely feedback and evaluate the ECDIS training as a whole.

6. Conclusion

China's Administration and MET industry are currently facing a strong challenge regarding ECDIS training and examination due to a large number of trainees waiting to be trained since STCW 2010 came into force. In order to meet both the international requirements and national de facto situations, ECDIS training and examination in terms of the national legislation, performance standards of training classroom and simulator, competence of instructor and assessor etc. have already been developed or conducted. As well, the standardization and accreditation system of ECDIS simulator, the use of new ECDIS model course, the development of automatic assessment tool and the establishment of ECDIS training forum have been promoted in China.

References

[1] China Maritime Safety Administration, "China Annual Seafarer Report", China Maritime Safety Administration, (2011).

[2] China Ministry of Transport, "Code of Competence Examination and Certification for Seafarers serving on Sea-going Ships", China Ministry of Transport, (2011).

[3] China Maritime Safety Administration, "Implementation Rule for the Code of Competence Examination and Certification for Seafarers serving on Sea-going Ships", China Maritime Safety Administration, (2012).

[4] China Maritime Safety Administration, "Implementation Rule for the Transitional Regulations of the STCW 2010", China Maritime Safety Administration, (2012).

[5] International Maritime Organization, "STW 43 Session Draft Report to Maritime Safety Committee", International Maritime Organization, (2012).

Development and Algorithmic Analysis of Maritime Human Resource Database

Junzo Kamahara
Associate Professor, Kobe University, kamahara@maritime.kobe-u.ac.jp

Mathew Rooks
Associate Professor, Kobe University, rooks@maritime.kobe-u.ac.jp

Masao Furusho
Professor, Kobe University, furusho@maritime.kobe-u.ac.jp

Abstract: Although IAMU was founded more than ten years ago, the information of IAMU member MET systems was still not detailed enough to carry out comparisons of each MET system. Therefore, this project, which focused on creating an algorithm to collect valuable information regarding MET systems and human resource information of IAMU Member universities/institutions, was accepted as an IAMU Research Project in 2010-2011. The authors have developed the Maritime Human Resource Database (MHRD), which maintains the information of educational staff and faculty who belong to corresponding member institutes of IAMU. Currently, 616 people in 45 universities/institutions have added their profiles into the database.
Keywords: Maritime, Human Resource, Database, CakePHP

1. Introduction

Member universities/institutes of IAMU each have original Maritime Education and Training (MET) Systems which are regulated by the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) [1] via IMO and their own domestic restrictions. In particular, member institutes of IAMU not only have training courses for seafarers, but also advanced courses/functions of maritime-related research. However, the information of the MET system in each institution was not shared with IAMU. Although IAMU was founded more than ten years ago, the information of IAMU member MET systems was still not detailed enough to carry out comparisons of each MET system. Therefore, we proposed a research project to develop an algorithmic analysis via a maritime resource database which focused on creating an algorithm to collect valuable information regarding MET systems and human resource information of IAMU Member universities/institutions. This proposal was accepted as an IAMU Research Project in 2010-2011, and was jointly created with help from Odessa National Maritime Academy.

Human resources may be indicative of individual institutions' academic ability for education and research. Furthermore, the faculties of institutions may have some relation with their graduates or career institutions/universities. Such human connections may show the mobility of maritime educators and researchers.

In the project, we focus on the professional aspects of maritime human resources and have developed the educator and researcher database for member institutions of IAMU. This database maintains the information of educational staff and faculty members who belong to corresponding member institutes of IAMU. This information could be the same as the curriculum vitae. The information of maritime members is shared with other registrants via web-based Internet.

Our database has been created as a Web application using CakePHP [2], which is a rapid application development (RAD) framework. CakePHP is a very popular application framework and has various additional components that integrate new functions of web applications that are created by outside developers.

The problems of collecting personal data are centered around three points; 1) Initial start, 2) Privacy/Security and 3) Maintenance. Concerning the initial starting problems, the authors have a policy to register into the database voluntarily. We discuss these problems in section 4.

In the following section, we describe the details of the maritime human resource database. The implementation of our database is explained in section 3. We show the preliminary analysis in section 5 and conclude in section 6.

2. Maritime Human Resource Database

In this section, we explain the details of the Maritime Human Resource Database (MHRD). MHRD is web-based database which can be accessed via the Internet. MHRD was created using the CakePHP framework which can create web sites by rapid application development and operates by object-oriented programming. The data structure of the personal database is separated from the presentation on the web site. Therefore, the authors focused on the structure of personal information and logic of collecting data. Because the implementation of our database is explained in section 3, we will describe the data structure of personal information in this section.

2.1 Overview

MHRD should contain personal information specialized for maritime human resources. Therefore, the fields of database records should include maritime related information (ex. ship's officer license). MHRD has 5 tables: the user table, profile, paper table, image table and university table.

The profile table is centered with other tables (see Fig. 1).

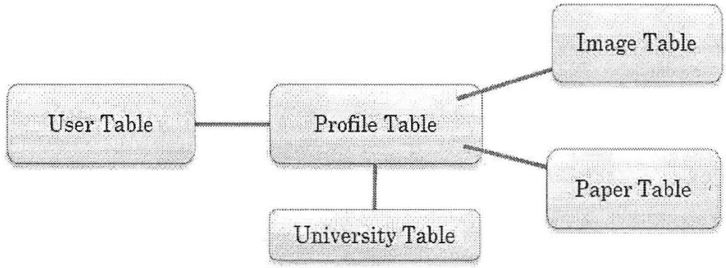


Figure 1. The relationship of database tables.

The user table is used for managing user account information. Registered users must have an account on the system to input and access information. The profile table is the main information of the user corresponding to the user table. The image table keeps the photographs of user portraits while the paper table records the citation information of the papers which are written by the user. The university table maintains the pair with the ID and the name of university, and is used in the selection box of the profile edit page.

Currently, MHRD maintains only fundamental information concerning maritime human resources. The profile table has a URL field which links to the external web page of the user. However, some users may have more web pages; for example, a Facebook page. MHRD may be able to add other tables for maintaining the external web links connected with the profile table of the user. Such extensions may become available in future database updates, as MHRD is flexible enough to add new information.

In the next section, we will show more detailed table information.

2.2 Data Structure of Maritime Human Resource

We have designed 5 tables as follows:

(1.) User table:

Field Name	Type	Description
ID	Number	ID number of account
User name*	String	Account name used for logging
Email	String	Email address for sending confirmation mail
Password	String	Password string used for logging
Active	Boolean	Indicator of the account status
Moderator	Boolean	Indicator of special privilege to be able to modify other account
Created	Date	Created Date of the account
Modified	Date	Modified Date of the account

(2.) Profile table:

Field Name	Type	Required?	Description
ID	Number	Automatic	ID number of profile
User ID	Number	Automatic	User account ID number
Full name*	String	Yes	Full name of user (Family name, Name)
University ID	Number	Yes	ID number of university where user belonged
Sub section*	String	No	Sections of user's institution
Job title	String	Yes	Academic Position of user
Tel	String	Yes	Telephone number
Fax	String	No	Fax telephone number
Language1	String	Yes	Primary language of user
Language2	String	No	Second languages of user
Careers*	String	Yes	Academic Career of user (Last graduate)
Degree	String	Yes	Academic Degree of user
License	String	No	Mariner License
Specialties*	String	Yes	Educational or research specialties of user
Associations	String	Yes	Academic Societies or Associations
Interests*	String	Yes	Research interests of user
Prizes	String	No	Awarded prized of user
Under graduate Course*	String	No	Teaching course in under graduate
Graduate Course*	String	No	Teaching course in graduate school
URL	String	No	External web resource of user
Created	Date	Automatic	Create date of the profile
Modified	Date	Automatic	Modified date of the profile

(3.) Paper table:

Field Name	Type	Required?	Description
ID	Number	Automatic	ID number of paper
Profile ID	Number	Automatic	IDnumber of profile linked with this paper
Names	String	Yes	Authors' name
Title	String	Yes	Title of paper
Publication	String	Yes	Publication information
Year	Number	Yes	Published year
Created	Date	Automatic	Create date of the profile
Modified	Date	Automatic	Modified date of the profile

(4.) Image table:

Field Name	Type	Required?	Description
ID	Number	Automatic	ID Number of image
Profile ID	Number	Automatic	ID number of profile linked with this image
Contents	Binary	Yes	Photograph image shown on the browser
Created	Date	Automatic	Create date of this profile
Modified	Date	Automatic	Modified date of this profile

(5.) University table:

Field Name	Type	Required?	Description
ID	Number	Automatic	ID number of university
Title	String	Yes	Name of University/Institution
URL	String	No	Internet Address of university (not used)
Region ID	Number	Yes	Region ID(Asia/Europe/Central Europe/America)
Order	Number	Yes	Registered Number of university

An asterisk next to a field name indicates that the field will appear in database searches. The only restriction of the search field derives from the 'String' type field. Users can select target search fields for the convenience of the searcher. Currently, detailed searches (filed specific search) are not enabled due to insufficient man-power. Only searches by university/institution are implemented and can be viewed after logging into the database.

2.3 Information Access

Users who are not logged in cannot see the contact information like telephone number, fax number and email address. Access by unlogged users sometimes turns out to be a web robot (automatic web crawling program) which collects all information on a web site for an Internet search engine (ex. Google). Therefore, if we do not protect the contact information from those who are not logged in, the information can be accessed easily by anyone who knows basic information (ex. Name) of registered members. We have to protect private user information from casual searches.

2.4 Policy of Personal Information

We need some personal information in order to collect maritime human resources. Therefore, we decided on a fundamental policy that personal information should be entered by each individual user. We call this policy the 'Self Entry Policy.' This means that any operations or modifications of database records have to be done by the owner of personal information, with the exception of the database administrator. However, past experience with database operations suggest the necessity of moderated functions in order to modify the account information. Because some users did not receive the confirmation mail from the database or forgot the login password, he/she needed to help to modify the account entry.

Another point of the policy is that information of registered users must be maintained by each individual user. Managing personal information on one's own is important to maintain the fidelity of the database by updating personal information in a timely manner. We plan to send notification e-mails for updating user information from the database periodically.

3. Application Development using CakePHP

Our database was developed using CakePHP. CakePHP is a very popular web application with an object-oriented framework. Such Object-oriented frameworks are the current fashion of programming that represents all information as "objects." In our case, the objects are 5 database tables which represent the personal information. CakePHP also adopts the MVC model. MVC stands for Model, View and Controller. The model is the object of application and essential data for application. The user needs to modify only the model to change the data. The view is the expression of the model; for example, web page design. Separating the web page view from the model can support the web page design easily without modifying the data of the model or controller programs. The controller is the program for operating the model via the view input. The controller should be implemented for realizing operational functions in computer programs. The components of CakePHP are abstracted with the controller for specific functions. There are many components created by CakePHP users, and the implementer of the web application can select and use such components to add new functions on the web page.

Figure 2. Shows example profile of our database.

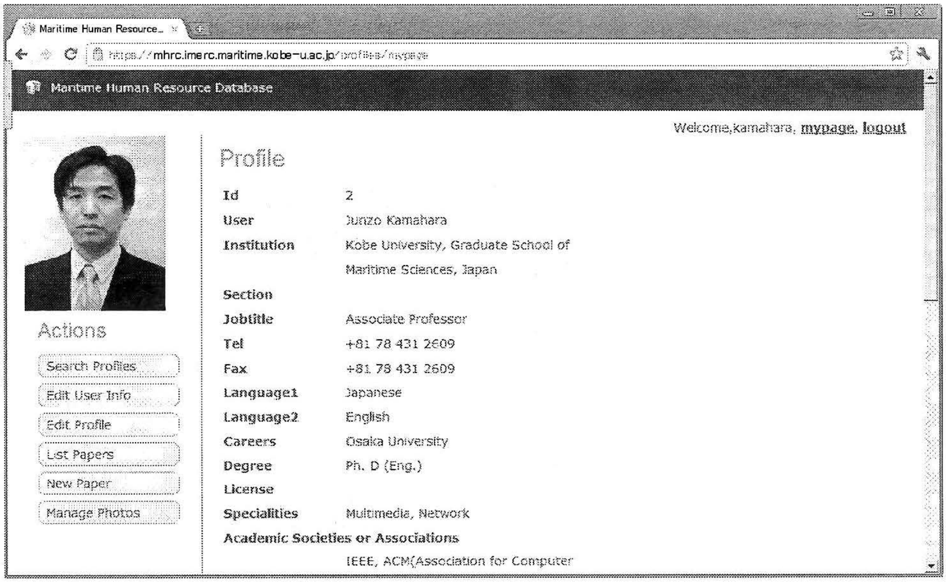


Figure 2. Example of Profile Page

3.1 Avoiding automatic account creation

We have used the kcaptcha component which requires the user to enter a distorted string shown on the screen for recognizing that the user is a human being. An example of a distorted string is shown in Fig.3.

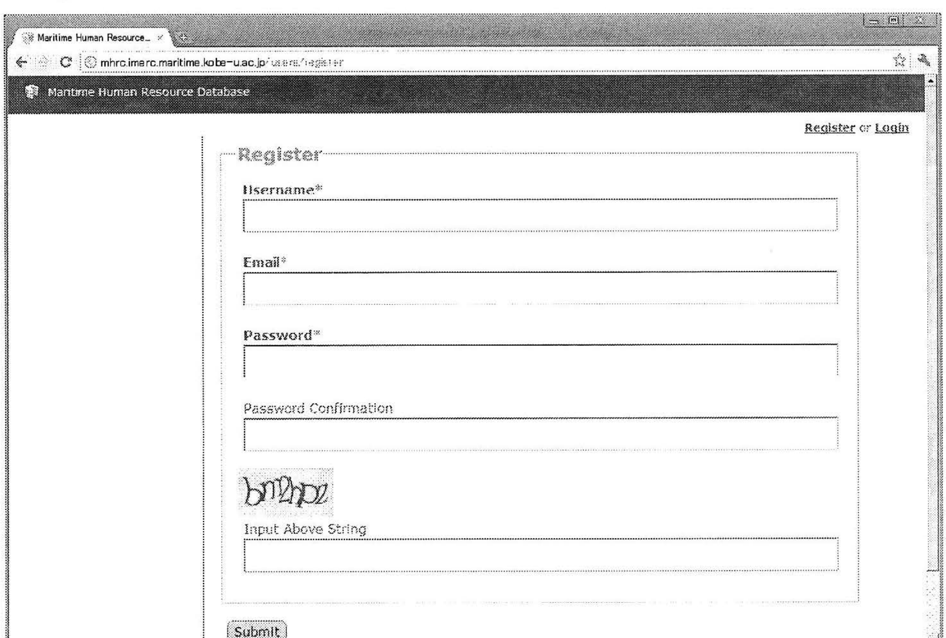


Figure3. Example of Distorted String.

This function prevents automatic account creation by web robots (program) because the web robot cannot recognize such distorted strings by image analysis.

Furthermore, the database sends the activation email for self authentication when the user first registers with the database. The user must click to the link address in the email for self authentication. This method also can avoid automatic account creation.

4. Concerning Issues

In this section, we discuss some concerning issues that arose when we developed the database for collecting maritime human resources.

4.1 Initial Start Problem

We adopted a 'Self Entry Policy' (SEP) for registering personal profiles. Therefore, the database needs individual users' instructions to enter a personal profile. However, the people have less incentive to enter the personal data when there is little data in the database which may not be expected for use in searching for human resources. For this reason, we need to collect a minimum amount of data in the database for increasing future expectations of use.

We sent numerous emails, asking staff and faculty to register with the database, to the representatives of IAMU member universities/institutes. Furthermore, we promoted the database to some members of IMAU by visiting them directly. Due to these efforts, we now have 621 profiles for 45 universities/institutes (83.3%) in the database. The maximum number of registered users in one university is 82 people. The regional number of registered users is shown in Table 1.

Table 1. Regional Number of registering.

Region	Number
Asia	301
Europe	118
America	118
Africa/Central Europe	84

4.2 Security/Privacy

For the security/privacy of our users, we have instituted many security measures for adapting SEP, such as using the kcaptcha component and the view of non-logged in users. We also use secure connection (SSL) to access our database. SSL connections can be used for encrypted communication. When using SSL, we needed to buy an electrical certificate which is used on an Internet browser. We have used the VeriSign SSL certificate (Currently, the name has changed to Symantec SSL certificate). This can avoid wire tapping through the Internet by encryption, and protects the password and other private information.

Furthermore, we have utilized activation emails with initial registered accounts to guarantee self-authentication in SEP. However, this scheme causes some account creation failures for various reasons, like incorrectly entered email addresses and activation messages that were not received. There are 994 accounts already created in the database, however only 735 accounts (73.9%) have been activated by email authentication. 259 people might have failed to activate their own account. Another 114 people were able to activate their accounts by email authentication, but they have not entered detailed profile information into the database yet. We need to send further promotional emails to activated accounts and remind users to enter detailed profile information.

4.3 Maintenance

Because we will continue to maintain this database in the future, we have some supervised functions to maintain the information of people. These functions can be used by the moderators who are specified by IAMU member universities/institutions. The moderator can create a new account for their faculty, activate their account, modify the information of the account and delete wrong accounts (see Fig.4). However, the moderator cannot edit the profile information to protect the validity of personal information pertaining to the SEP.

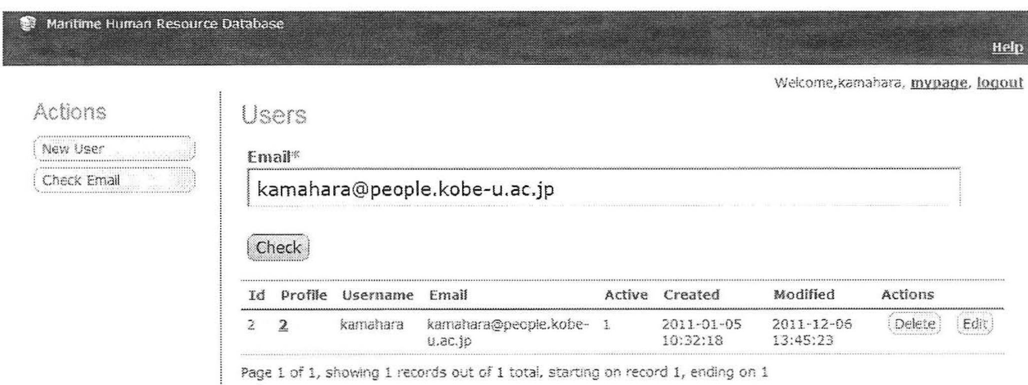


Figure 4. Maintenance page of moderator.

We have requested new functions such as uploading CSV files to faculty profiles through a moderator of the university/institute. We are technically able to implement such functions; however, we have not yet implemented this request as it may violate our SEP. However, as users from various institutes cannot enter their profile information by themselves, the information security policy of those institutes can be used as a backup policy. In that case, we need to consider defusing our SEP.

5. Conclusion

In this paper, we demonstrated the design and implementation of the maritime human resource database. We also discussed the operational issues of our database. We have developed our database as a Web application. Therefore, our database can evolve into a new communication tool among maritime people. The MHRD will continue to develop new functions as it establishes itself as a major hub for connecting maritime education faculties. For future work, we will analyze the characteristics of organizational structures for each university/institution in our database. For example, there are 39 people (6.3%) who have indicated that they possess some type of mariner license. We hope such analysis will contribute to better communication and a more robust information network for all IAMU members.

References

[1] http://www.imo.org/About/Conventions/ListOfConventions/Pages/International-Convention-on-Standards-of-Training,-Certification-and-Watchkeeping-for-Seafarers-(STCW).aspx

[2] http://cakephp.org/

Three-Dimensional Engine Simulators with Unity3D Game Software

Sergio Perez-Gruszkiewicz, Ph.D.
Professor, U.S. Merchant Marine Academy, Department of Marine Engineering, Kings Point, NY 11024 perezs@usmma.edu

Elwood Baumgart
Chief Engineer, Captain, U.S.M.S., U.S. Merchant Marine Academy, Kings Point, NY 11021 baumgarte@usmma.edu

Abstract: The difference between a computer game and a simulator can be a small one – both require the same capabilities from the computer: realistic graphics, behavior consistent with the laws of physics, a variety of scenarios where difficulties can emerge, and some assessment technique to inform users of performance. Computer games are a multi-billion dollar industry in the United States, and as the production costs and complexity of games have increased, so has the effort to make their creation easier. Commercial software products have been developed to greatly simplify the game-making process, allowing developers to focus on content rather than on programming. This paper investigates Unity3D game creation software for making three-dimensional engine-room simulators. Unity3D is arguably the best software product for game creation, and has been used for numerous popular and successful commercial games. Maritime universities could greatly benefit from making custom simulators to fit specific applications and requirements, as well as from reducing the cost of purchasing simulators. We use Unity3D to make a three-dimensional steam turbine simulator that achieves a high degree of realism. The user can walk around the turbine, open and close valves, activate pumps, and run the turbine. Turbine operating parameters such as RPM, condenser vacuum, lube oil temperature, and governor status are monitored. In addition, the program keeps a log of any errors made by the operator. We find that with the use of Unity3D, students and faculty are able to make custom three-dimensional ship and engine room simulators that can be used as training and evaluation tools.
Keywords: simulators, PC simulators, game-programming

1. Introduction

Consider a computer game where the user drives a car around a track. The car must respond in a manner consistent with the laws of physics, accelerating when the accelerator is pressed, slowing when the brakes are applied, detecting when the car collides or goes off the road. The user must respond to inputs, and the game must keep track of the user's performance (score).

A 3-dimensional engine simulator is not very different from a game: like the game, the simulation must behave in a physically realistic way, respond to user inputs, allow motion in the 3-D space, and advise the user of the status of the simulation (pressures, temperatures, etc.).

Creating a PC-based simulator or a game from the ground-up is not an easy task.

Computer games and simulators are typically written in C++ or some other programming language. The seemingly simple act of displaying a 2-dimensional image on a PC screen requires about 200 lines of code in C++ [1]. The problem is that a game or simulator must perform two non-trivial tasks: deal with Windows, and display and move objects in three dimensions.

To aid programmers in developing PC games, powerful software products have been developed which can greatly simplify the programming task. These programs have pre-made functions or subroutines that handle some of the difficult parts of creating 3D simulators or games, and allow the programmer to focus on the content of the simulation.

Some of these products are free, such as Lite-C [2], Panda3D [3] and Blender [4], while most are commercial products, such as DarkBasic [5], Torque [6] and Blitz 3D [7]. Readers are referred to Wikipedia [8] for a list of software products which can be used to make games and simulators.

Perez [9] showed that game-making software product Jamagic could be used for making a variety of 3-D simulators, including ship handling and flight simulations. Jamagic was also used to make a 2-D engine room simulator, presented at the 9th International Conference of Engine Room Simulators (ICERS 9) by Perez and Byra [10]. The authors showed that game-making software could be used to make a 2-Dimensional panel-type simulator of a steam turbine.

Some of the products mentioned above use their own or simple programming languages, for example DarkBasic, Blender and Blitz3D, while most require writing code in C++ or Python language to access pre-programmed routines for making games (known as game engines).

Using game programming software, the task of making a simulator becomes greatly simplified, enabling learning institutions to make their own simulators. An important aspect of this, aside from the obvious one of cost, is the ability to tailor-fit assessment techniques to the needs of individual institutions. However, it must be remembered that creating a simulator is not an easy task, as algorithms still must be created to model the physics involved with engine room simulators.

In this paper we explore the use of Unity software (www.unity3d.com) for 3-D modeling of a small steam turbine, including user assessment.

Unity is an extremely powerful tool for creating 3D video games, and can run on Microsoft Windows and Mac OS X. Many highly successful commercial games have been created with Unity. The games it produces can be run on Windows, Mac, Xbox 360, PlayStation 3, Wii, iPad, iPhone, as well as the Android platform.

The software version used for this simulation is freely available from the Unity web site – this is a fully functional version of the Pro Version which costs about $1500.

2. 3-D Art

One of the first steps in making a game or simulator is obtaining the 3-dimensional images of the simulated object. For this project we needed a realistic 3-dimensional model of a steam turbine, with valves, pipes, and displays.

Usually one has to make the 3D objects using commercially available software like Maya, Studio Max, or the freeware Blender. Making 3D game objects can be a very time-consuming task, but occasionally the 3-D objects can be found on the internet already made – these objects may be ready for use, or may be modified using 3-D modeling software.

We were fortunate to find 3-D art of turbines, pipes and valves that was sufficiently similar to actual systems to greatly simplify our task. The turbine model came with no piping, but the pipe models used were easy to modify and add to the 3-D scene.

Once the 3-D art is available, it can easily be "dragged" into the Unity scene.

3. Programming

Any simulator must be given instructions how to behave. For example: what happens when a pump is activated or a valve opened? How much does the pressure drop across a valve while throttling? How does one control the pitch of the turbine sound as the RPM change? By writing a computer program, developers can control the action on the simulation.

Unity can be programmed in either Java or C# - the programmer selects which. For this paper Java was selected because it is somewhat simpler to use.

A sample portion of the main program used for this project is shown below. It illustrates an algorithm used to control the pitch and speed of the turbine based on the amount that two valves upstream of the turbine are opened. The simulator created for this project required about 500 lines of program.

```
rate = spin1/90*spin3/90 ;   //rate depends on valve 1 and valve 3 open amount
rpmgoal = 1250*rate;
  if (rpm>0)
    {
    audio.pitch = 0.1 + rpm/300.0;  //adjust the pitch based on rpm
    if( tsound<0)
      {
      audio.clip=turbsound;  //the turbine sound clip to use
      audio.Play();          //play the clip
      tsound = 1.0;
      }
    }
if (rpmgoal>rpm & rpm<900)   //we add to rpm
  {
  rpm = rpm + Time.deltaTime*(-spin3)/7;
  }
```

4. The Simulation

The simulation developed for this project is based on a steam-driven turbine/generator at the U.S. Merchant Marine Academy. The goal was to demonstrate the capabilities of Unity for engine room simulations and evaluation of student performance.

The model displays operating parameters such as turbine RPM, condenser vacuum, lube oil temperature, and governor status. A list of errors is displayed on the screen informing students and instructors of any missteps.

The operator must perform tasks in the proper in order to avoid error messages. Before admitting steam into the turbine the following tasks must be performed: oil must be checked, gland-sealing steam must be admitted into turbine, the lube oil pump must be primed, vacuum raised in the condenser, and sea water and condensate pumps turned on.

In addition, a drain must be opened in the main steam line before opening the throttle; this allows steam to be visible exiting the drain so the operator can visually check the flow of steam for presence of liquid droplets.

Once the turbine begins rolling after the throttle is opened, the pitch of the turbine sound will rise as RPM increase. As the throttle is opened or closed, turbine RPM reacts accordingly. Also, the lube oil primer will shut itself off at a given value of the RPM.

The status of the turbine is displayed in a 3D text above the turbine, while the status of all pumps is shown in a pump menu at the bottom of the screen.

In order to aid students in understanding the system, the user can right-click on objects to display a message describing the item clicked. Valves are opened by left-clicking (more clicks open the valves more) and closed by right-clicking. The camera (which provides the view to the user) is moved using the arrow keys (Table 1) as well as by number keys:

Table 1: Camera Controls

Key	Camera action
1	Rotate left
2	Rotate right
3	Move down
4	Move right
5	Rotate down
6	Rotate up

The screenshots below show the simulator in operation. The user has the capability to walk around the 3D space at will using the arrow keys and the number keys listed above.

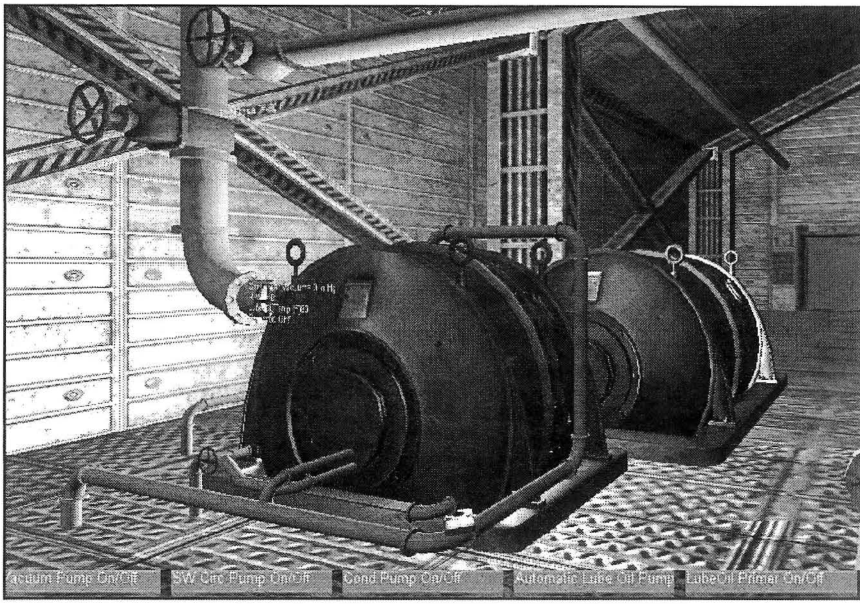


Figure 1. The turbine and generator.

Figure 1 shows the turbine with associated piping and valves. The vacuum, seawater circulation, condensate, and oil primer pumps are controlled by the buttons at the bottom of the scene. Turbine operating parameters are displayed over the turbine. The valves can be clicked to open and close.

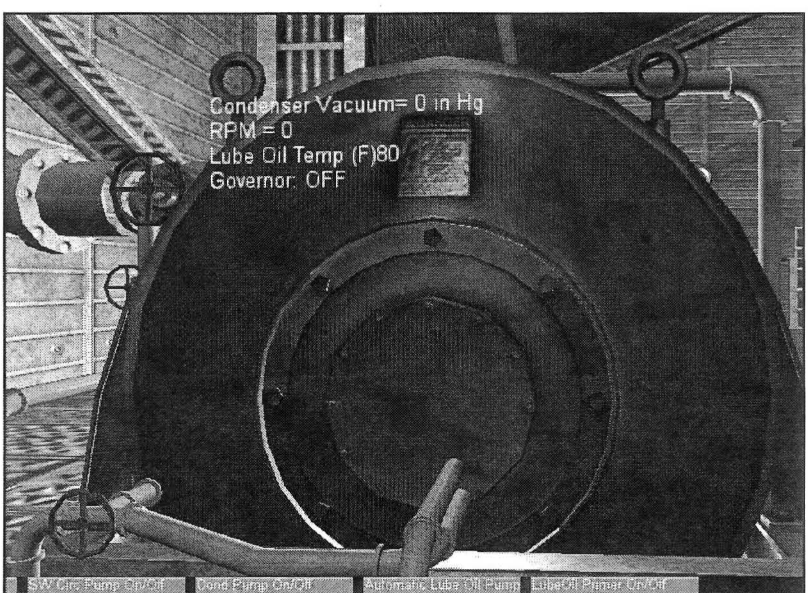


Figure 2. Turbine Close-up

Figure 2 is a close-up of the turbine. The upper left valve is the throttle, the middle valve is the steam drain, and the lower valve allows gland-sealing steam into the turbine. The two pipes exiting the turbine are the gland sealing steam inlet and outlet lines.

When the throttle is opened, the turbine slowly accelerates, and reaches a RPM value based on the amount the throttle and main steam valve are open. As the turbine turns faster, the pitch of the engine sound increases. Shutting the throttle down causes the pitch and RPM to drop gradually.

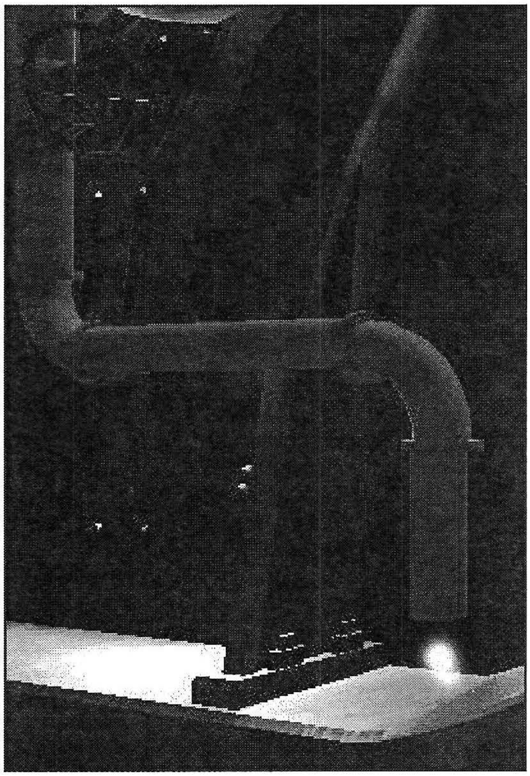


Figure 3. The steam drain line. Steam can be seen exiting the pipe.

When the steam drain line is open, steam is seen exiting the pipe as a fog. As the pipe is opened more, the steam exits further from the pipe, and becomes clear close to the pipe, indicating superheated steam at the exit.

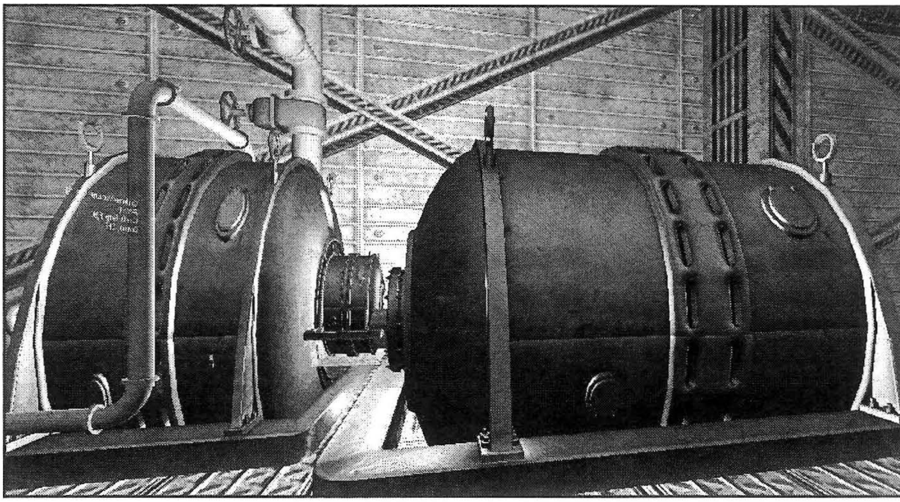


Figure 4. The turbine and generator.

Figure 4 shows the turbine from the side, with the generator connected to it.

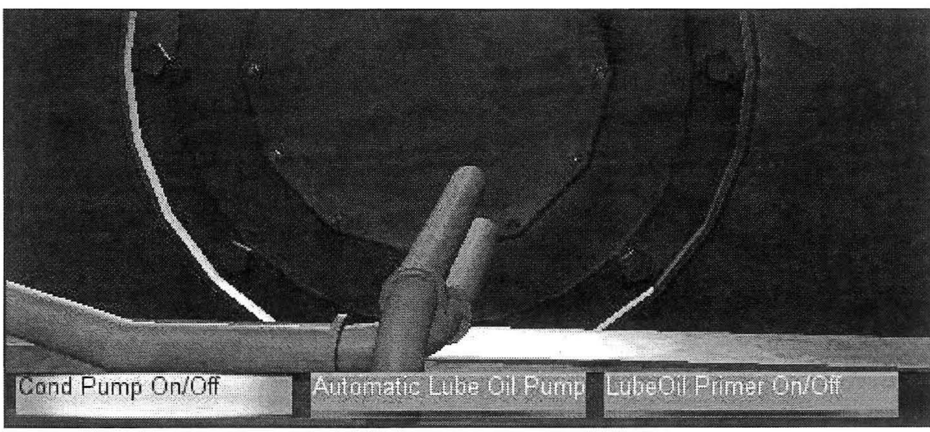


Figure 5. Close-up of pump controls.

Figure 5 shows three of the pump controls. The controls are a red color when pumps are off, and turn blue when activated. The lube oil primer pump shuts itself off automatically at a set RPM, and the lube oil pump starts.

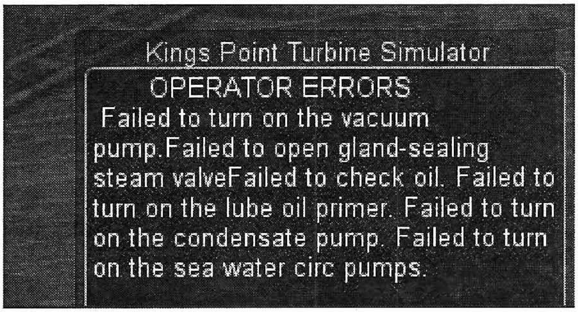


Figure 6. Display of error messages.

Figure 6 shows sample error messages displayed on the screen. The error messages are activated by a number of errors, including the failure of the operator to open the throttle slowly.

5. Observations and Conclusions

Unity is an extremely powerful and versatile tool that can create simulators as good as any commercial product on the market – in fact, Unity has been used to make many successful commercial games. Unity's ability to quickly render 3-D scenes and execute code makes it ideal for simulators as well as games. The entire engine room of a ship could potentially be simulated using the software, with much less work than if the simulation were programmed directly using a programming language.

Unity has a rather steep learning curve, especially if the programmer is not accustomed to object-oriented languages. However, the on-line documentation is very good, and the user forums are of immense value in learning how to do specific tasks – one merely has to type what one wishes to learn into a search engine, and usually someone else has already answered that same question in the past.

The project was completed with 60 -100 hours of work, with the programmer already somewhat familiar with Unity. Quite a bit of time was saved by purchasing pre-made 3D models of the turbine and piping systems, which came to about $50 total. It is anticipated that the time required for any future projects of similar complexity would be considerably less due to the programmer being more familiar with the software.

References

[1] Parberry I., "Introduction to computer game programing with DirectX 8.0", Wordware Publishing, 2001.
[2] www.conitec.com/english/gstudio/litec.htm
[3] www.panda3d.org
[4] www.blender.org
[5] www.darkbasicpro.thegamecreators.com
[6] www.garagegames.com
[7] www.blitzbasic.com
[8] http://en.wikipedia.org/wiki/List_of_game_engines

[9] Perez S., "*Elementary Game Programming and Simulators using Jamagic*", Charles River Media, 2003.

[10] Perez S., and Byra A., "PC game technology for creating engine room simulators with student assessment capabilities", *Proceedings of ICERS 9*, 2010, Kings Point, NY, pp 1-15.

Response of Maritime Education and Training to New Requirements of STCW'78 Manila Amendments

Bai Jun
Tutor, Second Officer, Dalian Maritime University,
baijundlmu@126.com

Zhang Bin
Lecturer, Third Officer, Dalian Maritime University,
zhangbindlmu@126.com

Yu Jiajia
Tutor, Dalian Maritime University,
rara-aza@126.com

Abstract: The background of this paper is the STCW'78 implementation of the Manila amendments. It summarizes the content of the amended STCW convention about marine education and training (MET). Meanwhile, the paper analyzes new requirements about MET in a new situation. That is to say, the requirements of digital and electronic navigational strategy, the requirements for protection of the marine environment, the requirements of integrated application of modern navigation technology, the requirements of human factor, the requirements of ship security, the requirements of teamwork and leadership etc. Finally, to respond and implement the new requirements and higher standards of STCW'78 implementation of the Manila amendments, the paper draws a conclusion about strategies which should be taken by maritime education and training.
Keywords: MET; STCW Convention; New Requirements; Response

1. Introduction

The STCW Convention is one of the main international maritime conventions. With stricter requirements for protection of ocean environments and more use of new technology, standards of seafarers training and watchkeeping were increasingly improved. At the same time, owing to more piracy events, requirements for ship security had been put forward to seafarers training and watchkeeping. Therefore, a comprehensive review of the 1978 STCW Convention commenced in January 2006 and culminated in a conference of parties to the STCW Convention, held in Manila, Philippines, from 21 to 25 June 2010, that adopted a significant number of amendments to the STCW convention and STCW Code. The standard of training, certification and watchkeeping for seafarers would be much more rigorous and have higher requirements. In the face of the new situation, it was compulsory to research how MET responded to the new requirements of STCW'78 Manila Amendments.

2. Content of Manila amendments regarding to MET

2.1 Content of amendments in "Chapter II Master and deck department" and "Chapter III Engine department" [1]

2.1.1 The Manila amendments proposed new requirements about enhancing the protection of marine environment.

2.1.2 Bridge resource management and engine resource management had been mandatory standards. It was the first time to present new requirements on human factors including allocation, assignment, and prioritization of resources, effective communication, assertiveness and leadership, team experience, etc.

2.1.3 The Manila amendments added new requirements on application of leadership and team-working skill (operational level) and the use of leadership and managerial skill (management level). So, the MET institution should enhance the training of seafarers' awareness of teamwork, leadership, human management and assertiveness. In the meantime, it should be embodied in practical assessment.

2.1.4 The Manila amendments added new requirements about maintaining safe navigation through the use of information from navigation equipment and systems to assist command decision making for masters and officers in charge of a navigation watch on ships. Hence, during the MET training course, using navigation equipment and systems should be emphasized.

2.1.5 Use of electrical equipment and systems, such as ECDIS, was emphasized. It had different requirements respectively for operational level and management level, use of ECDIS to maintain the safety of navigation and maintain the safety of navigation through the use of ECDIS and associated navigation systems to assist command decision making.

2.1.6 Mandatory minimum requirements on certification of ratings, such as able seafarer of deck and engine, electro-technical officers. The MET teaching content and outline should be modified according to new requirements referring to the above ratings.

2.2 Content of amendments in "Chapter V Special training requirements for personnel on certain types of ships" [1]

2.2.1 The Manila amendments changed mandatory minimum requirements for the training and qualifications of masters, officers and ratings on liquefied tankers, oil tankers, chemical tankers and liquefied gas tankers.

2.2.2 The Manila amendments added guidance regarding training of seafarers on passenger ships including enhanced fire fighting and damage control. Masters, chief engineering officers, chief mates, second engineering officers and any person designated on muster lists of having responsibility for the safety of passengers in emergency situations on board passenger ships should have completed approved training in crisis management and human behavior as specified in section A-V/2, paragraph 3 of the STCW Code.

2.2.3 Added: 1) Guidance regarding training and qualifications of masters and officers in charge of a navigational watch on board offshore supply vessels; 2) Guidance regarding the training and experience for personnel operating dynamic positioning systems; 3) Guidance regarding training of masters and officers for ships operating in polar waters.

2.3 Content of amendments in "Chapter VI Emergency, occupational safety, security, medical care and survival functions" [1]

2.3.1 The Manila amendments confirmed mandatory requirements for safety familiarization and basic training and instruction for all seafarers. Meanwhile, ocean environment protection and effective communication have been added.

2.3.2 Guidance regarding requirements in medical first aid and medical care training programs for seafarers who provide medical first aid on board ship should take into account guidance in the revised International Medical Guide for Ships, as appropriate.

2.3.3 The Manila amendments confirmed mandatory minimum requirements for security-related training and instruction for all seafarers. It involved four kinds of security training and three kinds of security certification.

3. New requirements of Manila amendments for MET

3.1 The requirements of digital and electronic navigation strategy

The main content of the Manila amendments was the application of new technology based on informatization and digitization. Implementing of an e-navigation strategy had prospective content for MET. In the new situation, MET would soon be changed and advanced. Due to the use of electrical equipment and systems such as ECDIS, on the one hand, MET should pay more attention to training for intelligent equipment and digital technology, on the other hand, MET should take the initiative and adapt requirements of the STCW convention for digital navigation.

3.2 The requirements for protection of marine environments

Protection of marine environments was definitely presented in the Manila amendments to all seafarers. It was in accordance with society's developmental requirements for protecting the marine environment [2]. So, during MET courses, knowledge of protection of the marine environment should be introduced so as to enhance seafarers' consciousness of environment protection.

3.3 The requirements for integrated application of modern navigation technology

Following the development of satellite technology, communication technology, network technology, shipbuilding technology, surveying technology etc., navigation technology had made significant progress. Today's navigation is related to abundant content including Global Position System (GPS), Automatic Identification System (AIS), Electronic Chart Display and Information System (ECDIS), Port Ocean environment Reporting and Forecasting System, Admiralty Publication Digitization and Electronization System. Hence, lots of high-tech equipment will be used on board. That is to say, MET should pay more attention to the requirements of integrated application of modern navigation technology. At the same time, special training for modern navigation technology and equipment should be carried out.

3.4 The requirements of human factor

The Manila amendments presented new requirements about human factors for deck and engine departments. Human factors in the amendment included effective communication, assertiveness, leadership skill, team-work awareness etc, due to more than 80% of marine accidents being caused by human factors. So, the IMO had fully realized the effect of human factors in marine safety. Hence, MET institutions should pay more attention to the content of human factors.

3.5 The requirements of ship security

Security-related training and instruction for all seafarers were also mandatory requirements in the new amendments. Meanwhile, corresponding requirements for different ranks were presented thereby improving all seafarers' security awareness. In this situation, MET must adjust to the new requirements and consider how to fulfill the requirements of ship security training.

4. Response of MET to Manila amendments

4.1 Enhancing legislation about maritime education

The key to promote the development of shipping was personnel with abilities. Legislation about maritime education was the key to bring up qualified personnel who corresponded with the requirements of STCW'78 Manila amendments [3]. Legislation made significant sense to marine institutions which were mainly in place to train seafarers. Lack of marine education statutes, however, was a severe problem to MET. So enhancing the legislation about maritime education was imperative.

4.2 Revision of existing MET management system

Due to the STCW'78 convention being amended, MET management systems should be adjusted to synchronously develop new model courses. In this situation MET management systems, training quality management systems and training outlines should be revised. Consequently, MET can forwardly adapt requirements of integrated application of modern navigation technology.

4.3 Promotion of teaching level

The STCW'78 Manila amendments had perceptiveness for a digital and electronic navigation strategy. Meanwhile, knowledge updating and practical skills of teachers had been definitely included. The teachers of MET should do in depth research on e-navigational strategies and modern navigational technology, and master new theory, new technology, new equipment and new systems. On one side, renewed training for teachers of environmental protection and ship security should be carried out in advance. In another, based on the particularity of a marine vocation, MET institutions should provide opportunities for teachers to work onboard as seafarers, so as to enhance their practical skills.

4.4 Adjusting teaching equipment and content

Recognizing the importance of adequate education, training, and experience acquired by all seafarers, MET should appraise the use of new technology and new equipment through practical assessment tests to fulfill the STCW Convention and Code which established standards of training, certification and watchkeeping for seafarers. In order to meet the requirements for protection of ocean environments and ship security, MET institutions should revise teaching outline and training content. Aimed at requirements of human factor, MET institution can strengthen practical teaching and use simulators and training ships.

5. Conclusion

The Manila amendments have presented the mandatory minimum requirements for certification of seafarers in the future and pointed out the orientation of MET. Researching thoroughly the development and changes to the STCW Convention could make MET institutions forwardly implement the new requirements. MET will be confronted with the requirements of digital and electronic navigational strategy, protection marine environment, integrated application of modern navigation technology, teamwork and leadership, human factor and ship security. To respond to and implement these new requirements and high standards, MET should firstly enhance legislation about maritime education, and then revise existing MET management systems. Meanwhile, to reply to the use of various high technologies in the navigational area, MET institutions must promote teaching levels, update teaching equipment and adjust teaching content and practical assessment.

References

[1] STCW Convention and STCW Code including 2010 Manila amendments, (2011 edition).

[2] Liu Zhengjiang and Bao Junzhong, "The characteristic and effect of STCW78/10 amendments", CHINA MSA, (2010), pp 31-34.

[3] Wang Zuwen, "Accelerating legislation of maritime education and cultivating high quality navigational person", www.shuobo.org [2009-02-28].<http: //news.china-b.com/hydt. html>.

A Virtual Learning Environment for the Maritime Curriculum: Delivering Online Information and Instruction through Digital Library Resources and Distance Learning Modules

Ms. Constantia Constantinou
Maritime College, The State University of New York, United States
cconstantinou@sunymaritime.edu

Abstract: The study "A Virtual Learning Environment for the Maritime Curriculum: Delivering Online Information and Instruction through Digital Library Resources and Distance Learning Modules", demonstrates how advances in technology and information delivery support and enhance the teaching and learning mission of SUNY Maritime College. SUNY Maritime College prepares students for careers through a content-centered curriculum and a hands-on, team building approach to learning. As a part of the STCW requirements, the SUNY Maritime Students are required to participate on two ninety-day summer sea terms, both aboard the *Training Ship Empire State VI.* The SUNY Maritime College student experience is furnished ashore and afloat with instructional technology for teaching and learning in the classroom, in library, at sea, and virtually from anywhere in the world. The study describes the technology for delivering electronic content, such as electronic journals, e-books, digital reproductions of primary documents for the maritime based curriculum, as well as a number of virtual services to online/distance learning students and faculty. In addition, the study outlines the successful development and implementation of a distance learning program where over 109 courses are taught, 49 are exclusively online courses and 50 hybrid courses using technology solutions such as Blackboard.
Keywords: Maritime Curriculum; Library Electronic Resources; Distance Learning Education;

1. Introduction

The study "A Virtual Learning Environment for the Maritime Curriculum: Delivering Online Information and Instruction through Digital Library Resources and Distance Learning Modules", demonstrates how advances in technology and information delivery support and enhance maritime teaching and learning at sea and ashore. Maritime College is one of the 64 colleges and universities of the Sate University of New York System (SUNY) and one of the six Maritime Academies in the United States granting United States Coast Guard licenses. The curriculum offers undergraduate and graduate degrees, and a European summer sea term of 90 days aboard the Training Ship *Empire State VI*, SUNY Maritime [1].

The Stephen B. Luce Library of SUNY Maritime College is an academic department accredited by professional organizations such as the Middle State Commission on Higher Education and it adheres to the standards and guidelines of the Association of the College and Research Libraries of the American Library Association, American Library Association [2]. The Librarians hold a faculty status and they are members of the college faculty. The Stephen B. Luce Library has the great advantage of being one of the most specialized maritime libraries in the world. As a member of a 64 SUNY-campus consortium, the library collects and acquires maritime specific collections in print and electronic formats. The Library is also in agreement to share its collections and to borrow collections from the other 64 SUNY colleges and universities. Consortium agreements allow the library to concentrate its collections on discipline specific material while supplementing the need and demands of library users with shared collections from other SUNY institutions. In addition, the Library has developed a very robust instructional programs in information literacy that supports the research requirements of the maritime disciplines in engineering, science, business, marine transportation, and the humanities with classroom teaching.

2. Digital Content and Online Information Research

The maritime industry has a long tradition of innovation and technology achievement. Recent years have seen a growing dependence on using information technology to enhance teaching and learning. The libraries have been pioneers in transforming print resources to digital resources and electronic content and delivering this content to users beyond the library's physical environment. Similarly, technology on ships is constantly being implemented onboard to aid the seafarer in navigation, safety, and environmental awareness. Whereas our forefathers have used paper charts and sextants, today's mariner must be knowledgeable on use of radar, GPS, electronic charting, and various other electronic publications [3]. Consequently, maritime educators are recognizing the need for students to be trained in information technology.

In the mid 1990s, as information evolved in many different formats, maritime libraries increased emphasis on library instruction programs and information literacy emerged as the instructional framework to develop students' competencies in analytical skills and critical thinking. The Association of College and Research Libraries defined information literacy competency standards as "...a set of abilities requiring individuals to recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information." Information literacy, as defined, is the basis for lifelong learning because a student who graduates with the ability to locate, evaluate, and effectively use information can learn independently and address their own needs and questions in any area of life [4].

To train maritime students to become information competent, the Stephen B. Luce Library has interwoven a framework of technological tools, library instruction, and assessment activities to design a program that is infused in the Maritime curricula. The library facilitates access to a myriad of digital and print information sources along with some state of the art research tools such as enhance OPAC, federated searching, cross linking with Google, worldwide catalog, and more. Also, technology is incorporated into various pedagogical tools that are used to enhance students' training in information competency. In addition, with the tools in place, the Library designed a robust instruction program to integrate information competency in the curricula. Various assessment activities have been implemented to provide much needed feedback on the effectiveness of the information competency training. The Library uses the assessment data to continuously enhance the program. A key component for effective information competence training is to expose maritime students to some of the current technological tools.

2.1 Scholarly Resources at the Stephen B. Luce Library

As a member of the SUNY consortium of libraries, the Stephen B. Luce Library has access to online resources far beyond the scope of the maritime specific databases. These scholarly resources are subscription based and made available to students and faculty at SUNY Maritime from anywhere in the world through an authentication system. Some of these electronic databases are listed below:

EBSCO Databases	EBSCO includes 7 separate databases. They are Academic Search Elite, Business Source Premier, Clinical Reference Systems, Health Source Plus, USP DI Volume II Advice for the Patient, Newspaper Source and Alt-Health Watch. These databases feature full text for a wide range of publications.
FirstSearch	The OCLC FirstSearch service offers a variety of indexes, abstracts and full text databases.
Gale Databases	A collection of databases covering literature, current events, business and more. Includes newspaper, journal and encyclopedia articles, both scholarly and general, in arts and literature, social sciences, current social issues, financial research, and health information. Full text coverage and indexes from 1980 to date.
HarpWeek	The Civil War segment covers the years 1857-1865. HarpWeek is the full-text, full-image electronic version of Harpers Weekly for the nineteenth century.
Homeland Security Digital Library	The Homeland Security Digital Library (HSDL) is the nation's premier collection of documents related to homeland security policy, strategy, and organizational management.
JSTOR - Arts & Sciences I	This JSTOR collection includes full-text articles from the complete back runs of 118 journal titles in various disciplines, including many of the core research and society published journals in economics, history, political science, and sociology, as well as titles in the more science-oriented fields of ecology, mathematics, and statistics.
Lloyd's List	Lloyd's List is the leading daily publication for authoritative coverage on the shipping industry, including global shipping, logistics, global trade, marine insurance, and admiralty law.

Marine Technology Abstracts	The Marine Technology Abstracts database contains bibliographic information providing a reference and description for over 90,000 technical articles, reports, books, conference and transaction papers and other material on all aspects of maritime technology, dating back as far as 1940 and drawn from all major marine engineering publications, published worldwide in at least 10 languages.
Milestone Documents in American History	Salem History's *Milestone Documents in American History* is the first of five primary source resources from the Schlager Group and Salem Press. It combines 130 full-text primary source documents with expert analysis and commentary
NetLibrary	529 medical and health-related eBooks and 125 new business titles with the original collection of 715 titles, SUNY-Connect now provides 1369 purchased eBooks as well as the public (i.e., free) collection of 3823 titles.
ProQuest	ABI/INFORM Global: American Medical Association; Newspapers Periodicals; Peer Reviewed ProQuest Newspapers: National Newspapers (27); Barron's; The New York Times; Wall Street Journal
ScienceDirect	Contains 707 scholarly full-text scientific and medical journals. ScienceDirect offers full text access to over 700 Elsevier Science journal titles that cover areas including science, medicine and technology.
Springer Ebooks	A collection of about 17,000 titles of ebooks in 13 different subject areas, including Business & Economics, Chemistry & Material Science, Earth & Environmental Science, Engineering, Humanities, Law, Mathematics, Physics, and more.
TRID Database	TRID is the world's largest and most comprehensive bibliographic resource on transportation research information. It is produced and maintained by the Transportation Research Board. TRID covers all modes and disciplines of transportation and contains more than 900,000 records of published research. Over 64,000 records contain links to full-text documents.
Uncover Reveal Ingenta	UnCover Reveal is an automated alerting service that delivers the table of contents of your favorite periodicals to your email inbox.

3. Historical Research Digitized

Recognizing the value of historical maritime collections, the Stephen B. Luce Library decided to pursue the avenue of digitization to increase access and awareness and also to preserve the documents by minimizing handling of the physical collection. Starting in 2006, the Library laid the groundwork for digitizing major maritime collections and making them accessible to the public. The digitized portions of the collections served as a complement to the entire collection, increasing awareness to researchers and the public in general of the type of original documents that exist in maritime history. The major public entry point for the Stephen B. Luce Library digital collections is on a comprehensive web site devoted to the collection and hosted on the library's web server and at various servers in New York State [5]. The research value of historical collections inspires high interest because of their uniqueness and how they compliment other Maritime collections. The library has been receiving many requests from researchers to access these historical collections from the fields of Maritime and New York City history, and genealogy. Researchers in the humanities who undertake research that documents the social history of the Maritime world benefit greatly by the access that digitization provides. The collection remains unique because, aside from the collections at other maritime institutions, there are few fully digitized maritime collections extant. Image 1 depicts a screen caption of the SUNY Maritime College Library Digital Collections on the New York Metropolitan Server.

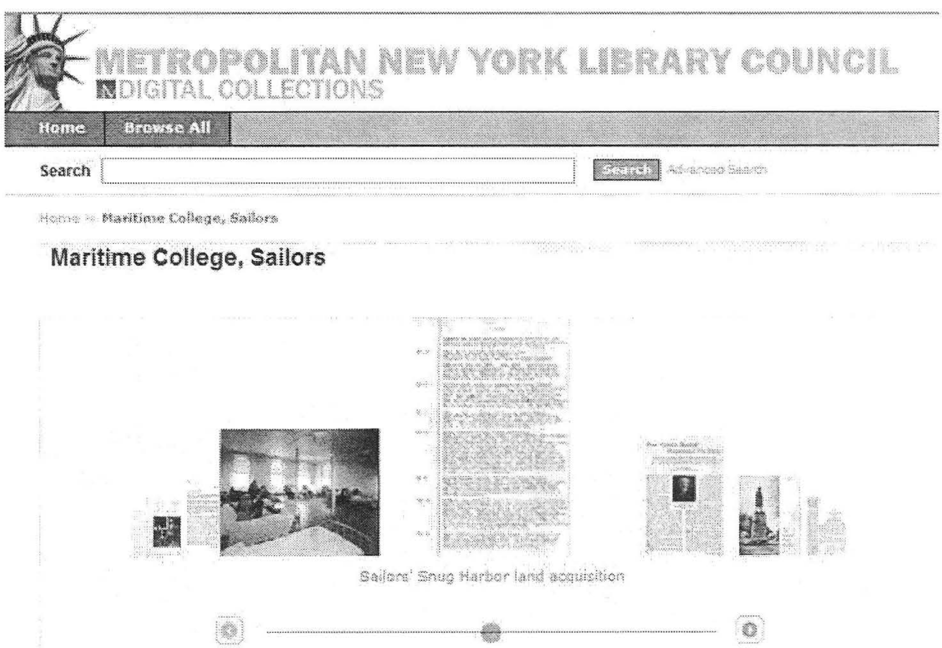


Image 1.

4. Library Technology at Sea

The Library on the Training Ship Empire State VI is located on deck four and it occupies approximately 2500 square feet. It has a reading room with seating capacity for 55 people and shelving that holds approximately 7,000 books. Similarly with the SUNY Maritime College Library ashore, the Ship's Library is furnished with the latest technology to facilitate the teaching and learning objectives of the SUNY Maritime students at sea.

The Ship's library computer workstations are working off a several local networks, including several types of servers that are connected with the Ship's intranet and the Ship's satellite communication systems to provide access to the library's digital resources. It is imperative to have the latest technology on modern ships. Technology is also a major mode of learning for the new generation of students. Young students are well proficient and oriented with technology and they are accustomed to instantaneous access to information. The decision making process at sea is subject to instantaneous access to information; prime examples are electronic navigation, electronic weather reports, electronic communication with other vessels and electronic access to important documents and resources.

The Library's LAN is networked to the Ship's intranet which is connected to the *Empire State VI* satellite communication system. Library computers provide access to electronic publications needed by the students for their studies. Electronic information is also provided specific to library operations and personnel; image and data banks; a suite of various training software; and the Library's OPAC. Management of library operations is done using LibrarySoft, an integrated library management system. The LAN system also serves as a databank that houses images and the library's electronic resources. The Library's server is part of the Ship's intranet server. It is possible that anyone from anywhere aboard the ship can access the library's LAN system.

4.1 Maritime Electronic Resources at Sea

The Ship's Library technology infrastructure is built on a local area network (LAN). Several computer workstations are networked to the Ship's intranet which is connected to the Ship's satellite communication system. Students and crew can access the electronic publications and research material through an image and data banks of various training software. The most updated editions of various official government publications are transferred in electronic format and made available on the library's computers. These publications are on subjects such as ocean conditions, navigation, federal regulations; and several sources on countries/cultures information and port guides to support travelling to various ports of call. [Image 2.]

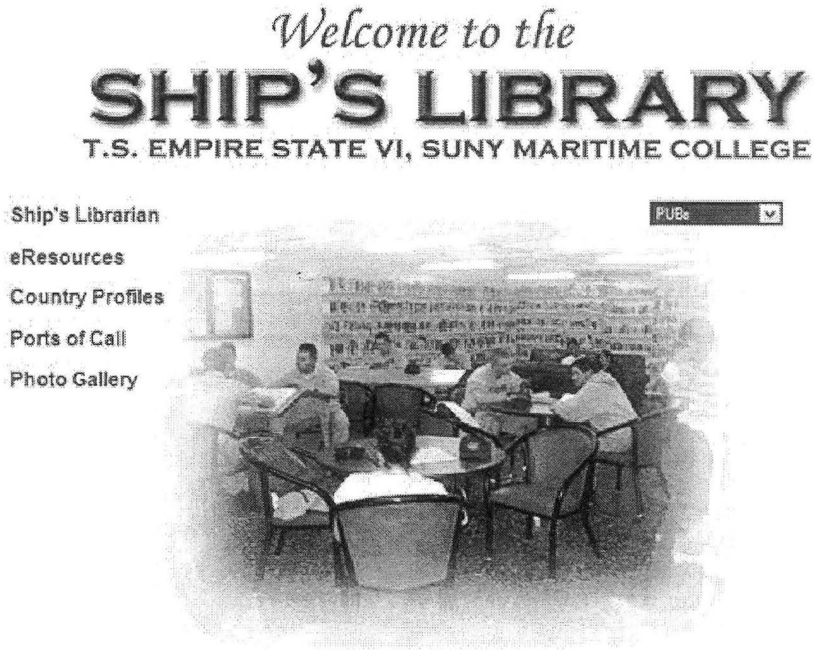
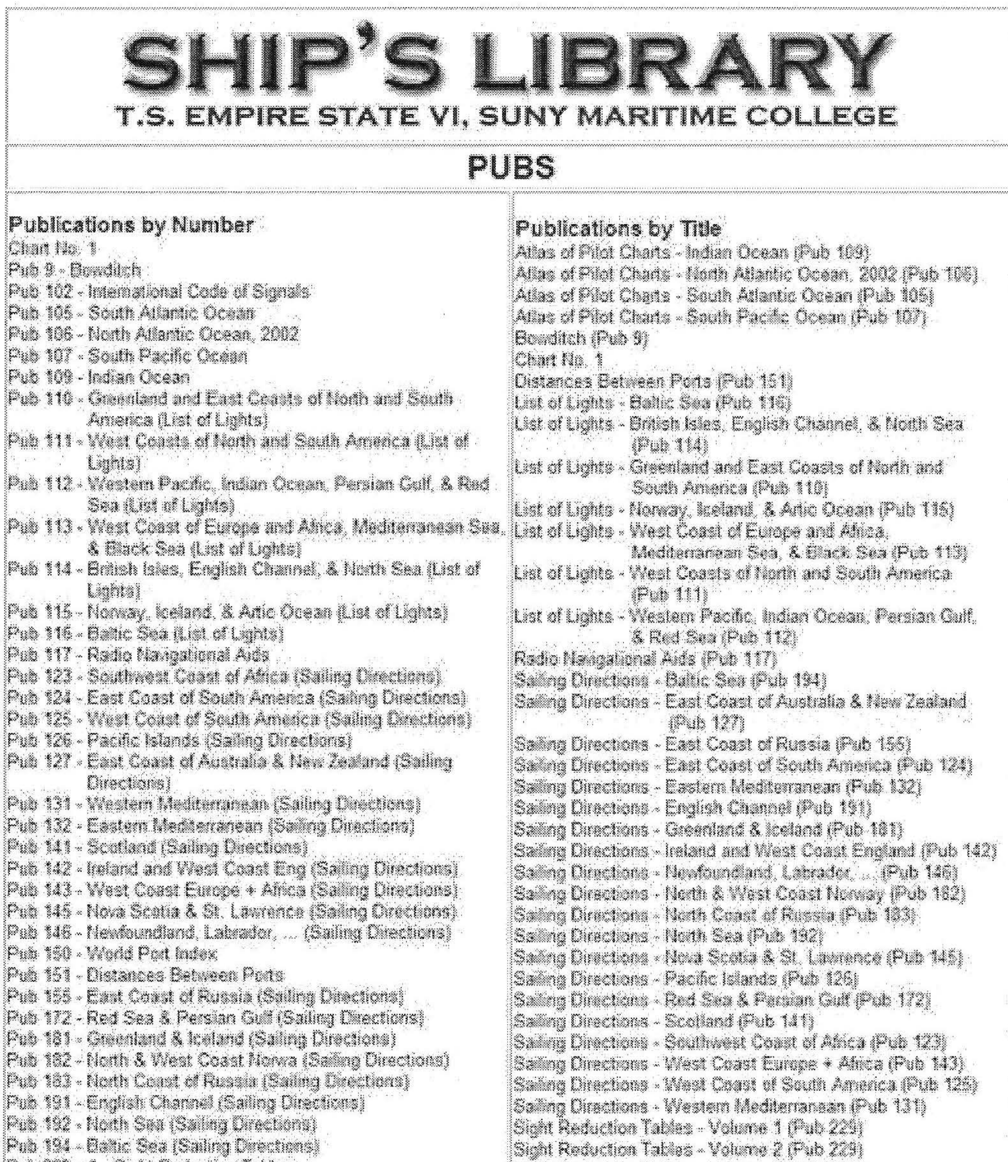


Image 2.

Students and crew have electronic access to titles such as *American Practical Navigator, List of Lights, International Code of Signals, Code of Federal Regulations, Pilot Charts, Sailing Directions, Radio and Radar Navigation*, and *Sight Reduction Tables, Countries and their Cultures, CIA World Factbook*, and *Encyclopedia of Food and Cultures*. Additionally, access to email enhances the delivery of electronic information to the Ship's Library. The email system is set up to work with the Ship's data satellite service. The Ship's Librarian remains in constant communication with the librarians at the main library ashore. Whenever there is a need for access to additional electronic materials, the librarians are able to transmit the latest information via email to the ship's library.

Students studying navigation use one of the leading reference works for marine navigation, the *American Practical Navigator* [7]. The electronic reference work encompasses thirty-eight chapters, on marine navigation, piloting, electronic and celestial navigation, navigation mathematics, navigation safety, oceanography and marine meteorology. The electronic format of the *American Practical Navigator* is the digital version of the print book which includes charts, drawings, and mathematical formulas as they appeared in the print version. The *List of Lights* is made available electronically by the Navigation Center of the United States Homeland Security, Coast Guard department [8]. The resource includes the most up-to-date information on the list of lights presented in a PDF format. Electronic access to the *International Code of Signals* provides the students with an overview of the history of the international code of signals and a detailed list with colored pictures of all signal flags.

The Code of Federal Regulations, (CFR) is published by the United States Government Printing Office (GPO). The CFR is the codification of the general and permanent rules published in the Federal Register by the executive departments and agencies of the United States Federal Government, CFR [9]. The table below identifies the list of maritime titles: (image 3.)



SHIP'S LIBRARY

T.S. EMPIRE STATE VI, SUNY MARITIME COLLEGE

PUBS

Publications by Number

Chart No. 1
Pub 9 - Bowditch
Pub 102 - International Code of Signals
Pub 105 - South Atlantic Ocean
Pub 106 - North Atlantic Ocean, 2002
Pub 107 - South Pacific Ocean
Pub 109 - Indian Ocean
Pub 110 - Greenland and East Coasts of North and South America (List of Lights)
Pub 111 - West Coasts of North and South America (List of Lights)
Pub 112 - Western Pacific, Indian Ocean, Persian Gulf, & Red Sea (List of Lights)
Pub 113 - West Coast of Europe and Africa, Mediterranean Sea, & Black Sea (List of Lights)
Pub 114 - British Isles, English Channel, & North Sea (List of Lights)
Pub 115 - Norway, Iceland, & Artic Ocean (List of Lights)
Pub 116 - Baltic Sea (List of Lights)
Pub 117 - Radio Navigational Aids
Pub 123 - Southwest Coast of Africa (Sailing Directions)
Pub 124 - East Coast of South America (Sailing Directions)
Pub 125 - West Coast of South America (Sailing Directions)
Pub 126 - Pacific Islands (Sailing Directions)
Pub 127 - East Coast of Australia & New Zealand (Sailing Directions)
Pub 131 - Western Mediterranean (Sailing Directions)
Pub 132 - Eastern Mediterranean (Sailing Directions)
Pub 141 - Scotland (Sailing Directions)
Pub 142 - Ireland and West Coast Eng (Sailing Directions)
Pub 143 - West Coast Europe + Africa (Sailing Directions)
Pub 145 - Nova Scotia & St. Lawrence (Sailing Directions)
Pub 146 - Newfoundland, Labrador, ... (Sailing Directions)
Pub 150 - World Port Index
Pub 151 - Distances Between Ports
Pub 155 - East Coast of Russia (Sailing Directions)
Pub 172 - Red Sea & Persian Gulf (Sailing Directions)
Pub 181 - Greenland & Iceland (Sailing Directions)
Pub 182 - North & West Coast Norwa (Sailing Directions)
Pub 183 - North Coast of Russia (Sailing Directions)
Pub 191 - English Channel (Sailing Directions)
Pub 192 - North Sea (Sailing Directions)
Pub 194 - Baltic Sea (Sailing Directions)
Pub 229 v.1 - Sight Reduction Tables

Publications by Title

Atlas of Pilot Charts - Indian Ocean (Pub 109)
Atlas of Pilot Charts - North Atlantic Ocean, 2002 (Pub 106)
Atlas of Pilot Charts - South Atlantic Ocean (Pub 105)
Atlas of Pilot Charts - South Pacific Ocean (Pub 107)
Bowditch (Pub 9)
Chart No. 1
Distances Between Ports (Pub 151)
List of Lights - Baltic Sea (Pub 116)
List of Lights - British Isles, English Channel, & North Sea (Pub 114)
List of Lights - Greenland and East Coasts of North and South America (Pub 110)
List of Lights - Norway, Iceland, & Artic Ocean (Pub 115)
List of Lights - West Coast of Europe and Africa, Mediterranean Sea, & Black Sea (Pub 113)
List of Lights - West Coasts of North and South America (Pub 111)
List of Lights - Western Pacific, Indian Ocean, Persian Gulf, & Red Sea (Pub 112)
Radio Navigational Aids (Pub 117)
Sailing Directions - Baltic Sea (Pub 194)
Sailing Directions - East Coast of Australia & New Zealand (Pub 127)
Sailing Directions - East Coast of Russia (Pub 155)
Sailing Directions - East Coast of South America (Pub 124)
Sailing Directions - Eastern Mediterranean (Pub 132)
Sailing Directions - English Channel (Pub 191)
Sailing Directions - Greenland & Iceland (Pub 181)
Sailing Directions - Ireland and West Coast England (Pub 142)
Sailing Directions - Newfoundland, Labrador, ... (Pub 146)
Sailing Directions - North & West Coast Norway (Pub 182)
Sailing Directions - North Coast of Russia (Pub 183)
Sailing Directions - North Sea (Pub 192)
Sailing Directions - Nova Scotia & St. Lawrence (Pub 145)
Sailing Directions - Pacific Islands (Pub 126)
Sailing Directions - Red Sea & Persian Gulf (Pub 172)
Sailing Directions - Scotland (Pub 141)
Sailing Directions - Southwest Coast of Africa (Pub 123)
Sailing Directions - West Coast Europe + Africa (Pub 143)
Sailing Directions - West Coast of South America (Pub 125)
Sailing Directions - Western Mediterranean (Pub 131)
Sight Reduction Tables - Volume 1 (Pub 229)
Sight Reduction Tables - Volume 2 (Pub 229)
Sight Reduction Tables - Volume 3 (Pub 229)

Image 3.

In addition to the course-specific electronic resources the students are required to use during their studies at sea, the library also makes other related non-course-specific resources available through its networked stations. During the ninety days at sea, the Training Ship *Empire State VI* visits five to six European ports. Students have the opportunity to be exposed to other countries, languages, customs, cultures and civilizations. Exposure to other countries' customs and ethnic identities is a valuable lesson learned in an international discipline such as the maritime studies.

In addition to course specific resources, the library also makes available electronic information on resources such as *Countries and their Cultures, CIA World Factbook,* and *Encyclo-*

pedia of Food and Cultures providing invaluable information on other countries. *Countries and their Cultures* is a searchable database with images and maps with emphasis on the local and ethnic culture of each country. The *CIA World Factbook*, is published and made available by the Central Intelligence Agency of the United States government. It is one of the most comprehensive and current databases on factual country information about the history, government, communication, transportation, population etc. The *Encyclopedia of Food and Cultures* is an electronic book format made available through the library's Gale databases subscriptions. [Image 4.]

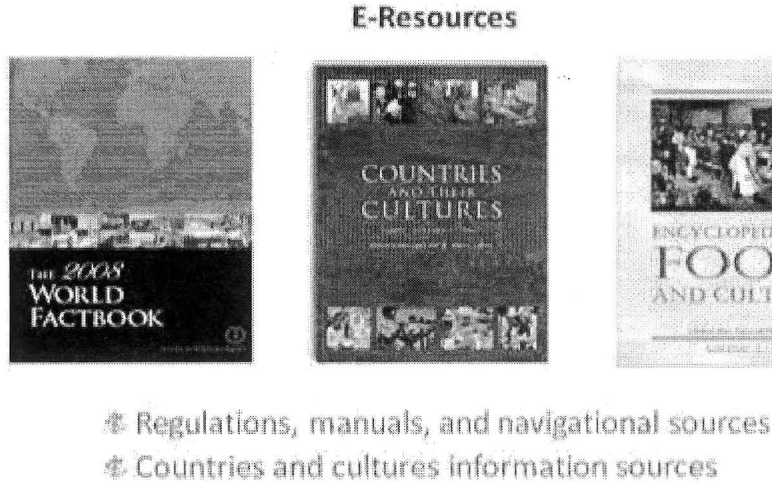


Image 4.

Web based sites are researched in advanced by the librarians and mounted to the Ship's Library network for the Students and Crew to study prior to arriving at the Ports of call. Image 5 the Country Profiles for Summer Sea Term 2012.

Image 5.

5. Teaching Information Literacy and Pedagogy for E-Resources

The new generation of learners arrives at our campuses far more prepared in computer skills, far more skillful in multi-tasking and far more experimental. The students are also far more demanding in their expectations for instantaneous access to information. To acknowledge the students' new mode of learning the Stephen B. Luce Library set forth to bridge the generation gap by ensuring that the information and formats through which it is conveyed to students remains relevant. We may not underestimate the abundance of electronic and digital resources that could be very overwhelming to students conducting research; therefore, it is critical that the Library strives to teach research strategies as well as a technology skills and competencies to students and faculty through the information literacy program. All library instruction sessions are computer-assisted, utilizing state of the art equipment for effective multimedia instruction and hands-on experience.

A major pedagogical tool for information competency training is the Library's online information literacy tutorial. This full-scale, multi-module tutorial is designed to assist students in navigating through the information research process at their own pace. It is also an important tool for distance learning students to learn about the information research process.

In addition to the information literacy program, the Library continues to streamline all library resources in support of the courses taught online for the SUNY Maritime College distance learning students. SUNY Maritime initiated its distance learning program in the spring of 2004. During the fall 2011 semester, there were 1,228 students enrolled in 80 blended and 29 online sections and 54 faculty involved across the 109 sections. Image 6 demonstrates the Library's online module in support of a distance learning courses.

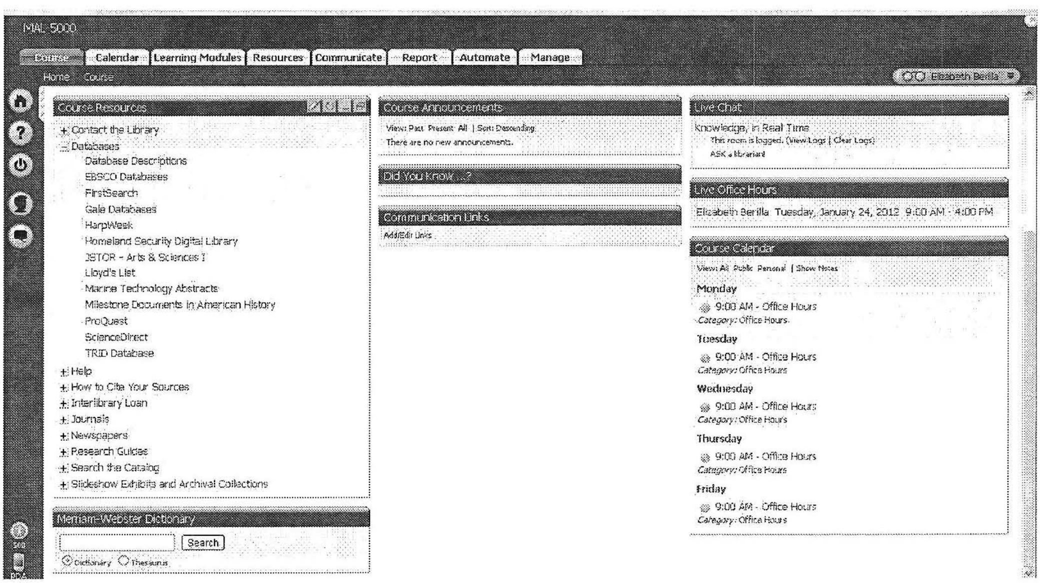


Image 6.

6. Research Tools for Retrieving Online Content

The online public access catalog (OPAC) is the main gateway to researching the Library's collection and students are well trained on its use. With the name of *The Sextant*, students easily associate the OPAC as a tool to navigate information. The librarians constantly incorporate new technology to enhance the OPAC as a one-search interface for all print and electronic resources. All electronic books (ebooks), electronic government publications, and other similar sources are fully searchable and are just a click away with embedded URLs in the OPAC. Detailed information on books such as summaries, table of contents, and excerpts are accessible through the OPAC with cross-linking service to Google Books.

Stephen B. Luce Library subscribes to over 70 information data banks with access to more than 47,000 titles of periodicals. With such an array of sources it is often a difficult task for students to search each information resource individually. To streamline this process the Library implemented a new information portal, called *The Beacon*, which uses federated search technology. This enables students to search multiple information databases through one search interface. Intense training on the use of the Beacon is done during library instruction sessions, where students are taught how to construct effective search strings to retrieve relevant results.

Today's generation of Maritime students are web savvy and very inclined to do all information research using Google only. It is a challenge for librarians to teach students on how to use Google competently and a significant part of library instruction dwells on evaluating web sources and suggests the use of academic versions of Google such as Google Scholar and Google Books. To facilitate the students' search habits, the Library has partnered with Google to make its collection searchable via Google search engine. So, as an example, a cadet searching Google Scholar for information on "Ship Navigation" will see results for Stephen B. Luce Library [see Image 7].

The Stephen B. Luce Library makes every attempt to increase access to information resources for the Maritime College community. All subscribed electronic resources are accessible 24/7 and from anywhere via special server technology, called EZProxy. Also, through Luce Library membership to resource sharing consortiums, Maritime students have access to many more books and other information sources not available in the Library's collections. Using a worldwide OPAC, called Worldcat, students can search and request any items from libraries nationally and internationally. This process, referred to as interlibrary loan, is managed by a 24/7 online system with the capability to deliver materials electronically.

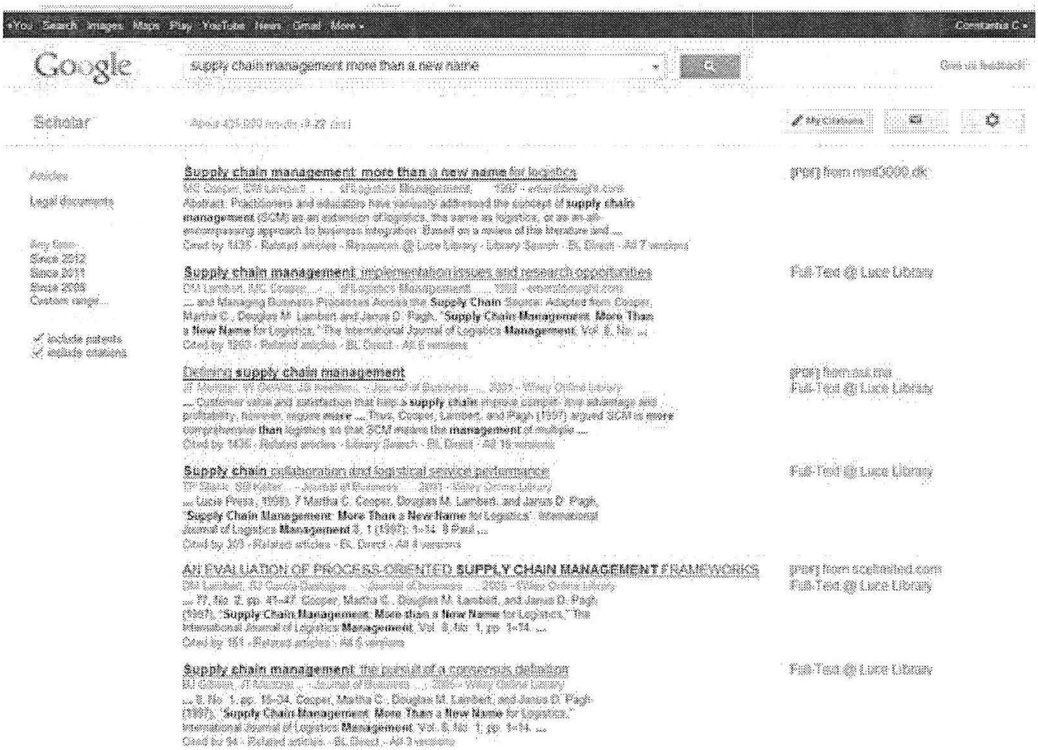


Image 7: Google Cross Link to Luce Library

7. Inter-Library Loan

Technology innovations have made it possible for the library to deliver scholarly content to the students and faculty by enabling delivery mechanisms such as electronic Interlibrary Loan that is initiated by the library user [6]. Students and faculty are able to initiate borrowing transactions of books and journal material directly from the library's portal and borrow any item from a network of libraries.

8. Conclusion

The SUNY Maritime College Library plays a critical role in providing the academic community ashore and at sea with the most relevant up-to-date information. One of the most important objectives of educating mariners at sea is learning to appreciate and understand access to information as a critical component to decision making. Traditionally and throughout history, young mariners learned how to read and write and received their education from books they read at sea. Advancements in technology have revolutionized maritime studies in the areas of navigation, engineering and communication. Academia and Libraries work closely with the demands of the maritime industry to train and educate students who are proficient with research and access to digital information. Work is underway to develop a complete online information literacy module and library services for mobile technology to incorporate into online courses for the distance learning program. In addition, the library remains diligent in conducting assessment programs and measuring the learning outcomes of our student success. The Library's ability to deliver a wealth of online resources and digital resources on land and at sea demonstrates how advances in technology and information delivery support and enhance the teaching and learning mission of SUNY Maritime College.

References

[1] SUNY Maritime College, "SUNY Maritime College web portal," available at http://www.sunymaritime.edu, SUNY Maritime College, 2009

[2] American Library Association, "Association of College and Research Libraries Standards and Guidelines," available at http://www.ala.org/ala/mgrps/divs/acrl/standards/index.cfm, American Library Association, 2009

[3]Gudelj, A., Krcum, M and Krcum, P., "The role of information technology in Maritime education for hazard avoidance", International Journal of Emergency Management, Vol.5, No. 3-4, (2008), pp 219-234.

[4] Association of College and Research Libraries, "Information literacy competency standards for higher education", American Library Association, (2000), available at: www.ala.org/acrl/ilcomstan.html (accessed 30 March, 2009).

[5] Sailor Snug Harbor digital Collection http://cdm128401.cdmhost.com/cdm4/browse.php?CISOROOT=%2FMC; . New York Heritage. http://www.newyorkheritage.org/browsecollections.php; Metro Digital Projects; http://www.metro.org/digital-collections/

[6] Constantinou, C. & Fazal, S., "Developing Information Literacy for the Maritime Curriculum: Strategy and Pedagogy." Presented at the 8th Annual General Assembly of IAMU, Odessa, Ukraine, 2007

[7] American Practical Navigator Online http://www.irbs.com/bowditch/

[8] The List of Lights website http://www.navcen.uscg.gov/?pageName=lightLists

[9] Code of Federal Regulations website http://www.gpoaccess.gov/cfr/

Simulator training of Marine Engineers

Nikishin, M. Y.
Baltic Fishing Fleet State Academy
miknik39@rambler.ru

Krymov, D. A.
Baltic Fishing Fleet State Academy
asu.Daniil@gmail.com

N. M. Ivanova,
Kalinigrad Technical College
nado_1@mail.ru

Abstract: Training of Marine Engineers is impossible without simulator practice using computer simulators. Modern computer simulators are intended primarily for solving operational problems such as preparation and starting up of all systems including apparatuses and machines for ship power and refrigeration plants. This also includes stopping and changing modes of operation of these plants. The efficient operation of marine equipment is impossible without knowledge of the structure and principles of operation of technical facilities. Our computer simulator is designed to study the structure and principle of operation of machines and apparatuses for marine refrigeration plants, and also for solving operational problems. Features of this computer simulator are: - the ability to run the simulator program on three operating systems (WinXP, WinVista and Win7), - the teacher can independently add, change, delete, renew the simulator's schemes, change basic units of the scheme and construct an apparatus by using the integrated multi-graphic system for automatic analysis of vector objects on the working plane. This system is protected by a certificate of registration program for PC in the Federal patent office for intellectual property of the Russian Federation; - the ability to add materials into schemes saved in the simulator program; - multilevel control system for knowledge, - this simulator program can be used not only on a PC, but also on large-format interactive displays. Cadets assemble the scheme using suggested elements in real time. If they assemble the scheme correctly, they must indicate the movement direction of refrigerant and sequence of actions for solving standard operational problems. Also, the simulator program provides testing during these stages. Another important feature of this simulator is the ability to adapt it to other ship's equipment such as engine and boiler room, if there is sufficient information (specifications, diagrams, etc.) on a particular machine. The use of our computer simulator will allow us to improve the quality of training of Marine Engineers for operation of ship power and refrigeration plants.
Keywords: computer simulator, marine engineers, training, integrated multi-graphic system, control system, training quality, self *education*.

Training of Marine Engineers is impossible without computer simulator practice. Simulator training is required for theoretical knowledge and operational skills and should be done before trainees leave for manufacturing practice on board.

Modern computer simulators are intended primarily for solving operational problems such as preparation and starting up of all systems including apparatuses and machines for ship power and refrigeration plants. This also includes stopping and changing modes of operation of these plants. 3D computer simulators that look like a computer game where trainee makes all necessary operations are developed very actively today.

The efficient operation of marine equipment is impossible without knowledge of the structure and principles of operation of technical facilities. This is particularly evident in abnormal and emergency situations, when an engineer makes wrong decisions that are most often due to lack of knowledge about the processes occurring in the apparatus.

The optimal way to test and consolidate knowledge of design and operating principles of technical devices is to use a stand made from real hardware. Due to the rather rapid equipment development, constant updating of stands is quite difficult. One of the variants for consolidation of theoretical knowledge about the design of an apparatus and its operation is the use of computer simulators.

Our computer simulator is designed to study the structure and principles of operation of machines and apparatuses for marine refrigeration plants, and also for solving operational problems, [2].

According to the state educational standards, the use of interactive media and information technology is actively encouraged, [1].

Features of this computer simulator are:

- the ability to run the simulator program on three operating systems (WinXP, Win-Vista and Win7)
- the teacher can independently add, change, delete, renew the simulator's schemes, change basic units of the scheme and construct an apparatus by using the integrated multi-graphic system for automatic analysis of vector objects on the working plane. This system is protected by a certificate of registration program for PC in the Federal patent office for intellectual property of the Russian Federation;
- the ability to add materials into schemes saved in the simulator program;
- multilevel control system for knowledge
- this simulator program can be used not only on a PC, but also on large-format interactive displays.

Cadets assemble the scheme using suggested elements in real time. If they assemble the scheme correctly, they must indicate the movement direction of refrigerant and sequence of actions for solving standard operational problems. Also, the simulator program provides testing during these stages.

Training and testing (control) modes are provided in the proposed computer simulator. In the first mode, the program immediately shows the wrong actions of the trainee. Hereby we consider work with simulator on the example of an ammonia brine horizontal shell and tube evaporator.

In the training mode, the program performs elementwise checking of the placing of details of the apparatus, the sequence of assembling and indicates correctness of the placing of details (green - right / red - a mistake), Fig. 1.

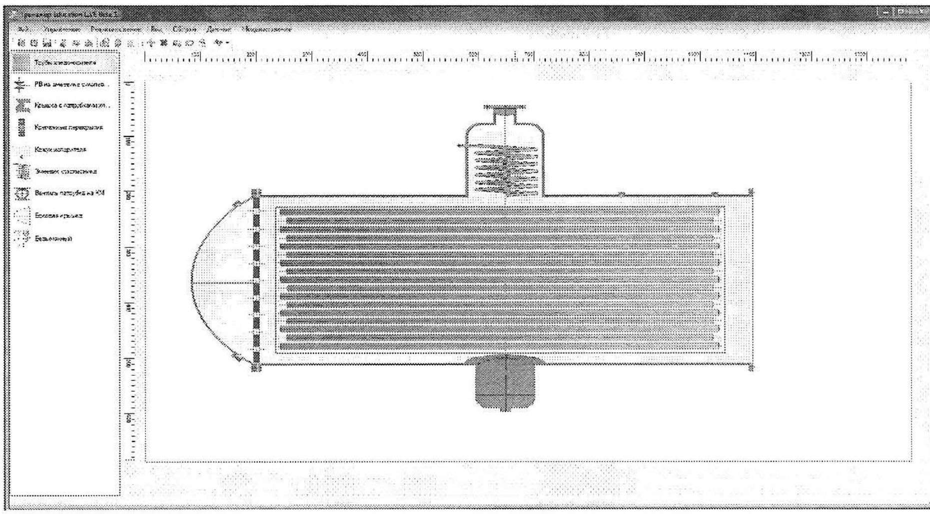


Figure. 1. Check of correctness of every detail's placing.

The second step is an intermediate control, in which the trainee must complete full assembly of the apparatus. After complete assembly, the check takes place. In the case of a mistake, it is necessary to correct incorrectly placed items in the unit, Fig. 2.

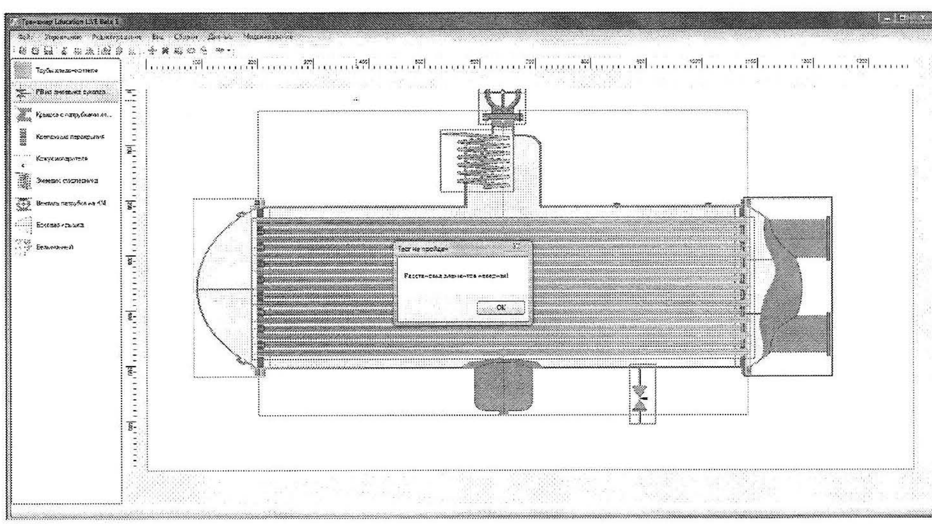


Figure 2. Check of correctness of all detail's placing.

The third step is a test of knowledge of the processes occurring in the evaporator by pointing to the direction of movement of refrigerant and brine (intermediate coolant) on the assembled scheme. After the cadet completes this task, the program performs the check, Fig. 3.

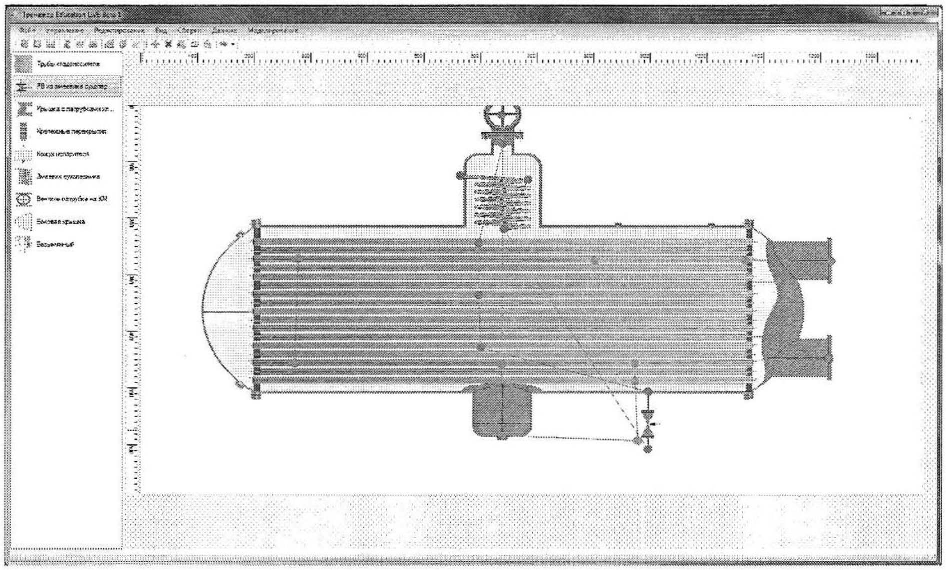


Figure 3. Check the directions of movement of working substances in a horizontal shell and tube evaporator

The fourth and final step is to solve operational problems. This phase includes tasks such as preparing for starting up and staring up of the brine system and evaporator, the output of oil and stopping the evaporator. To perform this step a separate scheme is displayed that includes the evaporator, all piping with shutoff and control valves and the brine system (Fig. 4). Solving problems is done by opening / closing of valves by double-clicking the left button of the mouse.

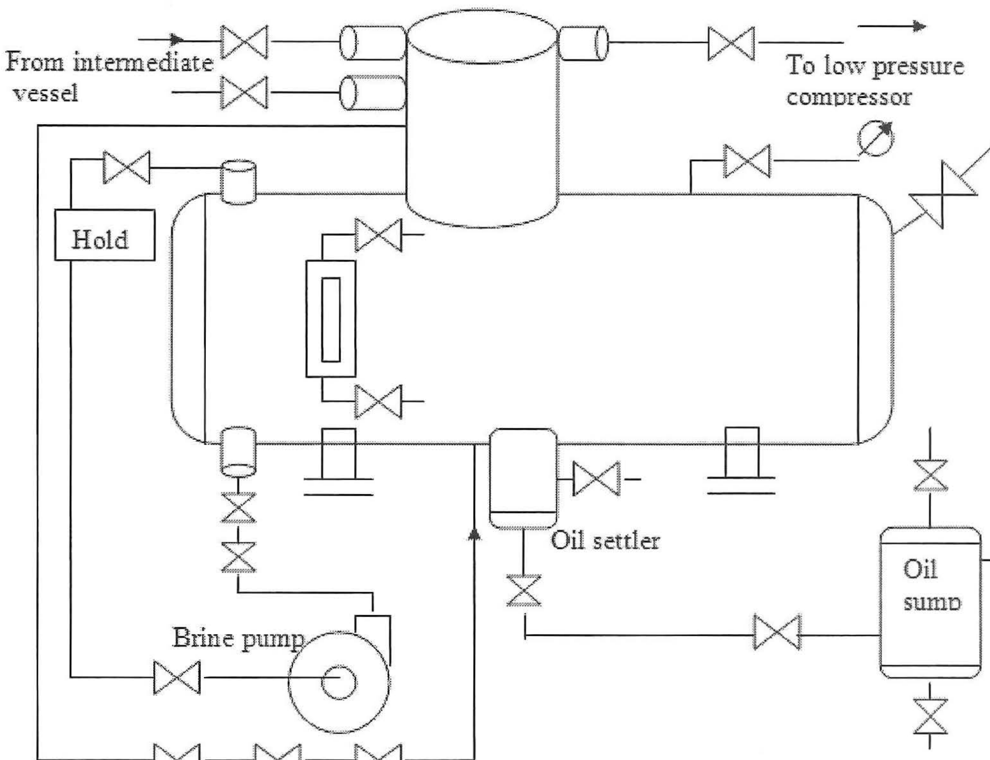


Figure 4. The scheme for solving operational problems

The important feature of this simulator is the ability to adapt it to the other ship equipment, such as engine and boiler room, if there is sufficient information (specifications, diagrams, etc.) on a particular machine.

Further work is planned towards the completion of the program schemes of other units of a ship's refrigeration plant and the creation of additional functions such as forecasting of operation modes under different external conditions. The implementation of this function will be developed on the basis of mathematical models of components and devices of a ship refrigeration plant which take into account the influence of external and internal factors on the operation of the plant. These mathematical models were developed by the "Refrigeration, air conditioning and cryogenics" department of the Baltic Fishing Fleet State Academy. Forecasting of operation modes means evaluation of one or more factors of the working parameters of the studied apparatus.

It is also planned to use photos of parts and components of devices instead of the schemes for better visibility.

The use of our computer simulator will allow us to improve the quality of training of Marine Engineers for operation of ship power and refrigeration plants and to minimize the impact of the "human" and "personal" factors on the safety of the ship's equipment.

References

[1] Ganieva R. and Krymov D., "Modern Information Technologies In Education: Status, Prospects", The problems of inter-regional relations - Research Almanac, Saint-Petersburg, 2009, pp 63-66.

[2] Krymov D., Nikishin M. and Ivanova N., "Project Simulator For Apparatus And Machinery Refrigeration Equipment For The Preparation Of Refengineers", Marine industry, transport and logistic in countries of Baltic Sea region: new challenges and responses. // IX International conference, Kaliningrad, 2011, pp 296-298.

Technology challenges and opportunities in the delivery of distance education

Lewarn, B.
Professor, Maritime Transport Policy Centre,
Australian Maritime College (an institute of the University of Tasmania)
sblewarn@amc.edu.au

Abstract: 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. The objectives of this paper are fourfold, namely to:

- Briefly review the waves of change sweeping through higher education;
- Explain the fundamentals of flexible/blended/e-learning;
- Report the outcomes of the research which identifies the challenges and opportunities faced by educators in using technology to provide/enhance the distance learning experience; and
- Consider why the take-up of technology for the delivery of distance education has been slow in maritime education and training (MET).

This paper is based on research into recent trends in education and training, including the use of technology and flexible learning techniques to deliver programs and assess students. This research is underpinned by 30+ years of experience in the delivery of distance education at the Australian Maritime College (AMC). The structured research, which was heavily internet based and international in nature, was carried out during 2010-11. The core component of the research reported in this paper is a review of developments in distance education in the university sector in order to identify the challenges and opportunities faced by educators in using technology to provide/enhance the distance learning experience. From this base the paper also briefly considers why maritime education and training (MET) has been slow in its take up of these developments. The results arising from this research include:

- Universities need to adapt to the education dynamics of the new world. Universities are information businesses and when the way information is handled changes fundamentally, information businesses must change.
- Traditional approaches to education are being reconfigured by technology as digital devices empower amateurs to do what professionals once did.
- Providing the right technology and systems, and ensuring that academics have the knowledge and skills to choose and use appropriate technology to enhance the learning experience are significant institutional challenges.

- MET is conservative by nature, 'wrapped up' in quasi-legal and administrative constraints, provides limited support for teaching staff to learn/enhance teaching skills, and has a traditional 'teacher centred' approach to learning; all of which reduce its capability to provide what the student requires, when, where and how it is wanted.

Keywords: Education changes, distance learning, education technology, maritime education and training

1. Introduction

This paper summarises research into recent trends in education and training, including the use of technology and flexible learning techniques to deliver programs and assess students. The structured research, which was heavily internet based and international in nature, was carried out during 2010-11. A core component of the research reported in this paper is a review of developments in distance education in order to identify the challenges and opportunities faced by educators in using technology to provide/enhance the distance learning experience. The objectives of this paper are to:

- Briefly review the waves of change sweeping through higher education;
- Explain the fundamentals of flexible/blended/e-learning;
- Identify the challenges and opportunities faced by educators in using technology to provide/enhance the distance learning experience; and
- Consider why the take-up of technology for the delivery of distance education has been slow in maritime education and training (MET).

Education today is in an era of rapid change where the traditional educational paradigms are being superseded. The primary medium for knowledge, books, is being 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 an important differentiator in the provision 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. 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.

2. Changing Paradigms

Education today is in an era of rapid and sustained change and the old paradigms are being replaced by new paradigms. These paradigm shifts were first reflected by Inglis et al [1] and are summarised in Figure 1:

Old Paradigm	New Paradigm
• Take what you can get	• Courses on demand
• Academic calendar	• Year round operations
• University as a city	• University as an idea
• Terminal degree	• Lifelong learning
• University as ivory tower	• University as partner in society
• Students 18-25 years old	• Students all ages
• Books primary medium	• Information on demand
• Tenure	• Market value
• Single product	• Information reuse/exhaust
• Student as necessary evil	• Student as customer
• Delivery in classroom	• Delivery anywhere
• Multicultural	• Global
• Bricks and mortar	• Bits and bytes
• Single discipline	• Multi-discipline
• Institution centric	• Market centric
• Government funded	• Market funded
• Technology as an expense	• Technology as a differentiator

Figure 1: Old and new paradigms in higher education

Summarising the effects of these shifting paradigms:

- Education institutions are moving away from bricks and mortar towards bits and bytes;
- Educators are moving away from being a sage on the stage towards being a wiz on the web;
- Teacher centric learning is being displaced by student centric learning; and
- Students are moving away from being passive learners towards being active learners.

In order to meet these education paradigm shifts/challenges, education providers have become more engaged with industry and their communities, customer oriented and flexible in the delivery of their educational services. In summary, education providers seek to provide their clients with what is wanted, when it is wanted, where it is wanted and how it is wanted.

As just-in-time learning replaces just-in-case learning and lifelong learning gains yet further acceptance, MET providers will change the way in which learning pathways are delivered to the student. It is inevitable that flexible learning techniques will play an increasing role and, provided conservative marine administrations agree, seafarer students will also benefit from these changes. Flexible learning, properly structured, is not a cheap option and it is therefore important for providers to determine whether to ‘go it alone’ or partner with others. The dangers of all providers ‘going it alone’ and trying to ‘re-invent the wheel’ are obvious and collaborative arrangements between providers seems a sensible way to proceed in order to maximise the skills of the collaborators and also to maximise the benefits to students.

Education as a commodity is very much part of the new paradigms in education. MET operates in a specialised niche market which, traditionally, sells its services directly to its customers i.e. its students. Commodification leads to the consideration of what, apart from teaching services, can be bought/sold. [2] Research by Coaldrake and Stedman [3] into the suite of tasks normally undertaken by academic staff shows that academic work can be commodified as illustrated in Figure 2:

Suite of Tasks undertaken by Academic Staff

- Assessing students' credentials and giving credit for entry
- Designing and co-ordinating units and courses of study
- Designing and developing resources used in learning, including textbooks, videos and computer packages
- Assessing resources for quality
- Navigating and advising students through choices of study options
- Delivering instruction e.g. lecturing, demonstrating practical work in laboratories
- Acting as guide and mentor to students, either individually or in groups
- Assessing, evaluating and providing feedback on student progress
- Certifying completion of award programs

Figure 2: Disaggregation of tasks undertaken by academic staff [3]

Accepting that education is increasingly globalised and massified it becomes evident that the various elements of academic work could be disaggregated such that they could be carried out by different persons in different locations i.e. commodified. This is happening now, particularly in the context of online delivery of learning where the globalised communications systems are used to maximise learning opportunities for students. For example, the curriculum design may occur in two partner institutions that then employ content experts, learning resource material developers, tutorial support, assessment markers all in different locations but all connected via the internet and managed by the partner institutions. MET providers have not yet grasped the potential of conducting business in the manner described, but networks such as IAMU make this scenario increasingly possible. "The inertia of the existing system should not be underestimated but the question is not whether the nature and structure of academic work will change, but what the timing and extent of change might be". [4]

3. Some distance learning fundamentals

3.1 E-learning

Synonyms for e-learning include Computer-Based Training (CBT), Internet-Based Training (IBT) and Web-Based Training (WBT). E-learning can be defined as follows:

"E-learning comprises all forms of electronically supported learning and teaching. The information and communication systems, whether networked learning or not, serve as specific media to implement the learning process. The term will still most likely be utilized to reference out-of-classroom and in-classroom educational experiences via technology, even as advances continue in regard to devices and curriculum." [5]

E-learning is essentially the digital and network-enabled transfer of skills and knowledge. E-learning applications and processes include Web-based learning, computer-based learning, virtual education opportunities and digital collaboration. Content is delivered via the Internet, intranet/extranet, audio or video tape, satellite, TV, and CD-ROM. It can be self-paced or instructor-led and includes media in the form of text, image, animation, streaming video and audio.

3.2 Blended learning

The terms 'blended', 'hybrid', and 'mixed-mode' are used interchangeably in current research literature. There is a range of different approaches to blended learning; it can take on many shapes or forms, depending on the teachers and learners involved. Consequently, there is no consensus on a single, agreed-upon definition for blended learning. However, Garrison and Kanuka [6] provide a straightforward explanation of blended learning which illustrates the simplicity of the concept and the complexity of its implementation.

"Blended learning is both simple and complex. At its simplest, blended learning is the thoughtful integration of classroom face-to-face learning experiences with online learning experiences. There is considerable intuitive appeal to the concept of integrating the strengths of synchronous (face-to-face) and asynchronous (text-based Internet) learning activities. At the same time, there is considerable complexity in its implementation with the challenge of virtually limitless design possibilities and applicability to so many contexts."

3.3 Flexible learning

Flexible learning is a term often used in New Zealand and Australia [7] and is sometimes also referred to as personalized learning. Flexible learning can be defined as follows:

"Flexible learning is a set of educational philosophies and systems, concerned with providing learners with increased choice, convenience, and personalisation to suit the learner. In particular, flexible learning provides learners with choices about where, when, and how learning occurs. Flexible learning approaches are often designed using a full range of teaching and learning theories, philosophies and methods to provide students with opportunities to access information and expertise, contribute ideas and opinions, and correspond with other learners and mentors. This may occur through the use of internet-based tools such as Virtual Learning Environments or Learning Management Systems, discussion boards or chat rooms; and may be designed as a 'blended' approach, with content available electronically and remotely, as well as 'face-to-face' classroom tutorials and lectures." [8]

To date, most flexible learning programs utilise computer-based systems ('E-learning'), but the rapid increase in the processing power and popularity of mobile digital devices is causing considerable interest in mobile learning i.e. the use of mobile devices such as mobile phones, iPods, and iPads which increase the mobility of learners and also enhance the flexibility of their learning. In providing learners with choices about when, where and how learning occurs, flexible/blended learning must provide the learner with valid and reliable learning experiences. This requires the correct mix/blend of location, study pattern, teaching technique, study material and delivery medium. [9]

3.4 Focus of e-learning, blended learning and flexible learning

These three learning approaches are closely related and partially overlap but are different as they focus on particular aspects of the learning experience. Figure 3 illustrates the primary focus of each of these approaches to learning.

Learning approach	Focus
E-learning	Electronically supported learning and teaching
Blended learning	Integration of classroom face-to-face learning experiences with online learning experiences
Flexible learning	Choices, convenience, and personalisation to suit the learner about where, when, and how learning occurs

Figure 3: Focus of learning approaches

E-learning is clearly part of both blended and flexible learning, whilst blended learning can be part of flexible learning. E-learning is primarily about choosing the correct media to support the delivery of the learning experience; blended learning poses the challenge of virtually limitless design possibilities; and flexible learning approaches are often designed using a full range of teaching and learning theories, philosophies and methods to provide students with enhanced learning opportunities. The use of these learning techniques clearly requires considerable instructional design skill (also referred to as educational design or learning design) if the learning experience is to be valid and reliable.

"The information age is making new demands on us all. Education must find ways to face these new challenges. We can no longer see learners as empty vessels that can be filled with information. The information now resides out there, distributed across a vast network and shared between all people. The challenge now is to help people to use this information safely, wisely and productively as they adapt to a rapidly changing world...The instructional designer is there to facilitate learning in this new epoch, the knowledge age." [10]

Instructional design involves an analysis of learning needs and the systematic development of instruction techniques to meet those needs that will facilitate the transfer of knowledge, skills and attitude to the learner. Instructional designers develop instructional strategies that are tailored to learning objectives and the needs of learners which aim to make instruction effective, efficient, appealing and cost-effective by using a variety of interactive media to improve learning and meet the learning objectives. Traditional face-to-face teaching methods can be enhanced or replaced by innovative e-learning methods which use the right technology to provide good pedagogy.

This raises a fundamentally important issue. 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. 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 suggest that information literacy has been, and remains a fundamental skill for educators but digital literacy, as an essential skill, is still gaining momentum. [11]

Clearly there is a significant body of knowledge to support the use of distance learning techniques; however, for the educator a real challenge is deciding on which medium and technology to use.

4. Technology challenges and opportunities

4.1 Technological progress

Technological progress presents both opportunities and challenges for educators to enhance the distance learning experience. In 1801 the blackboard revolutionized education. "In our present age of continually evolving desktop, laptop and palm computers, photocopy equipment, PowerPoint presentations, video displays, interactive whiteboards, and internet access, it's startling to realize that the 'technology' to first influence education was the invention of these black slate writing boards, also known as chalkboards. [12] Arguably the next significant step was the use of radio with the world's first School of the Air, based in Alice Springs, being opened in 1951. [13] Since the 1960s, the use of technology in education has evolved at an increasing rate, but it is the internet and associated access devices that have had the greatest effect on learning and teaching. Between 2000 and 2011 the worldwide growth in the use of the internet was 528.1%. The internet usage penetration rates in 2011 were: North America 78.6%; Australia/Oceania 67.5%; Europe 61.3%; Latin America/ Caribbean 39.5%; Middle East 35.6%; Asia 26.2%; and Africa 13.5%. [14] Unsurprisingly, many of the paradigm shifts illustrated in Figure 1can be partly, or wholly, attributed to society's adoption of the internet.

<table>
<tr><th colspan="5">Progression of Technology</th></tr>
<tr><td>Books</td><td>Radio</td><td>Audio tape</td><td>Desktop</td><td rowspan="4">?</td></tr>
<tr><td>Blackboard</td><td>TV</td><td>Video tape</td><td>Laptop</td></tr>
<tr><td>Whiteboard</td><td>Video link</td><td>CD</td><td>Tablet</td></tr>
<tr><td></td><td></td><td>DVD</td><td>Smartphone</td></tr>
</table>

Figure 4: Progression of the use of technology in learning and teaching

Finding one's way through the maze of information resources and using the most appropriate technology is an increasingly major task for educators as students take greater responsibility for their own learning. The challenge for educators is to become digitally literate and decide how to best use technology to enhance the learning process.

4.2 Resources

The resources available to enhance the learning and teaching process are immense and continuously expanding. Internet based material, simulation games and Apps all add to the rich and ever growing tapestry of available learning resources. Some examples follow:-

Examples of self study material-

- The online study database of 28,000 questions and answers covering all of the subject matter for both Deck and Engine Room used by the US Coast Guard for license examination. [15]
- Khan Academy where you can "Learn almost anything for free. With a library of over 2,700 videos covering everything from arithmetic to physics, finance, and history and 240 practice exercises, we're on a mission to help you learn what you want, when you want, at your own pace". [16]
- The Nautical Institute Alert! Vodcasts are short (approx 4min) films that can be viewed online or downloaded to a PC or Mobile device, aimed at anyone with an interest in the Maritime Human Element. [17]

Examples of simulation 'games'-

- Ship Simulator Extreme €40. An add on Ferry Pack is €14.99 whilst the Harbour Pilot Pack is free. If you want a physical, rather than screen based controls, the Ship Control Unit is €395. [18]
- Ports of Call Simulator licence costs €4 – 40. Also available as an iPhone and iPod App. [19]
- Examples of Apps-
- "The iTunes U app gives you access to complete courses from leading universities and other schools — plus the world's largest digital catalogue of free education content — right on your iPad, iPhone, or iPod touch. You now have a valuable tool to help you learn anytime, anywhere". ITunes U also allows you to take notes and highlight text in iBooks, as well as browse collections from education institutions including Stanford, Yale, MIT, Oxford, UC Berkeley, and the Library of Congress. [20]
- Marine Navigation in USA charted waters App for iPhone, iPod and iPad, USD 49.99. [21]

The opportunities presented by the ever growing amount of learning resources, many of which are freely accessible, are almost endless. However, the challenges of assessing the validity of material and how to incorporate it into the learning experience are increasingly complex.

4.3 Learning management systems

The control and administration of distance learning is increasingly reliant on technology and Learning Management Systems (LMS), also known as course management systems. LMS are based on software which can be applied to a range of tasks associated with the control and management of distance learning as Figure 5 illustrates:

Learning Management Systems	
Applications	**Common Attributes**
• Administration, documentation, tracking student progress and reporting of training programs	• Centralise and automate administration • Provide self-service and self guided services
• Classroom and online events/ activities	• Deliver learning events/ activities rapidly
• Delivery of e-learning programs	• Deliver learning content rapidly
• Development of learning content	• Assemble learning content rapidly • Personalise content • Enable knowledge reuse

Figure 5: Learning management systems; applications and attributes [22]

Apart from the magnitude and complexity of the tasks able to be carried out by LMS, there are two fundamentally different approaches to the provision of LMS software. Licensed software is institution-based whereas open software is provider based. Licensed software clearly comes at a price, frequently in the form of an annual fee. It provides an institution-based system which means that its use across the whole university would be common, as would the training in its use. It also gives the University greater control over its distance education programs. On the other hand, open software is 'free' but it does not give the institution the same level of control. It puts the emphasis on the individual user to develop and use it the way they want and this can take time and effort. In addition to costs, when deciding whether to adopt licensed or open software LMS, a key issue in the decision making process must also be the level of IT intellect/digital literacy of the intended users and their ability to develop the system to meet the goals of the university. There are at least forty different LMS available. This makes the challenge of which LMS to adopt a reasonably complex exercise. To assist in deciding the most appropriate LMS there is a considerable amount of internet based data available and some of the more useful sites contain detailed comparisons. [23]

5. MET, distance learning and technology

Ten years ago Newhouse [24] 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?

A similar question was raised at GlobalMET Ltd's 2011 annual conference, where it was pointed out that "There are plenty of new technological gadgets such as TV/videos, internet, and other handy tools including the iPod, tablet, cell phones and various other handheld devices, if capitalized on in education and training, these could make a deep impact. The classroom with walls need not be the set up for education training. We need to enter into a dialogue with students. Are we willing to walk that extra mile?" As a result, GlobalMET decided to reposition its training strategy to adjust to the paradigm shift in the learning processes appropriate for the 'Y' generation. Additionally, GlobalMET intends to submit a request to ILO/IMO for a review of the implications for maritime education and training with respect to the technical revolution underway. [25]

According to Fonseca [26], E-learning has several advantages but its user-friendly approach still has a long way to go before it can make a real break into maritime education and training. As an approach to educational delivery it should be attractive to today's digitally savvy youth. However, considerable attitudinal change and effort is needed to replace the traditional teacher-centred, classroom-based approach to learning. In the context of using e-learning in maritime education and training in India, he reports: "In his presentation, *E-Learning: The virtual world awaits*, Capt. Yashvir Saran, Director of Mast Ship (an India based, international shipping and logistics agency), made a passionate plea for its recognition and acceptance by the maritime training fraternity. However, he failed to cut ice, with both seafarers and trainers alike, present in large numbers at the conference organized by the Company of Master Mariners of India, not on account of e-learning's celebrated virtues or unlimited benefits but merely because the establishment is reluctant to accept revolutionary concepts that are far ahead of their time".

However, e-learning is no longer a revolutionary concept; rather its use is rapidly increasing across the primary, secondary and tertiary sectors. E-learning places the student at the centre of the learning process and helps to cater to the different requirements of students i.e. e-learning is not teacher centred, rather it is student centred. However, the uptake of e-learning in maritime education and training for seafarers is painfully slow, mainly due to factors such as conservative marine administrations, poorly trained teaching staff, lack of suitable technologies, resistance to change etc.

A recent survey of industry crewing experts identified the increasing requirement for Internet access to be readily available on board ship. Without Internet access, many seafarers see this as an employment disincentive [27].Much learning now requires Internet access and it is now technically feasible to deliver e-learning programs worldwide, including to seafarers wishing to study whilst at sea e.g. Inmarsat FleetBroadband service is available worldwide. However, even though Inmarsat services are eminently useable for the delivery of educational services to seafarers at sea, the issue for ship operators is costs.

Inmarsat Fleet Broadband services	
Internet access*	Company intranet access*
Email and webmail*	SMS and instant messaging*
Videoconferencing*	Store and forward video*
Large file transfer*	Secure communications*
Real-time electronic chart updates	Real-time weather updates
Vessel/engine telemetry	

Figure 7: Education service delivery at sea [28]*

Goldberg [29] suggests that the accelerating availability of onboard Internet is heralding new opportunities for mariners in terms of anywhere/anytime learning, informal education, professional advancement, and the establishment and maintenance of virtual maritime learning communities. Most importantly, onboard internet needs to be seen less as a 'nice to have' but more for what it really is - a tool that vessel operators can employ to create a better trained, safer crew. The implications of broadband availability on board for training are significant, particularly in the context of delivering distance education services to serving seafarers.

However, most MET teachers are 'digital immigrants' whilst many of our students are 'digital natives'. According to Prensky [30], the 'digital natives' are those who have always known the internet whilst the 'digital immigrants' are those that are coming to this new 'digital land', some kicking and screaming and others eagerly exploring and learning the new skills, language, and culture needed to travel in this 'digital world'. In this 'digital land' the natives have an advantage over the immigrants which stems from the immigrants' lack of cultural context with which to judge, and perceive experiences, while the natives grew up in the new land and have assimilated to the environment.

This presents another challenge for educators because the 'digital immigrant' instructors tend to speak an outdated, pre-digital age language which means they may struggle to teach and communicate effectively with the 'digital natives' who speak a new and different language. However, regardless of this it is reasonable to conclude that the role of the professional educator/teacher has expanded to include knowledge of how the technologies can be effectively used to enhance the learning and teaching process. This implies that professional development for educators, including MET teachers, is a necessity for education and training providers to deliver effective e-learning services. Whilst many MET providers have professional development programs for their academic staff, this is not always the case. However, for the committed educator there are internet based avenues for professional development e.g. Magna Publications, Professional Development for Higher Education. [31]

6. Conclusion

Universities need to adapt to the education dynamics of the new world. Acceptance of change is but the first step; actually adopting new paradigms is the second, and putting them into practice is the third. Users of education services are frequently driven by issues of time, place and cost whilst providers of education services are frequently driven by academic discipline, traditionalism and cost. The successful merging of these different drivers is one of the challenges faced by education today. [32]

Universities are information businesses and when the way information is handled changes fundamentally, information businesses must change. For example, the University of Leicester, U.K. has replaced printed distance education resource material with eBooks. It estimates that the cost of providing a student with printed resource material is GBP 500-600 whilst the cost of providing a student with a basic eBook reader is only GBP 150. A further benefit is that eBooks are also readable with iPads and smart phones. [33]

Traditional approaches to education are being reconfigured by technology as digital devices empower amateurs to do what professionals once did. Three examples serve to illustrate:

- "Last year (2010), Los Altos, California decided to use the Khan Academy videos and software in its public school classrooms. Doing so turns the educational model on its head. In the traditional model, students sit in class and receive information from their teacher while they busily take notes – a passive process that wastes valuable classroom time. They do the most challenging work – solving problems – at home without help. Under the new system they watch the Khan Academy videos at home and solve problems in class, where the teacher's talents can be put to work most fruitfully. In addition, students can learn at their own pace – rewatching videos – until they actually understand the material. The early results show huge leaps in student skills. Technology is being used to create customised, interactive education that is both novel and powerful". [34]

- "It's now possible to study a Yale or MIT course online without enrolling or paying for it. If you visit the MIT website it even tells you what online interactivity options are available in each course. You pay to be assessed and credentialed". [35]
- "Calibre is a free and open source e-book library management application developed by users of e-books for users of e-books".[36] It has six main features; library management, E-book conversion, syncing to e-book reader devices, downloading news from the web and converting it into e-book form, comprehensive e-book viewer, and a content server for online access to the book collection. It can also email books, download news automatically, and supports mobile devices including smart phones, Kindle, etc.

Providing the right technology and systems, and ensuring that academics have the knowledge and skills to choose and use appropriate technology to enhance the learning experience are significant institutional challenges. But any decision on just what is the right technology depends entirely upon having academic staff with sufficient knowledge and skills of both the technology's capabilities and limitations, and the pedagogy of e-learning. Bearing in mind that many, if not most, educators are 'digital immigrants' the need for institutionally supported professional development should be axiomatic. The application of technology is about the people and the process rather than the technology itself.

MET is conservative by nature, 'wrapped up' in quasi-legal and administrative constraints, provides limited support for teaching staff to learn/enhance teaching skills, 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. Distance learning is no longer a revolutionary concept as it is now used across all education sectors and, in particular, e-learning caters to the different requirements of students i.e. e-learning is not teacher-centred, rather it is student centred. However, the uptake of e-learning in maritime education and training of seafarers is painfully slow, mainly due to factors such as conservative marine administrations, poorly trained teaching staff, lack of suitable technologies, resistance to change etc.

The delivery of distance education is undergoing significant changes and there is more to come. The vice-chancellor of Britain's Open University, Martin Bean, suggests that" the next wave of change in further education will be fast and incredibly disruptive. It will happen when education meets social networking and it will be exciting as well as scary". [37]

To conclude; a comment from famous New Zealand yachtsman, Sir Peter Blake: "New technology is common, new thinking is rare". [38] Put another way; the technology provides the opportunity but how we use it is the challenge.

References

[1] Inglis A., Ling P. and Joosten U., "*Delivery digitally - managing the transition to the knowledge media*", Kogan Page, (1999) cited in Lewarn B., "Flexible learning systems and their role in meeting the changing needs of ports-from sage on the stage to wiz on the web", *Proceedings of "17th International Port Training Conference"*, Hamburg, (2003).

[2] Lewarn B., "Maritime education and training - the future is now!", *IAMU Journal*, Vol. 2, No. 1, (2002), pp 19-24

[3] Coaldrake P. and Stedman L., "*On the brink: Australia's universities confronting their future*", University of Queensland Press, (1998).

[4] Coaldrake P. and Stedman L., "*Academic work in the twenty-first century: changing roles and policies*", Higher Education Division, Department of Education, Training and Youth Affairs, (1999).

[5] Wikipedia, "E-learning". Wikipedia the free encyclopedia. 20 January 2012. Wikimedia. 24 January 2012 http://en.wikipedia.org/wiki/E-Learning

[6] Garrison D. R. and Kanuka H., "Blended learning: uncovering its transformative potential in higher education". Science Direct. 2011. Elsevier BV. 25 July 2011 http://www.sciencedirect.com/science/article/pii/S1096751604000156#sec2

[7] Shurville S., O'Grady T. and Mayall P., "Educational and institutional flexibility of Australian educational software", *Campus-Wide Information Systems*, Vol. 25, No. 2, (2008).

[8] Wikipedia, "Flexible learning". Wikipedia the free encyclopedia. 4May 2010. Wikimedia. 17 August 2011 http://en.wikipedia.org/wiki/Flexible_learning

[9] Lewarn B., "Keeping ports peopled: the role of sustainable maritime training", *Proceedings of "Regional Ports Conference 2011"*, Launceston, (2011).

[10] Devilee A., "What do instructional designers do?". Instructional Design Australia. 21 September 2011. Instructional Design Australia. 15 November 2011 http://instructionaldesign.com.au/

[11] Holt D., Smissen I. and 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? : proceeedings of the 23rd annual conference of the Australasian Society for Computers in Learning in Tertiary Education*, 3-6 December 2006, the University of Sydney, Sydney, Australia, (2006), pp. 327-337.

[12] "About Blackboards - Blackboard Technology and Chalkboard History Advances". ERGO in demand. 2012. Ergo in demand Inc. 20 March 2012 http://www.ergoindemand.com/about_chalkboards.htm

[13] School of the Air, "History". School of the Air –Alice Springs. 2006. School of the Air. 20 March 2012 http://www.assoa.nt.edu.au/_HISTORY/history.html

[14] "Internet Users in the World". Internet World Stats. 15 February 2012. Miniwatts Marketing Group. 20 March 2012 http://www.internetworldstats.com/stats.htm

[15] "Multiple Choice Quizzes with Illustrations for United States Coast Guard License Exam Preparation Assistance". SeaSources.net, Training for Mariners. 11 March 2012. SeaSources.net. 22 March 2012 http://www.seasources.net/index.html

[16] "Watch. Practice. Learn almost anything for free". Khan Academy. 2012. Khan Academy. 22 March 2012 http://www.khanacademy.org/

[17] "Alert! - Improving awareness of the human element in the maritime industry. A unique resource of professional maritime articles and bulletins, FREE to all". The Nautical Institute. 2010. A Nautical Institute project, sponsored by Lloyd's Register Educational Trust. 22 March 2012 http://www.he-alert.org/

[18] "Ship simulator extremes." ShipSim.com – Home. No date. ShipSim.com. 22 March 2012 http://www.shipsim.com/

[19] "Ports of Call 2012". Ports of Call. No date. Ports of Call. 22 March 2012 http://www.portsofcall.de/

[20] "iTunes U by Apple". App store iTunes U. 2011. Apple Inc. 22 March 2012 http://itunes.apple.com/us/app/itunes-u/id490217893?ls=1&mt=8
[21] "iNavX™ - Marine Navigation App for iPhone, iPod touch and iPad". iNavX. No date. iNavX. 22 March 2012 http://www.inavx.com/
[22] Wikipedia, "Learning management system". Wikipedia the free encyclopedia. 28 February 2012. Wikimedia. 26 March 2012 http://en.wikipedia.org/wiki/Learning_management_system
[23] "Edu Tools Course Management System Comparisons- Reborn". Wcet edutools providing decision making tools for the edu community. 25 March 2012. Edu Tools 2012. 26 March 2012 http://www.edutools.info/static.jsp?pj=4&page=HOME
[24] Newhouse C.P., "*A Framework to Articulate the Impact of ICT on Learning in Schools*", Western Australian Department of Education, (2002).
[25] Fonseca J., "GlobalMET to meet needs of Y-generation". Maritime Professional-the industry online. 5 December 2011. New Wave Media. 26 March 2012 http://www.maritimeprofessional.com/Blogs/GlobalMET-to-meet-needs-of-Y-generation/December-2011/GlobalMET-to-meet-needs-of-Y-generation.aspx
[26] Fonseca J., "Long way before E-Learning gains entry in maritime training institutes". Maritime Professional-the industry online.17 August 2011. New Wave Media. 28 March 2012 http://maritimeprofessional.net/Blogs/Long-way-before-E-Learning-gains-entry-in-maritime/August-2011/Long-way-before-E-Learning-gains-entry-in-maritime.aspx
[27] BIMCO/ISF., "*Manpower 2010 update*", BIMCO/ISF, (2010).
[28] "Maritime Services". Inmarsat. 2012. Inmarsat PLC. 28 March 2012 http://www.inmarsat.com/Services/Maritime/default.aspx?language=EN&textonly=False
[29] Goldberg M., "Onboard Internet and the Implications for Maritime Training". Maritime Professional-the maritime industry online. 7 December 2011. New Wave Media 2011. 26 March 2012 http://www.maritimeprofessional.com/Blogs/Maritime-Training-Issues/December-2011/Onboard-Internet-and-the-Implications-for-Maritime.aspx
[30] Gibson T., Koontz D. and Van Den Hende M. "The digital generation: teaching to a population that speaks an entirely new language". 2009. 28 March 2012 http://david.koontz.name/digital/Presentation_files/THE_DIGITAL_GENERATION.pdf
[31] "Teaching and Learning, Strategies for teaching face to face and online". Magna Publications. 2012. Magna Publications. 23 April 2012 http://www.magnapubs.com/teaching-and-learning/
[32] Lewarn B., "Flexible learning systems and their role in meeting the changing needs of ports-from sage on the stage to wiz on the web", *Proceedings of "17th International Port Training Conference"*, Hamburg, (2003).
[33] COFA online UNSW, "Creating eBooks for distance education - Case study". You Tube. 16 February 2011. You Tube. 22 March 2012 http://www.youtube.com/watch?feature=player_embedded&v=54vIwP-Dd00
[34] Zakaria F., "Why can't the U.S. learn?", *Time Magazine*, 14 November 2011.
[35] Tanner L., "Will the internet kill universities?". Campus Review. 31 October 2011. Campus Review. 23 April 2012 http://www.campusreview.com.au/blog/news/will-the-internet-kill-universities/
[36] Goyal K., "About Calibre". Calibre e-book management. 16 March 2012. Kovid Goyal. 22 March 2012 http://calibre-ebook.com/about#features

[37] Blackwell A., "Resist social networking at your peril". Campus Review. 2 April 2012. Campus Review. 23 April 2012 http://www.campusreview.com.au/blog/international/resist-social-networking-at-your-peril-open-university-vc/

[38] Blake P., "Educational Quotes for the 21st C". Leading Learning Co. NZ. No date. Future Edge Publications. 26 March 2012 http://www.leading-learning.co.nz/original-quotes.html

Study Programmes for Electro-Technical Officers Development: Two-Level Based Approach

Mykhaylo V. Miyusov
Professor, Doctor of Science, Rector of Odessa National Maritime Academy,
rector@onma.edu.ua

Vadym M. Zakharchenko
Professor, Doctor of Science, Vice-Rector of Odessa National Maritime Academy,
zvn@onma.edu.ua

Abstract: The standards of training and certification regarding Electro-Technical Officers (ETOs) established in the new edition of the STCW Convention and Code are the first international standards for electro-technical personnel in history. Development of study programmes for ETOs is one of the most important current tasks for maritime education and training institutions. Standards established in the new edition of the STCW Convention and Code regarding ETOs include requirements for one level of ETOs qualification. These standards should be accepted as minimum standards only. These standards do not cover a range of competencies that are necessary in modern marine engineering and do not take into account that the competencies of management level appear when vessels with powerful and complex electric power plants are maintained by electro-technical groups that might include a few ETOs. Analysis of modern and nearest future needs shows us that a minimum of two levels of qualifications (ranks) for ETOs are required. A number of countries have been supporting the idea of two-level standards for ETOs during the process of comprehensive review of the STCW Convention and Code. The first level of ETOs qualification should correspond to the standards of competence for ETOs at operational levels that are presented in the Section A-III/6 of the STCW Code. The second level of ETOs qualification must ensure the next level of knowledge, understanding and proficiency in the field of work, and the next level of problem solving abilities, communication skills, autonomy and responsibility. The approach to ETOs education and training, the descriptors of qualifications, the structures of study programmes with the view of the two ETOs ranks are considered in the paper.
Keywords: the STCW Convention and Code, Maritime Education and Training (MET), Electro-Technical Officers (ETOs), Standards, Study programme, Competencies, Qualifications.

The Manila amendments to the Annex to the International Convention on Standard of Training, Certification and Watchkeeping for Seafarers (STCW Convention) and to the Seafarers' Training, Certification and Watchkeeping Code (STCW Code) entered into force 1 January 2012 [1]. The authors have already attracted attention to the fact that one of the most important amendments to the STCW Convention and the STCW Code was the introduction of the standards of training and certification for electro-technical personnel [2]. The necessity of the inclusion of such standards into the STCW Convention and the STCW Code was predetermined by the rapid development of electro- and electronic technologies during the last decades and the wide use of the above technologies in maritime engineering.

The new edition of the STCW Convention and STCW Code includes standards regarding electro-technical officers (Regulation III/6 of the STCW Convention and Sections A-III/6 and B-III/6 of the STCW Code) and Electro-technical ratings (Regulation III/7 of the STCW Convention and Section A-III/7 of the STCW Code).

The necessity of the implementation of the above standards into the study programmes in the near future is one of the main challenges for Maritime Education and Training (MET) and an actual issue for the maritime educational institutions. The activity of maritime higher educational institutions relates to the officers' training. In this connection the authors propose to pay attention to the standards of the training of electro-technical officers (ETOs) and to discus the approach to the development of the corresponding study programmes in the maritime higher educational institutions.

Prior to the adoption of the above standards, the unified requirements of the competence and the level of responsibility of the electro-technical personnel were not established. Different countries and different maritime higher educational institutions trained ship electro-technical specialists in accordance with their national requirements. Besides, different shipping companies provided positions differently named and having different duties (Electrician, Electrical Engineer, Electrical Officer, Electronic Officer, etc.). In some cases the principal attention was devoted to the electrical power plants and distribution of electricity, electrical drives and so on. In the others the focus was on the electronic and control engineering.

Different approaches to the duties of electro-technical personnel and to the development of the associated training programmes before the adoption of the Manila Amendments were reflected during the process of the comprehensive review of the STCW Convention and the STCW Code. For instance, the proposals to include new definitions into the STCW Convention and work out the related standards regarding Electrical officer and Electronic officer [3], Electro-technical officer and Senior electro-technical officer [4] were submitted. As a result of lengthy discussions and the resulting convergence of the delegations' positions, the standards regarding Electro-technical officer were adopted.

After the Manila Amendments have entered into force, the training of electro-technical personnel should be provided in compliance with the adopted standards. The specification of minimum standards of competence for electro-technical officer as presented in the Table A-III/6 of the STCW Code requires knowledge, understanding and proficiency in the subject areas of mechanical engineering, electro-technology, hi-voltage technology, electronics, control engineering, computing and data processing and communication technology. It is evident that the area of competence of electro-technical officer covers a wide range of engineering and technology and requires the realization of the specific educational and training programmes, which may be classified as educational and training programmes in Combined Technology.

At the same time the authors pay attention to the fact that the standards regarding electro-technical officers in the STCW Convention and the STCW Code established only one level of ETOs' qualification and responsibility – operational level. In the authors' opinion the standards established in Regulation III/6 of the STCW Convention and Sections A-III/6 and B-III/6 of the STCW Code should be accepted as minimum standards only. These standards do not cover a range of competencies that are necessary in modern marine engineering and do not take into account the situations when competencies of management level are required.

The authors have already written that delegates from a number of countries at IMO have been supporting the idea of two-level standards for ETOs [2], [5]. During the process of the comprehensive review of the STCW Convention and the STCW Code standards regarding electro-technical personnel, three levels of responsibility were proposed [2], [4]:

Electro-technical rating (Support level);

Electro-technical officer (Operational level);

Senior Electro-technical officer (Management level).

Delegates from China, France, India, Malaysia, Poland, Ukraine, United Kingdom and many others consistently supported that approach. This approach assumed the arrangement of training and certification of ETOs at two levels. Analysis of modern and nearest future needs shows us that a minimum of two levels of qualifications and ranks for ETOs are required.

At least two aspects may be singled out as arguments in favor of two-level standards regarding ETOs. The first one is the complexity and multitude of the equipment relevant to the ETOs competence. The rapid development and broadening of the electronic and computer technologies application in shipboard systems predetermined the growth of the requirements to the level of the personnel qualification. The arrangement of the competent and qualitative operation and maintenance of the electronics and control systems, computer and info-communication systems as well as complex control systems requires a deep theoretical knowledge, developed cognitive skills, abstract thinking and the skills of analysis and prediction. Even today's electro-technical competencies on ships are often performed by university graduates.

On certain vessel types (special purpose vessels, vessels with powerful and complex electrical power plants) electro-technical competences are provided by electro-technical specialists' groups that might include a few electro-technical officers. A necessity of management level task realization appears in such situations. At the same time, approved 2010 Manila amendments do not require training for the tasks of management level for ETOs.

It is important to note that in some countries traditionally existing national regulations for certification of seafarers include a few ranks for electro-technical officers.

Taking into account all the above the authors propose to discuss a two-levels based approach for the development of the study programmes for ETOs in MET institutions. Such programmes should be leading to awarding two levels of qualifications (ranks) to the electro-technical officers.

The above mentioned two levels of ETOs qualification may be indentified depending on the level of complexity and versatility of the professional tasks (competencies). According to that, the requirements to the study programmes leading to awarding the above qualifications may be defined. The framework requirements to such study programmes may be described by the expected learning outcomes which should be achieved by the candidates for the awarding of qualifications after successful completion of these programmes. The description of the competence systems and the associated learning outcomes giving the ground for defining the requirements to the study programmes for two levels of ETOs qualifications are given below.

The first level of ETOs qualification should correspond to the standards of competence for ETOs at the operational level that are established in the Sections A-III/6 and B-III/6 of the STCW Code. The system of competence and learning outcomes may be created on the basis of the requirements presented in the Table A-III/6 of the STCW Code. These standards include competencies at the operational level related to the functions:

- Electrical, electronic and control engineering;
- Maintenance and repair;
- Controlling the operation of the ship and care for persons on board.

The competencies related to the function "Electrical, electronic and control engineering" at the operational level are: monitor the operation of electrical, electronic and control systems; monitor the operation of automatic control systems of propulsion and auxiliary machinery; operate generators and distribution systems; operate and maintain power systems in excess of 1,000 volts; operate computers and computer networks on ships; use English in written and oral form; use internal communication systems. The presented competence specification should have been widened by the competence "Monitor the operation of bridge navigation equipment and ship communication systems", taking into account the duties of maintenance and repair established by the function 'Maintenance and repair".

Accordingly the above competences the study programme should provide the following learning outcomes:

- Comprehensive knowledge and understanding of electro-technology fundamentals, electrical machines theory, electronics and automation theory and ability to use their basic laws;
- Knowledge and understanding of operation principles of electrical motors and electrical drives, electrical propulsion; electro-hydraulic and electro-pneumatic control systems;
- Knowledge of electrical materials technology, high-voltage technology and basics of metrology;
- Knowledge and understanding of the basics of ship construction, mechanical engineering systems and heat-transmission;
- Knowledge of construction and understanding of operation principles of ships electrical power plants and electrical distribution systems, procedures for operating generators, and ability to make coupling, load sharing and changing over generators and operate distribution systems;
- Knowledge of the hazards of electricity, safety requirements and precautions procedures;
- Knowledge of construction computer systems and computer networks, control systems, internal and external communication systems, bridge navigation equipment, understanding main principles and features of data processing;
- Knowledge of instrumentation and construction alarm and monitoring systems;
- Ability to interpret sensors and instrument readings for appreciation of equipment condition;
- Knowledge of procedures and ability to prepare control systems, navigation equipment and communication systems for operation;
- Knowledge and ability to use English;

The competencies related to the function "Maintenance and repair" at the operational level are: Maintenance and repair of electrical and electronic equipment; Maintenance and repair of automation and control systems of main propulsion and auxiliary machinery; Maintenance and repair of bridge navigation equipment and ship communication systems; Maintenance and repair of electrical, electronic and control systems of deck machinery and cargo-handling equipment; Maintenance and repair of control and safety systems of hotel equipment.

The learning outcomes corresponding to the competences of the "Maintenance and repair" function may be defined as following:

- Ability to interpret electrical and electronic diagrams and use them for maintenance and repair;
- Knowledge of typical procedures for detection of electric malfunctions and location of faults;

- Knowledge of construction, operation principles and features of electrical testing and measuring equipment and instruments;
- Knowledge and ability to use ship's computer-based maintenance planning systems;
- Knowledge of the typical maintenance and repair procedures for electrical and electronic equipment, navigation equipment, communication systems, different kinds of control systems and appropriate practical experience;

The competencies related to the function "Controlling the operation of the ship and care for persons on board" at the operational level are: Ensure compliance with pollution prevention requirements; Prevent, control and fight fire on board; Operate life-saving appliances; Apply medical first aid on board ship; Application of leadership and team-working skills; Contribute to the safety of personnel and ship. The majority of these competences is traditional for the officers at operational levels and is not directly connected with electrical, electronic equipment and control systems.

Let us pay attention to the competence "Application of leadership and team-working skills" as it is related to the arrangement of operation, maintenance and repair of electrical and electronic equipment. Taking into account knowledge, understanding and proficiency necessary for the realization of this competence and given in table A-III/6 of the STCW Code, the expected programme learning outcomes may be represented as following:

- Ability to communicate effectively about professional activities, problems and solutions with ratings, officers and supervisors;
- Knowledge and ability to apply decision-making techniques;
- Ability to plan and structure work process and instruct others,
- Ability to manage resources and small groups of personnel;
- Ability to evaluate and improve performance of self and subordinated personnel.

The qualification and study programme learning outcomes described above do not include the ability to solve complicated and complex professional tasks and management tasks. At the same time as it was shown above, such tasks may arise on board in a number of cases. Solving such problems may become an item of the competence standard for an ETO with higher qualifications than that defined in Sections A-III/6 and B-III/6 of the STCW Code. Such qualifications should correspond to the qualifications of Senior ETOs.

The specifications of competences which, in the authors' opinion, meet such qualifications and expected learning outcomes which may define the contents of study programme for Senior ETO are given below. It is expected that the candidates studying this programme have formerly achieved the learning outcomes corresponding to the ETO qualification as established in the Sections A-III/6 and B-III/6 of the STCW Code.

Proposed below are competencies and learning outcomes grouped according to the three functions, as well as in the case of the standards regarding ETO as presented in the table A-III/6 of the STCW Code.

The specification of competencies for Senior ETO qualification should be as follows:

Function "Electrical, electronic and control engineering"

- Monitor and evaluate electrical power generation and consumption;
- Monitor and adjustment all electrical, electronic equipment and control systems, evaluate and predict their condition;
- Plan, schedule and manage complex activities for ensuring working condition of electrical and electronic equipment and control systems,
- Operate special purpose electrical equipment and integrated control systems;
- Operate safety power systems in excess of 1000 Volts;

- Operate all kinds of electrical and electronic equipment, electrical power plants in unpredictable and emergency situations.

Function "Maintenance and repair"

- Plan, schedule and manage maintenance and repair activities;
- Testing integrated control and monitoring systems
- Manage troubleshooting restoration of electrical and electronic equipment and control systems to operating condition;
- Detect and identify causes of malfunctions in electrical and electronic equipment;
- Organize recovery of electrical power plants and integrated control systems after accidents;
- Ensure safe working practices;

Function "Controlling the operation of the ship and care for persons on board"

- Manage and supervise complex activities of electro-technical personnel;
- Monitor and control compliance with legislative requirements and measures relating to electrical and electronic equipment and systems to ensure safety of life at sea and protection of the maritime environment.
- Manage development of professional knowledge and skills of electro-technical personnel;
- Organize training of shipboard personnel relating to operation of electrical and electronic equipment including emergency situations;
- Develop emergency and damage control plans and handle emergency situations relating to electrical equipment.

According to the description of qualification proposed above, the study programme for Senior ETO may be described by the following learning outcomes.

Relating to the function "Electrical, electronic and control engineering"

- Advanced knowledge of electro-technology, electronics and power electronics, electrical machines theory and automation theory, high-voltage technology;
- Knowledge of the forefront of metrology, computing and info-communication technology;
- Knowledge of design features and system configurations of integrated control systems;
- Knowledge of design features of power systems in excess of 1000 Volts;
- Knowledge of design features of electrical and electronic equipment, control and monitoring systems for special purpose ships;
- Knowledge of marine electrical engineering practice;
- Knowledge of the basics of the theory of reliability and ability to apply them for analysis and prediction of equipment and systems condition and provision of their reliable operation;
- Ability to gather and interpret relevant data for appreciation of equipment condition and operate it with incomplete or limited information;
- Ability to learn autonomously the operation principles of new and/or special-purpose electrical or electronic equipment and systems;

Relating to the function "Maintenance and repair"

- Knowledge of the classification societies' requirements concerning ships electrical, electronic and control systems;
- Knowledge of safe working practices;
- Knowledge and ability to use software for testing control and monitoring systems;

- Knowledge and understanding of interrelations of malfunctions in electrical and electronic equipment and systems and regularities of malfunctions;
- Ability to troubleshooting of electrical and electronic equipment, control monitoring systems;
- Ability to plan maintenance and repairs procedures basing on the monitoring and prediction data including procedures with non-prescribed algorithms.

Relating to the function "Controlling the operation of the ship and care for persons on board"

- Knowledge and understanding of basic personnel management principles;
- Knowledge of shipboard resource management;
- Knowledge of international maritime conventions and recommendations and national legislative requirements relating to ensuring safety of life at sea and protection of the maritime environment;
- Ability to apply task and workload management;
- Ability to train shipboard personnel;
- Ability to communicate effectively information, problems, ideas and solutions on board and ashore;
- Knowledge and ability to apply decision-making techniques to solve complex and unpredictable problems relating to electrical and electronic equipment and systems;

Looking over competences and corresponding learning outcomes described above, the qualification of ETO at the operational level may be identified as the qualification requiring:

- Comprehensive, specialized theoretical and factual knowledge within specialized field of work and basic knowledge of the interfaced fields:
- Ability to solve typical problems within specialized field of work where there is unpredictable change.

At the same time, general requirements to the Senior ETO qualification may be described as follows:

- Advanced and forefront knowledge within their specialized field of work;
- Abilities to manage complex professional activities and to solve complex and unpredictable problems within specialized field of work.

The above descriptions of two proposed qualifications of ETOs allow us to compare them with other professional qualifications and qualifications established in different education systems.

In the authors' view, qualification of ETOs at the operational level corresponds to the general qualification description of level 5 of the European Qualifications Framework (EQF) for lifelong learning. At the same time, this qualification may be partially associated with level 6 of the EQF. The qualification of such levels in the European education area is associated with study programmes of short cycle of higher education as minimum.

In its turn, the proposed Senior ETO qualification corresponds to the general qualification description of the level 6 of the EQF. Qualifications of this level are usually associated with study programmes of the first cycle of higher education and require a Bachelor degree as a minimum.

The authors are of the opinion that, despite of absence of standards regarding Senior ETO in the current edition of the STCW Convention and the STCW Code, MET institutions must take into account the possibility of the emergence of such standards in the imminent future and have to produce common approaches towards developing the appropriate study programmes now.

References

[1] The International Convention on Standard of Training, Certification and Watchkeeping for Seafarers (STCW), 1978 as amended.

[2] Mykhaylo V. Miyusov, Vadym M. Zakharchenko. Education and training of electro-technical officers and STCW Convention and Code new standards implementation / Technical cooperation in Maritime Education and Training / Proceedings of the 11-th Annual General Assembly International Association of Maritime Universities. – Pusan Korea, Korea Maritime University, 2010. – p. 159 – 164.

[3] Report to the Maritime safety committee / Subcommittee on Standards of Training and Watchkeeping - 38th session – Doc. STW 38/17, (2007), p. 36.

[4] Comprehensive review of the STCW Convention and the STCW Code // Subcommittee on Standards of Training and Watchkeeping - 39th session – Doc. STW 39/7/12, (2007).

[5] Report to the Maritime Safety Committee / Subcommittee on Standards of Training and Watchkeeping - 41th session – Doc. STW 41/16, (2010), pp. 25-36, 39.

The role of formal and informal leadership in the ship crew

Capt. Leonard Pozolotin, MNI
Senior Lecturer of theSafety and Security Department

Vladimir Torskiy, FNI
Head of the Safety and Security Department

Elena Kostyrya
Senior Lecturer of the Safety and Security Department

Marina Chesnokova
Senior Lecturer of the English in Hydrography and
Maritime Radio Communication Department,
Head of International and Economic Cooperation Department

Odessa National Maritime Academy
8, Didrikhson str. Odessa Ukraine 65029
Tel: +380 48 731 10 59; Fax: +380 48 731 10 63
onma@odtel.net

Abstract: The current intensification of world shipping and the consequent growth of ship size and speed considerably complicates the role of human factors and the importance of leadership in the crew organization. Managers of all levels should possess leader's qualities, both in the management of shipping companies and on board ships. As to the latter, this requirement has become mandatory after the IMO convened Manila International Conference 2010 made amendments to the STCW code. Tables AII/2, AIII/2 in the function "Controlling the operation of the ship and care for persons on board" contain a new competence "Use of leadership and managerial skill", which includes a number of capabilities and skills as necessary professional qualities for both deck and engineer officers of all the levels of management. The authors of these publications very often confuse the notions of "leader" and "manager" using them as synonyms. The manager is a formal leader officially entrusted with managing a certain group of people or an organization and arranging their activities. The manager bears responsibility for the functioning of the group or organization before the appointed (elected, approved) body and has the authority to punish and encourage his subordinates in order to stimulate their productive (scientific, creative etc.) activity. The principal task of the manager or the managerial body is the provision of the achievement of the maximum effect in the activity inn which the group or organization is engaged. There may be, besides the formal leader, an informal leader (unauthorized by any structure) who is a person who, due to his capabilities and personal qualities,

is able to lead people and influence their behavior. The influence of such an informal leader may sometimes be even stronger than that of the formal leader if the latter does not possess the qualities necessary for the successful management of people. The informal leader is a member of the staff who does not occupy any managerial position but, due to his personal qualities, life experience and behavior, occupies an exclusive position; that of the leader. The decisive factors determining the possibility of informal leadership include age, position, professional knowledge and skill, psychological characteristics, personal qualities etc.. There are certain peculiarities of management and leadership in ship crews where the authoritative style of management prevails. This is connected with statutory relationships, strict subordination and the extreme working conditions of the operations. The task of the official manager may be considered to be the control of the capabilities of the informal leader. According to the requirements of the STCW78 Convention, ship officers (both deck and engine officers) should possess the required professional knowledge and the practical skills to ensure the observance of disciplinary regulations, maintain an atmosphere of mutual understanding and amiability and care for the safety of their subordinate crew members. Leadership skills in an operational situation ensure the effective execution of ship operations, the requirements of the system of safety management and watchkeeping in critical situations. They also help to prevent panic, organize the necessary actions in the struggle for survivability of the ship, the rescue of people and the safety of the cargo.
Keywords: crew, human element, leadership, management, safety, team.

A crew's role, along with the role of the human element and leadership in crews, has been growing as navigation intensity develops and the size of ships and transportation speeds increase. Leaders at all levels in shipping companies' administrative apparatus and onboard must have leadership qualities.

As for the latter, this requirement became mandatory after the introduction of the relevant amendments to the STCW Code at the International conference organized by IMO (Manila, 2010). A new competency, "Use of Leadership and Managerial Skill", was included in Tables A II/2 and A III/2 under the function of "Controlling the *operation* of the *ship* and *care* for persons *on board and the management level" and it includes a number of abilities and skills as mandatory professional qualities for Navigators and Engineers of all levels.*

Authors of publications dedicated to the leadership phenomenon quite often mix up notions of "leader" and "manager"; using them as synonyms.

A manager is a formal leader; a person officially vested with functions of personnel management and organization of work. A manager is liable to an appointing (selective, endorsing) authority for a group's (staff's) functioning and has strictly defined staff sanctioning authorities (punishment and incentives) to affect their production (scientific, creative, etc.) activities. The goal of management is the provision of an administration for an organization (a group) with the aim of achieving an optimum effect of mutual activities.

Along with a formal leader there can be an informal (unauthorized by organizational authorities) leader; a person who is able to attract people and influence their behavior due to his/her abilities and individual qualities. An informal leader's impact on an organization's work results can quite often be even more significant than the influence of the formal leader who does not have the qualities required for successful personnel management.

An informal leader is a member of a team (group) who doesn't officially hold a managerial position but has taken a special position, leadership, due to his/her individual qualities, life experience and behavior. Significant factors defining possibilities for informal leadership include: age, position, professional knowledge and skills, personality psychology and personal traits.

There are several peculiarities of management and leadership in crews where authoritarianism is mostly used as a style of management. It concerns statutory relationships, strict subordination and extreme working conditions.

A manager's goal can be considered as controlling the informal leader's abilities.

In compliance with the requirements of STCW Convention 78, ship's Officers of all levels (Mates and Engineers) must have relevant professional knowledge and practical skills, ensure the following of current disciplinary rules, maintain an atmosphere of mutual understanding and benevolence among a ship's crew and take care of crew members subordinate to him/her.

Leadership skills in operational conditions ensure effective fulfillment of the ship's operation, requirements of the Safety Management System, watchkeeping, help to prevent panic in an emergency, organize all the activities of damage control, rescue of people and ensuring cargo safety.

Leadership and management are phenomena having considerable differences. The first one is their origin. Leadership appears naturally, i.e. it is a result of the processes happening in a small group which defines its structure. That means that leadership is a result of intragroup processes. A manager is appointed from the outside, usually from a higher management level.

Leadership in a small group is a phenomenon of an individual's impact or influence on opinions, evaluations, relationships and behaviors of an overall group and its single members.

The influence process through abilities and skills or other resources necessary for people is called ***informal leadership***.

Despite having a definite similarity, differentiation between 'a leader' and 'a manager' is essential for the psychology of small groups:

- management can exist only in formal groups,
- leadership is in both formal and informal groups;
- a manager carries out control over the official relationships of a group as "an organization", and a leader mainly controls interpersonal relationships within a group;
- a manager possesses a definite and restricted sanction regime (ways of incentives and punishment) for group members, while a leader can use only the means of personal influence (persuasion, suggestion, etc.).

An important difference concerns ways of performing leadership and managerial functions. Leaders' functions have an informal character in which he/she does not issue orders and written directives, however his/her decisions and instructions will be implemented by group members. Meanwhile, a manager must draw his/her instructions up officially. Finally, the third difference concerns the spheres of leaders' and managers' influence.

A leader's influence has been defined to be performed in both physical and mental spaces. Thus, if a person does not consider that he/she is a member of a group, the leader's influence does not apply to him/her. Meanwhile, a person working for some organization (employee) who might not inwardly consider being loyal to it, does not reduce the influence of his/her formal leader's instructions on him/her.

Thus, each cooperating group of people has formal and informal structures which can either coincide or not. For each of these structures there is a person coordinating functions and keeping people in a group with his/her actions. A manager is this kind of person for a formal structure, while a leader is the one for an informal structure. The most favourable situation for these group members is when these structures coincide, i.e. when one person combines as both a manager and a leader. Such a manager-leader has greater possibilities for influencing group members; it is easier to manage them. In practice, formal and informal structures mostly do not coincide and the manager needs to maintain good relationships with leaders of informal groups within the organization managed by him/her.

The display of leadership qualities can be more fully manifested by upper managers in independent forms.

Essentially, this should be taken into account when controlling a ship's operations. Thus, a master successfully combining the functions of both the ship's crew manager and their leader will surely provide efficient and safe operation of his ship. An experienced, competent Chief Engineer in a crew will ensure fast and quality fulfillment of maintenance work regarding a ship's operation.

A leader can be formal (for instance, appointed for carrying out management of a certain allotment of work, a subdivision). Along with a formal leader there can be an informal one (unauthorized by an organizational structure) in an organization, a person who by virtue of his/ her qualities can attract and lead people. An informal leader's influence on an organization's work results can quite often be even more significant than a formal leader's, who does not have the qualities essential for successful personnel management. Thus, for example, ship operations controlled by a ship's officer without sufficient experience and knowledge might cause his/her substitution in operations management by an experienced crew member who has previously performed this work as an informal leader.

To be the manager does not automatically imply that the same person is the leader of an organization since the informal framework is, to a considerable extent, natural for informal leadership. One can occupy the highest position in an organization but fail to be a leader.

For example, an official leader in school classes occupying a leadership position is not always the person of the highest authority in a group. Sometimes he/she is nominated by adults rather than the class (children themselves); therefore the supervising teacher should either know his/her pupils or give them an opportunity to choose the monitor by themselves. Unless the monitor is simultaneously "an informal leader" the person having high authority over pupils will corrupt the group's and organization's efficiency and the performance of activities will drop. A conflict might arise between formal and informal leaders. Therefore, it is very important for teachers to have an understanding of the class leader.

There is a similar position in cadet groups in a college. That is why a company's leader-commander should know which of the cadets has authority in a group and can influence the group's behavior (informal leader).

The use of an effective combination of both power bases is considered perfect.

Informal leaders are group members who do not occupy an official managing position but take a special place due to a set of personal qualities, life experience and specific behaviour. Informal leadership is based on competence, personal liking and a number of psychological attributes: for example, a person's ability to find an effective way out of difficult situations. The informal leader is usually an object of great attention in a group.

If the informal (natural) leader is outside of a formal organizational scheme he/she is often considered to be "a troublemaker". He/she might become a centre of collective resistance to an organization's influence and, if his/her inclination to domination is highly developed, i.e. if he/ she actively shows love of power, he/she might start to consciously or unconsciously commit acts allowing him/her to become the leader of an informal group in its resistance to the organization. A gifted person occupying a position far lower than his/her abilities can direct his/her energy to trigger discontent in his/her group just because of despair. Such personalities often become coordinators of groups which can influence the psychological climate within a group.

As a rule, organizations of any type and size consist of groups. Therefore a manager needs to know the peculiarities of a formal and informal groups' appearance and understand the importance of an informal group's existence. Quite often informal organizations affect the quality of work completion and people's attitude towards labour and administration.

One of the greatest and most widespread misconceptions preventing effective management of organizations and informal groups is the initially low managers' opinions of these groups. Some managers persistently consider informal groups to be a result of inefficient management. Actually, informal group formation in an organization is a natural and quite widespread phenomenon found in each organization. They have both negative and positive aspects just like many other factors acting within the management area.

Key administrative mechanisms of control over groups' behaviour consists of finding natural leaders and controlling them. One of the modern theorists developed this thought, "Each manager should know who is a leader in each informal group and work with them, encouraging those who don't hinder but further facilitate achieving the organization's goals. When an informal leader opposes his/her employer, his/her great influence can undermine motivation and labour satisfaction of formal organization's employees".

As a rule, informal micro groups are formed from 2 to 10 people when working in a crew on a vessel. At the same time, micro groups are formed either on a professional basis (representatives of one service) or on the basis of work regime and rest (the same watch) coincidence or on the basis of interests, or ethnic lines, which is especially important in case of multinational crews.

Like formal organizations, informal groups have their leaders. Their main distinction resides in the fact that a formal leader (manager) obtains powers in a certain functional area, while an informal leader's sphere is the interpersonal relationships within the group. Informal groups can be of both positive and negative directions initiating conflicts.

There are some management and leadership peculiarities in crews where an authoritarian management style is generally used. They are related to statutory relationships, strict subordination and extreme working conditions. Like in any other group, relationships between ship's administration and informal leaders of micro groups can be subdivided into three types:

1. positive – an informal leader helps to solve tasks set by an administration and quite often serves as a linking element between ship's administration and the crew, i.e. group's management is carried out interactively.
2. neutral – group's management can appear uncoordinated. The way informal leadership is revealed is not related to tasks set for a crew and is carried out concurrently, without covering ship's administration's interests.
3. negative – is the worst option, when a leader and a manager are in conflict, group's relationships get worse, it is divided into micro groups hostile to each other.

Having an informal leader in a crew is often a sign of a lack of administration' s attention towards crewmembers. Holding various events, where the initiative belongs to the administration or management (safety meeting, management meeting) and holding various competitions (chess tournaments, photography contest) can help to restore management unity.

Thus, informal groups can either assist a group's official leader or be in opposition to him/her. Negatively oriented informal groups cannot be abolished with the help of orders; the formal leader should learn to cooperate with them and to neutralize their influence by encouraging them to achieve the group's goals.

Informal leaders are singled out in a crew due to their personal qualities having different 'levels' of:

- informal micro groups (watch, working crew);
- professional groups (deck, engine room);
- crew overall (inspiring liking and respect of a majority of a crew).

The main distinction of an informal leader from an official manager (formal leader) exists in the fact that he/she does not have an official status and official powers.

The list of factors defining the possibility of informal leadership is quite extensive: age, length of service, business competence, communication skills and initiative, intelligence, personal psychological qualities, and good oratorical skills. The mechanism of their appearance is connected with the fact that each group member admits (at least by their behavior) that a person aspiring to leadership is superior to them in one or a few parameters. 'Informal leadership' appears on the basis of interpersonal relationships between members. It is a so called leadership character.

Back in 1950s, R. Bales found experimentally that at least two types of leaders are singled out in each small group: emotional and instrumental. An emotional leader's function is ensuring the psychological climate within the group and care for optimal settlement of interpersonal relationships. He/she usually serves as an arbitrator or adviser.

An instrumental (business) leader is a group member who takes initiative in solving a problematic situation in compliance with the group's goals and has certain knowledge, information, skills and methods.

There are two main functions of an informal leader of the instrumental type; establishment of group behavior forms and motivation of each group member's behavior.

An informal leader is perceived as 'one of us', he/she uses the pronoun 'we' instead of 'I' when speaking about group problems; he/she is 'like most of us'.

Nevertheless, it is not the one who is 'one of us' but 'one of us but superior in something' due to experience, knowledge, social status, etc., who can lead in a group. Thus, the leadership phenomenon is inseparably connected with peculiarities of the leader's personality and that of the other group members.

A leader's status can be either situational or functional.

An emotional leader is a group member who takes the function of the group's mood control in problematic situations. Sometimes the emotional leader's position is called a centre of emotional contacts. In a positive way, an emotional leader is eager to prevent or settle conflicts and iron out or relieve emotional tension arising among group members in problematic situations. In a negative way, an emotional leader can become an initiator of panic, displeasure, hysterical reactions and the group's asocial behavior.

Besides the two most important functions of an informal group leader (establishment and maintenance of group's norms of behavior according to the established norms), such a leader can perform functions of:

- a group's behavior coordinator (distributes roles, duties and tasks);
- a supervisor of each group member's behavior (monitors fulfillment of assigned roles, duties and tasks);
- a planner of actions and means, with the help of which the group achieves its goals.
- an expert (almost in all cases when group members depend on a person whose technical knowledge and qualification are essential for fulfilling group's goals. Polarization of power, which can be used for strengthening a leader's role, takes place around this person);
- an arbiter (acts as a judge, prosecutor, advocate and comforter motivating behavior of group members; a leader uses informal social sanctions, i.e. methods, with the help of which people who know each other well express respect to those whose behavior corresponds to their expectations and show dissatisfaction with those who fall short of their expectations).
- an example (serves as a standard, model of behavior for other group members, i.e. provides them with graphic instructions of who they should be and what they should do).

- Group's fault bearer (sometimes the leader in this function is called 'a scapegoat'; a negative emotional leader in this case, when the group gets over a problematic situation, will really appear the object of attacks and accusations; this happens in the cases when the group loses illusions regarding actual goals and a personality of their leader).

A key administrative mechanism of control over a group's behavior is finding informal leaders and controlling them. One of the modern theorists developed this thought: "Each manager should know who is the leader in each informal group and work with him/her encouraging those who don't hinder further achieving organization's goals. When the informal leader opposes his/her employer his/her great influence can undermine motivation and labour satisfaction of formal organization's employees".

An obvious truth consists of admitting informal leadership as a natural phenomenon. Such a leader will, sooner or later, appear within any group numbering from 10 people. If he/she is still missing, it is just a matter of time. A group without a leader (like a leader without a group) cannot exist. A manager's task can be considered to be the informal leader's talent management.

An informal leader's significance in a crew can not be underestimated since sometimes accuracy and timeliness of ship's operations performance ensuring ship's safety can depend on it.

The main tasks of ships crews are ensuring the ship's operation safety, the ship's personnel labour protection from detected risks and constant readiness for actions in an emergency in the whole industrial and closed cycle of cargo transportation, technical operation and repair and preventive work.

These tasks are solved on the basis of a ship's safety management system. The ship's safety management system covers all the spheres of ship's production activity. It provides for:

- identification of main ship's operations (administrative-managerial and industrial-engineering) at the whole industrial and closed cycle of a port of delivery and cargo delivery to a recipient as well as operation, repair and preventive work;
- formalization, algorithmization and documentation of these operations in a form of normative procedures and instructions regulating a safe order and their performance methods;

A number of tasks and activities (operations) are performed according to each function given in the STCW Code 95. These are navigational and engineering watch, cargo operations, ship work, maintenance of ship's supply and equipment.

Groups headed by an appointed manager at management or operational levels are created for carrying out all ship's operations. This can equally apply to the functions specified in STCW Code 95.

It is necessary to take into consideration the existence of small groups, informal leaders in a crew and their influence on safety management and work organization on board. It is also necessary to take into account the fact that a new competence – "Use of Leadership Principles and Managerial Skills", which includes a number of capabilities and skills as essential professional qualities for a ship's crew, was introduced into STCW Convention, into table A-11/2 under function "Controlling the Operation of the Ship and Care for Persons on Board".

Examples of actual management of informal leadership in ship's operations can be given:

1. A Master ordered a Chief Mate to carry out inspection and scraping of rust and silt from ballast tanks making him officially personally responsible (a formal leader) for this work fulfillment. The Chief Mate was not experienced enough in carrying out such work, while a leading seaman had coped well with this work many times on this ship. The crew, knowing this fact, acknowledged him as an informal leader and

they, including the Chief Mate himself, followed his instructions. The Chief Mate regained his formal leadership after the work completion.

2. A Boatswain and 2 sailors received the task to weld on railings broken while unloading. The boatswain was officially put in charge of this work but, having no welding experience, he commissioned this work to a professional welder who, when having overall charge of the operation (informal leadership), began the welding work and gave instructions to the entire group including the boatswain.
3. A crew (12 people) consisting of citizens of Cape Verde arrived at a ship. A son of a famous oligarch of this state was among them. This OS was the youngest and most inexperienced among the group but, due to his social status, the whole group including a boatswain obeyed him. He was an informal leader of this group for 8 months having a contract of 12 months. After receiving information about this OS's father's death, his leadership ceased (a social sign).
4. A Chief and a Second Engineer (Ukrainians) were on a ship belonging to a shipowner from Germany. Being a German, the Third Engineer was an informal leader performing linking and coordination functions between the ship and the Company concerning all technical, repair and ship's supply issues.
5. A Chief Mate (formal leader) with the help of two pumpmen was in charge of the work of hand chipping cargo tanks on the tanker carrier "IRAN BEHESHI". The deck crew fulfilled the work with a boatswain in charge who, in the absence of Chief Mate, took responsibilities of the informal leader having deviated from the coordinated operation of tanks chipping. Having measured the tank's gas contamination, the boatswain was incompetent to assess the results correctly and sent 2 people into the tank who fainted there due to being poisoned by oil vapour. Lacking experience and skills, the boatswain (an informal leader) was at a loss in such an emergency and did not ask for assistance through VHF. Without informing anyone he himself descended into the tank after taking off a VHF station, a helmet and boots. When the pumpman noticed that the boatswain was missing on the deck near the tank he came up, looked inside and saw the boatswain and sailors lying unconscious. The pumpman called the Bridge through VHF and informed them about the situation. The General emergency alarm was soundeded. The three injured people were taken out of the tank and sent to the hospital in Montevideo.

References

[1] Soviet maritime law / Edited by V.M. Meshchera. M., 1985. pp. 41-47.

[2] Captain's juridical reference book / Edited by A.C. Kokin. Saint-Petersburg, 1992. pp. 3-8.

[3] Deep sea captains reference book / Edited by B.P. Khabura. M.; 1964. pp. 5-9;

[4] Contemporary maritime law and practice of its use / I.I. Barinova, B.C. Kheiphets, M.A. Gitsu and others. M., 1985. pp. 4-15.

[5] Istomina O.A. Professional seafarer's psychology. Lectures. Leadership and management peculiarities in maritime crew. Lectures of Maritime State University named after Admiral G.I. Nevelskoy. Vladivostok. 2007.

[6] Peter F. Drucker. The Effective Executive: The Definitive Guide to Getting the Right Things Done, Harper Collins, 2006.

[7] Peter F. Drucker. Management Challenges for the 21st Century, Harper Collins, 2007.

[8] Vikhanskiy O.C., Naumov A.I. Management: textbook / O.C. Vikhanskiy, A. I. Naumov. —4th edition, revised and edited. — M.: Economist, 2005. — 670 c: ISBN 5-98118-131-1
[9] Fred E. Fiedler, "The Effects of Leadership Training and Experience: A Contingency Model Interpretation", Administrative Science Quarterly 17,1972,455.
[10] Fielder F.E. A Theory of Leadership. McGraw-Hill, 1967.
[11] Fiedler, F.E. Leadership, New York: General Learning Press, 1971

The Role of ECDIS in Improving Situation Awareness

Ender Asyali
Assoc. Prof. Dr. Master Mariner, Dokuz Eylul University,
ender.asyali@deu.deu.tr

Abstract: Efficient and safe navigation requires the systematic management of numerous socio-technical system components such as personnel, information, procedures, equipment and facilities. Electronic navigational systems are becoming a focal sub-system for appraisal, planning, execution and monitoring steps of safe and efficient navigation. As a result of high level integration and interaction between navigation components on a unique ECDIS display, the quantity and complexity of data and information available to the Officer of Watch (OOW) is dramatically increased. An important part of an OOW's job is developing Situation Awareness (SA) and keeping it up to date in a rapidly changing dynamic environment and ECDIS can play an important role in improving and maintaining SA of the OOW and the whole bridge team. The aim of this study is determine the relation between ECDIS and SA as it is perceived by the maritime officers. A questionnaire was applied to officers and masters to determine the reliability of existing ECDIS technology, the impact of the introduction of ECDIS on preventing collisions and groundings and the navigational skills of the OOW and SA from the users' perspective. 82.5 % of the respondents agreed and strongly agreed that "ECDIS improves SA of the OOW". The results show positive correlations between the role of ECDIS on improving SA and the effect of ECDIS on prevention of collisions and groundings as it perceived by the maritime officers. It is also concluded that respondents are generally favorable towards the introduction of ECDIS but there are still some objections related to the reliability and complexity of the systems and readiness of the operators.
Keywords: ECDIS, Situation Awareness, Cognitive Hierarchy

1. Introduction

Efficient and safe navigation requires the systematic management of numerous socio-technical system components such as personnel, information, procedures, equipment, and facilities. Although many navigational equipment and aids have been introduced, safety of navigation highly depends on the competence of masters and mates and their ability to make the right decision at the right time. "Acquiring relevant data and information from different sources, processing them, creating an accurate mental picture/model for accurate and timely decisions which allows safe action", is the process that makes a voyage safe or unsafe. Modern electronic navigational systems are becoming a focal sub-system for appraisal, planning, execution and monitoring steps of efficient and safe navigation and provide substantial data and information to the officers during this process.

The amendments to SOLAS Chapter V, Regulation 19, Section 2.4 "Carriage Requirements for Shipborne Navigational Systems and Equipment" which came into effect on 1 January 2011 state that "All ships irrespective of size shall have: nautical charts and nautical publications to plan and display the ship's route for the intended voyage and to plot and monitor positions throughout the voyage. An electronic chart display and information system (ECDIS) is also accepted as meeting the chart carriage requirements of this subparagraph". This amendment to SOLAS is governing the statutory introduction of ECDIS and will require all merchant vessels to be equipped with ECDIS by 2018.

"Electronic Chart Display and Information System (ECDIS) is a navigation information system, complying with the up-to-date chart requirements by displaying selected information from a system electronic navigational chart (SENC) with positional information from navigation sensors to assist the mariner in route planning and route monitoring, and if required display additional navigation-related information" [1]. ECDIS is not only an e-navigation tool which replaces paper charts and is a step towards a "paperless" bridge, but will also totally change the way/method of performing marine navigation. In the future this unique display will be the focal and main hub for Integrated Bridge Systems where all the voyage related data and information from different sources such as propulsion, navigation control systems, steering systems, alarms etc. can be reached, seen and used as a "decision support system" for routine and emergency situations.

The results of a Formal Safety Assessment of Electronic Chart Display and Information System study performed by Det Norske Veritas concluded that the main benefits of using ECDIS considered include:

- Liberate time for the navigators to focus on navigational tasks,
- Improved visual representation of fairway,
- More efficient updating of charts [2].

Studies related to the effectiveness of ECDIS concluded that the grounding frequency reductions achievable from implementing ECDIS vary between 11% and 38% for the selected routes [3]. Another study concluded that, by implementation of ECDIS the reduction in number of groundings and grounding related fatalities is calculated to be about 36%. Use of ECDIS is also expected to have a risk-reducing effect on collision scenarios. This effect was estimated to be 3%, mainly due to liberation of time to focus on monitoring of the traffic picture [4], [5]. Other research concluded that "ECDIS produced better performance and a smaller workload than paper charts and the radar overlay was slightly better than the separate radar display [6].

After the first introduction of marine radar on board of merchant vessels, ECDIS is the second important cornerstone for marine navigation which will provide real time position on electronic navigational charts (ENC). The collision of Stockholm and Andrea Doria on 25 July 1956 in heavy fog was written to maritime history as the first "Radar assisted collision" [7]. This term is summarizing the cause of accidents inherent in trusting and over relying to modern electronic aids and tools which are there for improving safety. Reason [8] defines this as trading off added protection for improved production and concludes that "Protective gains are frequently converted into productive advantages, leaving the organization with the same inadequate protection that prevailed before the event or with something even worse". He gave examples such as the Davy lamp in mining and radar assisted collisions in the maritime domain. Besides its numerous benefits, because of the high level of integration and complexity, ECDIS can also become an aid to accidents. "ECDIS-assisted accidents" may be a common term used to point out the role of ECDIS in maritime accidents. There are some early warnings of this type of accident such as the groundings of CFL Performer [9], CSL Thames [10] and MV Maersk Kendal [11].

Kopacz et al. present the process of maritime navigation as a kind of logical structure of functions and information and they defined that the ship's navigational information describes the whole environment of maritime navigation, including (a) geographical environment, (b) maritime navigation safety system,(c) own ship and (d) surrounding shipping traffic. The ship's navigational information should be adequate, comprehensive, timely acquired, updated, and easy to gather, store, retrieve and display in the most suitable form for use in the navigation process [12].

2. Situation Awareness

The term SA has been widely used in the aviation domain and it is being widely used in other high risk, complex and dynamic working environments where a huge amount of data and information is processed by the operator to make accurate, safe, effective and timely actions. As in many high risk jobs, developing and maintaining a high level of situation awareness is the most critical and challenging task in maritime watchkeeping. During watchkeeping, OOWs gather huge amounts of data and information from different sources (aids to navigation, other team members, other vessels, VTS etc.). By bringing these data and information together, they create an integrated "whole" which we call a "Mental Picture or Model" on which his/her decisions and actions will based. To have safe actions, creating accurate, timely and close to the real life mental picture in a rapidly changing environment is vital. During watchkeeping an OOW performs three important tasks such as collision avoidance, navigation and other administrative duties. For performing each of these tasks, a high level of SA is required.

An important part of an OOW's job is developing Situation Awareness (SA) and keeping it up to date in a rapidly changing and complex environment especially in coastal areas, congested waters, in ports and approaches. Studies indicate that SA is a significant causal factor in 88% of aviation accidents in which human error was indicated [13]. Other studies have found SA errors account for over 50% of air traffic control operational errors [14]. In the maritime domain, accident investigation results show that loss of SA has been directly responsible for the 27% of marine accidents [15]. U.S. Coast Guard analysis of navigational mishaps for cutters and boats revealed that 40% were due to a loss of situational awareness [16].

According to a synthesis of 15 SA definitions, Dominquez [17] defined SA as an "individual's continuous extraction of environmental information, and integration of this information with previous knowledge to form a coherent mental picture, and the use of that picture in directing future perception and anticipating future events". SA can also be defined as an internalized mental model of the current state of the operator's environment [18].

According to Endsley, SA is "the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning, and the projection of their status in the near future" [19]. SA is comprised of three levels: (1) perception: perceiving critical factors in the environment, (2) comprehension: understanding what those factors signify, and (3) projection: anticipating what will happen with the situation in the near future [20]. These levels are cumulative, as projection cannot occur without comprehension and comprehension cannot occur without perception.

Developing and maintaining SA can be a difficult process influenced by individual (e.g. experience, training, workload, etc), task (e.g. complexity) and systemic factors (e.g. interface design) and environment (visibility, darkness etc). The difficulty occurs from the interaction between the features of human information processing capabilities of operators and the design of the technologies. These difficulties have been labeled “SA Demons” where data overload is the foremost among these [21]. (See Table 1)

Table 1 Categories of SA demons

SA demons	Description
Attentional narrowing	As humans easily fall prey to attentional narrowing, systems need to support multitasking across multiple goals and decisions.
Requisite memory trap	Systems should not require operators to hold information in memory, since short term memory is limited and easily disrupted.
Workload, fatigue and other stressors	These factors all act to reduce already limited working memory and disrupt information acquisition.
Data overload	The volume and rate of change of data in many systems can outpace operators’ abilities to keep up with it
Misplaced salience	The overuse of prominent visual features such as bright colors and flashing lights overwhelm and misdirect operators’ attention.
Complexity creep	The more complex the system, the harder it is for operators to develop accurate situation comprehension and projection.
Errant mental models	Without good mental models of how a system operates being triggered, it is easy to misinterpret data based on how a different part of the system works.
Out-of-the-loop syndrome	Highly automated systems can leave operators with low awareness of the state of the system.

Source: Endsley et all [20]

2.1 Relationship between Cognitive Hierarchy and Situation Awareness

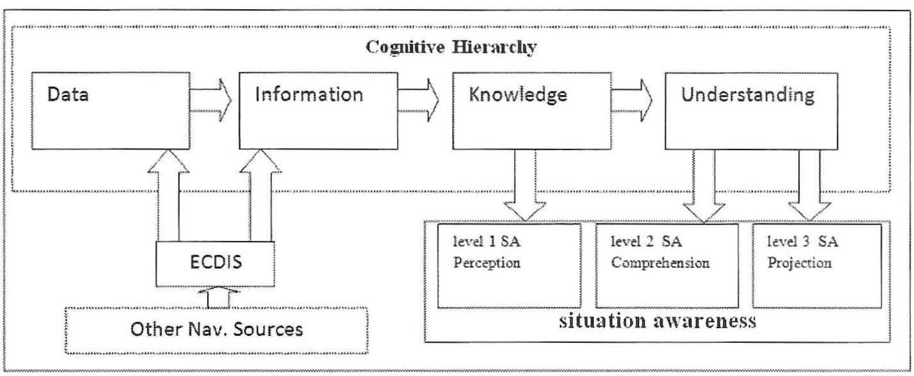
For understanding SA, the difference between the terms data, information, knowledge and understanding has to be defined. According to IAIDQ, *Data* is 1) symbols, numbers or other representation of facts; 2) the raw material from which information is produced when it is put in a context that gives it meaning. *Information* is 1) Data in context, i.e., the meaning given to data or the interpretation of data based on its context; 2) the finished product as a result of processing, presentation and interpretation of data [21]. Information is the data that have been shaped into a form that is meaningful and useful to human beings [22]. *Knowledge* is the understanding of the significance of information or information that is actionable. Knowledge contributes to *understanding* when experience, expertise and intuition are applied. The Cognitive Hierarchy Diagram (Figure 1) is describing this relationship.

The need to process and understand large volumes of data is critical to many endeavors, from the cockpit to military missions, from power plants to automobiles, and from space stations to day-to-day business operations[23]. Success (and even survival) depends on rapidly sorting through, understanding and assimilating vast quantities of data [24]. Bolia et al., [25] point out that increased availability of information does not necessarily mean that users will make better decisions and factors such as information overload, poor interpretation and the presence of non-relevant information and false data are likely to degrade rather than enhance SA.

Endsley and Jones [26] suggest that the way in which information is presented by such systems influences SA by determining how much information can be acquired, how accurately it can be acquired and to what degree it is compatible with SA needs. Endsley and Jones draw a parallel between Endsley's three levels of SA and the "cognitive hierarchy" of data, information, knowledge and understanding. Data correlated becomes information. Information converted into situational awareness becomes knowledge. Knowledge used to predict the consequences of actions leads to understanding. Endsley and Jones suggest that "knowledge" in this description equates to level 1 (Perception) SA and "understanding" equates to levels 2 (Comprehension) and 3 (Projection) SA. (See Fig. 1)

For reaching higher levels of SA, relevant, accurate and timely data and information which will be transformed to knowledge and understanding is required as it is mentioned at cognitive hierarchy.

Fig. 1 Relationship between ECDIS cognitive hierarchy and situation awareness



Source: Author, developed from [26]

Acquiring needed information and the way of presenting it can have a high impact on SA. Both lack of information and too much information can create problems with SA [27].

2.2 ECDIS and SA

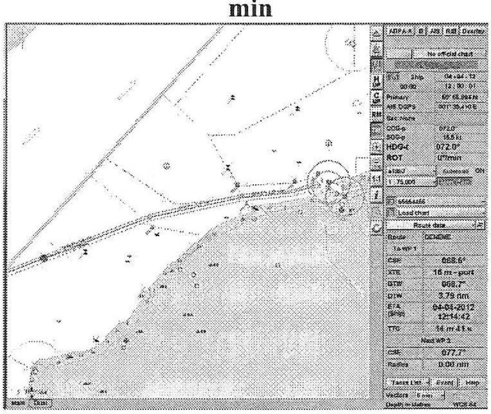
In the aviation domain, accidents investigations show that 75% of the SA errors were attributed to problems with level 1 SA including: data is not available, difficult to detect data, failure to monitor data, misperception of data and memory loss [23]. ECDIS related errors can be classified into two groups; 1) errors in displayed data associated with chart datum, shifting buoys, inaccurate hydrographic data, sensor limitations, poor resolution, user set-up errors, incorrect system configuration or calibration, system or sensor malfunction; 2) errors of interpretation by the operator [28]. Both of them have an impact on the SA of the operator.

Proper configuration of ECDIS layers is very important to SA. The OOW should have relevant, accurate and timely information to have and maintain a higher level of SA and should know what he can see and what he cannot see on ECDIS display. There should be clear watch hand-over procedures for officers in order to clarify the data and information available to them. Below, as an example, you may find three presentation options; min, medium and max. In the min. presentation mode, display mode is standard, radar overlay is off, safety contour is set to 0 meters and safety depth is 0 meter. As many of the important and critical data are not visible on the display at this level of presentation, it is difficult for the OOW to reach a high level of SA such as comprehension and projection as data is not available for level 1 SA. On the other hand in the max presentation mode, too much data from different sources can cause information overload limiting the perception of the OOW. The medium level presentation mode supports SA as it provides optimum levels of data on the display. (See Table 2)

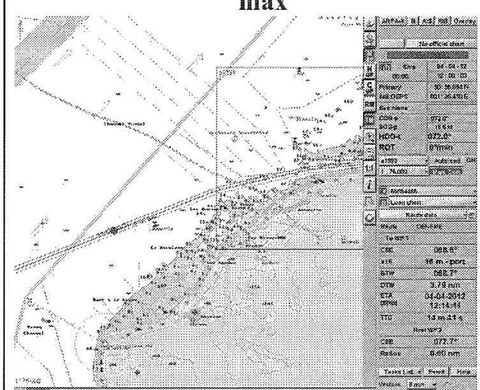
Table 2 Role of proper configuration of ECDIS layers on SA

Presentation mode	min	medium	max
scale	1/75.000	1/75.000	1/75.000
Display mode	Standard	Customized (sc:on)	All
Radar overlay	off	off	on
Safety contour	0m	10m	10m
Safety depth	0m	15m	15m

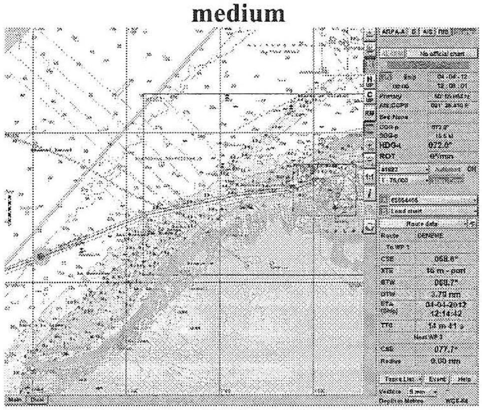
min



max



medium



Extract from Transas Navi-Sailor 3000 ECDIS-i

3. Research Design and Methodology

3.1 Objectives of the study

The aim of this study is to determine the attitudes of masters and mates towards ECDIS with a special focus on the relation between ECDIS and SA. A comparative analysis was performed by using quantitative technique among junior and senior officers to determine the reliability of existing ECDIS technology, the impact of introduction of ECDIS on preventing collisions and groundings, the navigational skills of the OOW and SA from the users' perspective.

3.2 Data Collection and Sampling

A one page questionnaire was used for collecting the data. Questions concerning the objectives of the study were developed in order to determine the attitudes of masters and mates towards ECDIS and to explore the relation between ECDIS and SA as it is perceived by the maritime officers. The questionnaire has three parts. The first part, which has two statements, is to determine the effect of ECDIS on preventing collisions and groundings. A 5-point "Likert Scale" with anchors at 1 (very low) and 5 (very high) was developed. For the second part, which has seven statements, a 5-point "Likert Scale" with anchors at 1 (I strongly do not agree) and 5 (I strongly agree) was developed to determine the attitudes of the officers concerning the introduction of ECDIS. The third part was an open ended question that allowed respondents to write their thoughts, in their own words, about the introduction of ECDIS. Nominal scales were used to collect data about the profile of the employees.

Convenience sampling method, which is a non probability sampling technique that attempts to obtain a sample of convenient elements, was chosen as the sampling technique [29]. The study was performed with Turkish Officers and Masters having an unlimited license and who had attended a two day ECDIS course training at DEU Maritime Faculty between June 2008 and October 2011. The questionnaire was applied at the end of the course and 230 usable questionnaires were collected. Data processing was maintained by SPSS (Statistical Package for the Social Sciences) Program.

4. Findings

4.1 Profile of the Respondents

Table 3. Summarizes the profile of the respondents. 42.2% (n: 95) of the respondents were oceangoing deck officers, 27.1% (n: 61) oceangoing chief officers and 30.7% (n: 69) were oceangoing masters. The average sea experience of the respondents is 7 years (Std. Dev. 7.2) which is 1 year min and 33 years for maximum. 47.0% (N: 108) of the respondents had experience on board with ECDIS. But care should be taken that the experience was not always on ECDIS complying with IMO performance standards.

Table 3 Profile of the respondents

Sea experience	n	%	License	n	%	Experience with ECDIS	n	%
1-3 years	93	41.7	Deck Officer	95	42.2	Yes	108	47.0
4-9 years	79	35.4	Chief Officer	61	27.1	No	116	50.4
10+ years	51	22.9	Master	69	30.7	Missing	6	2.6
Total	223	100.0	Total	225	100.0	Total	230	100.0

4.2 Perception of Officers Concerning the Introduction of ECDIS

Overall mean scores and standard deviations are listed in terms of overall mean score and standard deviation in Table 4. In the first part of the questionnaire, "The effect of ECDIS on prevention of groundings' (μ=4.1071), is found higher than "The effect of ECDIS on prevention of collisions" (μ=3. 84). In the second part of the questionnaire, "ECDIS is an aid to navigation that improves safety" (μ=4.43), "ECDIS improves SA of OOW" (μ=4.20) were determined as the statements having the highest mean scores. 82.5% (n: 189) of the respondents are agree (38.4) and strongly agree (44.1) that "ECDIS improves SA of OOW'. "ECDIS has negative contributions to the safety of navigation" (μ= 2.25) and "Usage of ECDIS reduces the navigational skills of officers" (μ= 3.03) were determined as the statements having lowest mean scores. (See Table 5)

Table 4 Perception of officers concerning the role of ECDIS on preventing collisions and groundings

STATEMENTS	n	Mean Score	Std. Dev.
The effect of ECDIS on prevention of collisions	227	3.84	1.213
The effect of ECDIS on prevention of groundings	226	4.65	.658

Note: 1= very low; 5=very high

Table 5 Perception of officers concerning ECDIS

STATEMENTS	n	Mean Score	Std. Dev.
ECDIS improves SA of OOW	229	4.20	.913
ECDIS has negative contributions to the safety of navigation	228	2.25	1.355
I prefer to have paper charts with ECDIS on board	230	3.49	1.546
The existing technology is relevant for the safe usage of ECDIS	227	3.42	1.243
ECDIS is an aid to navigation that improves safety	225	4.43	.894

STATEMENTS	n	Mean Score	Std. Dev.
The usage of ECDIS reduces the navigational skills of officers	230	3.03	1.483
Usage of ECDIS with radar overlay function enhance safety of navigation	228	3.83	1.300

Note: 1= I strongly disagree; 5=I strongly agree

In addition to the descriptive statistics, hypotheses tests (t-test and Analysis of Variance) were conducted in order to find the significant differences with regard to the specific variables such as participants' license, sea experience and their experience on board with ECDIS.

H1: Attitude of officers towards ECDIS differs according to their license. Analysis of variance (ANOVA) test showed the most significant difference for the statements are "I prefer to have paper charts with ECDIS on board" (F = 6.268; *p*-value = 0.002) and "The usage of ECDIS reduces the navigational skills of officers" (F = 5.928; *p*-value = 0.003) with respect to their license (master, chief officer and deck officers).

H2: Attitude of officers towards ECDIS differs according to their sea experience. Analysis of variance (ANOVA) test showed that there is not any significant difference for the statements of with respect to sea experience.

H3: Attitude of officers towards ECDIS differs according their experience on board of vessels with ECDIS.
"I prefer to have paper charts with ECDIS on board." with *p*-value of 0.022 (t value = 2.311) and "The existing technology is relevant for the safe usage of ECDIS." with *p*-value of 0.022 (t value = 2.826.) appear to differ significantly with respect to whether they have experience on board of vessels with ECDIS or not.

The data shows positive moderate correlations between "ECDIS improves SA of OOW" and "the effect of ECDIS on prevention of collisions" (r=.391, p<0.01); "the effect of ECDIS on prevention of groundings" (r=.388, p<0.01). This correlation concludes that ECDIS plays a significant role in prevention of collisions and groundings by improving SA.

The data shows positive moderate correlations between "the existing technology is relevant for the safe usage of ECDIS" and "the effect of ECDIS on prevention of collisions" (r=.238, p<0.01). Also there is a positive moderate correlation between "ECDIS is an aid to navigation that improves safety" and "the effect of ECDIS on prevention of collisions" (r= 0.247**, p<0.01); "the effect of ECDIS on prevention of groundings" (r=.401, p<0.01). (See Table 6)

Table 6 Correlation matrix for statements

Statements	the effect of ECDIS on prevention of collisions	the effect of ECDIS on prevention of groundings
ECDIS improves SA of OOW	.391**	.388**
ECDIS has negative contributions to the safety of navigation.	-.014	-.078
I prefer to have paper charts with ECDIS on board.	-.052	-.056
Existing technology is relevant for the safe usage of ECDIS.	.238**	.135*
ECDIS is an aid to navigation that improves safety	.247**	.401**
Usage of ECDIS reduces the navigational skills of officers	.037	-.048
Usage of ECDIS with radar overlay function enhances safety of navigation.	.176**	.062

**. *Correlation is significant at the 0.01 level (2-tailed). Pearson Correlation*

4.3 Analysis of the Remarks of Participants

Sixty-nine respondents added their remarks to the survey. The attitude of respondents towards ECDIS is clustered into three categories as favorable (21 respondents), conditionally favorable (40 respondents) and unfavorable (8 respondents).

The impact of ECDIS on mitigating workload, easing chart correction and voyage planning, supporting decision making, and supporting OOW make attitude of the respondents favorable to the ECDIS. Also it is mentioned that ECDIS is an important navigational aid/tool/system and useful especially in coastal areas, narrow channels and within high traffic and on high speed vessels, at night and on tankers.

Table 7 Attitude of respondents towards ECDIS

Favorable	Conditionally Favorable	Unfavorable
21 respondents	40 respondents	8 respondents
An important nav a aids/ tool / system (8) Lower workload (3) Good at coastal navigation, channels and high traffic and high speed vessels, at nights and at tankers (3) Increase nav safety (2) Ease chart correction(2) Ease voyage planning(1) Support decision making(1) Support OOW(1)	**Conditions:** Too much complicated (6) Training requirements (5) Over-confidence (5) Conventional methods (visual and radar) (4) Paper Chart (4) Makes people lazy (decrease navskills) (3) The quality of the user (3) Common menu (3) Needs to be more reliable software and hardware(3) Master supervision (2) With paper charts at special areas(1) Without radar/AIS on ECDIS(1) Alarms (1) Ergonomy on the bridge (noise and brightness)(1) More reliable inputs from other sources(1)	Paper charts(3) Decreases nav skills (2) Conventional methods (1) Relaxed (1) Hardware problems(1)

In the second category, the respondents are favorable to ECDIS but they have some objections. They mentioned that ECDIS is too complicated, appropriate training is very important, it has to be used with conventional methods and paper charts and point out the danger of over-reliance on ECDIS and overconfidence of the officers.

The third category is totally unfavorable to the ECDIS. It is mentioned that the conventional methods and paper charts are more suitable than ECDIS; ECDIS decreases the navigational skills of OOW and make them over relaxed and lazy and also they point out the hardware reliability problems that they experienced. The factors that affect the attitude of respondents towards ECDIS are mentioned in Table 7. with their frequencies.

5. Conclusion

ECDIS plays a significant role in prevention of collisions and groundings as it improves SA by lowering workload and providing accurate and timely information to the officers. The data shows positive moderate correlations between "ECDIS improves SA of OOW" and the effect of ECDIS on prevention of collisions and groundings. It is concluded that ECDIS plays an import role in improving and maintaining SA only if the OOW has proper knowledge, skills, experience and it has reliable hardware and software. Although there is a high consensus on the benefits of ECDIS in improving navigational safety; being too complicated, requirement for appropriate training, importance of conventional methods and paper charts, danger of over-reliance on ECDIS, overconfidence of the officers, loosing navigational skills, being over relaxed and reliability of the systems are the main reasons for objection. ECDIS training programs shall also focus on the methods and procedures for improving SA of operators while navigating with ECDIS.

Limitations and further study. The study has been accomplished in only one institution and the respondents' experience with fully implemented ECDIS had been limited. For further study, the attitudes of mariners who had more experience with fully implemented ECDIS without using paper charts can be examined.

References

[1] IMO, "Revised ECDIS performance standards", MSC. 232(82), 12/2006.

[2] Det Norske Veritas, "Formal safety assessment of electronic chart display and information system (ECDIS) ", Technical Report, DNV Research Report No. 2005-1565, annex II pp 3.

[3] Sub-committee on safety of navigation 53rd session Agenda item 14 NAV 53/14, 2 May 2007, Development of carriage requirements for ECDIS, Draft amendments to SOLAS regulation V/19

[4] DNV, Det Norske Veritas technical report research, "Formal safety assessment of electronic chart display and information system (ECDIS)", report no. 2005-1565, annex II pp 10

[5] MSC, "FSA study on ECDIS/ENCs: details on risk assessments and cost benefit assessments submitted by Denmark and Norway", Maritime Safety Committee, 81st session Agenda item 24 MSC 81/INF.9 6 February 2006.

[6] Donderi D.C., Mercer R., Hong M. B. and Skinner D., "Simulated navigation performance with marine electronic chart and information display systems (ECDIS)", *The Journal of Navigation*, 57, (2004), pp 189–202.

[7] Cahill R. A., "*Collisions and their causes*", second edition, Nautical Books, (1997), pp 8.

[8] Reason J., "*Managing the risks of organizational accidents*", Ashgate, (2002), pp 6.

[9] Marine Accident Investigation Branch, "Report on the investigation of the grounding of, *CFL* Performer, Haisborough Sand, North Sea,12 May 2008," Report No 21/2008 December 2008.

[10] Marine Accident Investigation Branch, "Grounding of *CSL* Thames in the Sound of Mull 9 August 2011", Report No 2/2012 March 2012.

[11] Marine Accident Investigation Branch, "Report on the investigation of the grounding of *MV* Maersk Kendal on Monggok Sebarok reef in the Singapore Strait on 16 September 2009", Report No 2/2010, March 2010.

[12] Kopacz Z., Morgas W. and Urbanski J., "The ship's navigation function, ship's navigation processes, and ship's navigational information", *The Journal of Navigation*, 56, (2003), pp 101–109.
[13] Endsley M. R., "Toward a theory of situation awareness in dynamic systems", *Human Factors, 37(1)*, (1995), pp 32-64.
[14] Rashaad E.T.J., Connors E. S., and Endsley M. R., "A framework for representing agent and human situation awareness", "*International Multi Disciplinary Conference on cognitive methods in Situation Awareness and decision support*", Miami Beach, Florida, (2011).
[15] Baker C. C. and Seah A. K., "Maritime accidents and human performance: the statistical trail", ABS Technical Papers, (2004).
[16] United States Coast Guard, "Team coordination training student guide" U .S. Department of Transportation (1998) pp.5-1
[17] Dominguez, C., "Can SA be defined?", "*Situation Awareness: papers and annotated bibliography*", M. Vidulich, C. Dominguez, E. Vogel and G. McMillan (Eds) Report AL/CFTR- 1994–0085 (Wright-Patterson Airforce Base, OH: Air Force Systems Command). (1994), from Salmon P. M., Stanton N. A.Walkerg. H., Baber C., Jenkins D. P., Mcmaster R. and Young M. S. "What really is going on? Review of situation awareness models for individuals and teams" "*Theoretical Issues in Ergonomics Science*", Vol. 9, No. 4, July–August (2008), pp 297–323.
[18] Endsley M. R., Bolstad C. A., Jones D. G., and Riley J. M., "Situation awareness oriented design: from user's cognitive requirements to creating effective supporting technologies", "*Human Factors and Ergonomics 47th Annual Meeting", October 2003, Denver, Colorado.*
[19] Endsley M. R., "Toward a theory of situation awareness in dynamic systems", *Human Factors, 37(1)*, (1995), pp 32-64.
[20] Endsley M. R., Bolté B. and Jones D. G., "*Designing for Situation Awareness: An Approach to User-Centered Design*". New York: Taylor and Francis, 2003. From Endsley M. R. and Connors E. S. "Situation Awareness: State of the Art", "*IEEE Power and Energy Society General Meeting - Conversion and Delivery of Electrical Energy in the 21st Century", IEEE* 20-24 July (2008)
[21] IAIDQ, International Association for Information and Data Quality, IQ/DQ Glossary. April 25, 2012. *http://www.iaidq.org/main/ glossary.shtml*
[22] Laudon K. C. and Laudon J. P.," *Management information systems, managing the digital firm*", Eight Edition, Pearson, (2 04), pp 8.
[23] Endsley M. R., Bolstad C. A., Jones D. G. and Riley J. M., "Situation awareness oriented design: from user's cognitive requirements to creating effective supporting technologies", *"The human factors and ergonomics 47th annual meeting", Denver, Colorado, October (2003),*
[24] *Endsley, M. R.,* "Designing for situation awareness in complex systems", Proceedings of the *"Second international workshop on symbiosis of humans, artifacts and environment", Kyoto, Japan. (2001).*
[25] Bolia R.S., et al., 2006. "A history lesson in the use of technology to support military decision-making and command & control" In: Cook M.J., Noyes J.M. and Masakowski Y., eds. "*Decision making in complex systems*". Aldershot, UK: Ashgate Publishing Ltd, pp 191–200.
[26] Endsley M. R. and Jones W. M., "Situation awareness, information dominance, and information warfare" (Tech Report 97-01). Belmont, MA: Endsley Consulting (1997).

[27] Endsley M. R., "Situation awareness in aviation systems", "*Handbook of aviation human factor*", Garland. D.J. Wise J.A. and Hopkins V. D., (Eds), Mahvah, Nj. (1999), pp 266.
[28] Swift A.J. and Bailey T.J., "*Bridge team management*", Second Edition, Nautical Institute, (2004), pp 69.
[29] Malhotra N. K., "*Marketing research an applied orientation*", 5th edition, Pearson (2007), pp 341.

The International Maritime Labour Regulatory Framework And Women Mariners: A Legal Protective Approach

Onur Sabri Durak
Maritime Law Research Assistant
Istanbul Technical University
Maritime Faculty
Ph.D. Candidate
Shanghai Maritime University
duraks@itu.edu.tr

Abstract: As a global service industry, the maritime industry has been evolving like other global service industries. It is, however, generally accepted that the maritime industry is comparatively more conservative than other global service industries in some perspectives. Accordingly, acceptance of woman actors into the maritime industry, and in this connection, acceptance of woman mariners on board a ship took much longer time than acceptance of woman actors into other service industries. Even though the international maritime labour regulatory framework has gradually developed since the establishment of the International Labour Organization (ILO), it is analyzed that the international maritime labour regulatory framework is lacking a protective approach and a comprehensive legal regime for women mariners. In this connection, this article initially introduces recent developments in maritime labour industry. The article addresses the role of women mariners in the maritime industry and widely discusses problems of women mariners. The International maritime labour regulatory framework, from protective and feminist approaches and deficiencies arising thereof, are the subject matter of further legal discussions in this article. In the end, this article provides recommendations in accordance with the legal deficiencies of the international maritime labour regulatory framework, needs of maritime practice and fundamental rights of women.
Keywords: Women, women mariners, seafarers, women's rights, discrimination.

1. Introduction

The role of women in the shipping business is relatively small comparing to male colleagues from a viewpoint of statistical analysis [1], [27]. Seafaring is an extreme sample of a globally male-dominated industry [1], [7], [26], [27]. For many years, women were almost totally excluded from any kind of seafaring and sea-related occupations [7], [13], [19]. The designated institutions of the United Nations (UN), likewise the International Maritime Organization (IMO) and the International Labour Organization (ILO), have led campaigns promoting recruitment of women on board ships [21], [26]. However, as Kitada and other researchers note, there have not been regular surveys conducted to analyze women's participation in a male-dominated shipping industry. In this regard, it is estimated that only 1 - 2 percent of global work forces of seafarers are women [13], [21].

The BIMCO/ISF 2010 report on labour trend indicates that, despite the financial crisis and its negative impacts on shipping industry, there are still some shortages for officers, particularly for certain ranks and for ship types such as tankers and offshore support vessels [1], [15]. The report results illustrate that the supply-demand balance for officers has a modest overall shortage (about 2%); with the implication that there is not a serious shortage problem for officers in aggregate [1]. However, this does not mean that small sized shipping companies are not experiencing recruitment problems [1]. In addition to that, due to the recovery of the global economy, increasing demand for more ships may trigger the demand for more officers as well.

To challenge the shortage of officers, it is strongly recommended to create a sound working and living environment and to establish comprehensive policies to promote women entering into the shipping industry and working on board ships. In this context, from the beginning of 20th century, more women have been recruited on board merchant ships [1], [7], [13]. However, those women generally work in the service sectors rather than navigation or engine departments of vessels [8], [13], [21]. In other words, very few women are in marine sections where navigation or engineering work takes place. For reducing the global officer shortage on board ships, international organizations strongly recommend that maritime education and training institutions accept and train more women [21]. Even though some of the maritime education and training institutions are eager to train more women for shipping industry, there are problems yet to be solved for a sound working and living environment for women on board ships.

The second chapter of this article briefly addresses employment, working, safety and health issues in the context of cultural, practical and legal environments. The third chapter provides a brief legal survey and introduces fundamental international legal instruments, the ILO and the IMO documents relating to women's working and living environment on board ships in line with the fundamental principles of human rights. The fourth chapter discusses issues from a legal and protective viewpoint, and the last (fifth) chapter addresses final remarks and recommendations.

2. Gender Issues in The Shipping Industry

Working and living on board a ship has the same meaning with perils of sea, dangers, physical and physiological isolation and restriction [4], [5], [8], [15], [20]. Beside all these negative issues, seafarers, in most cases, are not available to access any legal protection [3], [4], [5], [18].

In addition to such difficulties, women in the maritime industry are faced with many difficulties almost every day while ashore or on board a ship. These difficulties exist for a wide range of reasons, namely as; literal matters, cultural matters, misconceptions, education(al) matters, negative attitudes on women on board ships, gender discrimination, lack of sound working and living environment and insufficient legal framework. These difficulties are briefly addressed in following paragraphs.

Literal matters have two sides in a male-dominated shipping industry; these are, firstly, lack of proper terminology without any gender discrimination and secondly, lack of research and studies relating to women mariners. The terminology problem exists in the context of male-dominated and characterized drafting and wording of international legal and policy instruments. Even though international institutions consider the drafting process of legal and policy instruments very carefully in order to avoid any kinds of discrimination [16], legal and policy instruments promulgated particularly by the ILO have not paid that much attention for the terminology used in such instruments and documents in terms of maritime industry and women. In a chronological order, the ILO and the other institutions have not considered and taken into account the wording of their texts which might be a reason for gender discrimination against women and reflect the male-dominated character of the maritime industry while drafting the very first legal and policy instruments relating to maritime labour. Analysis shows that the very first ILO Conventions such as; Placing of Seaman Convention (1920), Repatriation of Seamen Convention (1926) and Seamen's Articles of Agreement (1926) [23] and some more legal and policy instruments prefer to use the term "seaman" for referring to officers and rankings on board a vessel [23], [24]. To some extent, the term "seaman" might lead to ambiguities whether officers and rankings on board a vessel must be male or not. The etymological/semantic background of "man" particularly refers to males rather than females. It might be discussed that the term originally had no gender discrimination and only refers to person(s) working on board a ship. In addition to that, it may be argued that the term "man" refers to humankind, not to male kind. However, it is observed that leading English language dictionaries and encyclopaedias explain the term "man" in a male-dominated and characterized way rather than natural and non-gender characterizations in the very first instance. A further problem arises from incorporation or reception of these international instruments into national legal systems. Incorporating States, while translating such instruments into their national languages, generally do not pay attention to possible gender issues and this leads to continuation of male-dominated and characterized drafting of legal and policy instruments. This is a result of the masculine description of the seafaring occupation for centuries [7], [13], [19], [26]. The second matter in terms of literal context is lack of research and studies on women mariners [13], [19]. The history and role of women is rarely covered in literature and academic works. There are very few documents about the history and role of women on merchant vessels in the 19th century [7], [13]. Several woman characters in the navy had influences on literary works. However, all those works are in character of fairy tales or legends rather than academic research and analysis [7], [13].

Even though the shipping industry, the international institutions and the Governments aim to promote women working on board a ship, the maritime education and training environment for women candidates has its own unique problems. These problems might be briefly stated as below;

- Acceptance of very limited numbers of female candidates into maritime education or training institutions [7],
- Lack of State policy in most countries to promote maritime education or training for females [7],
- Bullying, physiological and/or physical harassment or difficulties during the maritime education or training [13].

Thomas reveals that a number of myths or misconceptions relating to women mariners continue to pervade shipping industry even in recent days [19]. These myths and misconceptions are briefly;

- Description of appropriate occupations for men and women [7], [13], [19],
- Natural and physical differences between men and women [7], [13], [19],
- Women are eligible to work on only certain types of ships, thus women can work on board cruise or passenger vessels in positions such as assistant cook, steward, hotel or catering departments, but not in navigation or engine departments [7], [13], [19],
- Perceptions of women's role in the family, beliefs about the incompatibility of sea career and marriage and motherhood [7], [13], [19],

- The presence of women on board a ship can lead to sexual tensions and jealousy among male crew members and, as a consequence, it may threaten sound, peaceful and effective working and living environment [13], [19],
- The possibility that women mariners might cut short their sea careers due to their commitment to marriage, family life and motherhood expectations [13], [19].

In addition to myths and misconceptions, women mariners face a large number difficulties in practice while they pursue their career at sea. These difficulties are, briefly;

- Sexism from staff at the education and training institutions [19],
- Rejection of women's application on the grounds of gender [19],
- Hostility from male colleagues [19],
- A number of male colleagues have difficulties accepting women in maritime positions [19],
- Women mariners may need to work harder, and perform much better than their male colleagues in order to prove themselves [7], [13], [19].
- Reluctance to promote women mariners to senior positions [13], [19],
- The status-oriented hierarchy and significantly, male control of this hierarchy [13], [19],
- Employment of women mariners in inappropriate positions or ranks which do not comply with their education, training, experiences and previous ranks [7], [13]
- Continuous comparison of female mariners with male mariners in terms of physical capacity and power [7], [13], [19],
- Continuous considerations and comments on women mariners faults/negligence/ mistakes on board a vessel without paying attention to ratio of women mariners sailing globally [13], [19]
- Foreign port, State entrance-exit and immigration office rules and practices creating difficulties based on gender [7],
- Inappropriate comments about women mariners on board a ship [7], [13], [19]
- Sexual harassment (sexual comments in the guise of humour, persistent sexual invitations, physical contact and so on) [7], [13], [19], [20], [25], [26],
- Drastic measures taken by women mariners on board a vessel to protect themselves etc. [13], [19].

The design of ships is illustrative of a masculine norm and values which are mainly based on the assumption that the ship is a male territory. In this regard, women working on board a vessel might face physical difficulties arising from the design of ships and so on [8], [13].

Availability of certain products in some regions/ports/States for women mariners is another issue. Such products are mainly sanitary, hygiene and personal care related [6], [7], [12], [13].

In the final stage, it should be emphasized that lack of specially designed, globally applicable and comprehensive legal instruments protecting women mariners is also a noteworthy problem. Lack of proper legal frameworks in order to protect women mariners is broadly addressed, discussed and analyzed in the third chapter.

3. A Survey of the International Legal Regime

3.1 Fundamental Human Rights Instruments

As to the international organizations and their research, women bear a disproportionate burden of global poverty in the recent world [28]. In the context of statistics provided by international organizations, women are more likely than men to be poor and at risk of hunger because of systematic discrimination they face in fundamental rights such as education, health care, social security and employment [28]. In accordance with the research of international organizations, it is estimated that women represent 70% of the world's poor category [28]. In addition to such issues, women have very few seats at the tables where economic and employment decisions are made, and women have very limited influence in terms of shaping economic and employment policies. The following paragraphs address the fundamental rights in order to protect women against any kinds of discrimination.

The right to equality has been designated as a fundamental right under international law and this principle has been addressed by a number of international legal instruments to achieve the goal of comprehensive protection for every human-being without any kind of discrimination. As a main principle, the right to equality is addressed by the United Nations and other international institutions in different forms of legal and policy instruments. However, since the term 'the right to equality' is a general term, to achieve the goal of this right, further and detailed principles and explanations are required in terms of the scope of this study. In this regard, international legal and policy instruments stipulate a principle of "prevention of discrimination against women" to achieve the aim of the right to equality principle in terms of gender issues. While some of these international legal and policy instruments prescribe womens' rights in general terms, the rest of these legal and policy instruments have a specific focus for the prevention of discrimination against women, thus the above-mentioned goal of the right to equality can succeed. "The right to work" and "the right to social security" are other main principles stipulated for achieving the goal of right to equality principles. In this context, the following Articles of international legal instruments address fundamental principles for the prevention of discrimination against women.

- The right to equality is prescribed under the 1st Article of the Universal Declaration of Human Rights (UDHR) with reference to the equality in dignity and rights. The 2nd Article of the same Declaration explicitly stipulates that every human being is entitled to all rights and freedoms set forth in the same Declaration without any discrimination based on race, colour, gender, language, religion, political or other kinds views and so on. To succeed in these goals, equality before the law and equal protection by the law principles are granted by Article 7 of the same Declaration.
- Each State Party is obliged to respect and ensure to all individuals within its territory and subject to its jurisdiction the rights recognized under the International Covenant on Civil and Political Rights (ICCPR) without any kind of discrimination in terms of race, colour, sex, language, religion, political or other kinds of view and so on. The same Covenant also obliges States Parties

to ensure the equality of women and men to the enjoyment of all rights set forth in the present Covenant in accordance with Article 3.

- Very similar to the ICCPR, the International Covenant on Economic, Social and Cultural Rights (ICESCR) obliges State Parties to ensure the enforcement of principles stipulated in the present Convention without any kind of discrimination including gender. In addition to this general principle, equality of women and men to the enjoyment of all economic, social and cultural rights is re-emphasized in Article 3 of the Covenant.
- In accordance with Article 1 of the European Convention Human Rights (ECHR), the obligation of State Parties to secure for everyone the rights and freedoms defined in the present Convention is repeated. The enjoyment of rights and freedoms in the present Convention without any kind of discrimination including gender is a subject matter of Article 14 of the ECHR.

A specific international legal instrument relating to prevention of discrimination against women, the Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW) Article 1, addresses the definition of discrimination against to women as, "... any distinction, exclusion or restriction made on the basis of sex which has effect or purpose of impairing or nullifying the recognition, enjoyment, or exercise by women, irrespective of their marital status, on a basis of equality of men and women, of human rights and fundamental freedoms in the political, economic, social, cultural, civil or any other field".

To achieve the goal of the above-mentioned principle, State Parties to CEDAW are responsible to take all appropriate means, mainly;

- To incorporate the right to equality into the State's national laws,
- To adopt appropriate legislative and other measures prohibiting all discrimination against women,
- To establish a legal protection regime for womens' fundamental rights on an equal basis with men and to ensure the effective enforcement of such regime,
- To refrain from engaging in any act or practice of discrimination against women,
- To take all proper measures to eliminate discrimination against women by any person, organization or enterprise,
- To modify or abolish existing laws, regulations, customs and practices which constitute discrimination against women,
- To repeal all national penal provisions which constitute discrimination against women.

The second fundamental international principle in terms of this study, "the right to work", has been stipulated under the UDHR Article 23. By virtue of Article 23, everyone has the right to work, free choice of employment, to just and favourable conditions of work and to protection against unemployment. As a consecutive result of this principle, everyone has the right to equal pay for equal work without any discrimination. The ICESCR repeats the principle of right to equality in the present Covenant Articles 6 and 7.

The CEDAW Convention Article 11 explicitly stipulates that State Parties are responsible to take all appropriate measures to prevent and eliminate discrimination against women in the field of employment in order to ensure the basis of equality of men and women. The basis of equality includes following principles;

- The right to work as an inalienable right of all human beings,

- The right to the same employment opportunities, including the application of the same criteria for selection in matters of employment,
- The right to choice of profession and employment,
- The right to promotion, job security and all benefits and conditions of service,
- The right to receive vocational training and retraining, including internship and so on,
- The right to equal treatment in respect of work of equal value, as well as equality of treatment in the evaluation of the quality of work.

The third principle in order to prevent discrimination against women, the right to social security, has also been stipulated under a number of international legal instruments. Firstly, the UDHR Article 22 stipulates that everyone has the right to social security and is entitled to realization, through national effort and international co-operation and in accordance with the organization and resources of each State, to the economic, social and cultural rights indispensable for his dignity and the free development of his personality.

In addition to that, the ICESCR Article 9 provides for social security including social insurance undertaken by State Parties. The CEDAW Article 11 (e) and (f) grants the fundamental social security principles in terms of prevention of discrimination against women.

3.2 General Instruments of the International Labour Organization

Prevention of discrimination and promoting equality of gender are fundamental principles highlighting the work of the ILO since its creation in 1919 [16], [22]. These principles are major components of the ILO's Decent Work Agenda which promotes decent and productive work in conditions of freedom, equity, security and human dignity [9]. Conventions and Recommendations promulgated by the ILO are primary means of action to improve working and living conditions of women and men, and promote equality in the workplace for all workers. The ILO instruments apply equally to women and men, with some exceptions, in particular those standards addressing issues relating to maternity conditions and reproductive role of women [7], [9]. However, the reality for gender equality is rather different than rules stipulated by the ILO instruments. The rights stipulated under the ILO instruments are simply lacking effective practice. Unawareness of the existence of such legal instruments is one of the significant reasons for lack of effective practice [2], [4], [5], [7], [9].

Application of international labour standards aims to provide;

- Equal access to benefits derived from such standards for men and women,
- Recognition of the needs, experiences and interests of both men and women,
- Advocating of equality brought by the implementation of international legal instruments [25], [26], [27].

The ILO's very first, and the most comprehensive, action with respect to gender discrimination is the Discrimination (Employment and Occupation) Convention, 1958 [23]. The Convention provides that, in accordance with Article 2, Member States undertake to declare and pursue a national policy designed to promote equality of opportunity and treatment in respect of employment and occupation. Article 1 further stipulates the grounds of discrimination including gender, race, colour, religion, political opinion, national extraction and social origin [23].

The Equal Remuneration Convention of 1951 specifically stipulates the issue of equal remuneration for men and women for equal value work [23]. In addition to these two Conventions, the Workers with Family Responsibilities Convention of 1981 and the Maternity Protection Convention of 2000 acknowledge gender equality [23].

3.3 Specific Instruments of the International Labour Organization

The ILO provides for international legal instruments governing;
- fundamental principles and rights,
- maternity protection, work and family,
- employment promotion,
- working conditions, and,
- the status of migrant workers in terms of specifically protection of women workers.

In line with the fundamental principles and rights at work, the following Conventions, Recommendations and their principles relating to gender equality need to be emphasized;
- Equal Remuneration Convention, 1951, Articlel [23],
- Equal Remuneration Recommendation, 1951 [24],
- Discrimination (Employment and Occupation) Convention, 1958, Article 1/1(a) and 1/1(b) [23],
- Discrimination (Employment and Occupation) Recommendation, 1958 [24],

In accordance with maternity protection and work and family issues, the following international legal instruments should be addressed;
- Maternity Protection Convention (Revised), 1952 [23] ,
- Maternity Protection Recommendation, 1952 [24],
- Maternity Protection Convention, 2000 [23],
- Maternity Protection Recommendation, 2000 [24],
- Workers with Family Responsibilities Convention, 1981 [23],
- Workers with Family Responsibilities Recommendation, 1981 [24],

Equal employment promotion has been addressed in terms of gender issues by the following international legal instruments;
- Employment Policy Convention, 1964, Preamble and Article 1 [23],
- Employment Policy Recommendation, 1964, Preamble, Article 1 and Annex Article 1 [24],
- Employment Policy (Supplementary Provisions) Recommendation, 1984, Preamble [24],
- Human Resources Development Convention, 1975, Article 1/5 [23],
- Human Resources Development Recommendation, 1975, Article 5/2(a), Article 54 and 56 [24],
- Termination of Employment Convention, Article 5(d) [23],
- Termination of Employment Recommendation, Article 2/1 [24].

Sound working conditions for women workers have been stipulated under the following international legal instruments;
- Night Work (Women) Convention (Revised), 1948 [23],
- Protocol of 1990 to the Night Work (Women) Convention (Revised), 1948 [23],

- Night Work Convention, 1990 [23],
- Night Work Recommendation, 1990 [24],
- Occupational Safety and Health Convention, 1981 [23],
- Protocol of 2002 to the Occupational Safety and Health Convention, 1981[23]
- Occupational Safety and Health Recommendation, 1981 [24].

The protection of migrant workers has been a focus of International Labour Organization and the institution has already provided international legal instruments in terms of protection of women against gender discrimination. Such international legal instruments are as follows;

- Migration for Employment Convention, 1949, Article 6/1 and Article 6/7(a) [23],
- Migration for Employment Recommendation, 1949, Article 17/2 and 17/2(a) (i) [24].

The above-mentioned Conventions and Recommendations promulgated by the ILO aim to protect women in every working field. In other words, these legal instruments are applicable for all classes of employment and include general provisions. In addition to such generally applicable provisions for the protection of women, the ILO instruments relating to maritime employment provide provisions in terms of women seafarers' protection. These international instruments and their relevant provisions are presented below;

- Sickness Insurance (Sea) Convention, 1936, Article 5/1 [23].
- Seafarers' Welfare Convention, 1987, Article 3/1 [23],
- Migration (Protection of Females at Sea) Recommendation, 1926, this is not applicable for women working on board a ship [24],
- Seafarers' Welfare Recommendation, 1987, Article 5 [24].

3.4 Instruments of Other Designated International Institutions

In line with the global shortage of seafarers, international institutions established campaigns promoting seafaring as an attractive option for young people. The "Go to Sea" campaign was established in November 2008 in cooperation with the ILO, the BIMCO, ICS/ISF, INTERCARGO, INTERTANKO and the ITF [21]. With the "Go to Sea!" initiative, the IMO has opened an umbrella under which the shipping industry and Governments can mount their own campaigns to improve seafarer recruitment [21].

In the context of the promotion of a seafaring career, the shipping industry aims to encourage more women to work in seafaring positions. In addition to industry action, Governments have promoted seafaring positions for women in order to avoid a global seafarer shortage. In line with all these attempts, initiatives have been taken by the IMO/ILO to attract women to work in the shipping industry [21], [25], [26], [27]. Though the shipping industry, Governments and international institutions have promoted seafaring careers for women voluntarily, all these initiatives are of a non-binding character and unfortunately not effective to challenge the global seafarer shortage.

3.5 Recent Developments

International institutions have promulgated a number of international legal instruments regulating the legal status of seafarers, their rights and so on. In this line, the work of the ILO is noteworthy. The ILO, as the designated institution of the UN, has promulgated more than 40 Conventions and more than 30 Recommendations in order to protect seafarers and their rights [23], [24]. Due to a number of legal and practical considerations [2], [3], [4], [14], [15], the ILO has developed an international legal instrument which brings together into a consolidated text as much of the existing ILO legal instruments as it is possible to achieve (See [2], [3], [4], [14], [15], [17], [20] for further details and discussions). The new consolidated legal instrument, Maritime Labour Convention 2006 (MLC 2006), intends to be globally applicable, easily understandable, readily updatable and uniformly enforced [3], [4], [15]. The Maritime Labour Convention 2006 has consolidated and revised all ILO Conventions and Recommendations relating to seafarers and their rights, except the Seafarers' Pension Convention, 1946 and the Seafarer's Identity Documents Convention, 1958 into a single and superior Convention [4]. The Maritime Labour Convention 2006 will be a new pillar of the international and uniform regulatory regime complementing SOLAS, STCW, and MARPOL [3], [4].

In the context of the MLC 2006, seafarer means any person who is employed, engaged or works in any capacity on board a ship to which the MLC 2006 applies. This definition is rather neutral and non-gender from a standpoint of literal and legal approaches by not referring to any gender. However, the Convention itself does not provide any special provision for the protection of women seafarers against gender discrimination.

Article III of the MLC 2006 stipulates the fundamental rights and principles requiring the ILO member States to satisfy themselves that the provisions of national laws and regulations respect, in the context of the MLC 2006, the following fundamental rights;

- freedom of association and the effective recognition of the right to collective bargaining,
- the elimination of all forms of forced or compulsory labour,
- the effective abolition of child labour, and,
- the elimination of discrimination in respect of employment and occupation.

For achieving the above-mentioned goals, Article IV provides for seafarers' employment and social rights and states that;

- every seafarer has the right to safe and secure workplace that complies with the safety standards,
- every seafarer has a right to fair terms of employment,
- every seafarer has a right to decent working and living conditions on board a ship,
- every seafarer has a right to health protection, medical care, welfare measures and other forms of social protection,
- Each Member State shall ensure, within the limits of its jurisdiction, that the seafarers' employment and social rights prescribed under the MLC 2006, are fully implemented in accordance with the MLC 2006.

For the implementation and enforcement of the provisions of the MLC 2006, the ILO provided two Guidelines; the Guidelines for Flag State Inspections under the Maritime Labour Convention 2006 and the Guidelines for Port State Control Officers Carrying out Inspections under the Maritime Labour Convention 2006 (For further details and explanations see [10] and [11]).

Despite the success of the MLC 2006 for the consolidation of existing maritime labour legal instruments under a single-superior convention and providing fundamental rights for seafarers in line with the right to equality, right to work and right to social security, the MLC 2006 is silent on the matters of special conditions of women mariners, especially on the matters of, pregnancy, maternity, menstruation, sanitary, hygiene, harassment, bullying and so on.

A newer Convention adopted after the MLC 2006 and which regulates the work in the fishing sector, Work in Fishing Convention, 2007, provides a basic principle for women working on board fishing vessels. In accordance with Article 50 of the Work in Fishing Convention, sleeping accommodation shall be suited or equipped, as practicable, so as to provide appropriate levels of privacy for men and women [23].

In addition to the 2007 dated Work in Fishing Convention, the very new recommendation in the context of fishing, the Work in Fishing Recommendation, provides several provisions for the protection of women working on board a fishing vessel. In this line, first of all, Article 24 stipulates that, on vessels of 24 meters in length and over, separate sleeping rooms for men and women should be provided. Article 32 provides that separate sanitary facilities should be designed and applied for men and women. Finally, Article 35 requires a medical supply and equipment list including women's sanitary protection supplies together with discreet, environmentally friendly disposal units [24].

Even though the application of the Work in Fishing Convention 2007 and its Recommendation of 2007 is comparatively narrower than the application of the MLC 2006, the provisions of the Work in Fishing Convention 2007 and Recommendation 2007 should be regarded as more liberal and protective for women.

4. Analysis

The shipping industry is a global and generally male dominated industry. The global shipping industry has been faced with a seafarer shortage for decades. To challenge the global seafarer shortage, the industry, international institutions and Governments have worked on international legal and policy instruments. However, due to financial crisis affecting the shipping industry since 2008, the global seafarer shortage still exists. One of the fundamental instruments challenging the global seafarer shortage is promotion of sea careers for women. However, with a male-dominated character, the shipping industry has internal problems yet to be solved from different standpoints to accept more women into the global shipping industry. In this context, such problems are briefly analysed as below;

- The terminology used in the shipping industry, international institutions and Government documents stipulate a male dominated character for to referring sea employment. In other words, conceptualization of sea employment has not evolved within the line of protection of women and gender equality approach .
- Research and studies relating to women mariners and indicating their, social, economic, practical and legal problems are very few. International institutions, the shipping industry and Governments are lacking the interest and intention to promote such research and studies.
- The maritime education/training institutions do not provide enough capacity for women candidates.

- The modern world of the shipping industry still has myths and misconceptions about women mariners. In other words, the global shipping industry retains its antiquated traditions.
- Gender discrimination is the core problem that needs to be solved. As with the previous problems, gender discrimination problems will remain for a while longer.
- The design, construction and living conditions of ships are generally inappropriate for women mariners. The sanitary and hygiene conditions are also generally improper.
- Through general international legal instruments, the ILO provides provisions in order to protect women against gender discrimination, the ILO documents relating to the maritime industry do not have explicit provisions in order to protect women mariners against gender discrimination.
- The provisions aiming to protect women mariners' rights which are stipulated under the existing ILO documents relating to maritime industry are very few and simple and therefore, far from solving the problems of modern maritime industry. In other words, such provisions are still at their infancy to help women mariners and their working and living conditions on board a ship.

5. Final Remarks and Recommendations

The promotion of a seafaring occupation for women is one of the most effective and quick ways to challenge the global seafarer shortage. To achieve the promotion of seafaring for women, the shipping industry, international institutions and Governments have already initiated campaigns and programmes. All these attempts, however, are far from a real success due to a number of reasons. Taking into account the problems of women mariners, this study provides practical and legal recommendations in order to promote a sound seafaring occupation for women to challenge the global seafarer shortage.

The practical recommendations may be addressed as below;

- The seafaring occupation should be globally introduced. These kinds of campaigns should be designed to attract more women.
- With the cooperation of international institutions and the shipping industry, policies should be developed to promote maritime education and training for women.
- Such policies should include provisions for promotion of seafaring careers for women who work in similar industries such as fishing, docking and so on.
- International institutions, in particular the ILO and the IMO should undertake the responsibility to improve the working and living conditions of seafarers. Any efforts and initiatives improving the working and living conditions of seafarers will also let women mariners to enjoy such benefits.
- The international cooperation of institutions, industry and Governments should establish a joint policy to dictate non-discriminative terminology.
- The international cooperation of institutions, industry and Governments should support academic and practical studies and research on women mariners.
- The design and construction of ships and should take into account the special needs of women and provide a sound working and living environment for them.
- Sanitary conditions and equipment designed for women mariners should be available on board ships.

- International organizations and States should jointly act to encourage shipping companies to adopt policies and procedures providing sound working and living conditions for women mariners. Such policies and procedures should form an integral part of the ship's management system mandated under relevant international legal instruments.
- Trade unions and seafarers' unions should consider matters such as protection of women against gender discrimination, sexual, physical and physiological harassment, sound working and living conditions on board ships, comprehensive and appropriate social security and so on.

The legal recommendations maybe addressed as follows;

- International cooperation should take initiatives to draft a 'Magna Carta – Bills Of Rights for seafarers indicating the fundamental rights and principles and echoing the same rights and principles stipulated under other international legal instruments. Although, the MLC 2006 is introduced as the most comprehensive international legal instrument relating to maritime labour, the MLC 2006 does not stipulate any provision in order to protect women mariners or to promote seafaring occupations for women.
- Such kinds of legal instruments should be introduced and incorporated into national legal systems by the full and continuous support and cooperation of international organizations and States. International organizations should provide technical and legal assistance to States for the introduction and incorporation of legal instruments and their enforcement into their national legal systems.
- International and national legal instruments should consider the right to marriage and right to family for women mariners, while promoting seafaring occupations for women.
- International and national legal instruments should provide a comprehensive social security regime for women mariners, including maternity rights, taking into account the special conditions of a ship.
- Port States should establish a system or designate a person for women mariners' complaints relating to gender discrimination, sexual, physical and physiological harassment, bullying, sound working and living conditions on board a ship and so on.
- A communication and notification system should be established among Flag States, Port States and global transportation workers' institutions relating to issues of gender discrimination, harassment and bullying, and so on.
- International organizations such as the IMO and the ILO should jointly establish an inspection office for the possible violation of women mariners' rights.
- With the cooperation of international organizations, the shipping industry and the States, standard employment contracts which include provisions against gender discrimination and protection of women mariners against harassment and bullying, should be drafted and then introduced to the shipping business environment. Such contracts should be strongly recommended for contractual relations among shipowners, mariners, employment agencies and so on.
- Every single State should observe and revise its national legal system in order to comply with the general principles of the right to equality, the right to work and the right to social security for women. In this context, every single State should provide a legal framework protecting women mariners in its territory, ships and Ports.

- The legal instruments introduced at international and national levels should have a binding character rather than a non-binding character as should recommendations or policy papers and so on.

In summary, it may be concluded that, although there have been attempts to improve working and living conditions for seafarers and provide a sound environment for them, as it is analyzed here, business and legal environments for women mariners are far from being sound and protective. Provisions stipulated by the general international legal instruments and the ILO legal instruments are lacking an understanding of the special conditions of seafaring and women mariners. In other words, global cooperation of international organizations, the shipping industry and States should take further measures to establish a comprehensive, sound and protective labour and social security system. To achieve this aim;

- Maritime culture should be introduced globally,
- Misconceptions and myths relating to maritime business should be avoided and in this context maritime culture should be improved,
- Maritime education or training for women should be strongly supported.
- International maritime labour regulatory regime should be revised as soon as possible. A comprehensive, global, protective regime for women mariners should be established and enforced. This regime should be introduced and incorporated into national legal systems.

References

[1] BIMCO/ISF, *"BIMCO/ISF Manpower 2010 Update – The Worldwide Demand for and Supply of Seafarers"*, Warwick Institute for Employment Research, 2010.

[2] Christodoulou-Varotsi, I., *"Maritime Safety Law and Policies of the European Union and the United States of America: Antagonism or Synergy?"*, Springer, 2009.

[3] Christodoulou-Varotsi, I. & Pentsov, D. A., *"Maritime Work Law Fundamentals: Responsible Ship-owners, Reliable Seafarers"*, Springer, 2008.

[4] Durak, O. S.; "Remarks on Conditions of Employment in the Context of Maritime Labour Convention 2006", *Istanbul Commerce University Journal of Social Sciences,* Vol. 16, No. 2 (2009), pp. 135-157.

[5] Fitzpatrick, D. & Anderson, M., *"Seafarers' Rights"*, Oxford University Press, 2005.

[6] International Labour Organization, *"Safety and Health in Ports – ILO Code of Practice"*, International Labour Organization, 2005.

[7] International Labour Office, *"Women Seafarers: Global Employment Policies and Practices"*, International Labour Office, 2003.

[8] International Labour Organization, *"The Impact on Seafarers' Living and Working Conditions of Changes in the Structure of the Shipping Industry"*, International Labour Organization, 2001.

[9] International Labour Organization, *"Gender Equality and Decent Work – Selected ILO Conventions and Recommendations Promoting Gender Equality"*, International Labour Organization, 2006.

[10] International Labour Organization, *"Guidelines for Port State Control Officers Carrying Out Inspections Under the Maritime Labour Convention, 2006"*, International Labour Organization, 2009.

[11] International Labour Organization, *"Guidelines for Flag State Inspections under the Maritime Labour Convention, 2006"*, International Labour Organization, 2009.

[12] International Transport Worker's Federation; *ITF Women Transport Workers' Conference,* International Transport Workers' Federation, 2010.
[13] Kitada, M.; "*Women Seafarers and Their Identities*", Cardiff University School of Social Sciences (Doctoral Thesis), 2010.
[14] Li, K.X., Ng Mi, J.; "International Maritime Conventions: Seafarers' Safety and Human Rights", *Journal of Maritime Commerce and Law*, Vol. July, No. 33 (2002), pp. 381 – 405.
[15] McConnell, M. L., Devlin, D. & Doumbia-Henry, C.; *The Maritime Labour Convention, 2006 – A Legal Premier to an Emerging International Regime,* Martinus Nijhoff Publishers, 2011.
[16] Mukherjee, P. K.; "*Maritime Legislation*", World Maritime University Publications, 2002.
[17] Salter, I. R.; "*Business and Law for the Mariner*", Brown, Son & Ferguson Ltd., 2008.
[18] Shaw, M. N.; "*International Law*", Cambridge University Press, 2003.
[19] Thomas, M.; "'Get Yourself a Proper Job Girlie!': Recruitment, Retention and Women Seafarers", *Maritime Policy and Management*, Vol. 31, No. 4 (2004), pp.309-318.
[20] Tiangco, R. & Jackson, R.; "*Handbook of Rights and Concerns for Mariners*", Cornell Maritime Press, 2002.
[21] www.imo.org/OurWork/HumanElement/GoToSea/Pages/Default.aspx
[22] http://www.ilo.org/ilolex/english/constq.htm.
[23] http://www.ilo.org/ilolex/english/convdisp1.htm.
[24] http://www.ilo.org/ilolex/english/recdisp1.htm.
[25] http://www.itfglobal.org/seafarers/index.cfm.
[26] http://www.itfglobal.org/women/index.cfm.
[27] www.seafarersrights.org
[28] http://www.unwomen.org/.

A Code of Conduct for Shipmasters

Dr. Thomas Pawlik
Professor of Maritime Management & Dean of Studies,
Centre of Maritime Studies, Hochschule Bremen (Germany),
thomas.pawlik@hs-bremen.de

Capt. Willi Wittig
Associate Professor of Maritime Human Resource Management & Director of Studies,
Centre of Maritime Studies, Hochschule Bremen (Germany),
willi.wittig@hs-bremen.de

Abstract: In the aftermath of the recent "Costa Concordia" disaster several media reports raised the question whether Shipmasters are bound by some kind of "Code of Honour" or "Code of Conduct". In other industries and professions such codes have been in existence for a long time. This paper addresses the following research questions:

- Is there a need for a code of conduct for shipmasters?
- What are the useful elements of such a code?
- Can codes of conduct be trained within MET?
- What are the appropriate training methods?

The methodology employed is a literature review in combination with a global online survey. The online survey was conducted among members of IFSMA including its National Member Associations.
Keywords: Code of conduct, MET, Shipmasters' responsibility

1. Introduction

Not long after the first information about the collision with a rock off the coast of the Italian island of Giglio and the subsequent sinking of the Italian flagged cruiseship MV "Costa Concordia" became public the media started to raise questions not only about the "how" and "whys" but also about the duties and obligations of a Shipmaster, particularly in cases of emergencies on board.

Of course there are legal responsibilities deriving from international and national law as well as the standing orders from the shipping company which already provide a framework of legal responsibilities of the individual shipmaster. But how has the Shipmaster to conduct himself in situations where there is no provision made in the applicable law nor in the standing orders?

For example, immediately after it became public that the Italian master of the ill-fated "Costa Concordia", Captain Schettino, had left the sinking vessel before all passengers were evacuated the question was raised about the legal provisions on how long a master has to stay on board. According to a brief survey amongst the IFSMA membership (representing 65 different nations) it seems that only the Swiss Shipping Law provides a clear statement that the master has to be the last to leave his ship. But this leaves the question of how to proceed open for the majority of the shipmasters.

Consequently the media started to make reference to a "Code of Honour" which would give guidance to the shipmaster in all circumstances where there is no defined legal provision available. As a result of a very brief survey amongst the members of the IFSMA Executive Council it appears that there is only one early draft of a "Code of Conduct" available which was proposed to IFSMA some ten years ago.

In order to stimulate the discussion about the necessity of a Code of Conduct for Shipmasters, but also to collect the professional views of shipmasters on the subject matter an Online-Survey was initiated by the Centre of Maritime Studies together with IFSMA, the International Federation of Shipmasters' Associations.

The purpose of professional Codes of Conduct, the findings derived from the Online-Survey as well as some first thoughts on how to integrate the familiarisation with a Code of Conduct for Shipmasters into MET will be discussed in the following paragraphs.

2. Professional Codes of Conduct: Functions and selected examples

Professional codes of conduct or codes of ethics have been in existence for a long time. Most probably the ancient Hippocratic Oath can be regarded as the root for all modern professional codes of conduct. The Hippocratic Oath still requires physicians "to prescribe only beneficial treatments, according to his abilities and judgment; to refrain from causing harm or hurt; and to live an exemplary personal and professional life."[1] Today, especially professions with a close interaction to their respective customers or clients tend to apply codes of conduct, sometimes only on the corporate level but in many cases also or exclusively on the level of their professional associations. For example, the American "National Association of the Deaf (NAD) and the Registry of Interpreters for the Deaf, Inc. (RID)" delivers to its members a very detailed code of conduct in line with the following definition: "A code of professional conduct is a necessary component to any profession to maintain standards for the individuals within that profession to adhere."[2]

Examples for professional codes of conduct can also be found in maritime industry related professions. The Federation of National Associations of Ship Brokers and Agents (FONASBA) is one case in point: FONASBA has issued a general code of conduct which has been adopted by a number of its member associations. In chapter 3 of that general code, the following rules of the professional code of conduct are stipulated:

> *"Members will:*
>
> *(1.) ensure that all activities are carried out honestly within the highest standards of professional integrity,*

(2.) *by proper management control, create and maintain a high standard of confidence that all duties will be performed in a conscientious and diligent manner,*

(3.) *observe all national and international laws and any local regulations appertaining to the shipping industry*

(4.) *operate from a permanent address with all the necessary facilities and equipment to conduct business in an efficient and timely manner,*

(5.) *take great care to avoid any misrepresentation and ensure that all activities are subject to the principles of honesty and fair dealing,*

(6.) *ensure that for all dealings, the necessary authority is held from the proper party and that no action will be taken which knowingly exceeds that authority,*

(7.) *ensure that brokers, acting for an owner, shall only offer firm a vessel for any one cargo at any one time,*

(8.) *ensure that charterers' brokers will only make firm bids of a cargo or cargoes to one vessel or one shipowners' broker at any one time,*

(9.) *ensure that a vessel or cargo will not, in any circumstance, be quoted unless duly authorised by a principal,*

(10.) *ensure that all business enquiries are bona fide by making all reasonable enquiries before placing them on the market." [3]*

A recent and prominent example for the introduction of a new professional code of conduct is the MBA Oath which should give orientation and guidance to MBA (Master of Business Administration) graduates and has been sworn by almost 7,000 MBAs since its introduction in 2009.[4]. The MBA Oath is interpreted as "part of a larger effort to turn management from a trade into a profession" [5] Indeed, it has been argued that codes of conduct are constitutive elements of a profession [6] "A profession's code of ethics is perhaps its most visible and explicit enunciation of its professional norms. A code embodies the collective conscience of a profession and is testimony to the group's recognition of its moral dimension."[7]. Frankel has categorized various functions of professional codes of conduct, out of which the following four were used in our survey: 1) Guidance: a code of conduct should be like a compass and provide direction for correct professional behaviour; 2) relation to the public: a code should be a "basis for the public's expectations and evaluation of professional performance"; 3) professional socialization: a code should "help to foster pride in the profession and strengthen professional identity and allegiance" and 4), reputation: a code of conduct should help "to gain the public's trust and enhance its status." From a conceptual point of view three types of professional codes of conduct can be distinguished: 1) Aspirational codes (what are the ideals to strive for?), 2) educational codes, which comment and interpret in depth the norms stipulated in the codes and 3) regulatory codes with detailed governing rules. [7]

3. Online survey on Codes of Conduct for Shipmasters

In order to address the above mentioned research questions on a global scale, an online survey was conducted among members of IFSMA including its National Member Associations. The survey's questions were developed within a team of IFSMA members and university lecturers. When designing the survey, relevant literature as well as the results of various discussions between faculty and student participants in corporate social responsibility and leadership courses at the Bremen Centre of Maritime Studies were taken into account. A pre-test of the survey was carried out among IFSMA members and after some slight alterations had been made the final version of the survey was online between 04.24.2012 and 04.30.2012. Anonymity was guaranteed to the respondents.

In total the online survey was visited 201 times; 90 respondents (obvious double entries were omitted) answered all questions with regard to their personal profile, whereas the number of content related responses differed from question to question. There was only one female participant. Table 1 summarises the basic data of the respondents, such as age and current employment.

Age		**IAMU-Region**		**Year of Master qualification**		**Present Employment**	
65-82	21	Asia/Pacific	10	After 1999	16	At sea	26
55-64	30	Europe (EU)	42	1988-1999	27	Ashore	52
45-54	27	Americas	8	1977-1987	27	Other (retired etc.)	12
31-44	12	Africa / Central Europe	30	1966-1976	17		
				Before 1966	3		

Table 1: Basic data of the respondents (N = 90)

In reply to the question whether codes of conduct exist in their professional environment 46 respondents reported that such codes exist on a corporate level and 22 responses referred to professional association's code of conduct (e.g. National Shipmasters' Association).

The participants were asked how important a professional code of conduct for shipmasters is from their point of view. Table 2 shows the responses to that question.

Maximum Responses: 70 (partially skipped)	**Very important**	**Important**	**Not important**	**Not at all important**	**Don't know**
A professional code of conduct for shipmasters on a global level (e.g. IFSMA) is ...	40	24	3	2	1
A professional code of conduct for shipmasters on a national level is ...	32	25	6	4	1
A professional code of conduct for shipmasters on a corporate level is ...	31	27	6	2	1

Table 2: Importance of a code of conduct for shipmasters

In regard to the various functions of codes of conduct for shipmasters, as discussed in chapter 2, the respondents had to give ratings for the importance (see Table 3).

Maximum Responses: 75 (partially skipped)	Very important	Important	Not important	Not at all important	Don't know
Guidance:	47	25	3	-	-
Relation To The Public:	27	31	9	3	2
Professional Socialization:.	42	24	4	3	1
Reputation:	37	21	10	3	1

Table 3: Importance of a code of conduct for shipmasters

4. Potential Topics of a Professional Code of Conduct for Shipmasters derived from survey

In reply to the request "Please suggest up to ten crucial elements that should be incorporated in a professional code of conduct for shipmasters" a total of 279 responses were delivered by the participants of the survey. In order to reduce complexity the authors grouped - as a preliminary proposal - the responses as follows (the citations refer to a small selection of original comments made by respondents): ***Fundamental issues***: It is required that links to other existing codes should be made clear. Within the code it has to be specified "who does it apply to and what happens if breached", whereas one respondent even proposes that a code "should empower other parties to assess Master's conduct and decide acceptable/ unacceptable conduct. It will have to provide a mechanism to countermand the Master, if the situation arises, via a third party (CEO/ senior Superintendent or other high ranking officer)." ***Meeting legal and regulatory obligations***: A number of survey entries mention the necessity to follow existing laws, regulations and norms. One might argue that this should be taken for granted but, as mentioned in chapter 3, a code also has the function to clarify expectations. Thus it might make sense to include this kind of content into a professional code. E.g., one participant proposed to "ensure that ship operator/ owners' expectations are properly understood and do not conflict with the law. Any deviation from this must be communicated in writing to those involved." A lot of responses referred especially to ***appropriate behaviour in relation to health, safety, security and the environment.*** A fourth grouping can be derived from proposals which target ***skills, competencies and knowledge***. Within that cluster, special emphasis is placed on ***leadership skills*** as well as on ***cross-cultural competency***. A number of survey entries refer to the topics ***Ethical- and social responsible behaviour*** which can also be linked to ***personality attributes*** such as "respect", "honesty", "reliability", "dignity" or "integrity". As a final cluster for potential code elements ***"Shipmaster's profession"*** is proposed which embraces entries such as "good ambassador of the profession" "active promotion of the profession as master and navigator" or "pride in the nautical profession".

5. Codes of Conduct for Shipmasters in MET

The participants of the online-survey were asked about their professional opinion of whom they consider to be the most appropriate for any necessary training provided that a Code of Conduct for Shipmasters would be available, both for already existing shipmasters and future shipmasters.

N = 58	multiple responses were possible
Individual Shipmaster:	26
A Maritime Education and Training provider:	24
A professional association (A National or International Shipmasters' Association):	40
The shipping company:	37
A peer (fellow shipmaster):	19
I don't know:	0

Table 4: Responsibility for Code of Conduct training for present Shipmasters

N = 53	multiple responses were possible
The individual:	14
Every Shipmaster:	23
A Maritime Education and Training institute:	36
A professional association (A National or International Shipmasters' Association):	26 + 19 [8]
The shipping company:	29
A peer:	11
I don't know:	0

Table 5: Responsibility for Code of Conduct training for future Shipmasters

Furthermore the question was raised whether or not the responders believe that it would be possible to train a Code of Conduct for Shipmasters.

N = 58	responses
Yes:	44
No:	10
I don't know:	4

Table 6: Can a Code of Conduct for Shipmasters be trained?

The huge majority of the responders believe that it will be possible to train shipmasters (present and future) in a Code of Conduct for Shipmasters. At the same time they consider in particular the National and International Shipmasters' Associations, the shipping companies and the maritime education and training institutes to be appropriate to take over the responsibility for this kind of training. Therefore it will become necessary to develop training scenarios and training material for these different settings to be available as soon as a final draft of a Code of Conduct for Shipmasters is existent.

One participant in the online-survey concluded "... In closing, the code will have to be embedded in the academic program to avoid it becoming another dusty file in the Master's already overloaded library." Therefore first thoughts on the potential integration of a training in the application of a Code of Conduct for Shipmasters into maritime education and training will be discussed.

Since learning a Code of Conduct is hardly an academic exercise but rather more something to be learned by experience a three step approach to the training of a Code of Conduct for Shipmasters within the framework of MET is suggested:

1. The students are introduced immediately after their enrolment to the Code of Honour of their own MET institute. This will enable the students to realize the concept of a Code of Honour and learn by their own experience the benefits of such a code since their actual behaviour and conduct over the course of their studies is rated against this code.
2. When the students enter into the STCW management level phase [9] of their nautical studies the Code of Conduct for Shipmasters is introduced to them. In all classes reference will be made to the Code of Conduct for Shipmasters. Furthermore practical experience in the use of this code can be made during simulator sessions where their professional conduct will be rated against both by the description of the STCW competencies but also against the contents of the Code of Conduct for Shipmasters.
3. At the end of their studies the students have to give evidence of the STCW competencies obtained. This competence based assessment could also be used to verify whether or not the students are able to apply the concept of a Code of Conduct for Shipmasters in their response to the given questions/problems.

6. Conclusions

Especially due to the limited time frame for the online survey the results have to be interpreted as preliminary results. Nevertheless it has become evident that there seems to be a need for a code of conduct which tackles particularly the Shipmaster's responsibilities and duties on a global scale and independent from company level codes or already existing regulatory frameworks. Respondents expect a number of benefits to be derived from a professional Code of Conduct for Shipmasters. These can be summarized as follows:

- Minimum standard of expected behaviour
- Additional guidelines to standards such as STCW
- Professional behaviour in regard to safety and environmental protection, especially in cases of emergency
- Improved public perception and reputation of shipmasters ("Respect")
- Role model for good leadership onboard ship
- Cornerstone for a professional culture
- Priority of professional duties (esp. in potential conflicts with company requirements)
- Protection against criminalisation.

32 respondents also see potential disadvantages of a professional Code of Conduct for Shipmasters. Some see it as "just another code" or fear "misinterpretation of the code and abuse by subordinates" or even see the threat that "it could be used in legal claims by lawyers and turned against the master."

In this paper it was only possible to highlight some of the statements given by the respondents of the survey on a professional Code of Conduct for Shipmasters. In the intended process to elaborate further on the idea to implement such a code all arguments have to be discussed more in depth. One challenge will be to agree on universal expected behaviour and it is suggested to refer to already existing frameworks such as the UN Global Compact [10] with its ten universal principles and adapt at least parts of it to the professional Code of Conduct for Shipmasters. Another universal framework was proposed by one of the respondents: The four-way-test of Rotary International [11]: "Is it the TRUTH? Is it FAIR to all concerned? Will it build GOODWILL and BETTER FRIENDSHIPS? Will it be BENEFICIAL to all concerned?"

Acknowledgments: The authors wish to thank Capt. Christer Lindvall, President of the International Federation of Shipmasters' Associations (IFSMA), London for his valuable support and comments and Mrs. Roberta Howlett from the IFSMA Secretariat for proof reading.

References

[1] Britannica Online Encyclopedia, *"Hippocratic oath (ethical code)"*

[2] Registry of Interpreters for the Deaf, Inc. (RID), *"Code of Professional Conduct"*, accessed April 25, 2012, http://www.rid.org/ethics/code/index.cfm.

[3] Norsk Skipsmeglerforbund, *"Code of Conduct of The Federation of National Associations of Ship Brokers and Agents (FONASBA) , Chapter 3"*, accessed March 24, 2012, http://shipbroker.no/tjenester/fonasba-quality-standard/kriterier/code-of-conduct/

[4] The MBA Oath, *"Signers"*, accessed April 25, 2012, http://mbaoath.org/list-of-oath-signers/

[5] The Economist (4 June 2009) "*A Hippocratic oath for managers Forswearing greed. MBA students lead a campaign to turn management into a formal profession*

[6] Carr, David, *Education, Profession and Culture: Some Conceptual Questions*, British Journal of Educational Studies , Vol. 48, No. 3 (Sep., 2000), pp. 248-268

[7] Frankel, Mark S., *Professional Codes: Why, How, and with What Impact?* Journal of Business Ethics 8 (1989), p. 110

[8] Due to a technical problem this particular answering option appeared twice in the online-survey. Therefore the figures for both options are given here separately.

[9] Example: In the International Degree Programme Ship Management, B.Sc. (ISSM) at Centre of Maritime Studies, Hochschule Bremen (Germany) Semester 5 to 8

[10] UN GLOBAL COMPACT, accessed May 5, 2012, http://www.unglobalcompact.org

[11] Rotary International, accessed May 3, 2012 http://www.rotary.org/en/aboutus/rotaryinternational/guidingprinciples/pages/ridefault.aspx

ECDIS As New Competence For Deck Officers - Questions And Answers

Capt. Dmytro S. Zhukov, Senior Lecturer
Prof. Dr. Mykhaylo V. Miyusov, ONMA Rector
Odessa National Maritime Academy (ONMA)
8, Didrichson str., 65029, Odessa, Ukraine
Telephone: +380 48 731 10 59 / +380 48 731 10 63
d_zhukov@mail.ru rector@ma.odessa.ua

Abstract: The STCW Conference was held in Manila, June 2010. During the Manila Conference the STCW Convention and Code were fully adopted by Members of the Organization. Some of these amendments applied to matters regarding mandatory standards and provisions in order to effectively respond to changes in technology, operations, practices and procedures used on board ships. ECDIS training was not included in the STCW Convention and Code for a long time. With the changes to the STCW Convention and Code (the Manila Amendments), ECDIS training becomes an integral part of the nautical officers training scheme. Following the new STCW Convention and Code standards and provisions the new edition of IMO Model course 1.27 "Operational use of Electronic Chart Display and Information System (ECDIS), 2010 Edition" was approved by IMO Sub Committee STW 43/3/1 in May 2011. Entry standards for this Model course are equal to navigational cadets' second year education level. Currently about 200 000 licensed deck officers and masters work at sea and most of them sail on vessels fitted with ECDIS. What kind of training do they need in order to fully comply with new STCW requirements and standards? How can they achieve such training? The Manila Conference determined the transition period to be from 01.01.2012 until 01.01.2017 however, the new MET system should be established before 01.07.2013. That means that we have about one year for clarifying these questions.
Keywords: STCW Manila Amendments, IMO Model Course 1.27, MET System, SOLAS Convention.

1. International requirements

1.1 SOLAS Requirements

On 01.01.2011 the amendments to SOLAS, as adopted by IMO Resolution MSC.282(86), entered into force. These included a number of changes to SOLAS Chapter V "Safety of Navigation".

Regulation 19 has been revised to include Electronic Chart Display and Information Systems (ECDIS). New and existing vessels must be fitted with this system according to rolling timetables as detailed below.

SOLAS Chapter V Regulation 19/2.1.4, which concerned the carriage of charts, now reads as follows:

"All ships, irrespective of size, shall have nautical charts and nautical publications to plan and display the ship's route for the intended voyage and to plot and monitor positions throughout the voyage. An electronic chart display and information system (ECDIS) is also accepted as meeting the chart carriage requirements of this subparagraph. Ships to which paragraph 2.10 applies shall comply with the carriage requirements for ECDIS detailed therein."

Paragraph 2.10 sets out a timetable for vessels engaged on international voyages to be fitted with an ECDIS using Electronic Navigation Charts (ENCs):

- Passenger ships of 500 GT and upwards constructed on or after 1 July, 2012
- Tankers of 3,000 GT and upwards constructed on or after 1 July, 2012
- Cargo ships, other than tankers, of 10,000 GT and upwards constructed on or after 1 July, 2013
- Cargo ships, other than tankers, of 3,000 GT and upwards but less than 10,000 GT constructed on or after 1 July 2014
- Passenger ships of 500 GT and upwards constructed before 1 July 2012, not later than the first survey on or after 1 July, 2014
- Tankers of 3,000 GT and upwards constructed before 1 July, 2012, not later than the first survey on or after 1 July, 2015
- Cargo ships, other than tankers, of 50,000 GT and upwards constructed before 1 July, 2013, not later than the first survey on or after 1 July, 2016
- Cargo ships, other than tankers, of 20,000 gross tonnage and upwards but less than 50,000 GT constructed before 1 July, 2013, not later than the first survey on or after 1 July, 2017
- Cargo ships, other than tankers, of 10,000 GT and upwards but less than 20,000 GT constructed before 1 July, 2013, not later than the first survey on or after 1 July, 2018

The term "first survey" is defined in MSC.1/Circ.1290 as being 'the first annual survey, the first periodical survey or the first renewal survey whichever is due first after the date specified in the relevant regulation or any other survey if the Administration deems it to be reasonable and practicable, taking into account the extent of repairs and alterations being undertaken. For a ship under construction, where the keel is laid before, but the ship is delivered after, the date specified in the relevant regulation, the initial survey is the first survey."

It will be noted from the above schedule that there is no provision for cargo ships (other than tankers) of less than 10,000 GT to be fitted with ECDIS. Flag States may also exempt a vessel from complying with the requirements if it is to be taken out of service permanently within two years of the applicable implementation date.

1.2 STCW Convention and Code Requirements

Table A-II/1
Specification of minimum standard of competence for officers in charge of a navigational watch on ships of 500 gross tonnage or more.
Function: Navigation at the operational level

Competence	Use of ECDIS to maintain the safety of navigation Note: Training and assessment in the use of ECDIS is not required for those who serve exclusively on ships not fitted with ECDIS These limitations shall be reflected in the endorsements issued to the seafarer concerned
Knowledge, understanding and proficiency	Navigation using ECDIS Knowledge of the capability and limitations of ECDIS operations, including: .1 at thorough understanding of Electronic Navigational Chart (ENC) data, data accuracy, presentation rules, display options and other chart data formats .2 the dangers of over-reliance .3 familiarity with the functions of ECDIS required by performance standards in force Proficiency in operation, interpretation, and analysis of information obtained from ECDIS, including: .1 use of functions that are integrated with other navigation systems in various installations, including proper functioning and adjustment to desired settings .2 safe monitoring and adjustment of information, including own position, sea area display, mode and orientation, chart data displayed, route monitoring, user-created information layers, contacts (when interfaced with AIS and/or radar tracking) and radar overlay functions (when interfaced) .3 confirmation of vessel position by alternative means .4 efficient use of settings to ensure conformance to operational procedures, including alarm parameters for anti-grounding, proximity to contacts and special areas, completeness of chart data and chart update status, and backup arrangements .5 adjustment of settings and values to suit the present conditions .6 situational awareness while using ECDIS including safe water and proximity of hazards, set and drift, chart data and scale selection, suitability of route, contact detection and management, and integrity of sensors

Methods for demonstrating competence	Examination and assessment of evidence obtained from one or more of the following: .1 approved training ship experience .2 approved ECDIS simulator training
Criteria for evaluating competence	Monitors information on ECDIS in a manner that contributes to safe navigation Information obtained from ECDIS (including radar overlay and/or radar tracking functions, when fitted) is correctly interpreted and analyzed, taking into account the limitations of the equipment, all connected sensors (including radar and AIS where interfaced), and prevailing circumstances and conditions Safety of navigation is maintained through adjustments made to the ship's course and speed through ECDIS controlled track-keeping functions (when fitted) Communication is clear, concise and acknowledged at all times in a seamanlike manner

Table A-II/2
Specification of minimum standard of competence for masters and chief mates on ships of 500 gross tonnage or more.
Function: Navigation at the management level

Competence	Maintain the safety of navigation through the use of ECDIS and associated navigation systems Note: Training and assessment in the use of ECDIS is not required for those who serve exclusively on ships not fitted with ECDIS. This limitation shall be reflected in the endorsement issued to the seafarer concerned
Knowledge, understanding and proficiency	Management of operational procedures, system files and data, including: .1 manage procurement, licensing and updating of chart data and system software to conform to established procedures .2 system and information updating, including the ability to update ECDIS system version in accordance with vendor's product development .3 create and maintain system configuration and backup files .4 create and maintain log files in accordance with established procedures .5 create and maintain route plan files in accordance with established procedures .6 use ECDIS log-book and track history functions for inspection of system functions, alarm settings and user responses

Knowledge, understanding and proficiency (cont'd.)	Use ECDIS playback functionality for passage review, route planning and review of system functions
Methods for demonstrating competence	Assessment of evidence obtained from one of the following: .1 approved i n-service experience .2 approved training ship experience .3 approved ECDIS simulator training
Criteria for evaluating competence	Operational procedures for using ECDIS are established, applied, and monitored Actions taken to minimize risk to safety of navigation

Table A-II/3
Specification of minimum standard of competence for officers in charge of a navigational watch and for masters on ships of less than 500 gross tonnage engaged on near-coastal voyages.
Function: Navigation at the operational level

Competence	Plan and conduct a coastal passage and determine position Note: Training and assessment in the use of ECDIS is not required for those who serve exclusively on ships not fitted with ECDIS. These limitations shall be reflected in the endorsement issued to the seafarer concerned
Knowledge, understanding and proficiency	Thorough knowledge of and ability to use ECDIS
Methods for demonstrating competence	Examination and assessment of evidence obtained from one or more of the following: .1 approved t raining ship experience .2 approved E CDIS simulator training
Criteria for evaluating competence	

1.3 IMO Resolution A.741(ISM Code) Requirements

6.3 The Company should establish procedures to ensure that new personnel and personnel transferred to new assignments related to safety and protection of the environment are given proper familiarization with their duties. Instructions which are essential to be provided prior to sailing should be identified, documented and given.

1.4 IMO Model Course 1.27 "Operational use of Electronic Chart Display and Information System (ECDIS)

The model course intends to provide the knowledge, skill and understanding of ECDIS and electronic charts to the thorough extent needed to safely navigate vessels whose primary means of navigation is ECDIS. The course emphasizes both the application and learning of ECDIS in a variety of underway contexts. This is achieved through sophisticated navigation simulation that provides each trainee with unrestrained access to ownship operations integrated with a complete type-approved ECDIS with numerous chart formats installed.

The course is designed to meet the STCW requirements in the use of ECDIS, as revised by the 2010 Manila Amendments, specifically as these apply to Tables A-II/1, A-II/2 and A-II/3, and also to revised guidelines pertaining to training and assessment in the operational use of ECDIS in Table B-I (paragraphs 36 through 66), assessment in navigational watchkeeping, and evaluation of competence, both in Table B-II.

The training equipment and method used, however, is just one step on the way to successful ECDIS training. Much also depends on the knowledge and teaching skills of the instructor and the quality of the courseware in use. Some ship owners have experienced problems with well-equipped training centers because the instructors are either too old, and have therefore never sailed with ECDIS before, or are young officers lacking training experience due to the fact that they are only filling in during their shore time. Course duration is 40.0 hours minimum

1.5 Flag State ECDIS training requirements

On modern ships, ECDIS systems have become extremely complicated and it is therefore necessary to have a user who is totally proficient. This fact has also been acknowledged by the IMO in the amended STCW Code, which now requires the user to have profound working knowledge of the ECDIS system. For some flag states, such as MCA (UK), MPA (Singapore) and Bermuda, the IMO's implied terms are not sufficient. Flag states including the UK and Australia have already stipulated generic ECDIS training as a requirement when ECDIS is used as a primary means of navigation. They therefore issued national circular letters requiring that the ECDIS manufacturer or an approved training agent has to provide a type-specific ECDIS course for all navigation officers on-board a vessel flying these flags. ECDIS is also part of the relevant safety equipment for which, according to the ISM Code, a specific training for the crew is required. This will be checked not only through Vetting, but also by Port State Control.

2. ECDIS training

With the changes to the STCW Convention and Code (also known as the Manila Amendments), ECDIS training becomes an integral part of the nautical officer's training scheme, starting in January 2012. Within the next five years, every officer serving on an ECDIS equipped vessel must have attended generic ECDIS training which is accepted by his home country and the Flag State of the ship in which he/she is serving.

Accidents involving vessels like the CFL Performer, Cosco Busan, LT Cortesia and the Pride of Canterbury, show the urgent need to not only to invest in the proper equipment and paper work, but to make sure that the crew really possess solid knowledge of the equipment in use. In some cases sailors get on-board training with an ECDIS(IMO Model Course 1.27) certificate but have never touched an ECDIS before. Also we can find training providers, who teach up to 30 students in a beamer equipped classroom with only one ECDIS, reading the manufacturer's manual page-by-page.

The industry has emphasized the need for watch-standers to demonstrate all IMO identified competencies and to maintain these competencies – including familiarization with any updates or alterations. James Robinson, DSM FNI Irish Navy (Retired), President of The Nautical Institute, commented: "ECDIS is a complex system and will be one of the most essential tools for supporting mariners in their efforts to ensure the safety of navigation and protection of the marine environment. Shipowners must not assume that an ECDIS course certificate is enough to ensure safety and masters should work with their bridge teams to ensure that ECDIS best practice and company procedures for familiarization and use of the ECDIS are continually maintained". The guidance also makes recommendations to ensure that officers in charge of a navigational watch remain competent and that other industry stakeholders such as trainers, inspectors and auditors are capable of assessing such competence.

The "Human Element" aspects of ECDIS introduction and operation should not be ignored. This includes:

- roll-out risk assessment
- effective training
- effective communication/feedback on ECDIS operation
- effective navigational auditing
- effective ECDIS near miss collection and analysis
- effective ECDIS assisted accident investigation – learning from mistakes

The introduction of a complex system such as ECDIS requires a high standard of training and understanding.

2.1 Generic ECDIS Training

Generic ECDIS training should follow the provisions of the IMO-approved standardized Model Course 1.27, which lays down the minimum training and knowledge requirements for a navigation officer to operate ECDIS equipment. It is the objective of IMO that the model course will provide flag states and training companies with a standardized competency level for training navigation officers.

This course should cover all relevant safety aspects regarding ECDIS including operational functionality, maintenance and limitations of electronic chart navigation. The generic training should include a thorough understanding of the basic principles of electronic chart navigation and include but not be limited to:

- legal background and requirements of ECDIS
- theoretical background information, including knowing limitations of ECDIS
- types of electronic charts (ENC and RNC)
- functions and settings, including familiarity of different alarms and sensors
- types of display and orientation
- operating basic navigational functions
- understanding route planning functions with particular emphasis on route checking and monitoring

- updates and maintenance of ECDIS software and electronic charts
- knowing what back-up systems are required and necessary updates/maintenance
- knowing the risks – overreliance on ECDIS

The IMO Model Course suggests 40 hours of training (minimum) to be carried out over a five-day period. However, flag states including the UK have permitted a three-day training course as fulfilling the IMO model requirements. The IMO model course is seen by many as fulfilling the absolute basic requirements for generic ECDIS training. It is recommended that an effective generic ECDIS course is undertaken rather than simply fulfilling the basic statutory requirements. A full understanding of ECDIS is very important.

Flag states, such as Norway, have stipulated that they may allow generic ECDIS training to be conducted in the form of computer-based training (CBT). Certain private navigation specialists are in the process of creating and introducing a product-specific computer-based ECDIS training programme, which will have two separate CBT programmes for generic and type specific ECDIS training. However, most flag states have rejected this programme as concern over the effectiveness of generic CBT fulfilling IMO Model Course 1.27 requirements may prove inadequate and substandard compared to a college-based training course.

2.2 Type specific ECDIS Training

Type/model specific ECDIS training is a requirement of the International Safety Management (ISM) Code under section 6:"*The Company should establish procedures to ensure that new personnel and personnel transferred to new assignments related to safety and protection of the environment are given proper familiarization with their duties. Instructions which are essential to be provided prior to sailing should be identified, documented and given.*" Under the terms of the ISM Code, all officers must be familiar with the equipment they are expected to use; this includes ECDIS equipment.

Type specific training should be based on the actual equipment installed onboard and be provided before the officer is expected to use the equipment, for example, prior to sailing. The general consensus from the IMO is that officers who have undergone ECDIS generic training may not be familiar or be able to fully and confidently operate an ECDIS model that they have never used or trained on before. However, debate remains within the industry on acceptable forms of providing type/model specific training. STCW does not make type/model specific training a mandatory requirement and it is very much left open to the interpretation of flag states to determine training requirements.

The UK's MCA has issued Marine Information Notice 405(M+F) 'Training for ECDIS as Primary Means of Navigation', stating that masters and navigational officers using ECDIS as their primary means of navigation are required to have completed both generic and type specific ECDIS training. The MCA requires training to relate to the make and model of the equipment fitted on the ship and to be delivered by "*the manufacturer; the manufacturer's approved agent or a trainer who has attended such a programme, trickle down training (that is, one officer training another) is not acceptable*". This implies that the MCA requires type specific training to be carried out in a training establishment ashore before a navigational officer joins a ship as opposed to an onboard training course.

However, certain flag states have now stipulated in their merchant shipping notices that, depending on flag state approval, a computer-based training course may be acceptable in fulfilling requirements of type specific training. Bermuda Shipping Notice 2011-010 has agreed that "*a manufacturer's computer based training package can be accepted for this purpose*" as it is widely seen as the most practical and easily facilitated type specific training course available. Isle of Man's Merchant Shipping Notice 026 "*Replacing Paper Charts with ECDIS*" also agrees that 'this may be in the form of computer based training'. It is clear that differing views of flag states on type specific training makes it difficult to explain what kind of training would be acceptable and, more importantly, how it can be delivered. Not all flag states may accept computer-based training (CBT) and the ones that do will require their approval.

Companies should be aware that learning to be competent in the use of electronic chart navigation takes time; generic and type specific training only provides the minimum amount of knowledge necessary to operate ECDIS equipment and does not take into account the experience factor.

3. The 43rd Session IMO's Sub-Committee on Standards of Training and Watchkeeping

The IMO's Sub-Committee on Standards of Training and Watchkeeping held its 43rd Session at IMO Headquarters on Monday 30 April through Friday 4 May 2012 under the Chairmanship of Rear Admiral Peter Brady (Jamaica).

Three working groups were convened to consider:

1. The Development of an E-Navigation Strategy Implementation Plan,
2. The Development of Guidance for the Implementation of the 2010 Manila Amendment, and
3. Role of the Human Element.

In view of the large number of model courses submitted for validation, the Sub Committee established two drafting groups to finalize them. Following is a short summary of salient points emanating from the meeting on items of greatest interest to Intermanager members:

Consideration of model courses following manila 2010 Spearheaded by the USA, there was vigorous and unanimous agreement in Plenary that:

- the contents of the model courses submitted lacked consistency and did not comply with the 2010 Manila Amendments;
- model courses should facilitate career progression where required and there was a need to avoid duplication or redundancy of course content;
- the process to develop model courses needs to be completely reviewed under a structured programme with proper terms of reference and this was beyond the scope of a drafting group;
- the 2010 Manila Amendments entered into force on 1 January 2012 and bearing in mind that there was an urgent need for the updated model courses, the proposal to develop them in accordance with the proposed philosophy at this stage was not practical;

- there is a need to provide appropriate guidance to maritime education and training providers on the preparation of training programmes to address the 2010 Manila Amendment in a timely manner; and
- the model courses should follow the knowledge, understanding and proficiency (KUPs) in the tables of competence.

3.1 Revised model course on the operational use of Electronic Chart Display and Information

Systems (ECDIS)

3.1.1 The Sub-Committee gave preliminary consideration to the draft model course on the operational use of Electronic Chart Display and Information Systems (ECDIS) (STW 43/3/1).

3.1.2 GlobalMET (STW 43/3/9), ICS et al. (STW 43/3/10), Finland and Germany (STW 43/3/11) and Poland (STW 43/3/19) commented and proposed amendments to the above-mentioned model course.

3.1.3 The United Kingdom (STW 43/3/20) identified aspects of the revised draft model course on the operational use of Electronic Chart Display and Information Systems (ECDIS) that may pose problems for both administrations and training establishments in its implementation and proposed amendments to demonstrate an alternative approach.

3.1.4 The United Kingdom (STW 43/3/21), commenting on the revised draft model course on the operational use of Electronic Chart Display and Information Systems (ECDIS), expressed the view that the mariner should be fully aware of the potential pitfalls within ECDIS as a generic system and particularly the overall reliance on correct software installation maintenance and updating and the possibility that ECDIS may contain display anomalies.

3.1.5 In the ensuing discussion, the following views were expressed that the ECDIS model course:

- was for global use and should contain generic references and terminology, focus on clear training objectives and guidelines, relevant teaching facilities and appropriate equipment;
- should form a template for training in operational and management levels and retain assessment at individual levels rather than in groups;
- should not be too prescriptive but be functional and flexible;
- should specify that the qualifications of trainers should include that they have had ECDIS training;\
- onboard training and familiarization for trainers at regular intervals was impractical; and
- meets the knowledge, understanding and proficiency (KUPs) in the tables of competence.

3.1.6 After some discussion, the Sub-Committee referred the above documents to Drafting Group 1 to be established on validation of model courses for finalization of the model course, with a view to validation by the Sub-Committee.

Meanwhile, Drafting Group 1 considered a Revised Model Course on the operational use of ECDIS. They recommended that the model course should not be too prescriptive, agreed that it is primarily a technical course designed to teach proper operation of an ECDIS and should be delivered by trainers with relevant management level qualifications and experience 'at the discretion of the administration approving the course'. Because ECDIS is subject to 'anomalies', it was agreed to address how to cope with this inherent weakness within the detailed teaching syllabus. Terms specific to a manufacturer's product would be revised to follow generic terminology. In the light of their discussions, the Drafting Group prepared amendments to the ECDIS model course in a 153 page amendment document (STW 43/WP.6/Add 1 dated 3 May 2012).

3.2 Electronic Chart Display and Information System (ECDIS) Training

9.17 ICS and ISF (STW 43/9/6) commented on ECDIS training requirements wherein they have identified a training gap when implementing the EC DIS carriage requirements and the transitional arrangements of the 2010 Manila Amendments to the STCW Convention and proposed a way forward.

9.18 In the ensuing discussions, the following views were expressed that:

- clarification was needed for the application of training requirements for navigating officers serving on ships fitted with ECDIS;
- equipment-specific ECDIS training courses were not practical;
- regulation I/14.1.5 includes familiarization training; and
- there was a need to consider, if there was a need to issue guidance to port State control authorities relating to ECDIS training.

9.19 After some discussion, the Sub-Committee referred this document to the Working Group for detailed consideration and advice, as appropriate.

4. Conclusion

It is important that traditional navigation skills are not forgotten or lost. Navigators should become confident, but not overconfident, in the use of ECDIS. There is a danger that some navigation officers will increasingly trust what is displayed on the screen without question, which could lull them into a false sense of security. As with all electronic equipment, ECDIS is an aid to navigation, albeit a very significant one, but it is not a substitute for maintaining a proper lookout at all times.

With the increasing reliability of GPS as a primary means of position fixing using ECDIS, traditional navigational skills using terrestrial based position fixing should not be overlooked as an important cross check of the ship's position. Additionally, in the event of GPS failure, a suitable back-up procedure should be in place to utilize traditional position fixing directly onto the ECDIS. GPS failure drills have been identified within military navies as an effective training tool ensuring navigators are fully familiar with traditional position plotting techniques. The introduction of GPS failure drills onboard ships using ECDIS as primary means of navigation will ensure that, in the event of position input failure from GPS, navigators are experienced in using traditional position plotting techniques for the safe takeover of navigation.

The understanding of the STCW Manila Amendments has caused confusion within the industry, particularly with respect to the transitional provisions for deck officers who already possess (or are due to revalidate) their watch-keeping certification and who have not undergone ECDIS training. It is of course left to flag states to interpret the code and clearly define what training and certification requirements they will specifically impose.

ECDIS training is changing today: in the age of electronic communications and games, the teaching methods need to move with the skill set of those coming into the industry. In the end, it will certainly become more professional and the officer on-board will feel more confident using ECDIS to its full potential

References

[1] STCW Convention with Manila Amendments, www.imo.org, IMO Documents, STCW/CONF 2/33

[2] STCW Code with Manila Amendments, , www.imo.org, IMO Documents, STCW/CONF 2/34

[3] IMO Model Course 1.27 "Operational use of Electronic Chart Display and Information System (ECDIS), 2010 Edition"

[4] STW 43/WP.6/Add 1 dated 3 May 2012, www.imo.org

[5] SOLAS Convention

[6] http://www.nautinst.org/

[7] http://www.maritime-executive.com/

[8] www.standard-club.com/ECDIS – UNDERSTANDING THE FUTURE/

Advances Through Fast Time Manoeuvring Simulation - New Technology for Teaching and Learning in Ship Handling

Knud Benedict

Professor, Hochschule Wismar, University of Applied Sciences - Technology, Business and Design, Dept. of Maritime Studies Warnemuende, Maritime Simulation Centre Warnemuende / Germany,

Knud.Benedict @hs-wismar.de

Michael Gluch, Matthias Kirchhoff, Sandro Fischer, Michèle Schaub

Senior Scientists, Hochschule Wismar, University of Applied Sciences - Technology, Business and Design, Dept. of Maritime Studies Warnemuende, Maritime Simulation Centre Warnemuende / Germany,

michael.gluch @hs-wismar.de

Michael Baldauf, Sebastian Klaes

Associate Professor, World Maritime University WMU, Malmoe / Sweden,

mbf@wmu.se

Thomas Jakob

Dipl. Engineer/ Sales Manager,

Rheinmetall Defence Electronics Bremen, Germany

Thomas.Jakob@rheinmetall.com

Abstract: Safe and efficient ship handling in every situation and under all potential prevailing circumstances of the ship status and environmental condition is a substantial contribution to the safety of the maritime transportation system and requires a high level of training. New technologies such as Fast Time Simulation (FTS) have great potential for teaching and learning in the maritime training environment and for use on board ships. New concepts for application of these new technologies were developed at Maritime Simulation Centre Warnemünde MSCW in research projects for development of prediction tools for manoeuvring of ships. New concepts based on FTS were developed to simulate the ship's motion with complex dynamic models in fast time and to display the ship's track immediately for the intended or actual rudder or engine manoeuvre. These simulations allow for a new type of manoeuvring design and optimisation of not only the next manoeuvring segment ahead but also for the following or even for series of manoeuvring segments. Within this paper are selected case studies and existing solutions for using the new technology for teaching and learning processes in manoeuvring / ship handling. For practical application and testing, the new technology was interfaced to a

ship handling simulator at Maritime Simulation Centre Warnemünde to support briefing and debriefing processes. The potential of this technology will be identified and approaches for advanced manoeuvring education and training will be introduced and discussed.
Keywords: Fast time simulation, manoeuvring, ship handling, decision support, teaching technologies

1. Introduction – description of the concept

Normally, ship officers have to steer ships based only on their mental model of the ship's motion characteristics. This mental model has been developed during their education, training in a ship handling simulator in real time simulation and, most importantly, during their sea time practice. Up to now there was no electronic tool to demonstrate manoeuvring characteristics efficiently. Moreover, to design a manoeuvring plan effectively, even in briefing procedures for ship handling training, the potential manoeuvres will be explained and drafted on paper or described by sketches and short explanations. To overcome these shortcomings, a fast time simulation tool box was developed to simulate the ship's motion with complex dynamic models and to display the ship's track immediately for the intended or actual rudder or engine manoeuvre. This "Simulation Augmented Manoeuvring Design and Monitoring" (SAMMON) tool box will allow for a new type of design for manoeuvring plans as an enhancement exceeding the common pure way-point planning. The principles and advantages were described at MARSIM 2012 [4] specifically for the potential on board application for manoeuvring real ships.

This paper presents the potential of the new method specifically for the teaching and learning process at maritime training institutions. Manoeuvring of ships is a human centred process. The most important elements of this process are humans and the technical equipment to support their task (see Figure 1). However, most of the work is to be done manually because even today almost no automation support is available for complex manoeuvres. Even worse, the conventional manoeuvring information for the ship officer is still available on paper only: the ship manoeuvring documents are mainly based on the initial ship yard trials or on some other selective manoeuvring trails for specific ship / environmental conditions - with only very little chance to be commonly used in the overall ship handling process situations effectively.
Ship Handling Simulation for simulator training has a proven highly effective for qualification however, it is based on real time simulation, i.e. 1 second calculation time by the computers represents 1 second manoeuvring time in the real world. This means, despite all other advantages of full mission ship handling simulation, that collecting/gathering of manoeuvring experiences remains the utmost time consuming process.

For increasing the effectiveness of training and also the safety and efficiency for manoeuvring real ships, the method of Fast Time Simulation will be used in future. Even with standard computers simulations can be achieved in 1 second computing time for manoeuvres lasting up to 20 min using innovative simulation methods. This allows substantial support in both the training process and the real manoeuvring process on board ships. In Figure 2 a comparison is given for some essential elements of the real manoeuvring process on ships and in training within the ship handling simulators. Additionally, in the right column some of the Fast Time Simulation (FTS) tools are mentioned and their roles to support each element of the manoeuvring process are indicated. These tools were initiated in research activities at the Maritime Simulation Centre Warnemuende which is a part of the Department of Maritime Studies of Hochschule Wismar, University of Applied Sciences - Technology, Business & Design in Germany. It has been further developed by the start-up company Innovative Ship Simulation and Maritime Systems (ISSIMS GmbH).

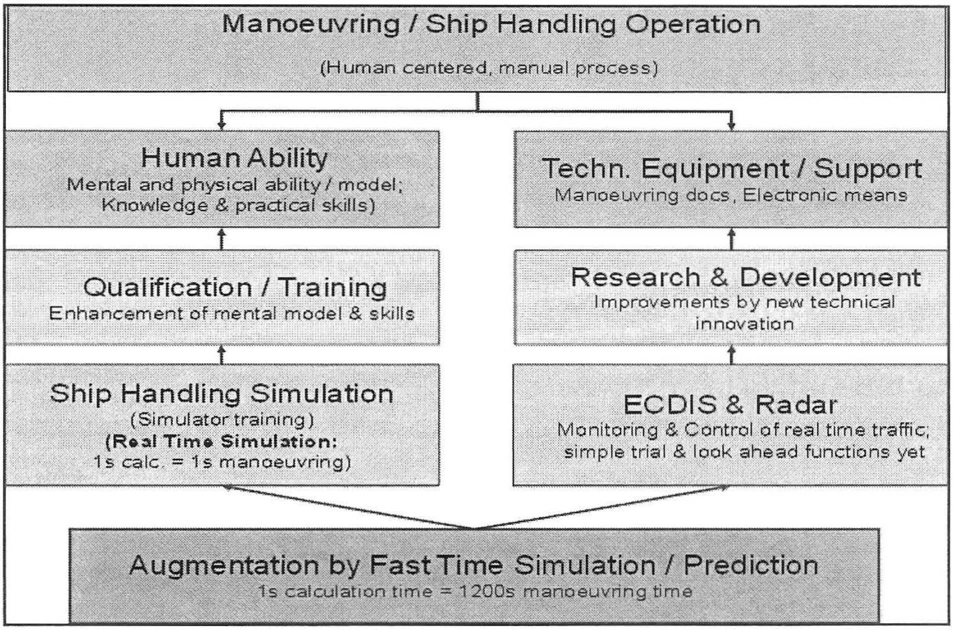


Figure 1 Elements of the manoeuvring process and potential for enhancement by new Simulation / Augmentation methods

A brief overview is given for the modules of the FTS tool and its potential application:

- SAMMON is the brand name of the innovative system for "Simulation Augmented Manoeuvring – Design, Monitoring & Control", consisting of four software modules for Manoeuvring Design & Planning, Monitoring, Multiple Dynamic Prediction & Control and Simulation & Trial. It is made for both:
    - application in maritime education and training to support lecturing for ship handling to demonstrate and explain more easily manoeuvring technology details and to prepare more specifically, manoeuvring training in SHS environment, i.e. for developing manoeuvring plans in briefing sessions, to support manoeuvring during the exercise run and to help in debriefing sessions with the analysis of replays and discussions of quick demonstration of alternative manoeuvres and
    - application on-board to assist manoeuvring of real ships e.g. to prepare manoeuvring plans for challenging harbour approaches with complex manoeuvres up to the final berthing / unberthing of ships, to assist the steering by multiple prediction during the manoeuvring process and even to give support for analysing the result and for on board training with the Simulation & Trial module.
- SIMOPT is a Simulation Optimiser software module based on FTS for optimising Standard Manoeuvres and modifying ship math model parameters both for simulator ships and FTS Simulation Training Systems and for on board application of the SAMMON System.

- SIMDAT is a software module for analysing simulation results both from simulations in SHS or SIMOPT and from real ship trials: the data for manoeuvring characteristics can be automatically retrieved and comfortable graphic tools are available for displaying, comparing and assessing the results.

Elements of Manoeuvring Process on Ships & in Education/Training and support by Fast Time Simulation Modules / Tools

Real World/ Ship Operation	Ship Handling Simulator Training	Fast Time Simulation Tools
Real ship /	Math model of the ship for simulation	**SIMOPT & SIMDAT** tool for developing & tuning of parameters of math models
Familiarisation runs	Familiarisation Exercises	**MANOEUVRING TRIAL & TRAINING** tool for Demonstration / Lecturing / Familiarisation
Mission / Planning	Scenario / Briefing	**MANOEUVRING DESIGN & PLANNING** tool to generate and edit a manoeuvring plan
Manoeuvring Operation	Execution of exercise	**MANOEUVRING MONITORING & MULTIPLE DYNAMIC PREDICTION** tool to monitor and control the vessels motion
Recording (VDR, ECDIS)	Recording by simulator	**SIMDAT** tool to display and assess recordings
Evaluation of success	Debriefing	**MANOEUVRING TRIAL& TRAINING** tool for verification of results by simulation & prediction

Figure 2 Elements of Manoeuvring Process on Ships & in Training and support by Fast Time Simulation Tools for Simulation / Augmentation

The SIMOPT and SIMDAT modules were described in earlier papers ([1] and [2]) for tuning of simulator ship model parameters and also the modules for Multiple Dynamic Prediction & Control [3]for the on board use as a steering assistance tool.

In this paper the focus will be on the potential of the SAMMON software for supporting the teaching and learning process.

2. Fast Time Simulation Tools for Standard Ship Manoeuvring Elements Ship dynamic model and SIMOPT / SIMDAT tools for fast time ship manoeuvring simulation and investigation

The following equation of motion was used as the math model for the ships dynamic:

$$X = m(\dot{u} - rv - x_G r^2)$$
$$Y = m(\dot{v} + ru + x_G \dot{r})$$
$$N = I_z \dot{r} + m x_G (\dot{v} + ru)$$
$$Q = I_{ME} \dot{n}_{ME}$$

On the right side are the effects of inertia, where u and v represent the speed components in longitudinal and transverse direction x and y; r is the rate of turn of the ship. The ship's mass is m and x_G is the distance of centre of gravity from the origin of the co-ordinate system. I_z is the moment of inertia around the z-axis.

The ship's hull forces X and Y as well as the yawing moment N around the z-axis are on the left side. Their dimensionless coefficients are normally represented by polynomials based on dimensionless parameters, for instance in the equation of transverse force Y and yaw moment N given as the sum of terms with linear components N_r, N_v, Y_r and Y_v and additional non-linear terms depending on speed components u, v, rate of turn r and revolution n. Other forces; for instance, rudder forces and wind forces are expressed as look up tables. There are other models, e.g. for the engine or thruster operation: for the sample in the fourth equation in (1) the variable Q represents the sum of the torque components of engine, propellers and others; on the right side there is the inertia moment of the rotation parts around the propeller axis.

Additional differential equations represent the calculation of heading and position. The solution of this set of differential equations is calculated at least every second; some internal calculations are even done with higher frequency.

The quality of the math model for the simulation and the parameters in the equations are of high importance for the effectiveness of the simulation. There is a great need for fast and effective modelling / tuning processes both:

- for the general operation of Ship Handling Simulators SHS where clients from several shipping companies need to be trained on their specific ship types and
- for the SAMMON dynamic predictor and manoeuvre planning modules.

The parameters of these equations of motions can be found by parameter estimation technology (some methods were described at MARSIM 2009 and 2006 [1][2]) using the SIMOPT and SIMDAT Programs. The advantage of the module is to be seen in the performance: it is remarkably faster than real time and the steering of vessels is organized automatically by prepared files from a library for Manoeuvre-Control Settings / Commands for standard procedures and individual manoeuvres.

These software packages were developed to be used for fast time simulation procedures by SIMOPT and assessment of the results by SIMDAT [6] . The advantages and capabilities of this software are: The Math Model reveals the same quality for simulation results as ship handling simulators (SHS), but it is remarkably faster than real time simulation (the ratio is more than 1/1000) and the steering of simulator vessels is done by specific manoeuvre-control settings / commands for standard procedures and individual manoeuvres dedicated for calculation standard ship manoeuvring elements (basic manoeuvres) but moreover for the estimation of optimal manoeuvring sequences of some characteristic manoeuvres as for instance, person over board manoeuvres.

Simulations can be done in SIMOPT either as a single run or as a simulation series for selection of up to a 3 parameter series to be simulated in parallel or sequential for: Simulation parameters, e.g. Manoeuvre series; Ship Parameters (L, B, T, or others); Hull / force parameters coefficient and Environmental data, e.g. wind force and direction.

The SIMDAT software tool (see Fig. 3) was originally designed at the MSCW to supply the instructor with semiautomatic assessment of the recorded exercise data in a ship handling simulator [3]. For the purpose of ships model parameter tuning, the optimisation of manoeuvres and for lecturing, this SIMDAT tool was extended. The Data for the manoeuvring characteristics can be automatically retrieved for all manoeuvres and enhanced Graphic tools are available for displaying various types of results. Some results of particular evaluations are shown in the next figures.

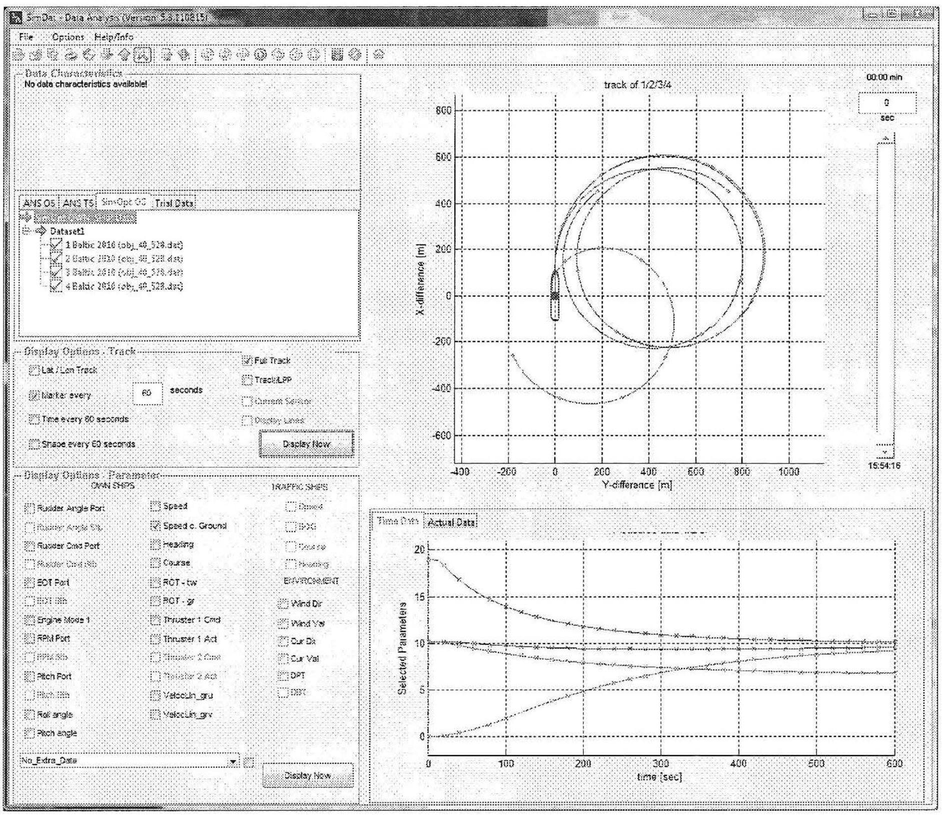


Figure 3 Comparison of turning circles for Hard Rudder (35° STB) and constant speed rates with kick turns (CV 2500, left: ships' tracks, right: speed history):

- Turning Circle with constant speed rate Full Sea Speed = 25.5 kn (blue)
- Turning Circle with constant speed rate Slow Ahead = 11.3 kn, (green)
- Kick-Turn from straight track with constant speed rate Slow Ahead = V_Start=11.3 kn) and change to Full Sea Speed (brown)
- Kick-Turn from STOP at zero speed V = 0 kn and change to EOT = 100 % (red)

Samples of Manoeuvre Demonstration and Optimisation with SIMOPT/SIMDAT

In order to explain ship dynamics, simulations are very suitable to demonstrate the effect of specific manoeuvres. In Fig. 3 the effect of so called "Combined Manoeuvres" will be shown where both rudder and engine will be changed at the same time to give some advantage in comparison with standard manoeuvres. The turning circles with constant speed rates for Full Ahead and Slow Ahead have nearly identical tracks however, in the case of using so called Kick Turns from Slow Ahead to Full Ahead or even more for Stop to Full Ahead the advance and transfer of the tracks are much smaller. The final steady state turning diameter is the same in all four cases.

Also for crash stop manoeuvres with Full Astern the rudder can help to significantly reduce the speed and therefore the stopping distance: in Fig. 4 the standard crash stop manoeuvre is compared with a fishtailing manoeuvre where the ruder is used periodically from full starboard to port and vice versa additionally to the reversed engine to save nearly one third of the stopping distance. The smallest advance can be seen for the turning circle with hard rudder where also the speed goes to zero after nearly half of the time compared to the standard stop manoeuvre.

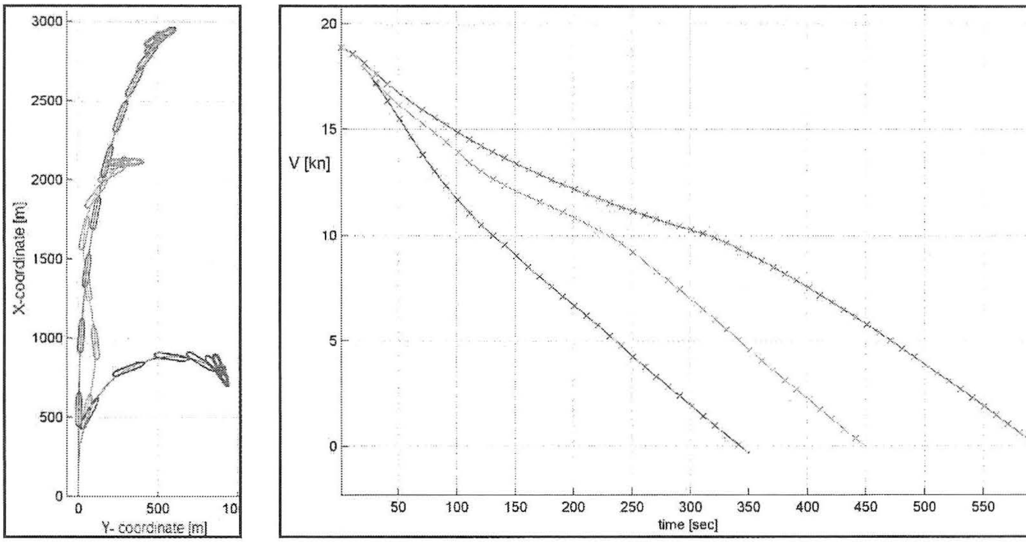


Figure 4 Comparison of Crash Stop Manoeuvre (red) with Fishtailing (grey) and Hard Rudder Turning Circle from Full Ahead to Full Astern (blue) (CV 7500, left: ships' tracks, right: speed history)

Another important issue is the behaviour of the vessel under wind impact which can be easily explained and investigated by means of the SAMMON system. The basic understanding of this effect can be given to the students by explaining the equilibrium conditions under wind impact on a straight track with constant ship speed. For this purpose a series of calculations were made varying the wind speed from 0-40 knots and also the wind directions from bow wind (0°) to stern wind conditions (180°). In Fig. 5 the table can be seen for the input control of the calculation series for simple Constant Speed Manoeuvres in SIMOPT. The results are shown in Fig. 6 in 2D and, more clearly, in 3D-representation respectively. It can clearly be seen that the rudder and drift angles to balance the wind moment and transverse forces are increasing with the wind speed, more precisely with the wind-to-ship speed ratio. The effect of these equilibrium conditions will be demonstrated in the next chapter for the turning manoeuvres under wind.

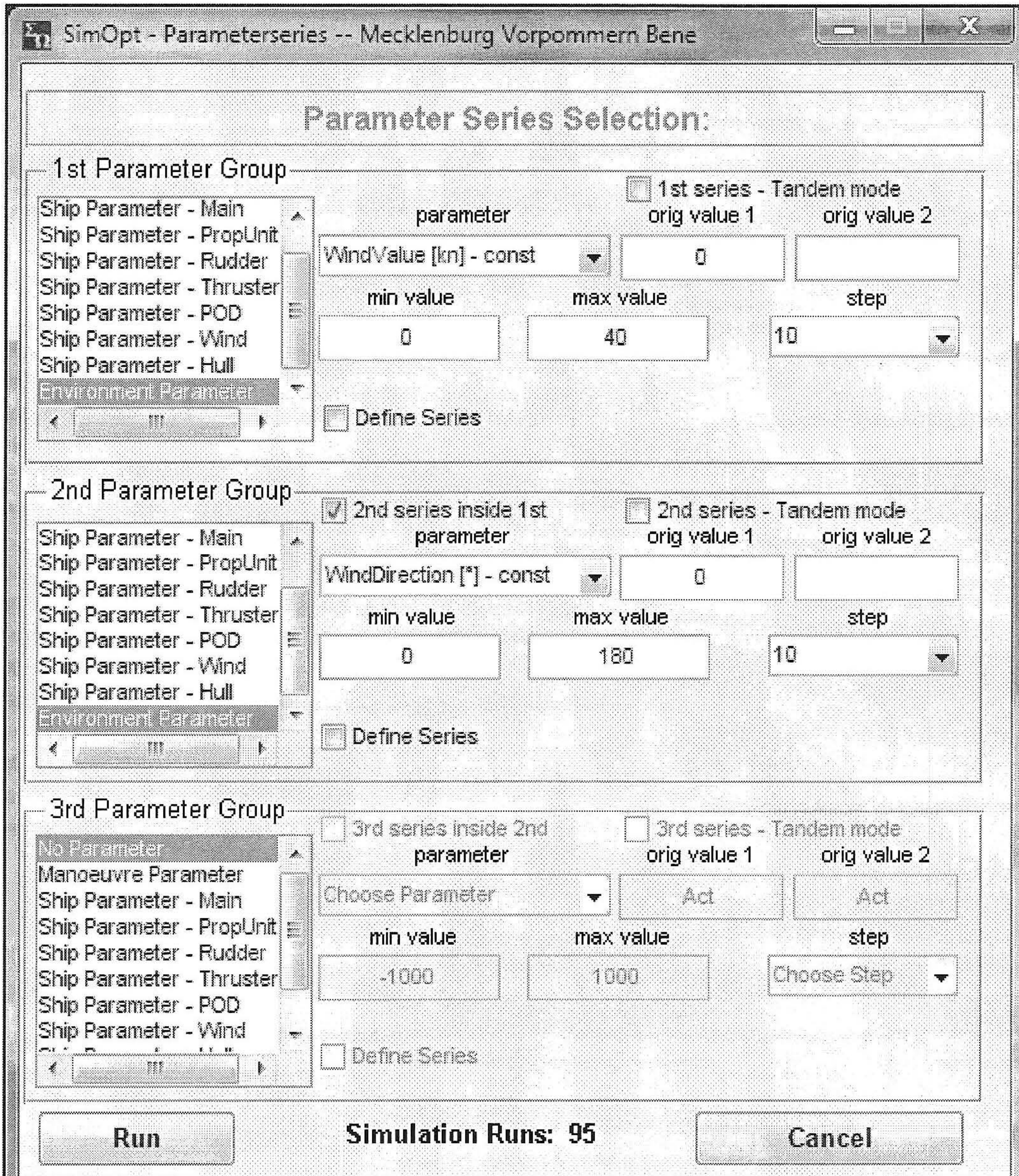
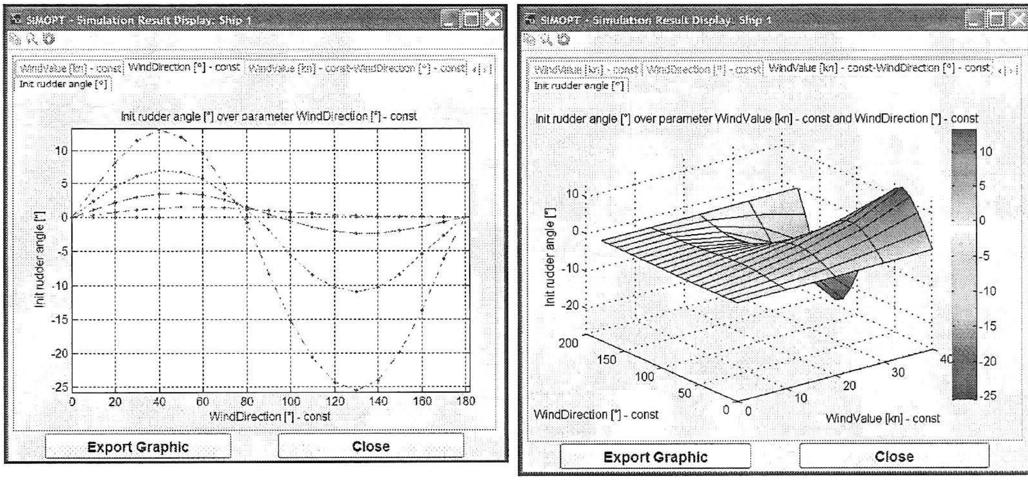
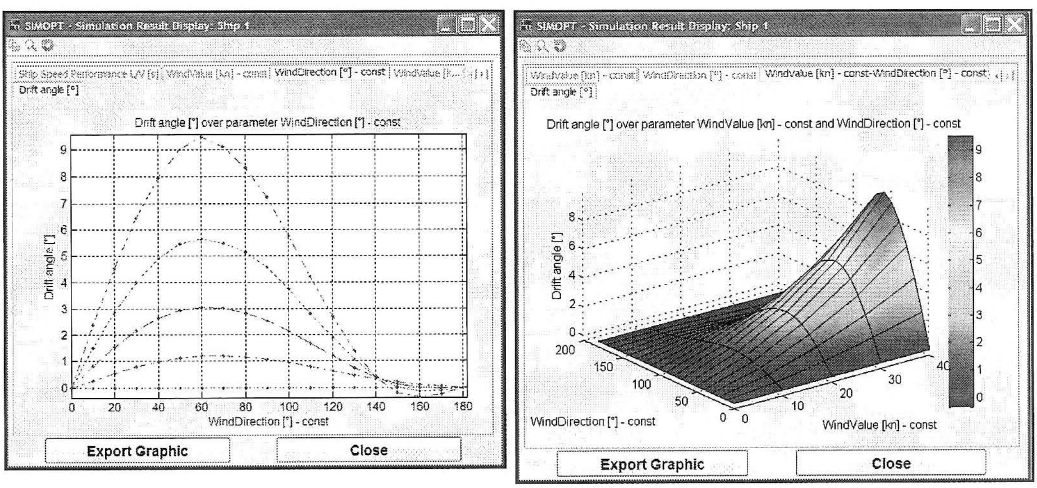


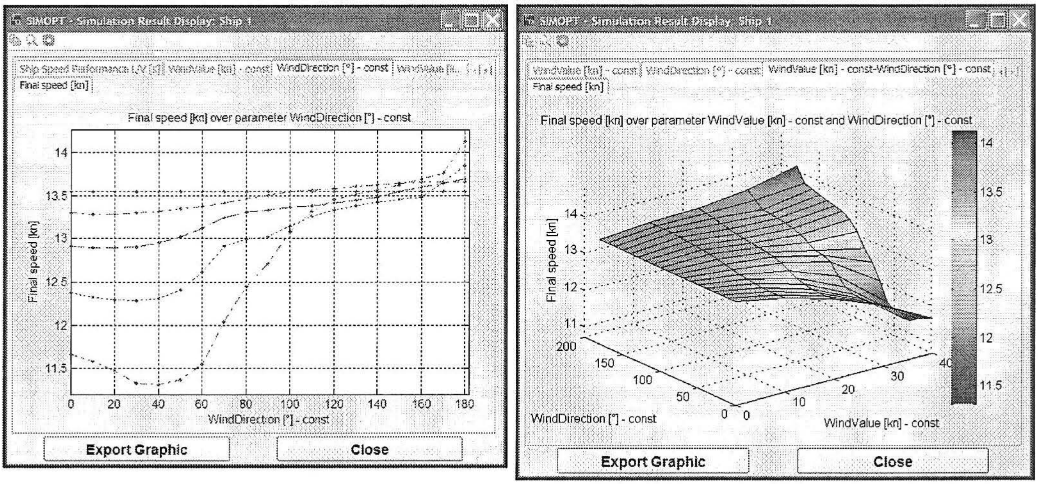
Figure 5 Interface table for defining a parameter series in SIMOPT for calculation of wind effects on straight track with constant speed



(a) Initial rudder angle versus Wind direction and Wind speed



(b) Drift angle versus Wind direction and Wind speed



(c) Speed loss versus Wind direction and Wind speed

Figure 6 Balance of wind effects on straight track with constant speed in 2D & 3D presentation

3. Fast Time Manoeuvring Simulation for Manoeuvring Demonstration in ECDIS environment

The same fast time simulation tools can be used for the demonstration of manoeuvres up to the design of complete manoeuvring plans. Some basic functions are shown in the next figures.

Fig. 7 explains the operational interface in a sea chart environment which combines the electronic navigational chart ENC window (centre), the status of the current actual ship manoeuvring controls (left) and the interface window for the steering panel of the ship (right).

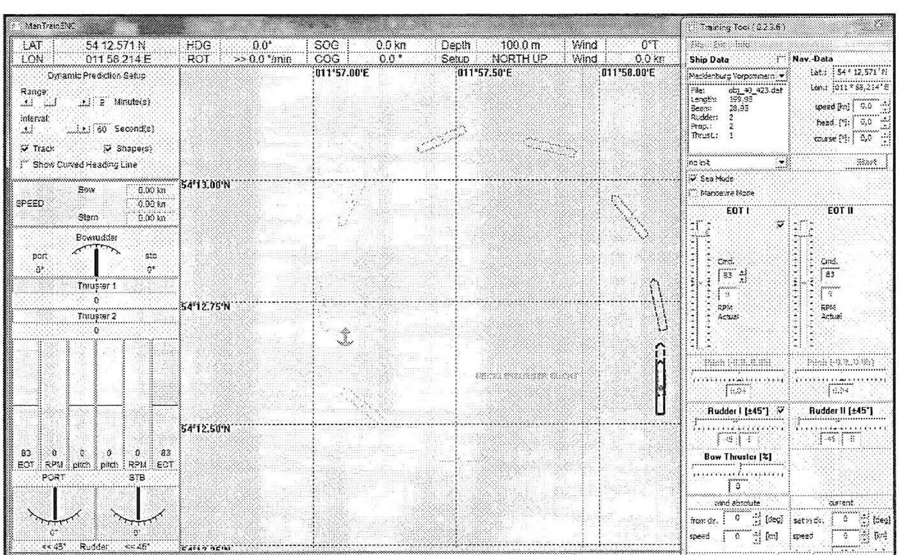


Figure 7 SAMMON Trial & Training Tool Interface with sample for Kick turn from zero speed to port as sample for potential ships manoeuvring capabilities

The ship was positioned in a certain place to demonstrate the ship's motion for a very simple manoeuvre kick turn from zero speed. The ship's motion can be controlled by the settings in the control panel window where any manoeuvre can be generated and immediately displayed in the ENC in full length within one second. The length of the track corresponds to the settings in the prediction window (left top corner). The range value represents the duration of the manoeuvre and the interval value controls the number of displayed ship contours on that manoeuvre track. The sample represents a kick turn from zero speed to full ahead with full rudder to Port.

For the demonstration of wind effect, the wind speed and direction can be set in the right bottom window. The effect can immediately be seen as in Fig. 8. The turning circle with full rudder to STB will be shifted in the direction with the wind from North (0°). This can be expected for low wind to ship speed because in the sample the engine order is set to 70%. If the EOT is set to only 30% the ship does not gain enough speed and therefore she goes on a straight track with beam wind where the full rudder is just enough for the equilibrium to balance the forces and moments due to wind as discussed in Fig. 6.

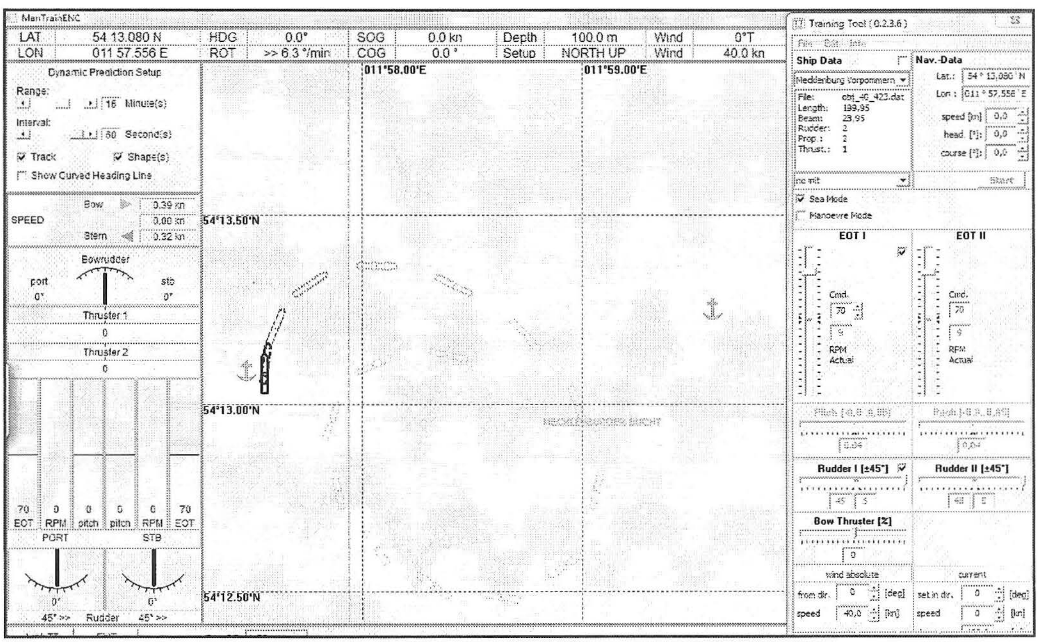


Figure 8 SAMMON Trial & Training Tool -Interface with sample for wind impact for low ratio of wind-to-ships speed

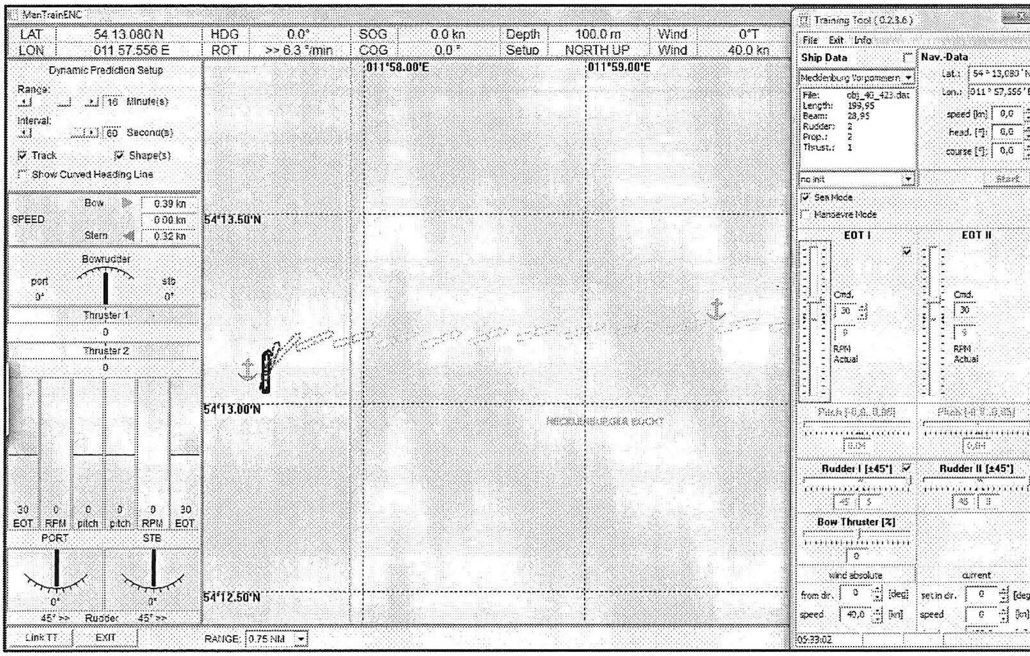


Figure 9 SAMMON Trial & Training Tool -Interface with sample for wind impact high ratio of wind-to-ships speed

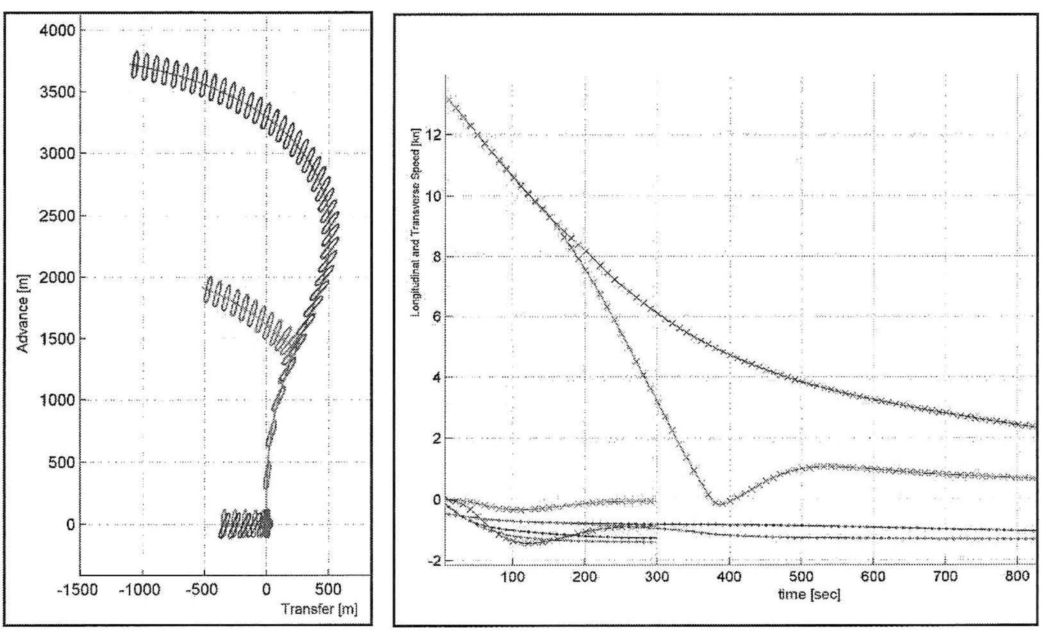


Figure 10 SAMMON Simopt tool: Transfer into a "lying abeam" situation under strong wind from several initial situations for ships speed (Left: ships tracks, Right: time history of longitudinal and transverse speed components)

In extreme heavy weather it is recommended to reduce the speed and to transfer into the "lying abeam" situation where the ship is only drifting with no engine power used. It is of great importance that this situation can be reached very quickly, i.e. that the transfer time from ahead motion into full drift motion requires a minimum of time to take advantage of the pure drifting motion as quickly as possible. These effects can be demonstrated in an ECDIS environment separately for every manoeuvring variant, but for an overview the different approaches are summarised in a SIMOPT / SIMDAT presentation as in Fig. 10. It can be seen that for a ship in the stopped condition this procedure happens very fast. In about two minutes the ship reaches the full steady state transverse drift speed (green for a ship with superstructure in the middle, brown for superstructure at the stern). If the ship has a higher initial speed then it is recommended to use a full astern stopping manoeuvre because in this case she needs only 7-8 minutes the full drift compared to the coasting stop where more than 20 min will be needed for the same result.

4. Fast Time Simulation for Designing Manoeuvring Plans

Principle of fast time simulation of manoeuvres in ECDIS and sample data

The fast time simulation method is used to find out efficient manoeuvres and even more for the design of manoeuvring plans within the briefing for Ship Handling Simulator exercises and practically for the route planning process on board [4]. The use of this tool will be explained by some sample scenarios:

The sample ship is the RO-PAX Ferry "Mecklenburg-Vorpommern" with Loa=200m, Boa=28.95m, Draft=6.2m, Displacement=22720t and Speed=22kn. She has two pitch propellers and two rudders located behind the propellers and additionally one bow thruster.

The test area is the Rostock Sea Port. The RO-PAX ferry is entering the fairway from north to be steered through the fairway and to be turned at the turning area followed by astern motion off the berth at west pier (as in in the sample Fig. 14).

Some basic functions and interface displays are shown in the following figures: Fig. 11 explains the method in a sea chart environment represented by an interface which combines the electronic navigational chart ENC window (centre), the interface window for the steering panel of the ship (right) for adjusting the controls for the selected manoeuvring point (MP) and the interface to display the status of the current actual ship manoeuvring controls (left) at the position of the next manoeuvring point which is indicated as ship shape in red colour in the ENC.

For purposes of demonstration of a complex manoeuvre procedure the ship is initially positioned in the fairway (black contour) and is going to enter the turning area as the objective for the first manoeuvring segment. For the planning procedure, the ship's motion can be controlled by the settings in the control panel window on the right side. Any manoeuvre can be generated and will be immediately displayed in the ENC with full length in less than one second. In this case the rudders are set 10° to STB to achieve a small turning rate ROT=4.5°/min to port. The length of the simulated track corresponds to the settings in the prediction window (left top corner). The range value represents the duration of the simulated manoeuvre and that means the track length of that manoeuvring segment. The interval value controls the number of displayed ship contours on that predicted manoeuvre track. The selected end position of the manoeuvring segment is indicated by the red ship's contour. Its position can be shifted and adjusted using the slider at the bottom line which is adjusted to 165 seconds after the beginning of the manoeuvre at the initial Manoeuvring Point (MP 0). If this position is accepted it will be acknowledged as the next manoeuvring point (MP 1).

This planning process guarantees the full involvement of the navigating officer. The best version of the manoeuvres can be found by trial and error but it is possible to bring in one's full knowledge and to take advantage of one's skills as it is possible to immediately see and to verify the results of one's own ideas and to make sure that the intentions will work. This is important for safety and efficiency, but also for gaining experience for future manoeuvres.

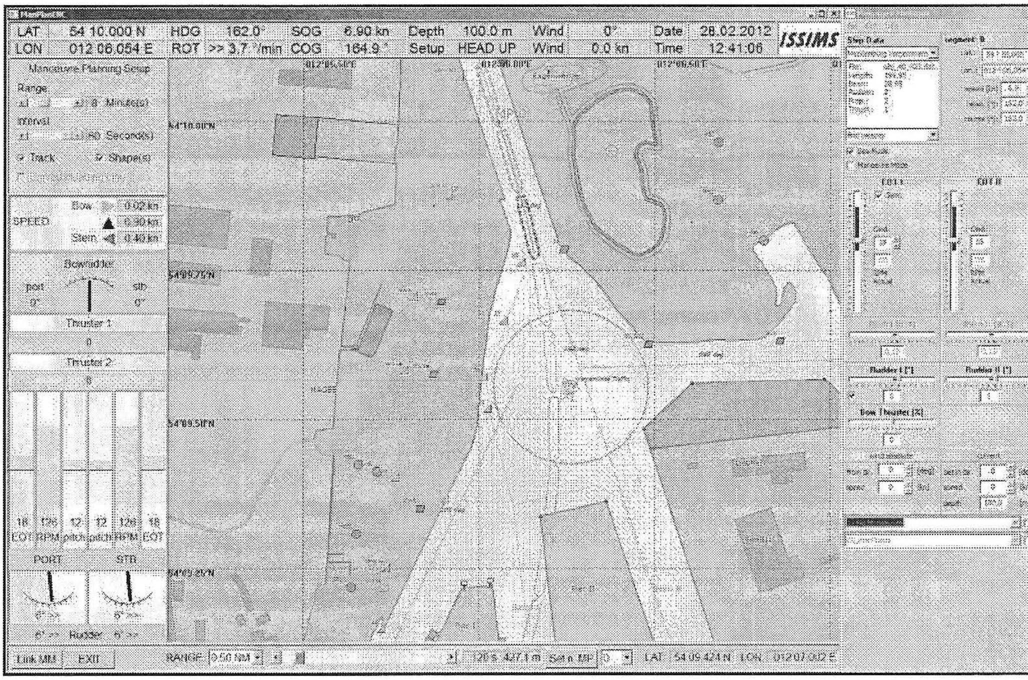


Figure 11 Display for Manoeuvring Design by Fast Time Simulation for immediate presentation of manoeuvring results: Sample for entering the turning area with slight turning to STB from initial conditions in a fairway at initial Manoeuvring Point MP 0

Sample of designing a full manoeuvring sequence as training concept

The planning procedure for a complete manoeuvring plan follows the principles as described for a single segment in Fig. 11. Following that, Fig. 12 presents the situation after accepting the manoeuvre previously planned and now the next segment is to be planned from MP 1 to MP 2 where the ship is going to enter the turning area and slow down. Both engines are set to STOP (EOT 0). In Fig. 13 the complex turning manoeuvre can be seen where the ship is using in-parallel engines, rudders and the bow thruster to turn as fast as possible. Afterwards the engines have to be reversed and the ship controls are adjusted to go astern to the berth. In Fig. 14 the result for the full manoeuvring plan is to be seen with the whole set of Manoeuvring Points (MP) for the complete approach and the berthing manoeuvre.

The different settings of the controls and the track of the planned manoeuvre sequences are stored in a manoeuvre planning file to be displayed in the ENC. For the execution of the manoeuvre this plan can be activated later to be superimposed in the ECDIS together with the actual position of the ship and, most important, with the prediction of manoeuvring capabilities for effective steering under the actual manoeuvring and environmental conditions.

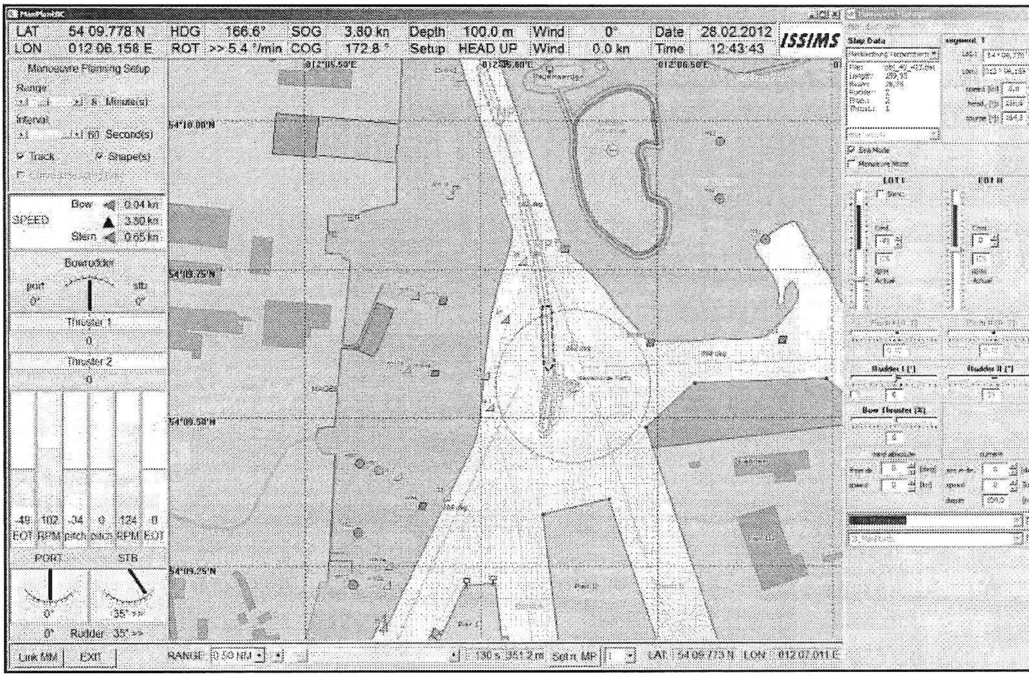


Figure 12 Planning of the next segment from MP 1 to MP 2 – speed reduction

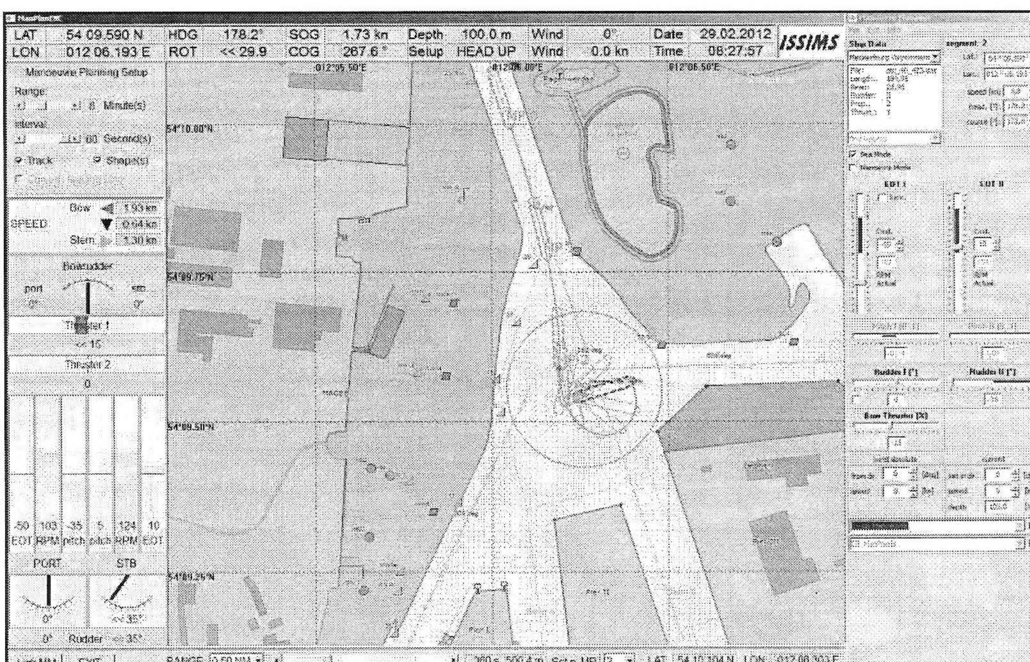


Figure 13 Planning of the next segment from MP 2 to MP 3 – complex turning and stopping with engines, rudders and thruster

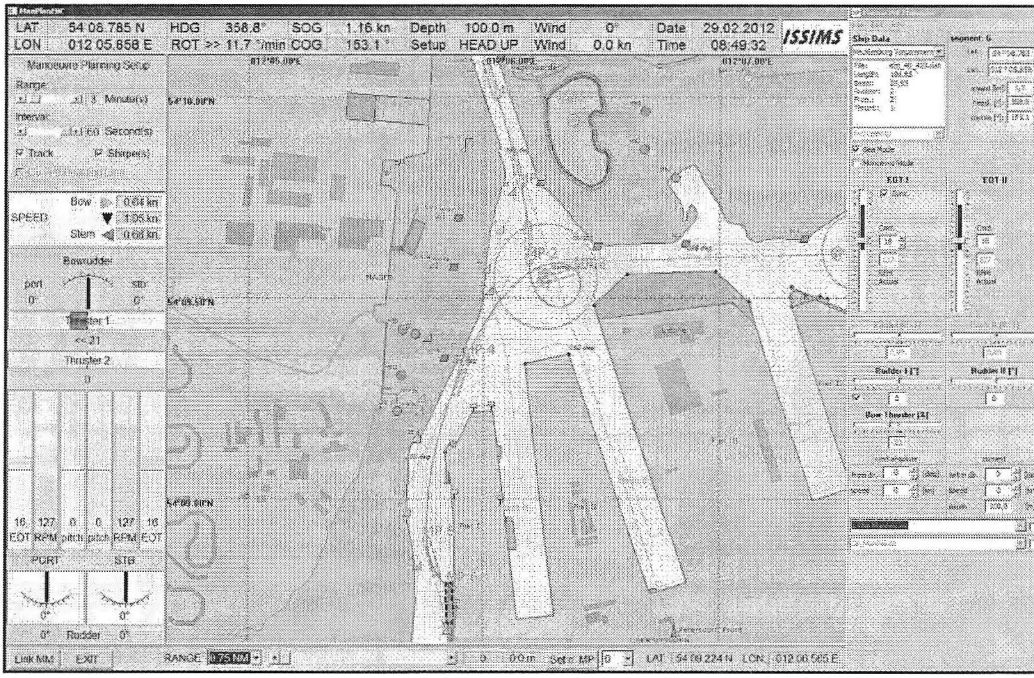


Figure 14 Complete manoeuvring plan for the route segment for passing the turning area and approaching the berth in astern motion

5. Manoeuvring Monitoring and Multiple Dynamic Prediction Module - Overlaid Prediction for On-line Manoeuvring Decision Support using Manoeuvring Plans

Presentation of dynamic predictions in ECDIS environment

For a compact presentation of information to the captain, pilot and responsible navigating officer respectively, a new layout of a conning display was designed and implemented into the equipment installed on an integrated navigation system. For the purpose of testing the technical feasibility and user acceptance the new conning display with the integrated MULTIPLE MANOEUVRING PREDICTION MODULE was implemented in the INS equipment of the large full mission simulator bridge of the ship handling simulator of MSCW. The sample ship is again the RO-PAX Ferry “Mecklenburg-Vorpommern” and the test area is the Rostock Sea Port. The RO-PAX ferry is leaving the berth to be steered through the fairway and leave the port.

The layout of a dedicated prediction display integrated into an ECDIS is shown in Fig. 15. It contains conning information together with the prediction and the planned manoeuvring track. The centre window shows the ENC in Head-up Mode together with motion parameters for longitudinal speed and transverse speed. Also, a circle segment with the rate of turn is shown. The ship’s position is displayed in the centre of the ENC as the ship’s contour where also the track prediction can be indicated as a curved track or as a chain of contours for the selected prediction time. The prediction parameters as range or interval of presentation can be set in the control window at the right side.

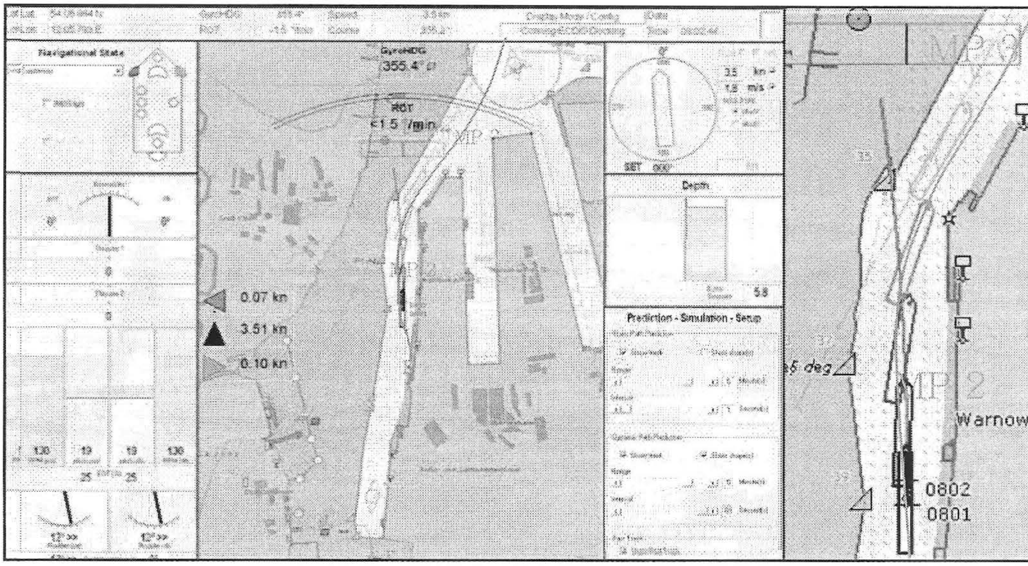


Fig. 15 Layout for Manoeuvring Prediction integrated into ECDIS and comparison of static and dynamic predictions together with planned manoeuvring track (blue line)

The Dynamic Path Prediction with the sophisticated simulation model is shown as a chain of ships contours based on the full math model (ship contours every 60 sec for 5 min with turning to STB). This dynamic prediction already reflects the effect of the setting of rudder and propeller control parameters shown in the left bottom window. In this sample, the two rudders of the ferry are set to 12° Starboard and the Engine Order Telegraph for the two controllable pitch propellers are set to 50% representing 130 rpm of the propeller. The actual pitch status is 19. This interface allows a presentation of dynamic predictions of steering and stopping characteristics as an immediate response according to the current steering handle or engine order telegraph position. It can be perfectly compared with the planned manoeuvring track as a reference line or curve, shown as blue line in the ENC window along the chain of manoeuvring points MP.

The predicted track for the simplified static path prediction based on current constant motion parameters (implemented as add-on in some ECDIS solutions) are shown as a magenta curve. According to the actual/present small rate of turn to Port the predicted track is presented as a circle segment at the left side.

The use of path prediction with simplified models was already mentioned in previous papers. However, the use of these new multiple predictions based on the full dynamic model including the propulsion / engine process together with the result of preceding manoeuvring design is a great innovation and advantage. It was found that, for the application of this dynamic prediction technology, new strategies were found to save some minutes in this area which is very important in tight time schedules [5].

SAMMON Manoeuvring Trial & Training Tool

This module combines a full simulation module for the ship manoeuvring process with all the modules above for planning and monitoring in order to test and try out manoeuvring plans and strategies, to be used both:

- as training tool in maritime education

- in briefing / debriefing sessions for ship handling simulator training,
- as well as in lectures on ships manoeuvring in classes and

- as training tool on board ships.

In order to control the virtual ship during the simulation process a manoeuvring panel on the screen allows steering the ship in real time along the planned route supported by the Multiple Predictor.

6. Integration of SAMMON System into Education for Lecturing & Training Simulation

For training and education, the SAMMON System is available as a portable version based on Tablet PCs for Planning of Manoeuvres in Briefing, Instructor stations and use on Simulator bridges. The SAMMON system is interfaced to the Rheinmetall Defence Electronics ANS 5000 Ship Handling Simulator (SHS) at the Maritime Simulation Centre Warnemünde by WLAN connection. All ships which are available for the SHS are also ready for use in the SAMMON system for the following Concept of Application for Ship handling simulation:

Briefing:

- Demonstrating ship's manoeuvring characteristics by using SIMOPT for familiarisation
- Drafting Manoeuvring Concept as Manoeuvring Plan (using MANOEUVRING DESIGN & PLANNING tool) according to the training objectives
- Optimisation of the concept by several trials of the trainee (using MANOEUVRING TRIAL & TRAINING tool)

Execution of simulator Exercise:

- Training of conventional ship handling procedures by using new FTS technology with underlying manoeuvring plan and dynamic prediction (MANOEUVRING MONITORING & MULTIPLE DYNAMIC PREDICTION tool)

Debriefing:

- Assessment of the exercise results from the full mission SHS by comparison of exercise recordings with trainees own concept or optimised manoeuvring plan by using SIMDAT tool for displaying and assessing the results of the exercise, e.g. comparing the result with the initial concept developed by the student in the briefing session and additionally to discuss alternative manoeuvring solutions by using the MANOEUVRING DESIGN & PLANNING tool).

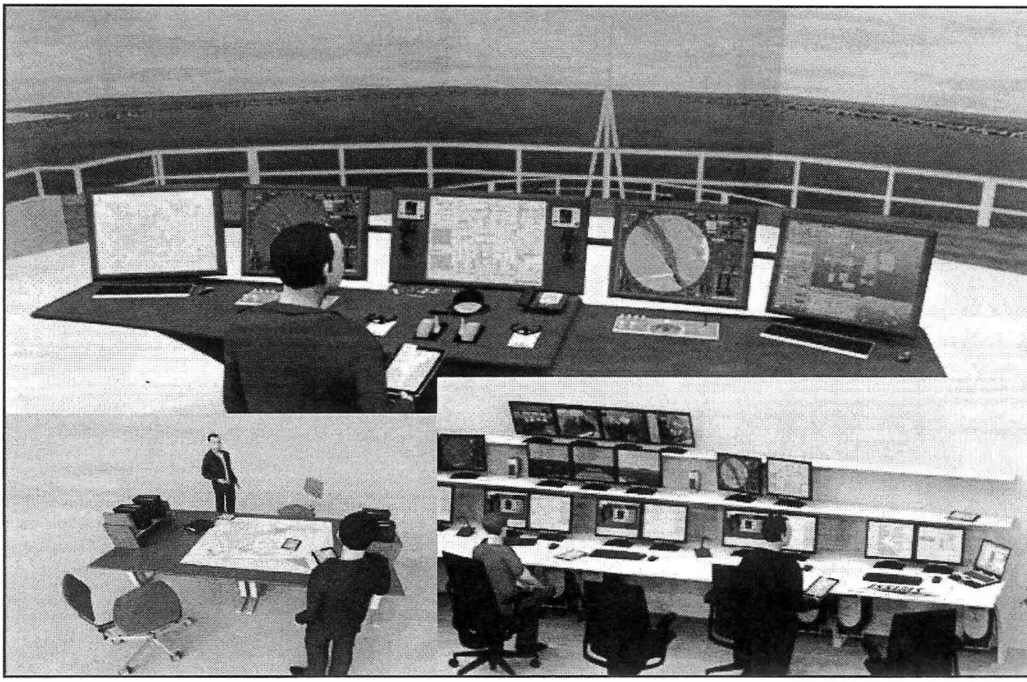


Figure 16 SAMMON System set up based on Tablet PCs within Ship Handling Simulator environment: as Bridge Version (top), Lecturer System (bottom left) and Instructor Version (bottom right)

7. Acknowledgements

The research results presented in this paper were partly achieved in research projects "Identification of multi variable parameter models for ship motion and control" (MULTIMAR), "ADvanced Planning for OPTimised Conduction of Coordinated MANoeuvres in Emergency Situations" (ADOPTMAN), "Multi Media for Improvement of MET" (MultiSimMan), funded by EU, by the German Federal Ministry of Economics and Technology (BMWi), Education and Research (BMBF) and the Ministry of Education and Research of Mecklenburg-Pomerania, surveyed by Research Centre Juelich PTJ and DLR. Additionally it has to be mentioned that the professional version of the SAMMON software tools has been further developed by the start-up company Innovative Ship Simulation and Maritime Systems GmbH (ISSIMS GmbH; www.issims-gmbh.com).

References

[1] Benedict, K., Baldauf, M., Felsenstein, C., Kirchhoff, M.: " Computer-based support for the evaluation of ship handling simulator exercise results" MARSIM - International Conference on Marine Simulation and Ship Manoeuvrability, Kanazawa, Japan, August 25th – 28th 2003

[2] Benedict, K., Baldauf, M., Kirchhoff, M., Koepnick, W., Eyrich R.: "Combining Fast-Time Simulation and Automatic Assessment for Tuning of Simulator Ship Models"

MARSIM - International Conference on Marine Simulation and Ship Manoeuvrability, Terschelling, Netherlands, June 25th – 30th 2006. Proceedings, M-Paper 19 p. 1-9

[3] Benedict, K.; Baldauf, M.; Fischer, S., Gluch, M. Kirchhoff, M.: "Manoeuvring Simulation for Dynamic Prediction Display to be used On-board and in Ship handling Simulator Training" MARSIM - International Conference on Marine Simulation and Ship Manoeuvrability, 36th AGA of IMSF and International Conference, Panama City, Panama; August 17-20 2009. Conference Proceedings p. S-60- to S-70.

[4] Benedict, K.; Baldauf, M.; Fischer, S.; Gluch, M.; Kirchhoff, M.; Schaub, M.; M.; Klaes, S.: Fast Time Manoeuvring Simulation as Decision Support for Planning and Monitoring of Ship Handling Processes for Ship Operation On-Board and Training in Simulators. MARSIM - International Conference on Marine Simulation and Ship Manoeuvrability, Singapore, 23 -27 April 2012.

[5] Fischer, S., Benedict, K.: "Analyses of manoeuvring procedures on ferry Mecklenburg-Vorpommern in Rostock Sea Port and potential improvements using alternative manoeuvring concepts with Dynamic Predictor" Internal research report (in German only), Hochschule Wismar, Dept. of Maritime Studies, Warnemuende 2009

[6] ISSIMS GmbH: Web page for SIMOPT & SIMDAT: http://www.issims-gmbh.com/joomla/index.php/software-products

Recruitment and Retention of Women in the Maritime Industry

Jane Pacht Brickman, Ph.D.
Professor of History, U.S. Merchant Marine Academy
brickmanj@usmma.edu

Abstract: While women maintain a permanent presence in the maritime industry, their numbers have not paralleled the increasing proportion of women in other formerly male-dominated fields, especially medicine and law. These fields now boast even gender representation, at least on the entry levels. And although the armed services share a defining male ethos with the sailing professions, proportionately more women choose to attend military academies than enroll in Coast Guard licensing programs at maritime colleges. Through the oral testimony of mariners, including midshipmen at the U.S. Merchant Marine Academy, and the author's synthesis of conversations, this paper offers a three-pronged approach to enhancing the recruitment and retention of women in the industry. Although based on the history of the integration of women in the United States, its recommendations should have international application. The paper is premised on the belief that diversity is inherently enriching to any field, and anecdotal observations suggest that women bring value to MET institutions and shipping and maritime businesses. Recruitment and retention of more women at all levels of the industry is good business. Change will come by concerted efforts led by industry and government agencies to increase public awareness of the attractiveness of maritime professions and to reach out to young women well before college. Maritime educators today must understand the history of what best facilitated female integration into academies and remain vigilant and ready to adopt policies that further that end. Shipping companies and shoreside businesses must know the value that diversity brings to their operations and hence ensure that their culture and policies are welcoming and supportive to women.
Keywords: Maritime industry, training academies, diversity, women, gender demographics

> "I am a free-spirited person and . . . that's why sailing is so appealing. There is nothing that can compare to a sunset out at sea, especially when you see the green flash on the horizon. . . . And the different kinds of weather and the different natural phenomena. [You go to] places that most people never get to see in their lifetimes." Midshipman Jessica Wiley, KP 2013

> "As a 17 year old, recruitment based on saying you will become a professional mariner would have meant nothing. But saying that I could work and still pursue my passions, get a half a year off and make a large enough salary to

afford to do what I want – that would have gotten me in the door." Midshipman Bernard Underwood, KP 2012

While some join shoreside businesses without earning professional credentials as ship's officers, this paper focuses on bringing more women into the industry via maritime academies, engaging them as ship's officers, and later retaining them and their expertise in shoreside businesses. It has evolved through conversations with midshipmen at the U.S. Merchant Marine Academy [USMMA] and with men and women working at sea and ashore, and although it is based on the U.S. experience, the conclusions apply equally to international MET institutions and maritime businesses. The paper is premised on the belief that it is worthwhile to enhance enrollment of women in the industry, but not because women bring fixed gender-based differences. Instead, diversity is inherently enriching to any field, and anecdotal observations suggest that this remains true for shipping and maritime business. Providing equal opportunities for men and women is certainly fair and equitable; it is also good business.

Success in recruiting and retaining more women as officers in the merchant marine continues to elude maritime educators.[1] Since the 1970s, when maritime colleges in the United States opened their doors to women,[2] the traditional shipboard hierarchy between the sexes has been jolted. But rocking the boat has not equated with transforming the profession. While women maintain a permanent presence in the maritime industry, their numbers have not paralleled the increasing proportion of women in other formerly male-dominated fields, especially medicine and the law. These fields have now closed the gender gap, at least at the entry level. (The STEM professions – the sciences, technology, engineering, and mathematics – continue to struggle with attracting and advancing women, but the proportion of women there nonetheless exceeds women's presence in maritime jobs.) And although the armed services share a defining male ethos with the sailing professions, U.S. military academies attract proportionately more women than maritime colleges.[3] Eager to increase female enrollment, maritime colleges have wrestled with recruitment issues, experimenting with varied ideas for bringing in more women. Yet enrollment remains stubbornly and persistently low.

Change will come only from a unified effort that involves industry and government promotion, attention to the education of women mariners, and deliberate efforts by the shipping industry and shore-side businesses to enhance gender mix by articulating the value that diversity brings to industry performance.

1. Get the Word Out

If female recruitment is to increase, the merchant marine and the reasons why a young person should aspire to become a ship's officer must become part of national (and international) conversation. Unlike in the days of packet ships, clippers, whalers, or steamers, with the ubiquitous understanding that shipping was the lifeline of nations, and with diminished recognition of the heroic role of the merchant marine in World War II, today most citizens know little or nothing about an industry still responsible for carrying over 90 percent of world trade and maintaining the logistical pipeline in international crises. Contemporary news of piracy at sea may provide some vague public awareness of the merchant marine, but the image is not encouraging. "People don't directly interact with the merchant marine the way they do with planes or trains, even though every day the goods they get and use . . . are delivered though the merchant marine. . . . [T]he key lies in showing how much the industry aids and affects everyone on a daily basis – that most things they buy have been shipped – and also the second message is how useful it is during a time of war."[4] Altering public perceptions is a necessary first step.

Through posters and movie trailers, the Marine Corps and the Coast Guard recruit young people by appealing to their idealism, desire to serve the country, and quest for adventure and travel. All of this can be said about the merchant marine (indeed, with a dramatically lower threshold of danger), but it is not. Jessica Wiley, a junior at the USMMA, noted that "the maritime industry might boast a bit. It's a lucrative career."[5] In general, the "romance" must be restored to the sea. As a young captain put it, we should emphasize "the responsibility and leadership aspect in much the way the Army or Navy might – profile a young officer [who] has just brought an $800 million ship through the Singapore Straits in a way that combines 'cool' with leadership."[6]

In the United Sates, the Military Sealift Command advertises, but primarily in military or maritime journals, to people who already have made professional commitments.[7] Outreach to women should start as early as the middle school years by identifying the maritime profession as a STEM career. Advocates for increasing the number of women in STEM areas know that the time to promote must start when young girls begin imagining independent lives for themselves and before they make decisive course commitments in high school.[8] Early intervention that allows young women to conceptualize themselves as ship's officers promises more deliberate and informed decisions to attend maritime academies.[9]

Young people with technical bents should be exposed to these ideas:

- For Captain Ben Lyons, serving as a ship's officer "has been an immensely satisfying career choice. . . . The appeal is based on many things: travel, of course. The job of not working in an office, sitting in front of a computer all day. The wonderful aspects of developing a 'ship family'. . . . The pay and ability to save money quickly. The satisfaction in gaining actual talents that you can apply and use – and the challenges that you face on the job, and the satisfaction you get from accomplishing them. The job is actually doing something – you are able to sign off every four hours and say, 'I accomplished this' and that isn't true in an office job. . . . You can see results.[10]
- Ship's Master Susan Orsini, an officer for 22 years, says, "if anything has influenced my career, it has been my desire to appreciate the world. Other people, other customs." [11]
- For Midshipman Kristin Bell, "there is something about being in control of a 900 foot ship . . . up there driving." [12]
- Third Mate Eric Mueller feels privileged: "I don't know anyone, besides a mariner, who has gone from the Roman Coliseum to the Tokyo Imperial Palace or who has seen the sunsets and starry nights that I have witnessed."[13]
- Connie Buhl, who retired after 22 years at sea, including as Chief Engineer, says that sailing was "cool . . . the best part-time job ever," where she experienced every "food group" that engineering presents.[14]
- Asked about the attractions of a maritime career, Jacqueline Twomey replied, "Travel opportunities. Good pay. Not being tied to a desk. New/changing technologies. Interesting people. Making a difference in the worldwide national and regional economies."[15]
- For Chief Mate Russell Horton: "I know that I could NOT do an '8-to-5' desk job and keep my sanity. . . . Sailing's appeal lies "with a 2-month-on, 2-month-off schedule. . . . Everyone . . . is ALWAYS jealous of the fact that I have two months at home to do anything I please. . . . When I was single, I played golf . . . took multiple

backpacking trips to Europe, and long trips to visit old friends. With a family, we focus on the time I'm at home: I get to be 'Mr. Mom' and be the primary care giver to my kids."[16]

- Chief Mate Terrie Bailey considered becoming a pilot, but "after sailing, literally all over the world, I find that is what I like. I enjoy interacting with people all over the world. I love that I have celebrated Eid with my Kuwaiti friends, that I've spent 5 and a half months living in Dubai. I've visited the Massei Tribe in Mombassa, ridden a camel down the beach along the Indian Ocean."[17]

Pre-college students need to know that upon becoming a ship's officer, a freshly-minted college graduate serving as a third mate or third assistant engineer moves immediately into a supervisory position. What other college graduate enjoys a 22-step commute to work (the bridge), has few papers to push, and makes decisions that are critical? To be a ship's officer, "you are it."[18] In contrast to an office job, sailing confers "independence" and "a sense of mastery of an ancient art. It felt rewarding to know how to navigate a massive vessel safely from one side of the world to the other."[19] This message, if it gets out, should resonate.

2. Maritime Educators

But recruitment does not ensure retention. Following the admission of women in the 1970s, U.S. academies struggled to hold female students, who, notwithstanding strong academic predictors, too often disenrolled.[20] Some early graduates of maritime schools likened their stays to "Lord of the Flies" experiences.[21] One sensed that "the school really did not want women in 1979 but they had to accept us."[22] Even after achieving a successful maritime career, more than thirty years after graduation a ship's officer broke down as she recalled her exclusion by classmates.[23]

Academies began to reverse high female attrition with the recognition that equality is not synonymous with sameness. One early 1980s graduate of the USMMA remarked that "the academy's approach to a mixed-gendered culture was to treat all students equally, without regard to gender. The difficulties arose because the fact is that men and women ARE different."[24] Increasingly, academies recognized that an equal education required some special programming for the female minority. With dramatically lopsided gender ratios, ensuring equality meant establishing arenas in which women might overcome their isolation and share strategies for navigating a shockingly new culture.[25]

Academies, including the Department of Defense schools, moved toward policies that were designed specifically to make schools more welcoming to their female minority.[26] At the USMMA, to stem female attrition, equalize the playing field, and neutralize the pernicious power of numbers, the administration adopted "conscious" policies that recognized that an equal education depended on acknowledging the divergent experiences of men and women. If women students were not to be silenced, if they were to be considered successfully-integrated full citizens of the student body, special programs were essential. Today, it remains pertinent for maritime educators to review these early efforts, prompted in part by studies of women's status on college campuses, to make maritime education truly coeducational.[27]

New USMMA academic scheduling, placing at least three women in each section, changed class dynamics and enhanced the quality of education for both men and women, as it improved female retention. Faculty and staff training increased awareness of possible inadvertent behavior that underscored womens' sense of isolation and reinforced stereotypes about female capabilities.[28] Pairing women cadets aboard merchant vessels for their training and debriefing them on their return improved the quality of the cadet experience by flagging hostile ships and crew members. Matching first-year female midshipmen with upper-class mentors reduced mistakes seemingly repeated by each incoming class of women and ending female exclusion from high leadership positions provided role models for underclass women.

Two other changes at the USMMA helped reverse the loss of women students. A female advisor, who coordinated a substantial program, provided women students with forums or "safe places" for discussion, individual advisement, and opportunities to hear from accomplished women in the field. These programs often came under criticism as "special privileges" and sometimes were attacked by women themselves for spotlighting them and seemingly exacerbating male animosity.[29] Nonetheless, surveys and correspondence reveal that this decade-long program at the USMMA enhanced women's confidence and resulted in happier campus lives and more informed career choices. One 1989 graduate remembered a program in which a woman pilot spoke to the female midshipmen: "She was very impressive, very professional, but very down to earth. She shared with us that she was momentarily terrified during her first maneuver situation and then she remembered, 'Rules – go right!' It was very encouraging and I've never forgotten it. Many times through the years when I've been unsure, I've remembered that she also felt unsure at times and that she persevered and that has encouraged me."[30] Speaking about the female advisor, another 1989 graduate wrote: "We always knew that we had at least one person at that place that cared about the women and tried to help us."[31]

Second, adding more women's team sports proved essential to the recruitment and retention of women, giving them (beyond the inherent reward of playing a cherished sport) a sanctioned space to bond, share support, and bolster confidence. Athletic teams are perhaps the only arena at academies where women can simply be themselves. As derivatives of participation in a team sport, in addition to learning team unity (critical for success aboard ship or in the military or corporate world) women on the Kings Point Varsity Basketball team described their acquisition of leadership and time management skills and the abilities to deal with stress and adversity. But mostly, they spoke about the distinct function of women's teams in a school where men significantly outnumber women. For Rebecca, "you're free here. You're free to be who you want to be, how you want to be it, and you just play basketball." Katie offered: "This sounds kind of . . . corny. But . . . we're like a big family. And I know that whether it's on the court or off the court, I can depend on these girls. I can go to them with anything." Allison likened her experience on the basketball team to "a sorority at a normal college. Like a family of girls that you can rely on."[32]

Even with progress, until women represent a "critical mass" (20 to 25%) in the student body, skewed gender demographics demand that maritime educators create programmatic counterweights that help to ensure equal educations for the "token" group.[33] While the passage of years and more human relations training has mitigated group behavior at the USMMA, separate meetings for women remain important instruments for female confidence and problem solving. What accommodations must women students make to an atmosphere dominated by men, and where do you draw boundaries? Speaking in an all- women's group, Casey acknowledged that in "an all male environment, you just have to let [certain] things slide. You have to learn to cope . . . because you are going to sea. . . . [But] if you are not comfortable, you need to speak up and say something. They will listen." Lauren shared that while she was a cadet on her last ship, she had a female engineer. "She would give it right back to the men. It's really nice to see; I really enjoyed it." What works best for a woman cadet in the ship's engine room for the first time? Casey asserted, "you go down [to the engine room] every morning with a smile on your face. . . . And if you can prove to them that you're trying, you're asking questions, you're interested, then they're going to give you more jobs. . . . They'll respect you."[34]

And there needs to be discussion of the historical resistance to women's presence aboard ships and the difficulties that have arisen from that: "There needs to be a place to talk about things that have gone wrong for women and how they have handled them. These are difficult things to talk about, but . . . as long as we continue to gloss over them, or ignore them . . . women will be doomed to repeat the mistakes of others."[35]

Women's cadet experience must still be monitored; as it was forty years ago, the apprenticeship is decisive to a woman's choice of career path. "Upon graduation, I really thought about sailing. But the reality was that on the four ships I sailed on as a cadet, two were awesome experiences, and two ships were a living hell (crew morale, fear of sexual assault, etc.). I wasn't truly confident that the 50% track record was compelling enough to take my chances on a ship. What if I got another bad vessel?"[36] And, like on other college campuses, incidents of sexual harassment and assault must be met with strong policy that provides safety for victims.[37] Finally, campus culture must be tracked with climate surveys, the results of which cannot be left fallow. New policies to further women's integration must be adopted with the confidence that in reducing gender inequity, the overall educational experience of male students is enhanced.

3. The Shipping Industry

For most women, the decision to become a ship's officer is connected intimately to what occurred (or did not occur) at their maritime colleges. Did women get equal opportunities to develop confidence and leaderships skills? Was the cadet experience marred by hostile crews? And did women undergraduates find answers to the nagging lifestyle issues that a sea-going career poses? If more women are to choose to sail on their licenses, they need to hear from women officers. They need to know that sailing does not preclude marriage and family and that beyond blue water sailing, opportunities exist for inland sailing, in ferry and tug boat operations, and on cruise liners. Women also need assurances that five years' blue water sailing is a legitimate and productive option, providing officers with strong credentials that can be parlayed readily into graduate school admissions and shoreside employment.

What can the industry do?

> "I am wondering if the shipping companies are actually interested in hiring more women." [38] If more women are to become ships' officers, this vexing uncertainty must be dispelled. Interviewees suggest that the industry should:

- Pay attention to quality of life issues that pose the biggest downside of sailing: separation from family and friends. Ships must be equipped with email and satellite phone service. "Nowadays technology enables vessels to have internet and other communication devices that can connect people even if they are in the middle of nowhere. [Also], since the crew is bound to be on the ship for a long time, nice warm rooms with good food makes the whole experience more attractive. It is not just a job, it is also life and that should not be forgotten."[39] Companies also must post and enforce policies banning discrimination and harassment and ensure that complaints are responded to promptly and without retaliation. Attention to these areas pays dividends in a happier crew.
- Take a hard look at itself: Are women officers subject to a double standard, measured by a professional model that does not apply to male colleagues? Must women

still work twice as hard to prove themselves and are they held to a level of competence that their male colleagues escape? What are the shared difficulties of shipboard life and what can be done to address the difficulties that women alone face? A three-decade ship's officer reported: "I have over 30 years of stories. Most of the stories are general, not female related. Most of the female related ones are not the good ones. It has never been a benefit to be a woman at sea. It has made the work more difficult. Every new ship is a proving group where they watch you and expect you to fail. They don't treat men that way."[40] Men and women ships' officers need to talk together about these perceptions.

- Sponsor conferences for men and women ships' officers to discuss the shared challenges of sailing, as well as the more intense isolation of women. Conferences build pride and foster mutual respect and collaboration. Today, with supertankers and megaships, small crews, and brief port calls, conferences help to create community among seafarers.
- Underwrite a study exploring the values that women bring to shipboard life. The desire to attract more women to the industry must be more than a numbers game, with interest rising or subsiding reflexively to fluctuations in industry demand for officers.[41] The industry, broadly defined, must understand and articulate the impact of enhanced diversity in its leadership corps. Anecdotal reports suggest that the presence of women officers brings greater civility to shipboard life[42] and establishes more cordial environments. "I have noticed that there is an increased respect for everyone on board, with less noise and fewer arguments."[43] One female chief mate gives birthday cards to all aboard and hangs stockings at Christmas. On a more substantive level, do women officers present styles of leadership that add profit to ships' operations? In an interview, this same chief mate recalled her success, after the "arrogant" skipper's failure, convincing a foreign port agent to send a launch so the ship could offload garbage.[44] Captain Orsini learned of racial conflict aboard her ship and called crew and officers together, not to lecture them, but to tell their stories. Reminders of their common humanity ended the conflict.[45] Chief Mate Horton spoke of a woman third with whom he had sailed for three years: "She was aware of Muslim culture and practices, so that helped us. Most of the time, half of the unlicensed crew is Muslim and the majority of the officer corps is WASP." He continued, "all other things being equal, ships having more diversity and culturally-moderate people would probably be more profitable."[46] Do women bring different qualities to leadership that contribute to shipboard success? Chief Mate Bailey couldn't say, because in almost two decades at sea, she hadn't sailed with another woman. She could only describe her leadership: "as 2/M I had an AB that had kidney stones. I was up with him around the clock for 500 miles, until we were able to get him off the ship and to a medical facility. He was writhing in pain, crying like a baby, and I just sat there, holding his hand."[47] Are these examples idiosyncratic or does diversity also improve shipboard operations? It should benefit the industry to know.
- Address the marriage and family issue head on.[48] One maritime couple, both ships' officers, sailed separately for three months and stayed home together with their children for six months.[49] Allison Buckler sailed blue water for two years until she became pregnant. As a pilot now, she finds motherhood and sailing easily compatible.[50] What other adaptive permutations have ship's officers made to accommodate professional and family lives? Might not sailing be a five-year option, before mar-

riage and family, "a great way to save money, learn skills, travel, get a different/broader perspective on the world, and really learn what responsibility entails and feels like, and gain practical experience in leadership"?[51]

- Establish a mentoring network linking women in the industry to those in maritime education and training institutions. "Especially since there are so few of us . . . and even fewer in my position," Captain Orsini asserts, it is critical to "support, aid, mentor and share with women in the community."[52] Mentors are essential agents to "pitch the idea that working on a ship is an 'empowering place' where you get to make decisions within the 'enclosed society' [in which] you live."[53]
- See sailing as a part of a career path, not necessarily an end in itself. Ships' officers present enormous professionalism, skill, and international breadth, qualities that are highly marketable. Maritime students should be exposed to the professional options; ships' officers become pilots and shore-side marine engineers, attend graduate school, and move into the business, government, and regulatory spheres.
- Place entry into maritime businesses on a continuum that starts with work in the field – at sea. A commitment to hiring former ships' officers would encourage all maritime professionals to initiate their careers at sea. Patty Finsterbusch's career represents a successful example about which fledgling mariners should hear. After graduation from the USMMA, she sailed on a tanker for five years, then moved ashore to become a port engineer and currently works in the operations department for Keystone Shipping. This migration allowed her to marry and have a child and belies the notion that shipping out is antithetical to happy family life.[54]

4. Shoreside Businesses

The literature around the integration of historically male professions suggests that to achieve real diversity, the maritime industry must engage in candid self-assessment of its business climate, asking difficult questions that probe the "nuances of exclusion."[55] Examining subtleties, although difficult, is essential to culture change. What is the composition of meetings? Do women speak freely without interruption? Are there role models in the company? Very often elements that are seemingly innocuous to the majority have silencing and discouraging impact on the minority. Self-evaluation also includes discussion of images. For example, do maritime journals project an inclusive industry? Do articles and photographs display women in authority? Even business outings and networking events need to be scrutinized to assure that they do not impose subtle exclusion.

What must shoreside companies do to foster greater diversity?

- Audit women's presence within companies, including their qualifications, salary scales, and rates of advancement. The maritime industry is both insular and diffuse, small yet far-flung. Nonetheless, leadership commitment to gender inclusion can result in common effort.
- Establish company mentoring programs, aligning senior and entry-level women. Female camaraderie is critical to retention.
- Encourage and support female employees who wish to attend conferences devoted to women's issues and networking.[56]
- Adopt deliberate integration policies until women achieve a critical mass. Although written of engineering firms, these words apply equally to maritime fields: "When someone asks, 'why special programs for women?' the answer must be that women

. . . do not need special help to be good engineers, but they do need to benefit from assistance in dealing with engineering culture."[57]

- Ask difficult questions. Has industry culture shaped a gender division of labor that discourages women? To gauge women's progress by numbers alone may obscure differences in hiring patterns that prevent women from reaching the top. Are women "ghettoized" in HR, marketing, and planning, jobs that do not generate profits and hence take women out of the competition for top positions? Are women working as port captains, area managers, terminal managers, or operations managers in meaningful numbers? "Women I've seen tend to dominate the 'administrative' support staff within shipping companies. Women tend to get pigeon-holed into a specific sector of their company . . . The woman in the highest position for my company is the Vice President of marketing. Within the operations division of the company, the woman in the highest position is the head of the 'claims' department and serves as the company's ISP/ISM coordinator. She has been in the claims department for over 20 years."[58] Are jobs in the non-operational areas more expendable? One woman who has worked in the business end for several decades and wished to remain anonymous described a recent reduction in force, "with about ten percent [in her company] being terminated. The interesting thing was that all but one person were women. Because women are in purely staff or administrative roles . . . they are much more vulnerable when downsizing occurs."[59] A systematic study of the positions women hold must endeavor to learn if barriers – the "glass ceiling" – bar women's full advancement.
- Change must be driven by the top. Beyond saying the right things, company leadership must make diversity happen by shaping new structures, committing resources, and requiring contractors to make the same commitments. For example, mentoring generally is not "organic" to the culture of maritime business, but it is often pivotal to the success of junior women. Mentoring programs and female affinity groups must receive the support of top company leadership. The benefits of enlightened management should not be minimized.[60]

5. Conclusion

The almost uniform maleness of the maritime industry has receded dramatically over forty years. The presence of women at maritime academies, as officers aboard ship, or in the senior levels of maritime business no longer ripples in shock waves or overt resistance. But numbers are still numbers, and extreme disproportion has impact on behavior. Dramatically imbalanced gender demographics may diminish the contributions of women to the maritime profession without policies that recognize the discrepancies caused by numbers. Recruitment and retention of women remain relevant concerns. The challenge can be met successfully through deliberate partnership among the three branches of the industry. Maritime educators and shipping and shoreside business leadership must embrace, affirm, and broadcast the value that diversity brings to the overall performance of the industry. Shipping is the quintessential global industry; its historical multiculturalism has always been a benefit. The same must be said for the value that women bring to the industry.

Endnotes

[1] In 1988, the IMO initiated efforts to interest more women in becoming ships' officers, by establishing a Women in Development Program to encourage MET institutions to recruit more women. In 1997, the IMO spoke of women as "under-utilized" resources. Although in 2003, an estimated 2% of international seafarers were women, it is unclear if this figure includes women crew members or only female officers. See Belcher, P, Sampson, H., Thomas, M., Veiga, J, and Zhao, M., *Women Seafarers. Global Employment Policies and Practices.*_(Geneva: International Labour Office, 2003), pp. 7, 8 41. The U.S. Coast Guard does not track the number of credentialed officers by gender.

[2] Maine Maritime Academy was the first maritime college to admit women, in 1973. In July 1974, the USMMA became the first federal service academy to enroll women. They entered the other US federal service academies, the Military Academy (West Point), Naval Academy (Annapolis), Air Force Academy, and Coast Guard Academy, in 1976.

[3] At the USMMA, where all graduates are required to earn U.S. Coast Guard licenses, women's representation has never exceeded 15%. For past figures of female enrollment, see *Final Report by the USMMA Women Recruitment and Retention Working Group*, January 31, 2007. Currently, the other federal service academies have female populations of between 20 and 25%. And the Marine Corps, the most thoroughly male military service, boasts a female representation of 15% and is currently creating new policy that should "open the door to thousands of new jobs for women." See "Marines Moving Women Toward the Front Lines," *New York_Times*, April 25, 2012. By contrast, In the 1970s women made up 1% of engineering college majors in the U.S.; in 2005, 20% of engineering majors were women. See Bystydziendski, Jill M., *Women in Academic Science. Removing Barriers: Technology, Engineering, and Mathematics* (Bloomington: Indiana University Press, 2006), p. 94.

[4] Benjamin Lyons to Jane P. Brickman, email interview, May 12, 2012.

[5] Jessica Wiley to Jane P. Brickman, interview, February 9, 2012.

[6] Benjamin Lyons to Jane P. Brickman, email interview, May 12, 2012.

[7] Captain Susan Orsini to Jane P. Brickman, interview, April 25, 2012.

[8] See, for example, Thom, Mary, *Balancing the Equation. Where are Women and Girls in Science, Engineering, and Technology* (Washington, D.C.: National Council for Research on Women, 2001).

[9] In a 2006 survey of the 517 women USMMA graduates, a third of the respondents said they had applied to the Academy because it was tuition free. See *Final Report by the USMMA Women Recruitment and Retention Working Group.*

[10] Lyons to Brickman, May 12, 2012.

[11] Susan Orsini to Jane P. Brickman, email interview, May 11, 2012.

[12] Kristin Bell to Jane P. Brickman, interview, February 9, 2012.

[13] Eric Mueller to Jane P. Brickman, email interview, April 11, 2012.

[14] Connie Buhl to Jane P. Brickman, interview, April 23, 2012.

[15] Jacqueline Twomey to Jane P. Brickman, email interview, April 26, 2012.

[16] Russell Horton to Jane P. Brickman, email interview, April 28, 2012.

[17] Terrie Bailey to Jane P. Brickman, email interview, July 14, 2009.

[18] CDR Dennis Compton to Jane P. Brickman, interview, April 23, 2012.

[19] Rick Mariner to Jane P. Brickman, email interview, May 29, 2012.

[20] In the early years at Kings Point, women's attrition often was 40% or higher. See Jane P. Brickman, "Maritime Education and Training of Women: Their Impact on the Program at

the United States Merchant Marine Academy," in *Conference Proceedings*, International Maritime Lecturers' Association, 2009.

[21] Laura Kovary to Jane P. Brickman, May 1, 2012. Jacqueline Twomey, a 1989 USMMA graduate, now a Commander in the U.S. Coast Guard, recalled, "When I was [at Kings Point], there was a persistently vulgar term for women, 'KP Cracks.' I can remember walking to class past a group of other students and then someone from behind would start saying, 'crack, crack.' I am sure you've heard of KPA for Kings Point ass, to indicate that the women tended to get fat bottoms." Twomey to Brickman, April 26, 2012. In 1988, the U.S. Maritime Administration ordered California Maritime Academy to investigate several serious allegations of harassment of women students. See *Report of Investigation into Allegations of Sexual Harassment and Discrimination at the California Maritime Academy*, June 1989. The report revealed a decade of harassment and intimidation of women students and a failure of leadership in response to complaints.

[22] An anonymous comment by a woman graduate of the USMMA. See Alumni (2007), "Survey of USMMA Women Alumni," developed by the USMMA Committee on Women's Recruitment and Retention.

[23] Mary Grimshaw to Jane P. Brickman, Interview, June 14, 2009. Another early USMMA graduate said: "The way I was treated by male classmates. It was truly brutal. They admit that now." "Survey of USMMA Women Alumni."

[24] Debra Krouse to Jane P. Brickman, email interview, April 25, 2012.

[25] These included lunch and dinner meetings, some around specific topics and others just social, and opportunities to meet with female graduates, and to attend professional conferences.

[26] For example, the U.S. Military Academy created the Corbin Seminar – named for Margaret Corbin, a hero of the American Revolution. The seminar annually gathered cadets and midshipmen for all of the service academies to discuss issues unique to women's experiences at academies and to promote better human relations climates on academy campuses. Following its investigation of women's status on campus, CMA sought to recruit female professional faculty and counselors, initiated human relations training, and held separate meetings for female students to discuss their concerns with administers.

[27] In the 1980s, the Association of American Colleges began sponsoring studies of college campuses with an eye toward understanding gender equity. The studies revealed that even on college campuses where men and women were evenly represented, women spoke less frequently in class, received less mentoring from faculty, and assumed fewer campus leadership positions. See, for example, Hall, Roberta, "The Classroom Climate: A Chilly One for Women?" (Washington, D.C.: Association of American Colleges, 1982); Krupnick, Catherine G., "Women and Men in the Classroom: Inequality and Its Remedies," *Teaching and Learning* (Volume I, May 1985).

[28] Educators learned about the connection between self-esteem and learning. "Chill" involves forms of inadvertent behavior that heighten the exclusion of a minority group. In unwelcoming environments, the education of the token group suffers. Although the early USMMA graduates did not have a name to attach to their experiences, their recollections reflect a "chilled" classroom experience: "One [professor] refused to call me by my name; instead [he] called me Mr. and my last name." Another wrote: "I felt most instructors would have celebrated my failure. I heard several times that I took a spot from a man and therefore shouldn't have been there. It was very hostile." Another: "The majority of my

instructors ranged from nonchalant about my progress to downright hostile and verbally abusive." 2006 Survey of USMMA Alumna.

[29] In professional environments that were formerly homogeneous, minority groups struggle with the "riddle of acceptance" – the balance between maintaining separate identity and fitting in to the dominant population. Statements by female graduates about the advisory program reveal this tension: "Stop focusing on 'female midshipmen.' It only perpetuates the myth that women have it easier than men and makes it more difficult for female midshipmen." 2006 Survey of USMMA Alumna.

[30 Jacqueline Twomey to Jane P. Brickman, email interview, April 27, 2012.

[31] Nancy Regan to Jane P. Brickman, email interview, April 26, 2012.

[32] Focus Group, USMMA Women's Basketball Team, conducted by Professors Laura Burton and Jane P. Brickman, February 9, 2012.

[33] Critical mass theory applies to shipboard life as well, but until more women are recruited and retained, it is unlikely to be achieved soon. Cadet Jessica Wiley noted the dramatically different dynamic when she trained on a ship with six other women aboard. Interview, February 9, 2012.

[34] These remarks were made in a focus group of the USMMA Women's Swim Team, April 26, 2012. The focus group discussion was led by Professors Burton and Brickman.

[35] Laura Kovary to Jane P. Brickman, email, April 26, 2011. For example, at Kings Point, gathering women to talk allows them to sort out comments from their male peers. During the focus group, members of the women's basketball team laughed about some of the denigrating statements of their peers, i.e., never date an academy woman. Laughing together is restorative and helps prevent damage to self-esteem.

[36] Captain Jennifer Williams, USCG, to Jane P. Brickman, email interview, April 5, 2012.

[37 U.S. academies are hiring SARCs – Sexual Assault Response Coordinators. A campus SARC monitors the climate, trains students on sexual assault prevention and response, and is the point of contact when a sexual assault has occurred. Policies give victims the options of "unrestricted" or "restricted" reports; the latter permits the victim to receive help even if he/she does not wish to make a public charge that would initiate an official investigation.

[38] Krouse to Brickman, April 25, 2012.

[39] Ana Petrovic to Jane P. Brickman, email interview, April 23, 2012.

[40] Mary Grimshaw to Jane P.Brickman, email interview, June 9, 2009.

[41] The International Labour Office should conduct a follow up to *Women Seafarers*, its 2001 study.

[42] In separate interviews with Captain Peter Kahl, CDR Dennis Compton, Chief Mate Bailey, Chief Mate Horton, and Midshipman Wiley, each confirmed to the sense of "normalcy" that derives from women officers' presence on merchant vessels.

[43] Horton to Brickman, April 27, 2012.

[44] Bailey to Brickman, July 14, 2009.

[45] Susan Orsini to Jane P. Brickman, May 15, 2012.

[46] Horton to Brickman, April 27, 2012.

[47] Bailey to Brickman, July 14, 2009.

[48] The findings of Michelle Thomas suggest that shipping companies' oft-stated rationale for not hiring women – that they will leave shipping once they start families – is incomplete. Many male mariners see blue water sailing as a chapter in their maritime careers and plan to leave once they have children. Thomas, M., "Get Yourself A Proper Job 'Girlie!':

Recruitment, Retention, and Women Seafarers," *Symposium 2003*, Seafarers International Research Center, Cardiff University, 2003.

[49] Connie Buhl shared this story of her friends' arrangement to Brickman, April 23, 2012.

[50] Allison Buckler to Jane P. Brickman, April 23, 2012.

[51] Lyons to Brickman, May 12, 2012.

[52] Orsini to Brickman, May 15, 2012.

[53] Horton to Brickman, April 27, 2012.

[54] Patty Finsterbusch to Jane P. Brickman, email interview, June 2, 2009.

[55] *Balancing the Equation*, p. 11. See also Rossiter, Margaret, *Women Scientists in America: Struggles and Strategies to 1940* (Baltimore: Johns Hopkins University Press, 1982); Rosser, Sue V., *The Science Glass Ceiling. Academic Women Scientists and the Struggle to Succeed* (NY: Routledge, 2004); Brockman, Joan, *Gender in the Legal Profession. Fitting or Breaking the Mould* (Vancouver: UBC Press, 2001).

[56] The U.S. Maritime Administration sponsors annual Women on the Water conferences. In 2011, the topics included Rules of the Road for Women at Sea, Transitioning to Being a Pilot, Transitioning to Government Service, Transitioning to Maritime Ashore. AcademyWomen, a mentoring organization for women on active-duty service (and veterans), holds an annual symposium for women in the military to share their experiences.

[57] Burack, Cynthia and Franks, Suzanne E., "Telling Stories about Engineering: Group Dynamics and Resistance to Diversity," in *Women in Academic Science*, p. 104.

[58] Horton to Brickman, April 27, 2012.

[59] Email to Jane P. Brickman, August 20, 2009.

[60] I thank Susan Hayman for these insights. Phone interview, May 30, 2012.

The Role of the Baltic Sea Region and Poland as a New part of the European LNG Market

Laczynski, Bogumil
Professor Doctor, Master Mariner, Gdynia Maritime University,
acamars@gd.pl

Abstract: The paper presents the actual situation of the import of LNG to the Baltic Region and contains the latest information about the new building of an LNG Terminal in Poland. The construction of the external port in Swinoujscie along with the terminal for LNG unloading constitutes one of the largest investments carried out in the post-war history of Poland. The fundamental objective of the investment is diversification of gas suppliers to Poland. The external port will be located within an area of approximately 130ha and the terminal surface will be approximately 48 ha. The external port will be able to receive 300-meter long ships with 100 000 DWT and draughts of 13.5 m. The LNG terminal will be capable of handling gas tankers with 200 000 m^3 and the capacity of the terminal will amount to 2.5 b m^3 of gas per year. The first ship will call at the Świnoujście LNG terminal in 2014. The paper addresses competition from pipelines, characteristics of the first LNG vessel build in a Polish shipyard in 2009, whether the shale gas revolution will reach Poland and plans and projects for building new LNG terminals and LNG bunkering stations. Also addressed is the EU strategy for the Baltic Sea Region, formal risk assessment for LNG carriers in the Baltic Sea Area, challenges for Maritime Education and Training concerning LNG investments in Baltic Regions and the role of Gdynia Maritime University in preparing reliable and competent personnel for transporting and transferring systems.
Keywords: LNG transportation, LNG Terminal, Shall gas, CNG

1. Introduction

Natural gas is expected to be the world's fastest growing energy source in the coming years. In a liquid state, LNG is not explosive, not corrosive and not toxic. Possible spillage does not cost any ecological problems as the liquid will boil to gas.

Poland, as with other countries within the Russia area of natural gas distribution, is trying to diversify their sources and increase the security of supply. New pipelines have been built in Europe which only increase the dependency on the supply from Russia[1]. The decision to build or plan receiving terminals in Poland, Lithuania, Latvia and other countries is a method of diversification of sources of supply LNG. Another option is exploration for our own shale gas.

2. Worldwide LNG Maritime Transport.

The main factors which determine development of world LNG trade and maritime transport are:

1. Sources located large distances from consumers (importers).
2. In many places pipelines are impossible to build (distances, earthquake etc.).
3. Systematic development of technical methods of transporting, storage and discharging.
4. Growing tendencies to eliminate non ecological sources of energy and change for LNG sector.
5. Increasing quantity of import countries.
6. Resignation of nuclear energy, especially after damage to a Japanese nuclear power station.

Dynamical development of LNG transport by specialized carriers has been observed from the beginning of the 21st century. Poland is one of the European countries that is desperately trying to change traditional methods of producing energy (90% based on coal) to more ecological methods such as nuclear or LNG sectors. Additionally, the most important matter is the necessary diversification of LNG exporters due to complicated dependence on the Russian strategy of political and economical addiction.

According to realistic prognoses, in the whole world there are approximately 187.5 billion m^3 of natural gas; enough for supplying in full energy for a minimum of 70 years. Actually production is around 3 billion m^3 of gas per year and this figure is systematically increasing[4]. The biggest consumers of natural gas are the USA, Japan and Western Europe (in Europe the biggest importers are UK and Spain). The structure of world importers and exporters is shown in Figure 1.

Importer	MMtpa
Japan	70.6
S Korea	34.1
Spain	20.5
UK	14.2
Taiwan	11.6
France	10.5
China	9.5
India	9.3
US	8.5
Italy	6.7
Turkey	5.9
Belgium	4.5
Mexico	4.4
Chile	2.3
Portugal	2.2
Kuwait	2.1
Brazil	2.0
Canada	1.5
Argentina	1.3
Greece	0.9
Dominican Rep.	0.6
Puerto Rico	0.6
UAE	0.1

Exporter	MMtpa
Qatar	57.5
Indonesia	23.6
Malaysia	23.1
Australia	19.1
Nigeria	18.1
Trinidad	15.2
Algeria	14.3
Russia	10.6
Oman	8.7
Egypt	7.1
Brunei	6.7
UAE	5.8
Yemen	4.3
Equatorial Guinea	4.1
Norway	3.5
Peru	1.3
US	0.6
Libya	0.2

Figure 1. Structure of import and export of LNG [6].

Analysis of the above world list of exporters and importers shows that the biggest exporters of LNG are Qatar (57.5 billion m^3), Indonesia (23.6 billion m^3) and Malaysia (23.1 billion m^3). In 2010 Qatar had a threefold increase in its profit from LNG export.

In 2005 and 2006 Maritime transport of LNG increased 8% and 12%. In 2008 Guinea Equatorial, Norway and Russia (Sakhalin) became important new exporters . In 2009 the big LNG Terminal at Canaport LNG in Canada was built. China (terminal in Guandong Dapeng) and, from 2014, Poland (Terminal Swinoujscie) were added to the group of importers. Singapore, Jamaica, New Zealand and Germany[3] expressed great interest to import LNG in the last year.

3. Maritime transportation of LNG in the Baltic Sea region.

Routing for LNG on the Baltic Sea in past years for the transport of natural gas was only by pipelines, but there is actually a great concept for 9 Baltic countries to establish a system of safety routes for the transportation of LNG through their vision of building LNG terminals in Baltic countries.

Actually, on the Baltic Sea, there exist IMO regulations concerning vessel traffic (IMO, 01-07-2006) which include separation zones and routes north of the Danish island of Bornholm and north of the German island of Rugia and near coastal routes of German waters(Fig.2).

Drafts of LNG tankers is the limiting factor for transportation on the Baltic, where the maximum draft is 15m. There is a plan in many of the Baltic countries to build import LNG Terminals and a few bunker stations. This gives a chance of approaching a wide energy market, strategic for energy independence, and is a tool to guarantee non-dependence on one source of supply. Figure 2 shows the proposed locations of LNG terminals and bunker stations in the Baltic.

Lithuania plans to open (in 2014) a new import terminal for LNG in Klajpeda for 2-3 billion m3 of gas per year. Latvia has a plan to build an LNG terminal (for 2 billion m3 a year) in the port of Riga. Estonia plans to build an LNG terminal in Palenski for 2 billion m3 a year.

In Sweden the plans for building import LNG terminals were stopped last year (Oxelosund). In May 2011 an LNG terminal was opened in Nynashamn where LNG from Norway was delivered. According to the last Swedish declaration, additional small LNG Termimals in Gothenburg and Gavie will be only bunker stations.

Finland declared (in 2011) a big interest in building an LNG Terminal in Turku but it is only a conception plan for now.

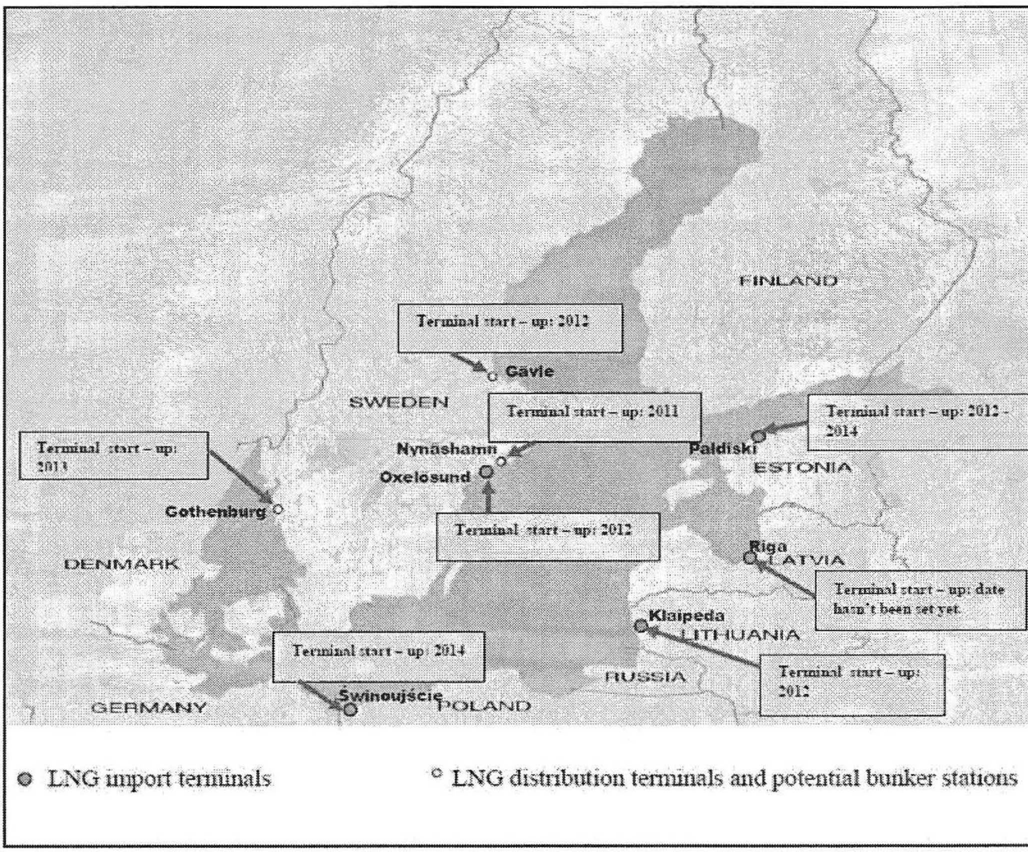


Figure 2 Proposed LNG importing terminals on Baltic Sea [8] .

4. Project for an LNG Terminal in Swinoujscie (Poland).

The most advanced plan for building an LNG terminal is in Poland. On January 3, 2006, the Government of Poland decided to build their own Polish LNG Terminal due to growing dependence from one importer (Russia) and possible pressure or economical extortion of Russia (as happened on the Ukraine and Belarus boundary). The total cost of building a terminal located in the western part of Poland is from 350 to 600 million Euro. Initial production in 2014 will be 2.5 – 3 billion m^3 of gas and in 2015; 5 – 5.75 billion m^3 [7]. This LNG Terminal is not enough to be fully independent in the energy safety sector. There are plans to establish a national fleet of LNG vessels with a maximum and optimal vessel size of 130 000m^3.

To defend sources of imported gas, a fleet should contain:

A. Delivery from North Sea – 1 vessel 130 000 m^3 and 1 vessel 75 000m^3 or 3 vessels 75 000m3 each.
B. Import from Algeria: 3 vessels 130 000 m3 each
C. Persian Gulf source: 6 vessels 130 000m3 each.

Polish shipyards have great experience in building LPG carriers up to 50 000 DWT. The first LNG vessel named "Coral Methane" with a capacity of 7500m3 and approximately 6000 DWT was launched on May 7, 2008 (the vessel was build for a Dutch owner for trading in North European waters).

On January 17, 2007 Poland and Algeria, to minimize energy and exploration, signed an agreement for delivery of LNG to Poland.

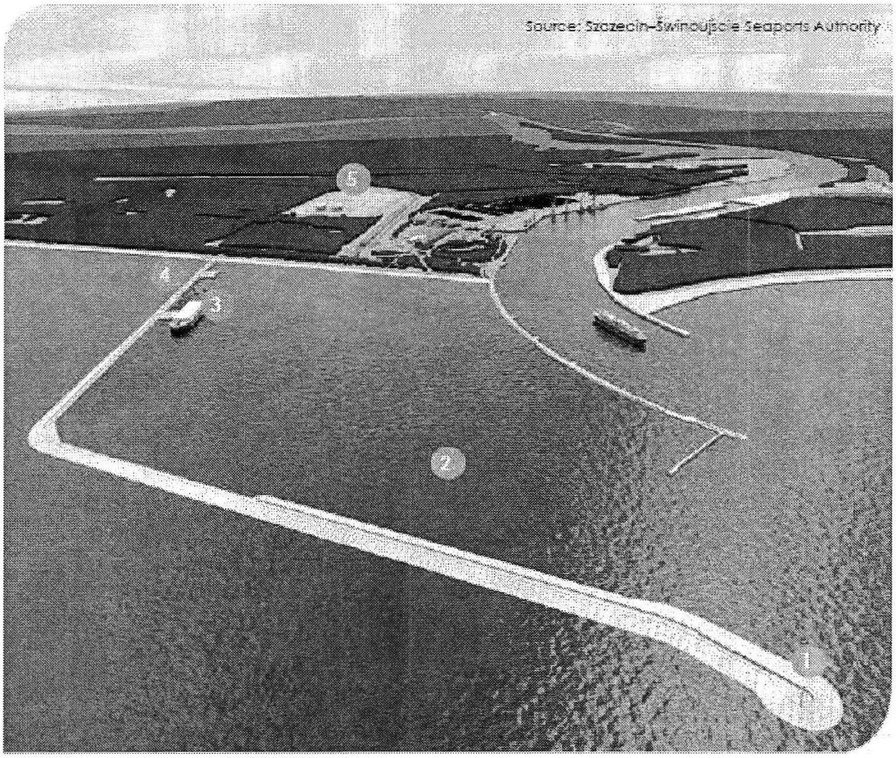
On April 17, 2007 a new company, Polskie LNG, was established for building and preparing for cargo operations for importing LNG into the port of Swinoujscie.

In 2009 a contract with Qatar Gas for delivering LNG to Polish Terminals from 2014 till 2034 was signed.

According to planned construction, there will be 2 gas tankers of 160 000 m3 each. The final productivity of the LNG Terminal provides the chance to receive close to 50% of actual Polish gas consumption. An international Consortium of the Canadian company Suanprogetti Canada Inc., Saipem SA (France), Saipem (Italy), Techint Compagnia Technica Internazionale SA (Italy) and 2 Polish companies PBG SA and PBG Export Ltd. set June 30, 2014 as the date of opening for theSwinoujscie LNG Terminal.

An underwater pipeline connecting Russia and Germany's "North Stream" which was concluded in 2011/2012 creates some problems for the Polish plan and the limiting draft of up to 13.5 meters for vessels approaching the new terminal (Fig.3).

Optimism for the new project of delivering LNG vessels gave stimulation to prepare a new project to build one more LNG terminal in the eastern part of Poland in Gdansk Bay.



Model of LNG Regasification Terminal in Świnoujście

1. Breakwater
2. External Port
3. LNG Unloading Berth
4. Pipe rack for process lines
5. LNG Terminal

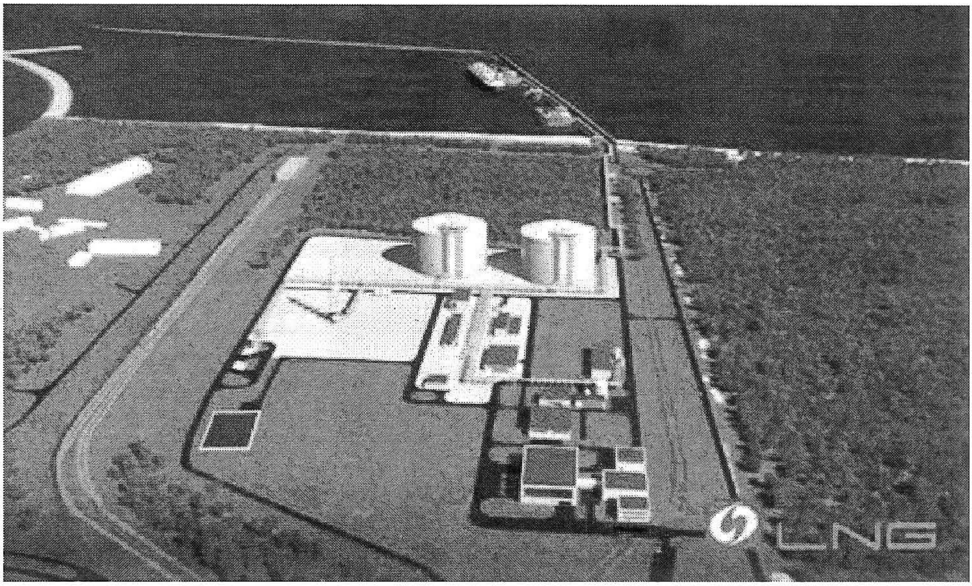


Figure 3 Project of LNG Terminal in Swinoujscie [7].

5. The shale gas revolution in Europe.

The shale gas revolution that has transformed the natural gas market in North America has yet to have an impact in Europe. The US Energy Information Administration in a recent report (April 2011) identified that the potential of shale gas technically recoverable resources in Europe are over 600 trillion ft^3, some four times more than the proven reserves of conventional natural gas (Fig.4).

Europe's Technically Recoverable Shale Gas Resources	
Country	**Resources in trillion ft^3**
Poland	187
France	180
Norway	83
Ukraine	42
Sweden	41
Denmark	23
UK	20
Romania, Bulgaria, Hungary	19
Holland	17
Turkey	15
Germany	8
Lithuania	4
Total	**639**

Figure 4 Europe's Technically Recoverable Shale Gas Resources

The growth in the role played by LNG In meeting Europe's natural gas demand is expected to continue but there will be competition from buyers elsewhere in the world for the available supplies (Fig.9).

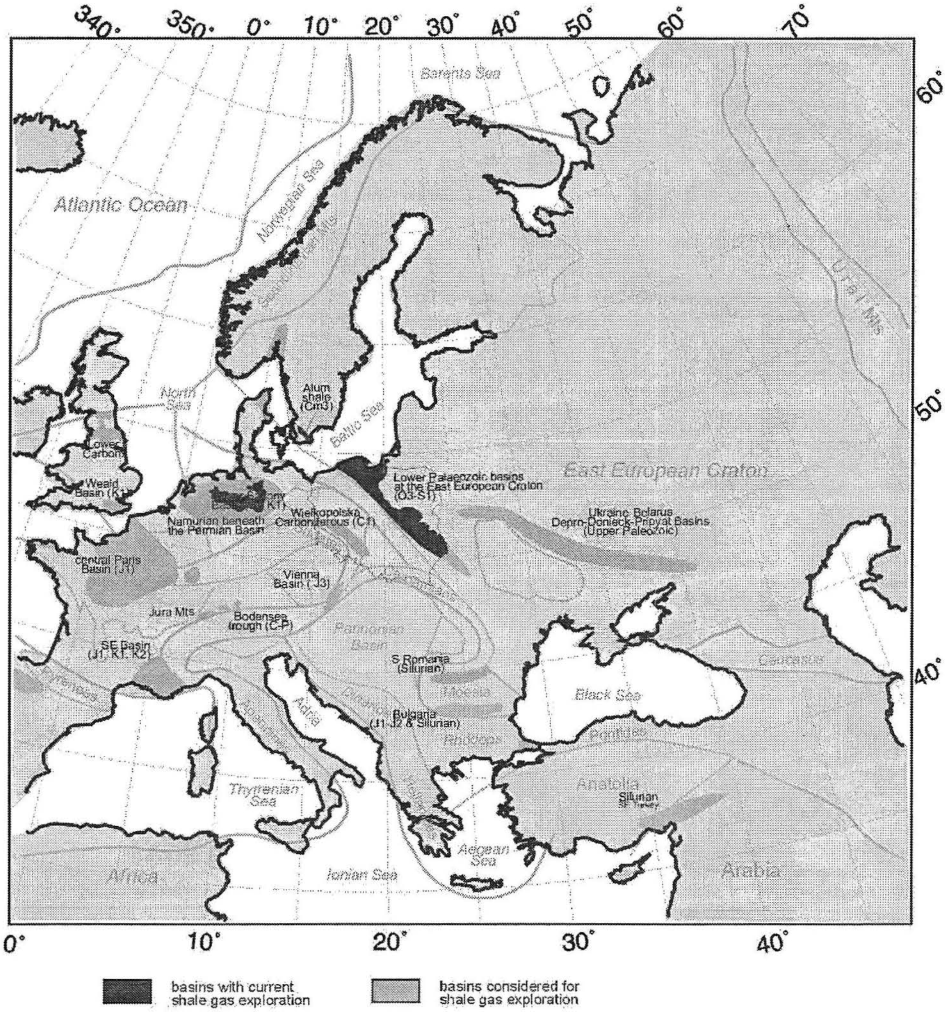


Figure 5. Location of shell gas in Europe [9].

6. First LNG carrier build in Polish Shipyard.

The April 2009 delivery of the 7,500m3 *Coral Methane* to Anthony Veder by the Polish Remontowa yard in Gdansk marks a new departure in the history of LNG ship construction. The ship is the first multipurpose gas carrier built to transport LNG, LPG and liquefied ethylene gas (LEG)

Coral Methane

Shipbuilder	Remontowa, Gdansk
Shipowner	Anthony Veder
Flag	Dutch
Year built	2009
Containment system	IMO Type C tanks
Class	BV
Intended sphere of operations	Regional distribution
Length	117.8m
Breadth moulded	18.6m
Draught, design	6.3m
Deadweight	6,150 tonnes (butane cargo)
Cargo capacity, 100%	7,500m3
Propulsion system type	Dual fuel
Propulsion power output (kW)	5,000
Service speed	14.0 knots
Main engines (four)	Rolls-Royce
Cargo system design	TGE Marine Engineering
Cargo pumps	Hamworthy Svanehoj
Inert gas generator	PSA system
Propellers	Azipull thrusters
Bow thruster	Rolls-Royce

Maritime transport of CNG seems to be an alternative solution for transport liquefied gas on short distances (up to 2000 km) and delivering smaller portions of cargo [2,5].

The maritime CNG system of transportation is sometimes called the "floating pipeline". New CNG vessels are able to carry liquefied natural gas in special tanks under a pressure of 8-10 Mpa and with a temperature mostly at -60°C.

7. Challenges for maritime education in Poland.

Deep analysis of the existing situation and the prognosis for coming years (time horizon 2014 and 2020) stimulated immediate action in establishing a program (accepted by industry) of a well organized system of education and training for cadets and officers for the LNG fleet.

In the common opinion of members of the Faculty of Navigation of GMU, the 54 hour IMO Model Course 1.06 is only a minimal standard for familiarization with LNG vessels, cargo and operations typical for that sector.

This training program for LNG junior officers has two parts:

1. Education during academic period of studies
   - Track A – LNG education during the whole academic period of studies (191 hours)
   - Track B – LNG education during the 2nd part of the period of studies (191 hours)
2. Special modules for officers Track D (139 hours).

Undergraduate studies
Faculty of Navigation

<table>
<tr><th></th><th>Semesters I + II</th><th>Semesters III + IV</th><th>Semesters V + VI</th><th>9 months from June till March</th><th>Semester VII</th><th rowspan="4">Graduation</th></tr>
<tr><td>Track C</td><td></td><td></td><td></td><td>Non liquid cargo vessel practice</td><td></td></tr>
<tr><td>Track B</td><td></td><td colspan="2">SM 1,2,3</td><td rowspan="2">LNG LPG/Tankers practice</td><td>SM 4</td></tr>
<tr><td>Track A</td><td>SM 1</td><td>SM 2</td><td>SM 3</td><td>SM4</td></tr>
</table>

Module 1 – LNG elementary knowledge
Module 2 – LNG ship operation
Module 3 – LNG Safety course
Module 4 – Senior cadets

Post graduate studies
M. Sc.
Faculty of Navigations
2 semesters

Offshore Operations from 2010	Ship Management from 2012	Ship Surveyor from 2013	LNG Operations from 2012

Master of Science project

Track D (experienced tankerman officers) should pass 139 hours special formed LNG course (3 weeks)which replace and modify IMO model course 1.06 (54 hours).

8. Conclusions.

New regulations concerning environmental protection and control of the emissions of NOx, SOx and vessel dust (3 kinds of air pollution) caused perhaps the most realistic solution: NEW FUEL – LNG. Different simulations of the cost of building new vessels with dual fuel supply engines in parallel with the equipping of existing vessels with machinery increasing the emission of pollutants are reasons to establish a system of LNG bunkering stations on the Baltic Sea.

The crucial interest for Poland are:

- economical independence,
- diversification of suppliers (exporters) of LNG,
- exploration of rich natural sources of shale gas located in Poland
- reach a level of 40% of national consumption of LNG delivered by LNG Carriers.
- Plans to start to build a second LNG import terminal in Gdansk (2016-2018).

The Faculty of Navigation in cooperation with the Engineering Department will initiate, in Oct 2012, a new system of specialization for a group of 20-25 students educated and trained specially for LNG vessels.

Experience in building modern LNG vessels in Remontowa Shipyard in Gdansk gives the chance to establish a specialized Polish LNG shipping company which will be operating 35000 – 70000 m^3 capacity LNG Carriers.

References

[1] LNG World Shipping March/April 2009
[2] Starenczak, P. "Mistrzowski gazowiec" journal pages 150-152 "Nasze Morze" 6(42)2009
[3] The Motor Ship Vol. 93 Issue 1090, February 2012
[4] BIMCO Bulletin vol. 106, December 2011
[5] Tanker, Shipping Trade vol. 6 issue 1 February/March 2012
[6] International Gas Union, World LNG Report 2007-2011
[7] http://www.gaz-system.pl/terminal-lng/wydawnictwa

[8] Rozmarynowska M., LNG In the Baltic Sea Region. Opportunities for ports, Gdynia 2011
[9] Albrycht I., Boyfield K., Gaz niekonwencjonalny – szansa dla Polski I Europy? Analiza i rekomendacje, Kraków, Instytut Kosciuszki, 2011

Philippine Maritime eLearning: Development, Status and Prospects

Benelyn P. Batiduan, Ph.D.
Distance Education Director, JBLFMU
John B. Lacson Foundation Maritime University
Graduate School, Molo, Iloilo City, Philippines
benelyn.batiduan@jblfmu.edu.ph

Lorna D. Gellada, Ph. D.
Administrator, DQMR, JBLFMU-Arevalo
lorna.gellada@jblfmu.edu.ph

Ralph L. Pador, Ph. D.,
Administrator, DQMR JBLFMU-Molo, JBLFMU IT Director,
ralph.pador@jblfmu.edu.ph

Abstract: Technology has shaped a changing picture of educational instruction and training. It has revolutionized learning, propelled changes in the goals of education and created different learning structures. It inevitably changes training and learning designs. Technology has altered the teaching and learning milieu and has allowed a more dynamic delivery of instruction and training. The evolving powerful systems of technology strengthen alternative learning modes built on the principle of "anytime, anywhere" delivery of education that brings people together for collaborative and reflective learning. This breakthrough was markedly felt in the maritime field as major revisions in the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (the STCW Convention) emphasize the need for modern training methodologies. The STCW '95 Manila Amendments of June 2010, which came into force on January 1, 2012, underscore the need to introduce modern training methodologies, including distance education and web-based learning.

As the Manning Capital of maritime manpower that supplies at least 30% of the global workforce, the Philippines looks intently on the challenge of alternative delivery modes of instruction and training. This further encourages maritime higher education institutions to consider more seriously distance education as an alternative academic delivery mode in the light of global themes and 21st century teaching and learning. If the Philippines hopes to remain as the top seafarer producing country, it should well be competitive in providing quality training and education that emphasizes a flexible mindset fundamental to lifelong learning, puts individual student needs at the core of instruction, and adopts cutting-edge technology.

As a premier educational maritime institution in the Philippines and being the only maritime university in the country, the John B. Lacson Foundation Maritime University takes

as its major task the promotion, development and delivery of maritime eLearning in the country.
It is in this regard that the JBLFMU is taking bold steps in spearheading this eLearning mode as it establishes baseline data on Philippine Maritime eLearning.
This study is aimed at providing a picture of the gradual evolution of eLearning in maritime schools in the Philippines.
Keywords: maritime eLearning, distance education, web-based learning

1. Introduction

New technology has conveniently ushered in new shifts in the learning paradigm. The inevitable technological breakthrough has established a learning landscape that makes learning management systems accessible through the internet, making it more feasible for learners. This rapid advancement in technology triggered a new perspective of distance education, a delivery system that rises beyond the limitations of traditional whole-class instruction. It has widened the access to education as it encourages unity, collaboration, and interconnectedness.

Specifically, this mode of instructional delivery—which may have taken variations of themes such as correspondence study, distance education, distributed education, hybrid classes, open learning, online learning and e-learning—ushers education to an extensive range of the student populace which the traditional residential or face-to-face classes fail to reach. Distance education removes learning barriers and promotes greater learner autonomy, independence and flexibility.

The features of Open Distance Learning (ODL) have been the impetus of its wide adoption by academic societies. ODL looks intently on aspects of students' needs, design of self-study materials, student support, cost-effectiveness and quality of materials and delivery system. Being a student-centered approach, ODL gives the learners ample freedom to establish their own goals while helping them recognize their potentials. It also paves the way to the understanding that self-development is a lifelong process and certainly not restricted by time and space.

The maritime industry is characterized by increasing and rapid development in communication systems. The growing need for fast and effective communications on board ship, which will facilitate efficient data exchange between ship and shore, has pushed for the establishment of internet infrastructures. Most companies to date adopt communication systems with unlimited and seamless broadband connectivity enabling the use of voice calling, e-mail, GPS system and also web browsing.

With the evident development in the maritime industry, former IMO Secretary General Efithimios E. Mitropoulos has challenged the maritime training and education providers to take a vital part in ensuring that standards of manning and operation will be equally high inasmuch as modern ships are designed and built to the highest technical standards (Mitropoulus, 2012).

Thus the STCW '95 Manila Amendments of June 2010 underscore the need to introduce modern training methodologies, including distance education and web-based learning. The web based learning portals open the use of both asynchronous and synchronous tools and support shared workplaces, net-based teamwork and intercultural communication.

This has encouraged the John B. Lacson Foundation Maritime University (JBLFMU) in the Philippines to take the lead among Philippine maritime higher education institutions to consider more seriously distance education as an alternative academic delivery mode. As the only maritime university in the country, the JBLFMU has helped establish baseline data in terms of maritime eLearning capability of the HEIs in the country.

2. Content

Online Distance Learning Development

The development of online distance education in the Philippines is categorized into four generations. Although it may have its roots in the US-based correspondence school, which operated in the 1940s and the 1950s, the first generation of distance education in the Philippines was the "School on the Air" for farmers in Iloilo province produced by broadcaster Pacifico Sudario in 1952 (Librero, 2007).

The second generation of Philippine distance education was the development of learning modules in printed form when the first effort to offer a degree program in the distance mode became possible at the UP Los Baños in 1984 (Librero, 2007). With the breakthrough of Information Communication Technology in the 1990s, the third generation of distance education in the country transformed the printed modules into technology-based materials, giving way to the development of computer-based and CD-form learning packages among others. However, technology became more sophisticated in the last decade and learning materials became more engaging, allowing students to navigate them on the web through a defined sequence, thus emerged the eLearning format, the fourth distance education generation.

The new world order, characterized by increasing interconnection and collaboration, directs education's fundamental purpose to ensure that all students benefit from their learning through the use of appropriate technology. Learning platforms and environments must foster social construction and knowledge, making students become active creators of knowledge and information with emphasis on the development of networks and online communities.

When people talk about modern methodology, they promptly think of technology as tools in exploring and communicating ideas. Does this influence maritime training and education as it tries to permeate the global village and traditional institutions? Distance education has in fact penetrated maritime education and training for more than a decade. The increasing demand for well educated officers and crew and the rising number of applicants in the maritime industry may well be met through the use of eLearning (Rangan, 2007). As Rangan puts it, eLearning is the new concept in Maritime Education and Training.

Maritime Education and Training in the Philippines

Educational maritime programs are among the essential courses which continuously contribute to the Philippine economy. The archipelagic nature of the country naturally exposes the population to sea-related activities, particularly seafaring. Since the establishment of the first Philippine maritime institution in 1820, there are now a total of 94 maritime higher education institutions in the country producing an annual average of 10,000 graduates. Data on maritime courses show an average of 52,789 enrollees every year clearly confirming many young Filipinos' preference for maritime careers.

Maritime schools in the Philippines stringently follow the requirements of the Standards of Training, Certification and Watch keeping (STCW) for Seafarers and all its amendments. The STCW is embodied in the Policies Standards and Guidelines for Maritime Studies which directs the curricular programs of all maritime schools. Government allows these schools to conduct and administer baccalaureate courses with three years of formal school attendance and one year of supervised shipboard apprenticeship for deck and engine cadets.

There are 94 maritime schools in the Philippines at present. However, the Commission on Higher Education for the country has identified only eight eligible for Distance Education delivery. This is due to the policy that only schools with Level III accredited status are allowed to offer the distance education delivery mode. Of the eight schools, only the JBLFMU has met the required accreditation level requirement. A school takes at least 15 years to reach Level III accredited status. The JBLFMU is at Level IV and has been granted Institutional Accreditation. Of the eight schools, two are on Level II accredited status and one on autonomous status. All of the schools are recognized by Government.

Distance Education for Seafarers, a tri partite project funded by the Canadian International Development Agency covering the years 2008-2011, involved the Commission on Higher Education, the John B. Lacson Foundation Maritime University and the Memorial University of Newfoundland's Marine Institute. The CIDA project helped paint a picture of the Philippine maritime eLearning landscape. It also opened the path for the establishment of the JBLFMUs eLearning infrastructure. Relevant training, workshops and benchmarking built the university's capability to spearhead and promote maritime eLearning in the Philippines. Through the project, baseline data on the Philippine maritime schools' capability for eLearning was likewise ascertained.

Using the components of the online distance learning used by the JBLFMU, the eight participating Philippine maritime schools identified their readiness for eLearning. The school participants in the workshops generally have their respective experts who can provide the technology infrastructure and conceptualize as well as execute delivery and support services. The concern on courseware development was best addressed by content experts among the faculty and consultants of the schools. The concern on the learning management system becomes less of a burden in view of the numerous options for LMS commercial or open software. The workshops offered the participating schools a clearer direction on how to employ an LMS to serve them best. Four participating schools felt the need to hire instructional designers to serve as administrators of their eLearning platforms. All eight schools agreed that top management and administration must embrace the concept of eLearning for it to succeed in their institutions, especially because of the financial costs involved

The interface of the eLearning infrastructure is illustrated in figure 1.

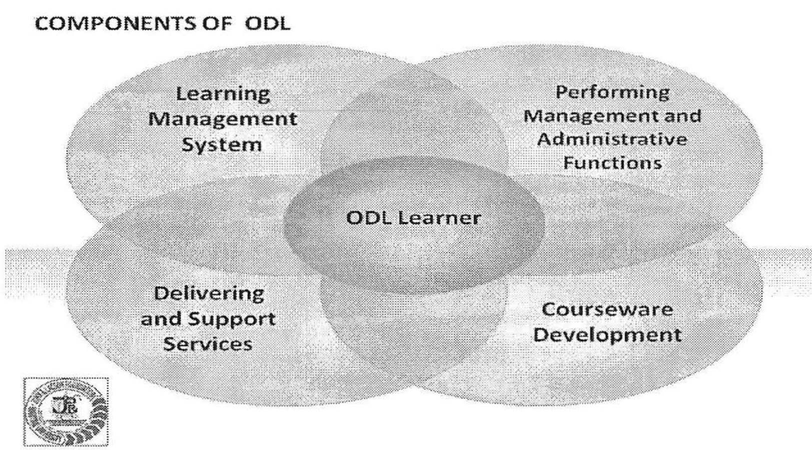


Figure 1. Components of the JBLFMU eLearning infrastructure

Philippine Maritime eLearning: The JBLFMU's experience

The JBLFMU Open Distance Learning syste was established with the objective of providing formal learning opportunities for maritime instructors/trainers and maritime and shipping industry personnel onboard ship and/or ashore. The conceptualization of the JBLFMU's maritime distance education system came about in 1999 and was granted a government permit in 2000. Seeing the potential of distance education in the maritime discipline and with technology providing multiple media, the University's management has established infrastructure for online learning through the use of an all-inclusive learning management system.

In this time of heightened competitive pressures, educational institutions can meet up with management responsibility through the application of the latest technologies for education and training, job performance improvement, and knowledge management. These technologies will help the organizations reduce cost, improve personnel performance, increase efficiency and enhance service quality.

As a prompt response to the needs of the time, the JBLFMU has established online learning as a mode of instruction delivery with its practical and operational advancement. The main objective is to make education and training available to clients at all times as they learn new skills and enhance present competencies to become professionally in-demand. Providing a non-linear approach to learning, the online delivery system affords the students access to instruction and helps them achieve educational goals. The eLearning system also enhances faculty excellence through training designed for their instruction empowerment along pure online application or blended instruction.

To date, the JBLFMU ODL system uses the internet as the learning environment anchored on accessibility, ease of circulation, and dynamic and systematic filing and storing capacity. It uses an open source learning management system (LMS), a software application or Web-based technology used to plan, implement, and assess a specific learning process. Typically, a learning management system provides an instructor with tools to create and deliver content, monitor student participation, and assess student performance.

A learning management system may also provide students with the ability to use interactive features such as threaded discussions, video conferencing and discussion forums. It also provides user reports, lesson reports, course reports, system reports and test reports. In terms of system administration, it is also capable of importing/exporting courses and lessons with multilingual support. The LMS must have advanced security which provides the user and administrator exceptional security, scalability and support.

The eFront LMS, being open by nature, has the means to customize relevant requirements that best suit the university's needs. What makes the LMS perfect for the JBLFMU ODL is the eLearning delivery which includes: content management, assessments, projects, scheduling, glossary, file library, lesson rules, Scorm 1.2, linked lessons, lesson capacity and course instances among others (eFront, 2011). It also has communication tools that provide both instructors and students with constant collaboration be it in or outside the classroom.

Benefits and Challenges of Maritime eLearning

Challenges

Although eLearning is a better option for delivering maritime training and education, there are challenges and barriers in its development. The significant barriers to distance education relate to faculty compensation and time, organizational change, and lack of technical and faculty support (Berge, Muilenburg, 2006). Along with this, the management must include in its strategic planning issues concerning start-up cost and long-term product updates; cross-cultural teaching and learning; competition and marketing; student support services and faculty support. Philippine schools will have to contend moreover with government regulations on distance education that require specific accreditation levels to qualify for distance learning delivery. Undergoing accreditation entails great financial outlay as it requires the improvement of all aspects of the institutions--curriculum and instruction; faculty; students support; library; research and other resources. The accreditation timetable makes it impossible for a school to earn Level III accreditation status in a year or two.

Benefits

The evident benefits of eLearning are far from what can be found in conventional schools. Other than flexibility, eLearning get students more involved in the learning process as they are given greater access to course instructors and tutors than in an on campus setting. The personalized instruction delivery allows learners to learn course materials in a better way, resulting in higher retention and greater collaboration. Learners thus benefit more and better from this academic experience.

If, in the past, distance learning issues included isolation; the present eLearning, being technology driven, has eliminated the isolation factor of distance learning. The eLearning platforms require students' involvement and collaboration in course projects. They can utilize learning materials even if they are offline. The eLearning system has shifted to a more learner-centered style which makes the learner connected to the classroom. The creation of eLearning platforms opens the door for collaboration and networking among Philippine maritime schools and eventually leads them to the global maritime field.

Prospects: Summary and Conclusions

Distance education has recently been getting much attention from, and attracts, many established universities as well as individuals. The principle of "anytime, anywhere delivery" of online education brings people together for collaborative and reflective learning. This "repackaging" of educational content has created new markets for education and training. It has inevitably changed the way training and learning are designed.

The eLearning platforms extend education and school management into the digital realm, deliver rich media resources, provide collaboration tools for project work, and encourage online communication between students and instructors. The primary benefit is that eLearning courses provided by the school can be delivered to, and accessed by, all concerned users over the school's network or internet. Instructors become adept in developing digital course content and learn how to set, mark and record student progress online.

Much support must be extended to the development of information technology since it plays a vital role in distance education. It makes possible the delivery of information to students in multiple locations via the internet.

With eLearning, democratization of maritime education and training is made possible. Maritime schools and training centers can easily reach out to interested learners who may not have the luxury of time for traditional classroom-based instruction but, because they are technologically competent, can enjoy the pleasure of maritime education via eLearning. On the other hand, maritime schools in the Philippines are given the opportunity to prove their goals of globally competitive education and effective technology-based instruction with their support establishments and implementation of maritime educational programs through distance learning.

For Philippine maritime education, there is no better path than the revolutionary way towards distance learning. There is no turning back—maritime education must go forward and welcome the fresh world of educational change. And in the Philippines, John B. Lacson Foundation Maritime University is leading the way.

References

[1] Anderson, T. (2008). The theory and practice of online learning. AU Press, Canada.

[2] Arante, C.; Batiduan (2011). Case study; john b. Lacson foundation maritime university online distance learning lms. Paper presented during the 10th eLearning Conference, Palawan, Philippines. December 2012.

[3] Baker, J.; Rovia, A; Ponton, M (2008). Distance learning in higher education, A Programmatic Approach to Planning, Design, Instruction, Evaluation, and Accreditation. Teachers College, Columbia University, New York.

[4] El Attar, I. (2009). Use of Progressive Technologies in the Maritime Educational Process. Paper presented during the 26th International Conference for Seaports and Maritime Transport. http://marlog-aast.org/old/2010/papers/S54.pdf. May 9, 2012.

[5] Flor, A. (2009). Economics of eLearning for the Indonesian Maritime education and Training Sector. http://up-ou.academia.edu/AlexanderFlor/Talks/57343/Economics_ May 11, 2012

[6] Librero, F (2008). Distance Education in the Philippines; Issues and Concerns. UP Open University, Quezon City, Philippines

[7] Mitropoulos, E (2010). Technical Cooperation in Maritime Education and Training, Keynote address. IAMU General Assembly, 15 October 2010, Busan,South Korea

[8] Rangan, KHK (2007). e-Learning—New Concept in Maritime Education and Training. www.thedigitalship.com/powerpoints/hk05/RANGAN%20e. May 10, 2012

Situation awareness is a new provision of STCW 78 , as amended

Loginovsky, V.A.
DSc, professor, Admiral Makarov State Maritime Academy,
vl.loginovsky@rambler.ru, loginovsky@gma.ru

Abstract: The paper is devoted to new provisions of STCW 78 (as amended) and namely "obtaining and maintaining the situational awareness " (SA). This new provision is mandatory by Manila amendments to STCW 78 Code as per *Tables A-II/1,2; A-III/1,2,6* . The wording of this provision is rather flexible but in any case it can imply the development of new approaches to maritime education and training (MET) to influence positively on both educational and training processes. Obtaining and maintaining SA means that a lot of other relevant SA-based skills, including decision making (DM) and performance of actions (PA), are also to be taught, learned and trained. Such Officer Of the Watch (OOW) skills as detecting the loss of SA and recovery of SA are also to be included in training programs of seafarers.
The paper reviews some aspects and trends supporting the possible design and guidance of courses on SA at Sea and encourages educators, instructors and students involved in MET to research and develop this very important Human Element (HE) topic.
Keywords: STCW Code, Human Element, education, training, safety, situation awareness, risk assessment, decision making.

1. Introduction

The new provision of STCW 78 (as amended) namely "obtaining and maintaining situation awareness ", is included in Column 2 (Knowledge, understanding and Proficiency) of the STCW Code by Manila amendments (*Tables A-II/1,2; A-III/1,2,6*) can imply the development of new approaches to MET to positively influence both educational and training processes. The STCW Code in itself is a competence oriented instrument and every competence contains an SA portion. Column 4 of the qualification tables delivers the criteria for evaluating different types of competences included in the Code. We suppose that it may be a quite ambitious theme to review the Code, checking if the SA classical [1] approach agrees with its general concept and if SA methodology can be included in the MET system.

2. What is Situation Awareness?

2.1 The Basics

In order to realize how to incorporate SA into the systems of the shipping industry and MET, it would be helpful to have a deeper understanding of SA. In its most basic form, SA is knowing *what is going on around you* [1]. It seems obvious but let's explicitly add the requirement that a decision maker on the vessel's navigating bridge must also have a grasp on what is important to know, for example, while proceeding in the English Channel to the south. It is 'so called' local knowledge in navigation but in SA terminology they call it *prior knowledge* about the tasks to be completed or goals to be accomplished during the passage. We understand the term *prior knowledge* in a broad sense not limited by the local professional knowledge of the navigation area. It is, in principle, determined by the experience and educational level of an individual. From here, it is not a giant leap to make the claim that SA varies with, and is completely dependent on, the goals for any given job[2].

More serious attributions involving SA occur when "Bridge (or Engine room) or Shore based Personnel" error due to loss of SA is listed as a cause of accidents. The results from a maritime operations literature survey revealed that 71% of human errors were Situation Awareness related problems[3]. Failure to mitigate accidents due to poor SA also is pointed out in frames of e-navigation concept [4,5].

A general definition of SA that has been found to be more close to marine navigation describes SA as the safety driven *perception of the elements in the environment within a volume of time and space* (navigational area), *the comprehension of their meanings* (dangers, marks, ships, lighthouses...) *and the projection of their status in the near future* (developing of navigational situation) [1]. In other words SA involves the real-time processing of event-based information coming from an evolving situation in an attempt to understand what is happening [6].

2.2 Levels of SA

One differentiates three levels of SA.

Level 1 SA – Perception of information
To speak about navigation, as per Endsley, the first level is perception of navigational information. It is fundamental and crucial. Without a basic perception of navigational information, the cases of forming an incorrect picture of the navigational situation increase rapidly, especially in dynamically changing environments. Without the simple recognition of important information in navigation areas it is unlikely that a Master/OOW will develop anything near an accurate evaluation of a situation and risk. Mariners should be carefully trained and their skill and knowledge duly assessed in the proper perception of navigational information. This level also includes the detection, recognition, and identification of significant things within a given (navigational) situation and area [2].

Level 2 SA – Comprehension of information

Following [2], situation awareness of the Master/OOW as a construct goes beyond mere perception of navigational information. It also encompasses how navigators combine, interpret, store, and retain this information. Thus, it includes more than perceiving and attending to information or formal scanning, but also the professional keeping of sharp look out, the integration of multiple pieces of information and a determination of their relevance to the safety goals. This requires the fusion of diverse bits of information and the establishment of importance to the goals at hand. A seafarer has attained Level 2 SA when he has extracted meaning and significance from Level 1 data. Level 2 SA reveals a comprehension of the current state and an ability to make inferences about how the current situation came to be.

Level 3 – Projection of situation

The highest level of SA includes the ability to forecast future navigational situation events and their dynamics. It relates to operators who have the highest level of understanding of the situation (this should be the Master, Pilot or VTS operator). This ability to project from current events and dynamics to anticipate future events allows for timely decision making. One can say that *risk assessment* is some sort of formal *projection* of the situation, i.e. level 3 SA in its principle can be based on statistical data and experience.

There is no doubt that education and training as processes are consistently linked and all the above said for navigation is applicable to other competences which are included in the functions and levels of the STCW Code.

The provision "obtaining and maintaining situational awareness" is included directly in the following STCW Code competences:

- Maintain a safe navigational watch, (A-II/1) as per function 1;
- Use of ECDIS to maintain the safety of navigation, (A-II/1) as per function 1;
- Application of leadership and teamwork skills, (A-II/1) as per function 3;
- Maintain a safe engineering watch, (A-III/1) as per function 4;
- Application of leadership and teamwork skills, (A-III/6) as per function 3;
- Use of leadership and managerial skill (A-II/2, A-III/2) as per function 3;

In sections A-VI/5A-VI/6 related to security, we can also find the competence which has a direct wording link with SA; it is "Encourage security awareness".

To understand that such concepts as Situation Awareness (3 levels), Decision Making and Performance of Actions exist in the STCW Code in intra-text information, we used the Leximancer software for analysis of the Code. To gain an insight into the content of the Code, the software was configured in such a way as to map the document in a manual mode. The following sample seed words were applied [7]:

- Level 1 SA = (perception, detection, recognition, identification);
- Level 2 SA = (comprehension, combine, interpret, store, retain, information);
- Level 3 SA = (project , projection ,dynamics, anticipate, future ,events);
- Decision making (DM) =(decision, making);
- Performance of actions (PA) = (performance, actions).

The Leximancer conceptual map is shown in Fig.1, where 50% of the most important concepts are identified. In principle, we can state that all the five above mentioned concepts have already existed in the STCW Code [7] prior to the Manila amendments, but they were not structured in the Code and they are not structured in the 2010 version. Arrows drawn by author show the consistency of SA1-SA2-SA3-

DM-PA algorithm. Straight lines linking concepts show their statistical correlations. The concept of ECDIS, linked with other concepts, is indicated only as an example of an important concept in the STCW Code text.

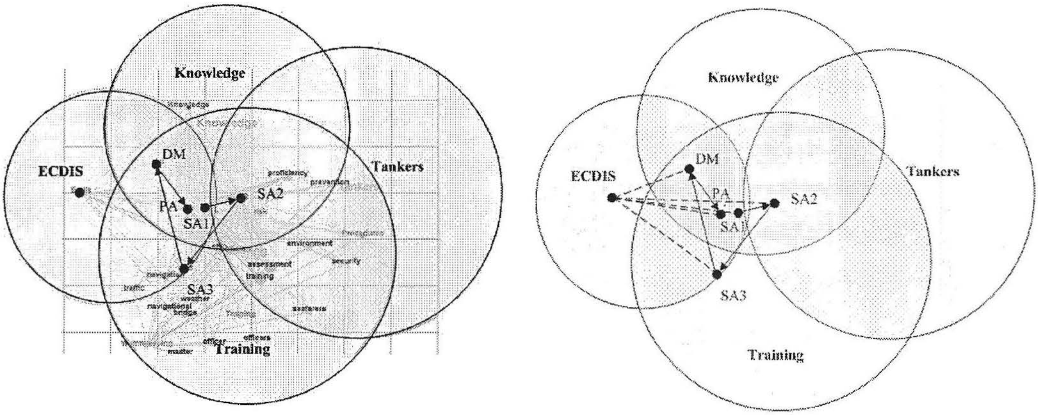


Figure 1 The intra-text information mined by Leximancer software from STCW Code text

The general results that can be extracted from the conceptual map in Fig.1 show that intra-text information mined from the STCW Code text is as follows:

- The above concepts have the intra-text probabilistic relationships with all other important concepts mined from the text.
- All 5 concepts, including SA levels, are positioned in the common area of intersection of the two very important themes of Knowledge and Training.
- The STCW Code pays great attention to SA though the combination of words Situation *(or Situational) and Awareness* practically occurs only few times in it. This finding is apparent from intra-text mined information.

It is possible to conclude that all the principles of SA are of high importance in the STCW Code; they "soar in air" of the Code and we subconsciously apply them in our professional activity. In other words the competences in STCW Code obviously exist, but Situation Awareness is submitted in a very much implicit format. In our view point it needs to be structured in salient manner, researched, and applied to maritime education and training.

3. STCW Code is the competence-oriented standard for MET

3.1 What is a competence?

The core definition can be formed by the followingmstatement. Competence is the acquisition of knowledge, skills and abilities at a level of expertise sufficient to be able to perform in an appropriate work setting[8]. It is quite obvious that STCW *competences* are included in the STCW *concepts* positioned above. The definition of competence can be written briefly as follows:

$$Competence = Knowledge + Skill + Ability$$

To gain *competence* in an appropriate field of activity is impossible without gaining SA in this field.

As per the STCW Code: *Standard of competence* means the level of proficiency to be achieved for the proper performance of functions on board ship in accordance with the internationally agreed criteria as set forth herein and incorporating prescribed standards or levels of knowledge, understanding and demonstrated skill [9].

The competencies of seafarers specified in the STCW Code are grouped at the following levels of responsibility: Management Level (ML), Operational Level (OL), Support Level (SL) and under the following seven functions:

1. Navigation
2. Cargo handling and stowage
3. Controlling the operation of the ship and care for persons on board
4. Marine engineering
5. Electrical, electronic and control engineering
6. Maintenance and repair
7. Radiocommunications

A competence-based mind map of the STCW Code (2010) is shown in Fig.2, where appropriate tables of minimum standards, functions and responsibility levels are submitted. Therefore, it can be used as competence- based taxonomy for inclusion of SA into STCW Code ideology and structure.

The STCW Convention and Code is a competence-based standard for MET. Competence-based education (CBE) is an institutional process that moves education from focusing on what academics believe graduates need to know (teacher-focused) to what students need to know and be able to do in varying and complex situations (student and/or workplace focused) [10].

Following the terminology of [10], in the STCW Code large skill sets are broken down into competencies which may have sequential levels of mastery. Competencies reinforce one another from basic to advanced as learning progresses. The impact of increasing competencies is synergistic and the whole is greater than the sum of the parts.

Competencies within different contexts may require different bundles of skills, knowledge and attitudes. The challenge is to determine which competencies can be bundled together to provide the optimal grouping for performing tasks. This is achieved in the STCW Code by including the appropriate competences into functions. If we define CBE as a process, then the SA approach, as a part of CBE, can be considered as a dynamic core of all sets of competences included in STCW Code, especially in watchkeeping.

For example OOWs on ships of 500 gross tonnage or more are to be educated, trained and assessed in the function of Navigation at the operational level by 9 competences; each of them including appropriate SA segments.

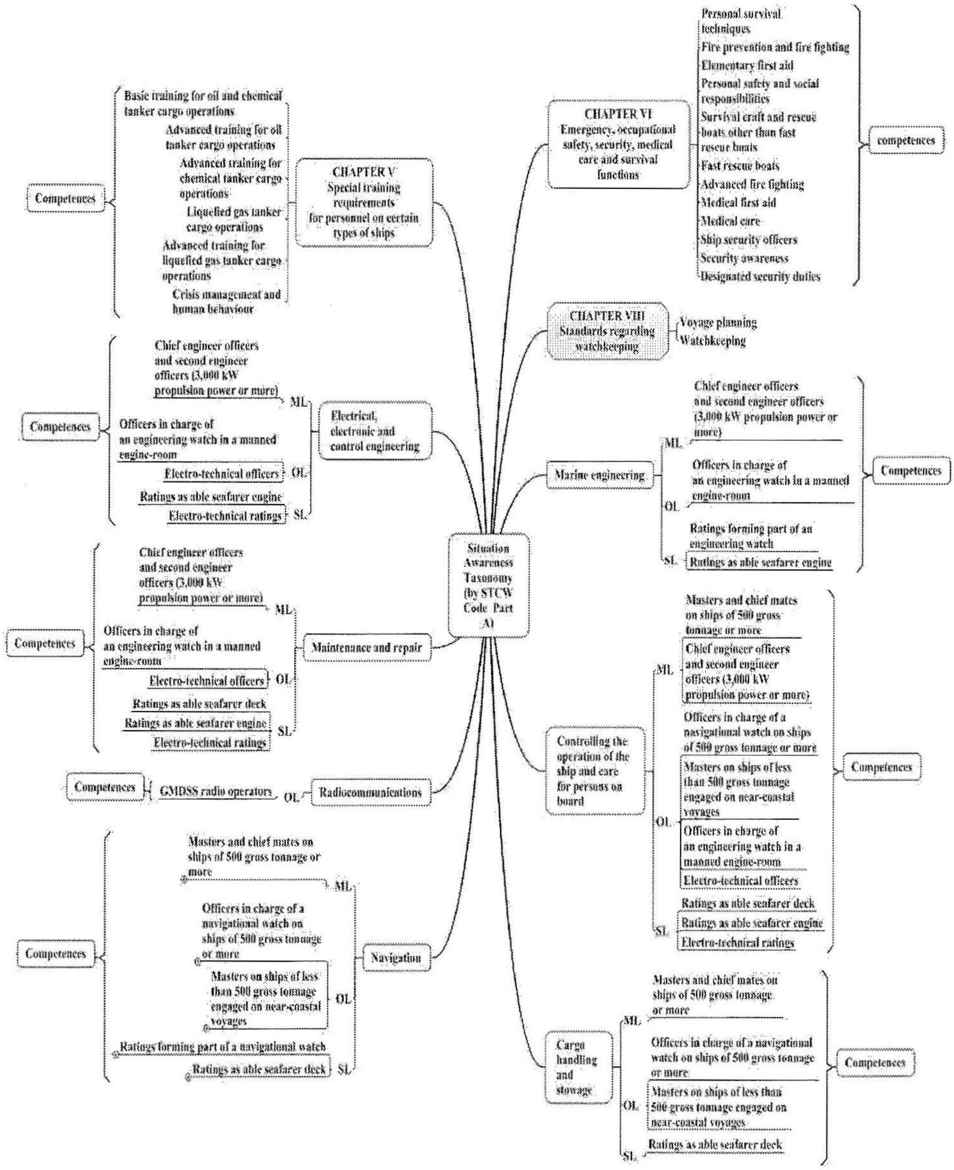


Figure2. STCW Code (2010) -Competence oriented mind map

Both techniques determine the required professional behavior that can be expressed by means of a verb and the appropriate taxonomy is presented as per Bloom [11] and as per Endsley [1] in the comparison table below.

3.2 Competence and SA behavior verbs

It is clear from the comparison table that competence contains an SA portion. Comparison of professional behavior verbs from the table below gave us an idea that SA principles, as a part of competence, can be applied both for training and education including assessment. Both techniques determine the necessary professional behavior which can be used to measure the competency and degree of SA at all three levels. The sets of behavior verbs confirm that a competence-based approach contains the SA process.

Table 1. Comparison of professional behavior verbs

Competence	Suggested professional behavior verbs (Bloom)	Situation Awareness	Suggested professional behavior verbs (Endsley)
Level 1: Knowledge (K)	Define, describe, find, **identify**, label, list, match, mention, name, outline, **recognize**, record, repeat, reproduce and state.	Level 1 SA – Perception (P)	detect, recognize, identify
Level 2: Understanding (U)	Classify, cite, **comprehend**, convert, discuss, distinguish, estimate, explain, extend, generalize, give examples, **interpret**, make sense out of, paraphrase, predict, restate (in own words), summarize, trace and translate.	Level 2 SA – Comprehension (C)	comprehend, combine, interpret, store, retain
Level 3: Application (A)	Act, administer, apply, articulate, arrange, assess, calculate, chart, collect, compute, construct, contribute, control, demonstrate, determine, develop, discover, establish, extend, implement, include, inform, instruct, manipulate, operate, participate, **predict**, prepare, preserve, produce, **project**, provide, report, review, show, solve, teach, transfer, use and utilize.	Level 3 SA– Projection (Pr)	project , anticipate

Level 4: Integration (I)	Analyze, appraise, categorize, combine, communicate, compare, compile, compose, conclude, contrast, correlate, create, criticize, decide, defend, design, develop, devise, differentiate, discriminate, express, facilitate, formulate, generate, hypothesize, illustrate, incorporate, integrate, interpret, invent, judge, justify, model, modify, negotiate, organize, outline, plan, point out, prioritize, rearrange, recommend, reconstruct, reinforce, relate, reorganize, revise, select, separate, solve, structure, subdivide, substitute, support and validate.		

Paraphrasing the definition of SA [1] to make it more flexible for the educational process, the following wording can be used. SA is a perception of elements of an arbitrary space within a volume of time or within a volume of any other of its characteristics, comprehension of their meanings and the projection of their status in the near of origin.

3.3 Human Element: Situation Awareness - core guidance proposal

The integration of all generic SA elements extracted from MET processes, watch-keeping procedures and different types of drills and training conducted on board ships as per SOLAS 74 requirements, can form the core content for the SA guidance and also for the appropriate course consisting of the following main items to be developed:

3.3.1 Situation awareness basics
- 3.3.1.1 SA impact on accidents at sea
- 3.3.1.2 SA as a basis for Decision Making and Performance of Actions

3.3.2 SA approach to Maritime Education and Training (at different levels of responsibility, qualification functions and competences as per STCW Code provisions)

3.3.3 Team SA
- 3.3.3.1 Communication and team SA
- 3.3.3.2 SA in Bridge team management
- 3.3.3.3 SA in Engine team management

3.3.4 SA behavioral markers

3.3.5 Assessment of SA

3.3.6 Errors in SA

3.3.7 Watchkeeping [12]
- 3.3.7.1 Building and obtaining SA
- 3.3.7.2 Maintaining SA
- 3.3.7.3 Detecting the loss of SA
- 3.3.7.4 Looking for clues of degraded SA
- 3.3.7.5 Recovering SA

3.3.8 Training for SA

4. Conclusion

The main conclusions from this research can be formulated as follows:

- SA is the basis for decision making and performance of actions;
- SA is a very important part of any professional competence;
- The concepts and principles of SA are included in the STCW Code, but they need to be structured, researched, and applied for maritime education and training. In other words the competences in the STCW Code obviously exist, but Situation Awareness is submitted in a very much implicit format;
- SA methodology can be applied both for training and education processes of seafarers, including assessment procedures;
- Implementation of ISM and ISPS Codes can be improved by using SA methodology;
- Watchkeeping procedures especially need to be researched from the view point of SA.

References

[1] Endsley M., "Theoretical Underpinning of Situation Awareness: Critical Review" in Mica R. Endsley and Daniel J. Garland (Eds.) *Situation Awareness Analysis and Measurement.* Lawrence Erlbaum Associates, Mahwah, New Jersey, 2000. pp. 3-32.

[2] Moore D., "Principles of Situation Awareness, Applied to Corporate Decision Support Systems", Business Avionics, Monday, April 23, 2007; http://www.dashboardinsight.com/articles/digital-dashboards/fundamentals/situation-awareness-principles.aspx, 11 May 2012.

[3] Grech M.R., et al., "Human error in maritime operations: analyses of accident reports using the Leximancer tool", Key Centre of Human Factors and Applied Cognitive Psychology, University of Queensland, Brisbane, Qld; https://www.leximancer.com/wiki/images/4/44/HFES2002_MGRECH.pdf, 11 May 2012.

[4] NAV 58/6 ,Development of an e-navigation strategy implementation plan. Report from the correspondence group on e-navigation to NAV 58, http://www.nmri.go.jp/navigation/staff/yasuyuki_niwa/e-NAV-CG-2012/NAV_58-6.pdf, 11 May 2012.

[5] STW 43/6 ,27 January 2012, Development of an e-navigation strategy implementation plan. Report from the correspondence group on e-navigation to STW 43, http://www.nmri.go.jp/navigation/staff/yasuyuki_niwa/e-NAV-CG-2012/STW_43-6.pdf, 11 May 2012.
[6] Matheus C.J. et al., A. "Core ontology for situation awareness", Versatile Information Systems, Inc., Framingham, MA, USA, 2003, http://www.mendeley.com/research/core-ontology-situation-awareness/, 11 May 2012.
[7] Loginovsky V., et al., "Research on situation awareness measures relevant to navigating bridge team surveillance functions (RSAM)", Final report, IAMU, 2007.
[8] Harvey, L., 2004–9, Analytic quality glossary, Quality Research International, http://www.qualityresearchinternational.com/glossary/, 11 May 2012.
[9] STCW 78, as amended (consolidated text). Saint Petersburg, ЗАО «ЦНИИМФ», 2010 г.
[10] Accreditation criteria for schools of public health, June 2011, http://www.ceph.org/pdf/Competencies_TA.pdf, 11 May 2012.
[11] Standard for certification NO. 3.303, STCW, Basic safety for seafarers, September 2005, DNV, http://exchange.dnv.com/publishing/stdcert/Standard3-303.pdf, 11 May 2012.
[12] Operator's Guide to Human Factors in Aviation, Human Performance & Limitations, Checklist, http://www.skybrary.aero/index.php/Situational_Awareness, 11 May 2012.

A Decision Making Human Resource Information Management System for Ship Management

Bilici, A.
Research Assist., Istanbul Technical University, Maritime Faculty,
bilicia@itu.edu.tr

Kum, S.
Assoc. Prof. Dr.Capt., Istanbul Technical University, Maritime Faculty,
kumse@itu.edu.tr

Arslan, O.
Assist. Prof. Dr.Capt., Istanbul Technical University, Maritime Faculty,
arslano@itu.edu.tr

Abstract: Human Resource Management (HRM) is a complex process in the shipping industry due to a variety of constraints: national, international rules and regulations such as International Maritime Organization's (IMO) International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), flag state rules, International Labour Organization (ILO) rules. Besides that, each employee (seafarer) has individual records including personal information, qualifications, travel arrangements and certificates. These records hold lots of information which can become complex for crewing/personnel departments to follow all necessary issues. According to this view point, information technology (IT) becomes more important for reliable and effective HRM applications. Employed seafarer's quality and qualification to work on board are other important issues for a safe ship management process and also for shore based personnel. Labour cost is another issue which makes HRM valuable and it is getting to be a large factor in overall operational costs in this global financial crisis. The world merchant fleet is increasing in size and deadweight; however, suitable/appropriate seafarers are becoming difficult to find and crewing departments in shipping companies and ship managers put much effort into handling available seafarers.

In this paper, seafarer recruitment process and assessment factors are outlined and a work flow for suitable assessment and recruitment of seafarers is examined. As a result of this study, appropriate functional web based Human Resource Information Management (HRIM) applications are developed for crewing departments in ship management companies as a decision support for eligible seafarer selection. With these applications for decision making support, a seafarer can be assessed and selected according to important factors such as nationality, international rules & regulations and company policy and, in the end, an eligible seafarer can be chosen for a suitable/appropriate position on board. This web based application can be modified for other important topics which aim to improve the quality of the recruitment process or other

process steps following the recruitment process such as seafarer training, trial period, performance measurement and career upgrading opportunities. These can be future studies which analyse and modify new structures and flows in web based application.
Keywords: Ship management, Human Resources Information Management (HRIM), Seafarer resources, Maritime Human Resource Management (M-HRM), seafarer recruitment process, .Net technology

1. Introduction

The qualified manpower shortage is one of the most important issues not only in Turkey, but also for the entire world. This is due to its natural phenomena, as man power is limited. According to regulations and laws for ship crews, especially STCW (Standards of Training, Certification and Watchkeeping), TMSA (Tanker Management Self-Assessment) and SIRE (Ship Inspection Report); crew performance shall be evaluated properly, so appropriate training should be given according to evaluation and a reward/penalty system must be applied for assigning to a higher position or dismissals. This study looked at determination of criteria for crew recruitment for ships, identifying new standards according to international/national standards and regulations to identify necessary training for personnel and application tools for their employment and recruitment. This study also covers an application work flow design with information technology tools, testing process and publishing results. As a result, this attempt improves evaluation of seafarer performance with high accuracy, helps to decrease work casualties, provides determination of proper training and tracking, hopefully reduces deficiencies related to crew served in, and finally, has positive effects on total quality benefits to the maritime industry.

In shipping management (technical and operational), labour is the primary factor of the maritime sector [1]. In technical shipping management, the easiest way to decrease the running cost of a ship is "labour costs". On the other hand, humans are the dominant factor in maritime accidents [2, 3]. As a result of that, human resources (planning, competency, training and development, performance measurement, payment, etc.) are critical management processes in shipping management. In the literature, some studies focused on integrating new approaches into the organizations on maritime policy and management for supporting their managerial activities (see Panayides [4], Jensses and Randoy [5]). In addition, Asyali and Zorba [6] handled a web-based survey on the human resource managers in Turkish shipping companies for understanding of their human resource strategies. They describe some human resource strategies in the field of resourcing, recruiting, selection and retention, compensation, performance management, training and development.

The role and systems of Human Resource Management (HRM) in the shipping business require different procedures compared with the other disciplines, due to various expectations and constraints on operational processes in the maritime industry [7]. Celik et al. [7] propose a model based on an Analytic Network Process to support the personnel selection facilities of crewing departments in ship management companies. According to their study, employing the Master is the prioritised evaluation factor due to he/she being the most significant and key person on board.

Hough and Oswald [8], Lievens et al. [9] and Robertson and Smith [10] presented excellent reviews on personnel selection and employment. Other papers published in the literature are mostly focused on knowledge measurement, skill, technical proficiency, personality, interview, performance, and so on for improving the personnel recruitment function of HRM. To find the right people for the right jobs and positions is the primary strategy for personnel recruitment in

HRM; this is also discussed by Chien and Chen [11]. Furthermore, there are some models and techniques in personnel employment using IT [12-14].

There are mainly two approaches in human resource management (HRM); the classical approach known as personnel management and the modern approach known as HRM. HRM is broader than personnel management. In the classical approach, a human was considered as a cost for the company. On the other hand, HRM considers a human as a benefit for the company. So, human resources could be competitive advantages through technology and financial capital. Today an effective HRM is the main issue for sustainable competitive advantage in global shipping. Personnel recruitment with its process is the most critical issue in Maritime HRM (M-HRM). Many shipping companies have performed HRM activities (especially recruitment of the crew) under personnel management activity in the crewing department instead of managing a HRM department in the shipping organization. As a result of that, this study will aim to support a systematic way for application in HRM departments of a shipping company by using information technology tools. This study considers not only the basic applications of a HRM department in a company but also considers additional requirements of STCW and ILO in the HRM of a shipping company.

2. Methodology

2.1 ".NET" Technology

Microsoft started development on the ".NET" Framework in the late 1990s; originally under the name of Next Generation Windows Services (NGWS). NET 1.0, which is the first beta version of .NET, was released in 2000. The .NET Framework is an integral Windows component that assists developing and running the following generation of computer applications and XML Web services. The .NET Framework is developed to meet the following objectives:

- To provide a consistent climate for object-oriented programming whether object code is saved and performed locally, performed locally but Internet-allotted, or executed at a distance.
- To provide a code-execution climate that decreases software deployment and versioning disagreement.
- To provide a code-execution environment that support safe performing of code, including that developed by not well known third parties.
- To provide a code-execution environment that removes the performance problems of scripted or interpreted climates.
- To make the developer knowledge logical across widely varying types of applications, such as Windows-based applications and Web-based applications.
- To build all communication on industry standards to provide that code based on the .NET Framework can combine with any other code.

The .NET Framework has two main constituents: one is the common language runtime known as CLR and the .NET Framework class library. The common language runtime is the infrastructure of the .NET Framework. CLR can be thought as an agent that controls code at execution time, performing core services such as memory management, thread management, and remoting, while also enforcing strict type safety and other forms of code certainty that promote security and durability.

A fundamental principle of the runtime is the concept of code management. Managed code is known as the code that targets the runtime and unmanaged code is known as the code that does not target the code.

The class library, the other main component of the .NET Framework, is a wide, object-oriented collection of reusable types that you can use to build applications ranging from traditional command-line or graphical user interface (GUI) applications to applications based on the latest innovations provided by ASP.NET, such as Web Forms and XML Web services [15].

2.2 Common Language Infrastructure (CLI)

The purpose of the Common Language Infrastructure (CLI) is to provide a language-neutral platform for application development and execution, including functions for exception handling, garbage collection, security, and interoperability. By implementing the core aspects of the .NET Framework within the scope of the CL, this functionality will not be tied to a single language but will be available across the many languages supported by the framework. Microsoft's implementation of the CLI is called the Common Language Runtime (CLR), or CL. Visual overview of the CLI is illustrated in Fig.1, and it shows that different programming codes can be compiled in CLI for execution. Fig. 1 shows how to use .NET technology in the CLI within its visual ovierview.

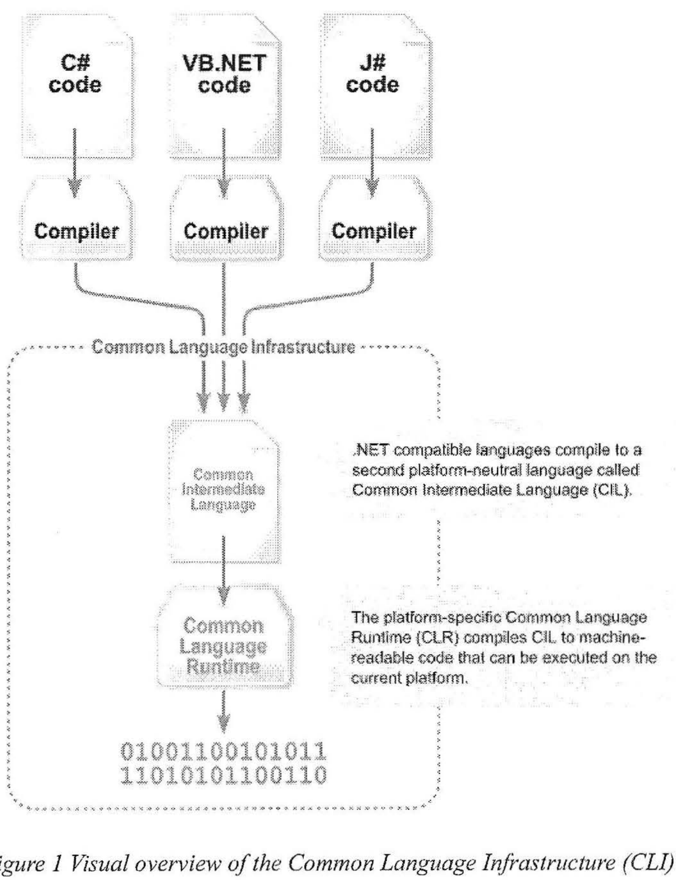


Figure 1 Visual overview of the Common Language Infrastructure (CLI)[1]

2.3 Database Flowchart

Database flow has been created to analyse the complete M-HRIM. The database diagram is shown in Fig.2. The centre of the concept is the "Crew Identity Card" which will collect all the information from other important topics. These topics are created according to requirements for shipping industry, such as: crew matrix index, certificates, trainings, performance evaluation, job history, seaman book, crew on ship, crew position, etc. Fig. 2 shows database diagram for the construction of HRIM tool and interfaces.

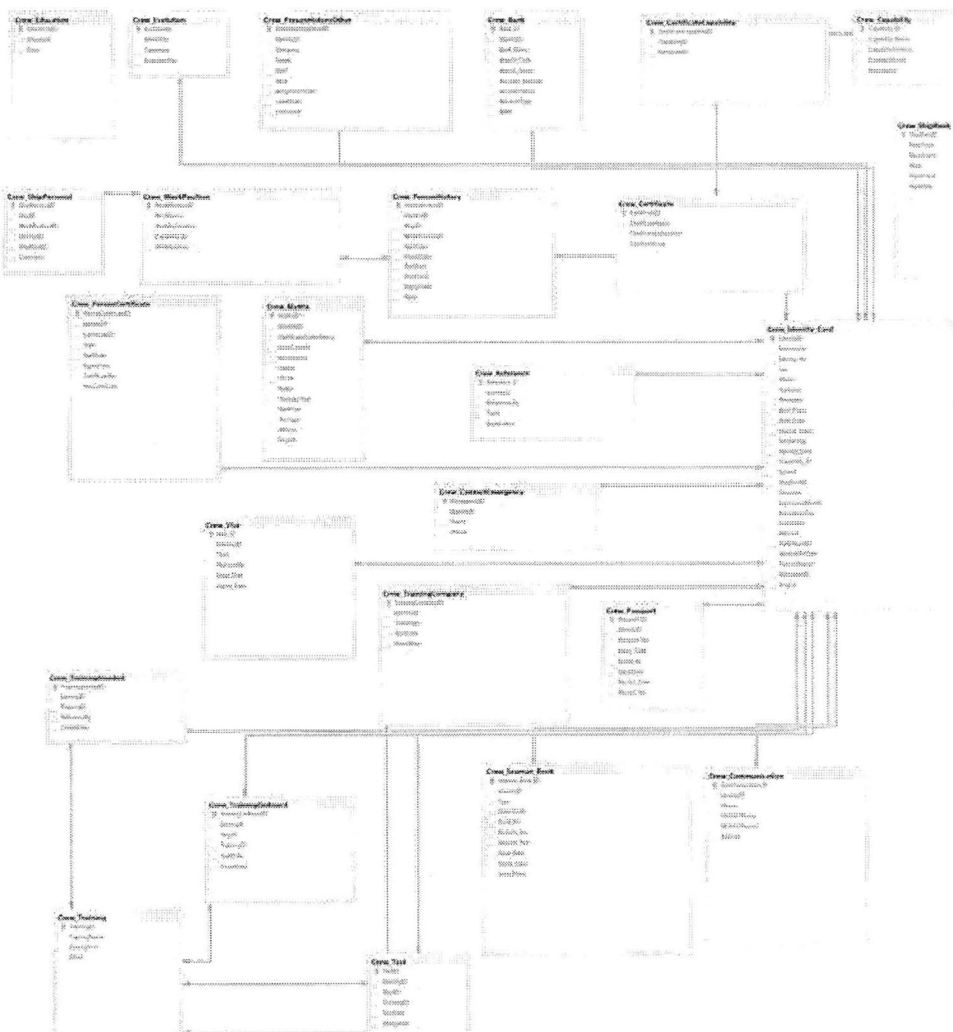


Figure 2 Database diagram

3. Application of Human Resource Information Management (HRIM) Tool

In this chapter, the basic concept of the M-HRIM outline is explained as shown in Fig. 3. The first phase of the recruitment process is the application form, and the form should be filled in by the seafarer candidate herself/himself. All information will be stored in the application and the company will easily evaluate the application form from the web. In addition, the person who is involved in the recruitment process can also view a candidate's application and review simultaneously. After that, the application will inform the candidate if he/she is eligible for an interview with responsible managers at the office. If it is preferred by the company, a pre-interview could be made by the Personal Manager or Deputy of Personal Manager. After interviewing with the personal manager, he/she would consult with the relevant manager. If the process of interviewing is finalized, then the next step will be to assess for competence. Some logical, physiological and psychological tests may be applied in this part, and other required measurements may be requested for details.

Fig. 3 shows logical algorithm of recruitment process for employment of seafarer to a vessel.

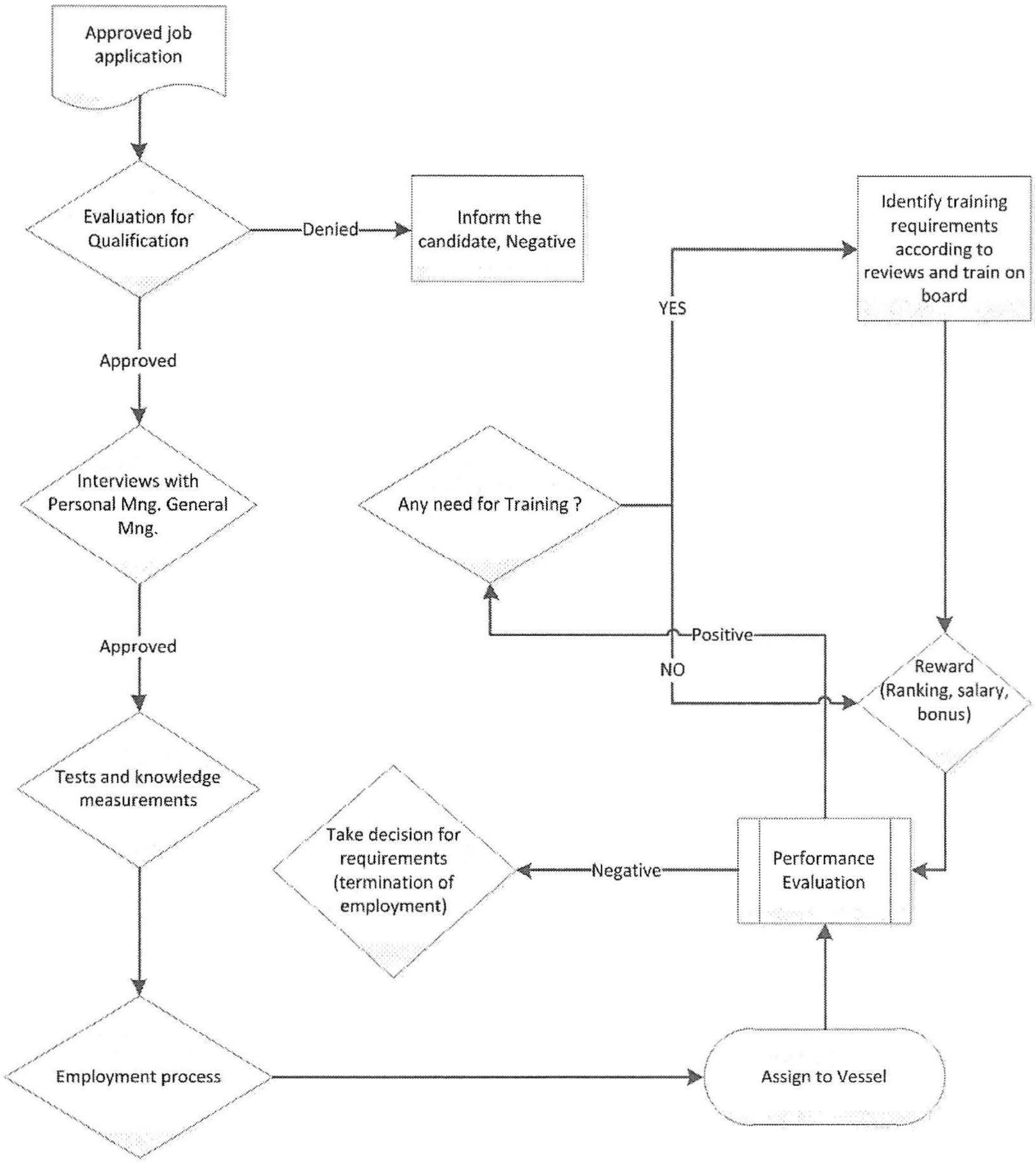


Figure 3 Basic work flow for M-HRIM

4. Conclusion

The seafarer recruitment process and assessment factors are very important for a shipping company. This selection can be organized properly by using a decision making support (with some applications). In this study, the seafarer recruitment process and assessment factors are outlined and a work flow for suitable assessment and placement of seafarers examined. As a result of this study, an appropriate functional web based application (called Maritime-Human Resource Information Management (M-HRIM)) was developed for crewing departments in any ship management company. M-HRIM will be a tool for decision support for eligible seafarer selection. With its applications, a seafarer can be assessed and selected according to important factors, such as; nationality, international rules and regulations, and company policy. At the end, an eligible seafarer can be chosen for a suitable and appropriate position on board. This web-based application can be modified for other important topics which aim to improve quality of the recruitment process or other process steps following the recruitment process such as seafarer training, trial period, performance measurement and career upgrading opportunities. There can be future studies which analyse and modify new structures and flows in web-based application.

References

[1] McConville, J., "Maritime manpower", *Maritime Policy and Management,* Vol. 26, No. 3, 1999, pp. 207–208.

[2] Baker, C. C. and McCafferty, D. B., "Accident database review of human element concerns: What do the results mean for classification?", *Human factors in ship design, safety and operation,* London, 23–24 February 2005.

[3] Er, Z. and Celik M., "Definitions of human factor analysis for the maritime safety management process", *Proceedings of "Maritime Security and Maritime Education and Training" IAMU AGA-6,* Sweden, 24–26 October 2005, pp. 235–243.

[4] Panayides, P. M., "Maritime policy, management and research: Role and potential". *Maritime Policy and Management,* Vol. 33, No. 2, 2006, pp. 95–105.

[5] Jensses, J. I. and Randoy, T., "The performance effect of innovation in shipping companies", *Maritime Policy and Management,* Vol. 33, No. 4, 2006, pp. 327–343.

[6] Asyali, E. and Zorba, Y., "The Impact of Global Economic Crisis on Human Resources Strategies in Maritime Industry", *Journal of Dokuz Eylul University Maritime Faculty,* Vol. 2, No. 1, 2010, pp. 33-48.

[7] Celik, M., Er, I.D. and Topcu, Y.I., "Computer-based systematic execution model on human resources management in maritime transportation industry: The case of master selection for embarking on board merchant ships", *Expert Systems with Applications,* Vol. 36, 2009, pp. 1048-1060.

[8] Hough, L. M. and Oswald, F. L., "Personnel selection: Looking toward the future-remembering the past", *Annual Review of Psychology,* Vol. 51, 2000, pp. 631–664.

[9] Lievens, F., Van Dam, K. and Anderson, N., "Recent trends and challenges in personnel selection", *Personnel Review,* Vol. 31, No.5–6, 2002, pp. 580–601.

[10] Robertson, I. T. and Smith, M., "Personnel selection", *Journal of Occupational and Organizational Psychology,* Vol. 74, No. 4, 2001, pp. 441–472.

[11] Chien, C.F. and Chen, L., "Data mining to improve personnel selection and enhance human capital: A case study in high-technology industry", *Expert Systems with Applications,* Vol. 34, No. 1, 2008, pp. 280-290.

[12] Beckers, A. M. and Bsat, M. Z., "A DSS classification model for research in human resource information systems", *Information Systems Management,* Vol. 19, No. 3, 1995, pp. 41-50.

[13] Kovach, K. A. and Cathcart, C. E., "Human resource information systems (HRIS): Providing business with rapid data access, information exchange and strategic advantage", *Public Personnel Management,* Vol. 28, No. 2, 1999, pp. 275-282.

[14] Liao, S. H., "Knowledge management technologies and applications – literature review from 1995 to 2002", *Expert Systems with Applications*, Vol. 25, 2003, pp. 55-164.
[15] Microsoft Corp., .NET Framework Conceptual Overview, Retrieved on May 2012 from, http://msdn.microsoft.com/en-us/library/zw4w595w.aspx
[16] Wikimedia foundation, Common Language Runtime, Retrieved on May 2012 from, http://en.wikipedia.org/wiki/Common_Language_Runtime
[17] Bamberger, P. and Meshoulam I., *"Human Resource Strategy: Formulation, Implementation, and Impact"*, SAGE, 2000.

Challenges and Opportunities in Maritime Education and Competence Development – a comparative analysis of lessons learnt

Froholdt, L.L.
Ph.D., Senior research Associate, Maritime Development Center of Europe,
llf@maritimecenter.dk

Kragesand Hansen, E.
MSc., Associate professor, Svendborg International Maritime Academy,
edk@simac.dk

Abstract: This paper sheds light on Maritime Education and Competence Development which has been investigated in various studies, both within and outside Europe. However, the topic is under-researched and still in need of attention, in order to ensure that competences are aligned with technological advancements and the needs that exist in a contemporary maritime industry. It is furthermore paramount that these competences are developed in a manner so that it contributes to the further development of the industry as a whole, in order to maintain a competitive position in the global market. Based on low levels of Research and Development intensity within the EU in comparison to international competitors such as Japan, South Korea and the United States, The EU has committed efforts to 'lift the bar' on these levels in order to achieve the objective of The Lisbon Strategy and The Bologna Process. The individual Member States and the maritime industry are also called upon to contribute to these efforts in 'The European Maritime Strategy 2008-2018', in order to assist in accomplishing this objective. In relation to this, the paper highlights the importance of enhancing the following key factors: maritime know-how, competence development, trans-national collaboration and standardisation. Research programmes within the EU have sought to address the challenges that the industry faces from a European perspective, supporting the development of trans-national efforts and synergies to battle the problems. The European Commission has supported The Maritime Transport Sector through research programmes from both a general perspective and a more specific maritime perspective. The paper then discusses the challenges involved in "lifting the bar" and teases out the findings in previous and current EU projects and National studies that have sought to address these challenges in the search for optimising Maritime Education and Competence Development based on the key factors mentioned above. Among such projects and studies that have been conducted at an EU level is the EU project, "Northern Maritime University Network". With both national and EU funding is "The Danish Maritime Cluster" project, and finally outside the EU is the Asian project by Ahn and McLean.[1] These projects will be presented and compared based on the key factors mentioned above and how these projects in practice enhance maritime education and training.

Keywords: maritime competence development, trans-national and national efforts, maritime know-how.

1. Scope of the topic

Maritime transport is an industrial sector that is global in every aspect of its core competence, such as economy, transport of cargo, insourcing of services and human resources. This demands a dedicated responsibility to national and global policymakers in the industry in order to ensure development, competitive terms and conditions. The international Maritime Organisation has placed efforts in attempting to create a global standard of education through the STCW 95 Convention[2] and the following amendments. This paper does not focus on the contents of this standard, but the maritime education and competence development that takes place beyond this.

The core competence of the maritime industry has thus evolved, from a need of competences in navigational and technical knowledge, to the needs of a global and complex business segment, calling for a range of different competencies[3]. Expanding trade in ports around the world and new emerging markets calls for specialised training and new competences in order to manage technological advancement, a global economy and complex logistic systems.[4] Research has shown that there is a problem in the quality of the training that seafarers currently receive,[5] and the level of competence in the European maritime industry is declining.[6] Another study claims that the lack of efforts to develop human resources in the maritime industry has resulted in a lack of knowledge about career path mobility possibilities within the industry[7]. This invokes a need to attract new upcoming generations and potential work forces in other or related industries. However, despite these studies, the topic of competence development is under-researched and in need of an orchestrated response to the needs of a contemporary maritime industry. Cullinane and Wilmsmeier[8] go so far as to argue that it is essential to battle the challenge that the EU faces due to new and emerging markets and growing knowledge specialisation that can threaten EU's position on the international scene. It is then of paramount importance that competence development in the maritime industry is enhanced in such a way that it contributes to the further development of the industry, in order to ensure a sustainable industry that is ready to meet the challenges of the future. In order to do this, the level of competence must be mapped out – what in reality is meant by competence development? How do real projects in fact seek to accommodate the challenges and opportunities of a competence development in the maritime industry?

2. Defining competence levels

Maritime competence development has been addressed in the maritime industry and in a range of EU initiatives. Relevant to this context, the EU commission has instigated strategies that focus on enhancing maritime education and competence development and maritime know-how. This can be seen in the European Maritime Strategy 2008-2018[9], which aims to strengthen the maritime industry's competitiveness by focusing on six main themes, of which, specifically, themes 2 and 6 are relevant for this paper.

1. Shipping trends and business conditions
2. Human Resources
3. Quality shipping
4. International scene

5. Short-sea shipping
6. Research and Innovation

2.1 Theme 2 - Human resources

This theme contains a description of the growing shortage of maritime professionals that can fill the knowledge-intensive and high-quality jobs that are available in the maritime industry today. This shortage poses a great threat to the industry of losing its critical mass of human resources, which in turn contributes to the development of competencies in a maritime EU. The initiative that this theme encompasses in order to address this threat is to intensify employment possibilities, facilitate life-long career paths and maintain high levels of competence development within a framework of education offerings through collaborations between maritime training institutions. The latter seeks to promote student mobility and move forward to create what is called maritime certificates of excellence. This strategy clearly addresses many of the foci points in the EU's Bologna declaration and the concrete efforts requested call for a standardization of maritime education and competence development offerings within the EU, which can enhance both student and teacher mobility. Human Resources are generally managed in organisations by focusing on increasing the effectiveness and efficiency through performance development based on three main elements: training and development, career development, and organisation development[10]. As part and parcel of Human Resource Management, the EU strategy specifies the necessity to maintain high levels of competence development in maritime organisations. In order to unfold how it is possible to maintain high levels of competence development, it is necessary to settle on a definition. The EU has sought to define the concept of competency, as entailing cognitive, functional, personal and ethical functions[11]. However, this definition is not very specific. Stewart and Brown define competency as the knowledge, skill, ability and other personal attributes, such as values and attitudes that are required in order to perform a specific task[12]. Lucia and Lespinger elaborate on the definition a little more to include "a descriptive tool that identifies the skills, knowledge, personal characteristics and behaviours needed to effectively perform a role in an organization and help the business meet its strategic objectives".[13] What divides the two latter definitions is that Lucia and Lespinger hinge in a business's strategic objectives. However, what connects the two definitions is that they both fail to define the level of knowledge and how it has been obtained in order to coin it 'a competence'. This task has been attended to by Quinn[14], who has based his study on the early works of Dreyfus et al..[15] Quinn believes that mastering a task or activity entails both a learning process over a length of time and that the capacity to learn evolves. This means that in order to learn a task, the learning process will be influenced by how far an individual's learning capacity has developed. Quinn coins five learning capacity stages, of which the third stage is called 'competency', which he defines as a further development of confidence and a reduced reliance on absolute rules by recognising a wider variety of cues from the working context. There is a greater degree of learning by trial and error, experimenting with new behaviours. It is not abandoning the rules, but being able to use them more imaginatively and with an interpretation that suits one's own personnel strengths and inclinations. This definition is seemingly equivalent to Piaget's concept of assimilative learning, where an individual adds a new element to existing cognitive schemes.[16]

Inspired by Piaget's[17] adaptation theory, Illeris has devised a typology for learning processes comprising four learning types. The starting point is that we through adaptation processes seek to create equilibrium between the world and ourselves. This dynamic balancing takes place constantly and creates new cognitive schemes for our actions and thus increases our competences. The first and most basic learning type is cumulative learning, also called mechanical learning. This is when a new cognitive scheme is created such as when a person has to learn a bank code for a credit card.

The second and most common learning type is assimilative learning, which was mentioned above. This is the case when new impulses are attached to existing schemes, which can be used in other similar situations. The third type of learning is accommodative learning which is when existing schemes must be restructured in order to establish understanding and meaning. Finally, Illeris emphasizes the fourth learning type, transformative learning, which is a substantial accommodative process. This learning type is a process of the acquisition of learning with a major restructuring of schemes, where an individual undertakes a personal change. However, the EU strategy makes specific knowledge-intensive and high-quality jobs and the increasing loss of critical mass of human resources due to the massive tendency to outsource, and this does point to a level of knowledge that involves the necessity of competence development that involves transformative learning.18

This then makes it possible to conclude that the definition by Lucia and Lespinger of the concept of competence as "a descriptive tool that identifies the skills, knowledge, personal characteristics and behaviours needed to effectively perform a role in an organization and help the business meet its strategic objectives" can be used to define that the EU strategy involves the development of maritime competencies at a transformative learning level.

However, the EU strategy also points to the necessity to continue to develop maritime know-how as part of the theme of human resources which does not necessarily involve transformative learning levels.

2.2 Maritime know-how

The maritime industry consists of a broad palette of professionals, ranging from seafarers, technical superintendents, shipowners and forwarders. This palette of professionals represents a vast knowledge base about maritime transport that is based on many years of history and tradition. This includes knowledge of the sea, extensive experience and an ability to seize challenges. Practical knowledge has been valued in the maritime industry, and this knowledge is based on the fact that the predominant and preferred form of learning in the industry is situated learning.[19] This entails the social dimension of learning which integrates the components of meaning, practice, community and identity that are necessary in order to characterize social participation as a learning and a realization process. The components are both interconnected and mutually defining.[20]

The distribution of this know-how and situated learning has tended to take place in so-called maritime clusters. The concept of clusters was introduced by Porter,[21] who defined the notion as "geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions in particular fields that compete but also cooperate".[22] Clusters are thus demarcated geographical areas where businesses that are co-related in some way have the possibility of obtaining better access and distribution of knowledge and by clustering businesses, competitiveness can be intensified and new products and solutions to challenges can arise. Maritime competence development has greatly profited from various regional, national and European so-called "maritime clusters", which have also been enhanced by national political policies that promote "national maritime clusters".[23] Research shows that shipping nations with strong maritime clusters have the best possibility of economical sustainability. This is the case in countries such as Norway and Denmark, and is also the case in Singapore. A study by the Danish Shipowners Association[24] showed that maritime clusters do have an impact on a nation's economy, i.e. in the year 2000, the economic contribution of the Italian maritime cluster was 26.3 billion Euros which was 2.3% of Italy's GNP. This shows that there is an economic incentive for nations to ensure the sustainability of maritime clusters by possibly diverting funds to facilitating the further growth of their economic significance, and the whole idea of clusters has also become more and more an integrated part of EU policies.[25] These maritime clusters have contributed to increasing maritime activities, productivity and innovation and this competence development should continue to be supported. The learning type of competence development here is seemingly equivalent to accommodative learning.

2.3 Theme 6 – Research and innovation

In the sixth theme, the EU admits that maritime transport is greatly dependent on research and innovation efforts. The EU calls on the maritime industry to utilize the vast amount of knowledge that has already been generated in EU research programmes and activities and to enhance advancement in specific technological and information heavy areas. The strategy also touches on the initiatives within the industry regarding a greener and sustainable sector. This focus is also necessary as the research and development intensity is general is still below the 3% target that was set for 2010 in the Lisbon Strategy. Below in Table 1.0., the research and development intensity levels can be seen for EU countries in comparison to countries that comprise international competition.

Table 1.0: Research & Development Intensity levels in % for EU-15, EU-27, Japan, South Korea, China and United States, 2007-2008[26]

	R&D intensity in % 2007	R&D intensity in % 2008
Japan	3.44	-
South Korea	3.21	-
EU-goal 2020	3.0	3.0
United States	-	2.76
EU-15	-	1.99
EU-27	1.85	1.90
China	1.44	-

Note: Research and Development Intensity entails R&D expenditure as a percentage of a country's GDP.

EU-15 encompasses the EU consisting of only 15 Member State members. EU-27 encompasses the EU with 27 Member State members. Not all R&D Intensity levels were available from United States and EU-15 in 2007 or Japan, South Korea and China 2008, and are therefore marked, - .[27]

Table 1.0 shows that the EU is slow to achieve the goal of 2020, which is 3% of GDP, and is overtaken by The United States, Japan and South Korea. This pace must change and can only be accomplished if more efforts are put into allocating resources to research and development. However, the EU policy of the EMTS 2008-2018 shows that the EU has acted on the obvious low levels of R&D intensity, and has addressed how these levels can be lifted by focusing on areas such as research and innovation, maritime know-how, human resources and competence development. These foci comprise both accommodative and transformative learning types. Although this data shows that there is expenditure in Research and Development, the data also underlines the fact that the EU still lacks serious actions towards enhancing research and development in order to ascertain a position in relation to international competition. The paper will now proceed to the comparative analysis of three selected projects that each seek to enhance maritime competence development

3. A comparative analysis of lessons learnt

The grounds for the selection and comparison of the projects will firstly be unfolded. The projects are related due to the fact that they all focus on the themes from the EMTS 2008-2018 that have been explicated above. Firstly, the project by Ahn and McLean is a project that focuses on human resources, and it seeks to map out a human resource management plan for a specific cluster within the maritime sector, that takes place outside the EU. The second selected study focuses on research and innovation, and is called the Northern Maritime University Network project. This project seeks to provide academic and research-based offerings to maritime professionals that are based on the needs expressed in trans-national stakeholder studies in three different countries. The third and last study to be presented is a Danish study with both a national and a regional impetus that focuses on creating competence development of the Danish maritime cluster.

3.1 Project by Ahn and McLean

The study by Ahn and McLean[28] is an excellent example of how to utilize maritime cluster competences. Ahn and McLean investigated Busan city in Korea as a case study in order to create a plan for Regional Human Resource Development. This was used to create an educational program that was built on existing knowledge and a regional human resource management policy that could be used as a strategic plan for enhancing growth and competence focusing on specified strategies industries, of which the port and logistics industry was the most competitive and value-added. The study shows how a concentrated effort is a simple yet clever way of building education on existing and emerging industrial needs.

3.2 The Northern Maritime University network project.

The Northern Maritime University Network is an EU financed project consisting of ten universities and maritime businesses which aims to build a strong trans-national network and knowledge cluster and to integrate relevant stakeholders from the maritime business sector in order to provide multi-disciplinary and internationally oriented qualification offerings for the maritime industry. The project seeks to contribute to providing research-based qualification offerings that are based on the needs that exist in the industry. A trans-national stakeholder group has been interviewed as to which offerings are relevant and how these offerings could be construed. It is the objective of the project that these offerings and the collaboration between the universities strengthen the competitiveness of the European education industry and the maritime business sector.

3.3 The Danish Maritime Cluster project – a national project with a regional impetus

The Maritime Development Center of Europe (MDCE)[29] has initiated a large research and development project, called Denmark's Maritime Cluster (DKMC). DKMC is a project that is co-financed by the EU social foundation and the Capital region of Denmark's Growth forum and has ten consortia partners, such as Copenhagen Business School, Denmark's Technical University, Force Technology and the maritime education institutions, such as Svendborg International Maritime Academy [30] (SIMAC).

MDCE is Lead partner of the project and apart from project administration, is also committed to the delivery of two analyses, so that each will contribute to the identification of competence gaps in the maritime industry, by conducting a SWOT analysis of, and an analysis of best practice in, maritime cluster development. The SWOT analysis will identify the strengths, weaknesses, possibilities and threats that the maritime cluster faces today and in the future. The analysis will then identify which maritime competence areas need attending to, which areas can easily be strengthened and which areas need to be constructed in order to sustain a competetive position in the global maritime industry. MDCE will also conduct a Benchmark analysis, which will function as a comparative analysis of the maritime cluster's current position in comparison to other maritime clusters. The analysis will tease out what it is that characterizes the Danish maritime cluster in comparison to others and identify possible actions necessary in order to sustain a strong and competetive cluster compared with other clusters.

SIMAC is conducting an analysis of the competences that a dual-officer contributes to growth in the maritime sector. The analysis will identify whether there is a competence potential that is not utilized which could be activated in other relevant education offerings, or the establishment of new job functions, either at sea or ashore. SIMAC will also establish an Educational Guidance Center that will provide methodical guidance for maritime instructors and tutors and academic writing guidance for students. SIMAC will finally establish a course in automation.[31]

4. Comparative analysis and lessons learned

The selected projects all focus on producing concrete education offerings to maritime professionals in the industry and thus enhance the collective competence level of the maritime cluster, respectively, in Busan City in Korea, The North sea Region, the Danish national and regional cluster. However, it is only the NMU project that is trans-national.

The project by Ahn and McLean and the NMU project both base their competence development on competence needs and the maritime know-how that already exists in the industry, whereas the DKMC has defined beforehand which competence offerings it will provide. Although all projects contain academic offerings, it is only the project by Ahn and Mclean, where there is a clear regional human resource management plan for the competence build that is initiated. Such a plan enables a very specified and focused action plan that can be executed in the demarcated area. Lessons learnt from such a regional study can be replicated and used in other regional clusters focusing on industries relevant for that respective region. Such efforts can also be part of larger orchestrated development plans, such as a National Human Resource Development plan. Such a plan will harness and develop the maritime competences and thus enhance a sustainable industrial development. Finally, the learning levels of competence development do seem clear in the case of academic offerings, however it is not explicit.

Although all of these three projects are commendably working to 'lift the bar' of the competence level of knowledge in the industry, they all create their own individual standard of excellence. The consequence of this is three different standards that can be difficult to harmonize. The lesson learned here could then be that whilst these projects are seeking to enhance competence levels of both accommodative and transformative learning types, efforts should be put into establishing a global 'standard of excellence', which enables borderless education offerings, and precisely as it reads, ensures a standardised level of maritime education and competence development in a sustainable global industry that excels across Illeris's learning types to also include transformative learning.

References

[1] Ahn, Y. and McLean, G.N.. *"Competencies of personnel for regional HRD"* Asia Pacific Education review. Vol. 9, No. 4., (2008). Pp. 542-551.

[2] Commission of European Communities, *"Towards a European qualifications framework for lifelong learning"*. Commission staff working document. Brussels. (2005).

[3] Cullinane, K. and Wilmsmeier, G., *"Beyond Policy and Process"*. Public service Review: Science and technology 3. (2009). Pp. 181-182.

[4] Dreyfus, H. and Dreyfus, S. *"Mind over machines"*. Oxford. (1986).

[5] Eurostata data (online data code: rd-e-gerdtot).

[6] Froholdt, L.L., *"MIEP report"*. Interreg IVB North Sea Region programme: NMU project: Deliverable WP6. (2010).

[7] Illeris, K., " *Læringsteoriens elementer*", In: Illeris, K. (ed.): *Læringsteorier*. Roskilde Universitetsforlag (2007). pp. 11 – 38.

[8] Illeris, K.," *Læring*". 2. udgave, 3. oplag. Roskilde Universitetsforlag, (2009).

[9] Ircha, M.C., WMU Journal of Maritime Affairs. Vol 5. No. 1. (2006). pp. 37-59.

[10] Lave, J. and Wenger, E. *"Situated Learning: Legitimate Peripheral participation"*. New York: Cambridge University press. (1991).

[11] Li, K.X. and Wonham, J., *"A method for estimating world maritime employment"*. Transportation research Part E 35. (1999). Pp. 183-189.

[12] Lucia, A.D. and Lespinger, R. *"The art and science of competency models: pinpointing critical success factors in organizations"*. San Francisco, CA: Jossey-bass/Pfeiffer. (1999).

[13] Piaget, J. *"The Construction of Reality in the Child"*. New York: Basic books. (1954).

[14] Porter, M., "*The Competitive advantage of nations*". The Free Press, (1990).
[15] Quinn, R.E., "*Beyond rational management: mastering the paradoxes and competing demands of high performance*". San Francisco: Josey-Bass. (1988)
[16] Quinn, R.E., Faerman, S.R., Thompson, M.P., and McGrath, M.R. "*Becoming a master manager*". New York: John Wiley. (2002)
[17] SKEMA – Consolidation study: SE 2.3. "*Human Resources - education and training*". A project supported by The European Commission. Directorate-General for Energy and Transport. (2009).
[18] Stewart, G.L. and Brown, K.G. "*Human Resource Management. Linking strategy to practice*" 2nd edition. John Wiley and Sons Inc. (2011).
[19] The Danish Shipowners' Association, "*The economic Significance of Maritime clusters. Lessons learned from European empirical research*". Working paper. (2010).
[20] Wenger, E. "*Communities of practice: Learning, Meaning and identity*". Cambridge: Mass.: Cambridge University Press. (1998).

Endnotes

1 Ahn and McLean, 2008
2 The STCW 95 has recently been revised, and a STCW 2011 version is downloadable at IMO.org
3 Leong et al., 2009
4 Ircha, 2006
5 Li and Wonham, 1999
6 MIEP report, 2010
7 SKEMA consolidation study, 2009
8 Cullinane and Wilmsmeier, 2009
9 http://ec.europa.eu/transport/strategies/2018_maritime_transport_strategy_en.htm acessed 26 march, 2012.
10 Ahn and McLean, 2006
11 Commission of the European Communities, 2005
12 Stewart and Brown, 2011
13 Lucia and Lespinger, 1999, p. 5
14 Quinn 1988, Quinn et al. 2002
15 Dreyfus et al. 1986
16 Illeris , 2001
17 Piaget, 1954
18 Illeris, 2001
19 Lave and Wenger, 1991
20 Wenger, 1998
21 Porter, 1990
22 Porter, 1998
23 Porter, 1990
24 Danish Shipowners' Association, 2010
25 The Danish Shipowners' Association, 2010
26 Eurostat
27 Eurostat
28 Ahn and McLean, 2006

29 The MDCE is a national maritime cluster organization that is situated in Copenhagen, close to the large maritime shipowners and maritime businesses with over 7800 members and is a common secretariat of six different organizations. This includes The Promotion of shipping, Transport Innovation Network, Transport Economic Association, the Development Center of Europe and the MARsters network.

30 SIMAC is the largest maritime education institution in Denmark, has over 500 students and offers three fields of studies, The ship's officer study programme, marine engineer study programme, and the shipmaster study programme.

31 It can be mentioned that the DKMC project also contains university education offerings at both BSc and MSc levels and there are two Ph.D positions.

Application of an Internet-based Tool for Visualization of Multi-Dimensional Objects with Missing Data in Maritime Education

Natalia Nikolova
Assoc. Prof. PhD., N. Vaptsarov Naval Academy, V. Drumev 73, Varna 9026, Bulgaria, natalianik@gmail.com

Daniela Toneva Zheynova
Assoc. Prof. PhD., Technical University – Varna, 1 Studentska Str., Varna, Bulgaria, d_toneva@abv.bg

Kalin Kalinov
Assoc. Prof. DSc, Captain, N. Vaptsarov Naval Academy, V. Drumev 73, Varna 9026, Bulgaria, va_vms@yahoo.com

Boyan Mednikarov
Prof. DSc, Captain, N. Vaptsarov Naval Academy, V. Drumev 73, Varna 9026, Bulgaria, bobmednikarov@abv.bg

Kiril Tenekedjievld
Prof. DSc, N. Vaptsarov Naval Academy, V. Drumev 73, Varna 9026, Bulgaria, Kiril. Tenekedjiev@fulbrightmail.org

Abstract: In certain disciplines of maritime education it is necessary to operate with multi-dimensional data that is difficult for students to comprehend. Such disciplines happen to be environmental monitoring of water, technical diagnostics of ship machines and equipment using statistical pattern recognition, decision analysis of alternatives with multi-dimensional consequences, etc. Worst still, some of the multi-dimensional vectors are not known completely. Even though there are some mathematical algorithms developed to tackle the problem stated, in some countries maritime education suffers certain limitations caused by the high prices of specialized software. Here, an Internet based tool is presented which solves two interconnected problems. The first problem is the visualization of multi-dimension environmental vectors. That problem is addressed with two methods: The Principal Component solution of orthogonal Factor Analysis model and with Multi-Dimensional Scaling procedure. The second problem is the generation (the imputation) of the missing data in multi-dimension environmental vectors. The implemented solution uses modified Roweis algorithm for Expectation Maximization (EM) algorithm for Principal Component solution of orthogonal Factor

Analysis method. The functionality of the system is described along with environmental examples.
Keywords: multi-dimensional scaling, principle component solution, Roweis algorithm,

1. General Set Up of the Visualization Problem

The records in an environmental database normally contain several environmental variables measured at approximately the same time point. Let us assume that we have an environmental database with n records each of which is represented by a p-dimensional column vector $\vec{x}_j = \left(x_1^{(j)}, x_2^{(j)}, \ldots, x_p^{(j)}\right)^T$, where T stands for the transpose operator and i=1,2,...,n. The whole data base can be written in a p x n matrix $D = \left(\vec{x}_1, \vec{x}_2, \ldots, \vec{x}_n\right)$.

If all the measurements of the environmental variables are known and recorded into the data base D then we can denote this matrix with $D_{full.}$ The problem which we face is to compress the p-dimensional vectors in $D_{full.}$ into m-dimensional vectors $\vec{f}_j$ for j=1, 2, ...,n. If m=2, the compressed vectors can be depicted by a scatter plot of the first against the second compressed coordinates. If m=3, the compressed vectors can be depicted by three scatter plots which show respectively the first against the second, the second against the third and the first against the third compressed coordinates. We call that a visualization problem. The result of the visualization problem is a compressed database in form of a m x n matrix $D_{compr} = \left(\vec{f}_1, \vec{f}_2, \ldots, \vec{f}_n\right)$.

Two classical algorithms are employed in the Internet based tool for solution of the visualization problem (that is for the data reduction from the p-dimensional to the m-dimensional space):

- Multi-Dimensional Scaling Procedure (MDS) [4]
- Principal Component Solutions of Exploratory Orthogonal Factor Analysis Model (PCA_EOFA) [6]

So the visualization module of the Internet-based tool has two sub-modules; the MDS sub-module and the PCA_EOFA sub-module.

The MDS sub-module uses 10 different distances as a measure of dissimilarity between the vectors:

- Manhattan distance: $\delta_{k,j} = \sum_{i=1}^{p} \left| x_i^{(k)} - x_i^{(j)} \right|$
- Euclidean Distance: $\delta_{k,j} = \sqrt{\sum_{i=1}^{p} \left(x_i^{(k)} - x_i^{(j)} \right)^2}$
- Minkovski r-distance (with r=3, 4, 5, 10, 20) : $\delta_{k,j} = \sum_{i=1}^{p} \left(\left| x_i^{(k)} - x_i^{(j)} \right|^r \right)^{1/r}$
- Hamilton (or Chebishev) distance: $\delta_{k,j} = \max_i \left(\left| x_i^{(k)} - x_i^{(j)} \right| \right)$

- Normalized Euclidean Distance: $\delta_{k,j}=\sqrt{\sum_{j=1}^{p}\left(\frac{x_i^{(k)}-x_i^{(j)}}{s_i}\right)^2}$, where s_i is the sample standard deviation of the coordinate i.
- Mahalonobis distance: $\delta_{k,j}=\left(\vec{x}_k-\vec{x}_j\right)^T K^{-1}\left(\vec{x}_k-\vec{x}_j\right)$, where K is the sample covariance matrix of the data.

The Java realization of the MDS sub-module has been based on [1] where the 'stress' criterion (formula (8) in the accompanying paper [8]) is optimized. The mathematical algorithms of PCA_EOFA sub-module are explained in the accompanying paper [8].

Sometimes the record $\vec{x}_j$ of the data matrix D is not a full vector. Instead, part of the coordinates $x_1^{(j)},x_2^{(j)},\ldots,x_p^{(j)}$ are missing due to various reasons. In this case the same data matrix is called $D_{miss}=\left(\vec{x}_1,\vec{x}_2,\ldots,\vec{x}_n\right)$. For example, let p=5 and for the third observation $\vec{x}_3$, the second and the fifth coordinates are missing (denoted as NaN), whereas the first the third and the forth coordinates are -17, 24 and 6 respectively. Then:

$$\vec{x}_3=\begin{pmatrix}x_1^{(3)}\\x_2^{(3)}\\x_3^{(3)}\\x_4^{(3)}\\x_5^{(3)}\end{pmatrix}=\begin{pmatrix}-17\\NaN\\24\\6\\NaN\end{pmatrix}$$

There are many reasons for the missing data, especially when social surveys are involved, because people do not always want to answer all questions. As long as the environmental data is gathered by direct measurements with some measurement devices we have accepted the hypothesis that the data is missing at random [7]. The problem that we face is to restore the values of the missing part in D_{miss}. Of course the missing part of D_{miss} is an unobservable quantity which has to be estimated from the observable quantities (the known data) in the data base. We call that the Missing Data Imputation Problem. The result of the missing data imputation problem is an imputed database in the form of a p x n matrix $D_{imp}=\left(\vec{x}_1^{(imp)},\vec{x}_2^{(imp)},\ldots,\vec{x}_n^{(imp)}\right)$. D_{imp} has the same values as D_{miss} but the missing values are substituted with values generated by a mathematical algorithm called imputed values.

A powerful expectation maximization algorithm for estimation of unobservable quantities was proposed in the seminal paper [3]. Six years later that algorithm was properly proven [10]. In [9], the algorithm was used for imputation of missing data in the context of a factor analysis method. In the accompanying paper [8] a modification of the Roweis algorithm is proposed which quickly converges for medium sized data points. In the developed missing data imputation module of the Internet based tool the linear system $T_j\vec{z}_j^{(nimp)}=\vec{t}_j$ with p equations and N_j unknowns in point 7) of the algorithm in [8] is solved by QR decomposition of the matrix T_j [5].

Once the missing data imputation problem is solved and D_{imp} is generated then (having in mind that there are no more missing position in D_{imp}) it can be put that $D_{full} = D_{imp}$ and the imputed data can be passed to the visualization problem for data reduction.

2. Examples and demonstration

An Internet based system is developed to realize procedures for visualization of multi-dimensional data and for imputing missing data into multi-dimensional data sets. The system is available through the webpage www.ubss-tuv.com and it has been developed under the activities of the UPGRADE Black Sea Scientific Network (financed by the Seventh Framework Program of the EU). The main window of the platform is shown in fig. 1. Here we focus on the options "Visualization" and "Missing Values", the others being described in [3]. The procedures to be commented on may run on three file formats: text document (*.txt), Excel document (*.xls) and comma delimited text (*.csv).

2.1 Visualizing multi-dimensional data

A test file is created, containing 70 numbers of 7-dimensional test measurements. The structure of the file is shown in fig. 2 (for the sake of all examples, only the operation with Excel files shall be discussed here, all the others being very similar). The names of the coordinates (i.e. the environmental variables) are given on the second row, columns from 2 to p+1=8 of the file. The third row (same columns) contains the variable dimensions. The fourth row, columns from 2 to p+1=8 contains the values of $\vec{x}_1$, and the other vectors are written consecutively on the next rows. The last one is on row n+3=70+3=73. The first column of the file contains the consecutive number of the vectors.

The visualization section of the UBSS system is given in fig. 3. Let us use factor analysis to perform the visualization. After selecting the file (fig. 4) the user might choose from the panel shown in fig. 5:

1. whether to use standardized data or not (the first option is selected in this example), i.e. whether to replace the original data $\vec{x}_j$ in the input by the data normalized in the first place in formulae (30) and (31) in [8];
2. the output dimension to be 2 or to be 3 (m=3 is selected in this example);
3. the type of compressed data that is ordinary least square factor score using formula (28) or weighted least square factor score (29) of [8] (the first option is selected in this example).

Choosing to proceed, the system generates output as follows:

1. scatter plot of the first two coordinates of the compressed data (see fig. 6 for one of the three scatter plots, because the compressed data is three-dimensional);
2. the m-dimensional compressed data values on screen;

3. an excel file with five sheets, containing the compressed data points, the covariance matrix, the absolute error, the relative error and the cumulative percentage of the total variance explained (fig. 7) (which are formulae respectively (21), (25), (26) and (27) from [8]).

If we choose to visualize using multi-dimensional scaling, then the partial differences would appear in the input and in the output of the system. The parameters which determine the course of calculation of the multi-dimensional scaling are defined in a panel shown in fig. 8.

1. 1) whether to use standardized data or not (the first option is selected in this example), as in the visualization with factor analysis.
2. 2) the output dimension to be 2 or to be 3 (m=2 is selected in this example);
3. 3) the type of distance measure (Manhattan distance in this example).

Choosing to proceed, the system generates output as follows:

1. 1) scatter plot of the first two coordinates of the compressed data (as in fig. 6 but here this is the only scatter plot because the compressed data is two-dimensional);
2. 2) the compressed m-dimensional data values on screen;
3. 3) an excel file with four sheets (fig.9), containing the compressed m-dimensional data points, ($\vec{f}_j$), the distances in the original space ($\delta_{k,j}$), the distances in the compressed space ($\delta_{k,j}$) and the difference between the corresponding pairs of distances ($\delta_{k,j} - d_{k,j}$).

Such a procedure might be employed to identify outliers or certain internal connections (e.g. sometimes data would lie on the same straight line, which would indicate high level of multicolinearity in the data).

2.2 Imputing Missing Values

A test file is created containing 500 numbers of 10-dimensional test measurements, where some of the values are missing. The structure of the file is shown in fig. 10. The names of the coordinates (i.e. the environmental variables) are given on the second row, columns from 2 to p+1=11 of the file. The third row (same columns) contains the variable dimensions. The fourth row, columns from 2 to p+1=11 contains the values of $\vec{x}_1$, and the other vectors are written consecutively on the next rows. The last one is on row n+3=500+3=503. The first column of the file contains the consecutive number of the vectors.

The missing values section of the system is given in fig. 11. After choosing the *.xls format and the file itself (fig. 12) the user might choose:

1. the dimension of the compressed space (m=5 in the example)

2. whether to use standardized data or not (the first option in this example), i.e. whether to divide by $\sqrt{k_{i,i}}$ or not in step 3) of the algorithm in [8];
3. the drifting moments (either moving or fixed moments on X on each iteration, i.e. whether to execute step 9) in the algorithm of [8] or not; it is executed for this example);
4. whether to have additional fixing of the recovered data or not (whether to execute step 17) in the algorithm of [8] or not; it is executed for this example).

Choosing to proceed, the system generates output as follows:

1. graphics of the imputed data (see fig. 13 for the first coordinate, where the imputed points are in blue; such a plot is created for each coordinate);
2. all the imputed values on the screen;
3. an excel file with a single sheet containing the imputed set D_{imp} with structure the same as the input data, however the imputed values are placed instead of the missing ones in red (fig. 14).

2.3 Real Data Analysis

A file with real environmental data is created, related to chemical characteristics of sea water, containing 110 numbers of 13-dimensional measurements. Some of the values in the dataset are missing. The structure of the file is shown in fig. 15. The names of the coordinates (i.e. the chemical parameters) are given on the second row, columns from 2 to p+1=14 of the file. The third row (same columns) contains the variable dimensions. The fourth row, columns from 2 to p+1=14 contains the values of $\vec{x}_1$, and the other vectors are written consecutively on the next rows. The last one is on row n+3=110+3=113. The first column of the file contains the consecutive number of the vectors.

We set the following input parameters for the missing value procedure:

1. 6-dimensional compressed space;
2. standardized data;
3. moving drifting moments on X on each iteration;
4. additional fixing of the recovered data.

The system generates the following result:

1. graphics of the imputed data (see fig. 16 for the second coordinate; such a plot is created for each coordinate);
2. the imputed data set on screen;
3. an excel file with a single sheet structured the same as the input data, but the imputed values are placed instead of the missing ones in red (fig. 17).

The resulting file is sent for visualization with multi-dimensional scaling at m=3 using Mahalonobis distance measure. As an output, the system generated the following:

1. 1) graphics of the compressed data (three two-dimensional plots; fig. 18 gives the plot for the second and third compressed coordinates);
2. 2) the m-dimensional compressed data values on the screen;
3. 3) an excel file with four sheets as in section II.1 (see fig. 19).

The resulting file from the missing values procedure is also sent for visualization with factor analysis at m=2. As an output, the system generated the following:

1. graphics of the compressed data (see fig. 20);
2. the m-dimensional compressed data values on screen;
3. an excel file with five sheets, containing the compressed data points, the covariance matrix, the absolute error, the relative error and the cumulative percentage of the total variance explained (fig. 21) as in section II.1.

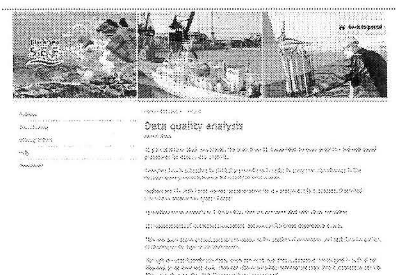
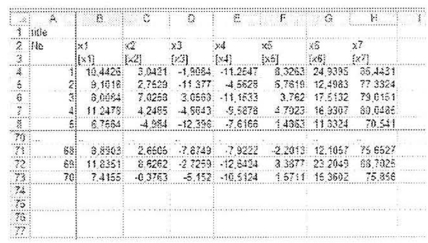


Fig. 1



	A	B	C	D	E	F	G	H
1	title							
2	№	x1	x2	x3	x4	x5	x6	x7
3		[x1]	[x2]	[x3]	[x4]	[x5]	[x6]	[x7]
4	1	10,4426	3,0421	-1,9084	-11.2547	8,3263	24,9395	66,4431
5	2	9,1818	2,7629	-11.377	-4,5628	5,7619	12,4983	77.3324
6	3	8,0684	7.0258	3.0668	-11,1633	3.762	17.5132	79,0151
7	4	11.2478	4.2485	-4,9643	-9,5878	4.7923	16.9307	80,0486
8	5	6.7664	-4,984	-12,396	-7,6166	1.4363	11.3324	70,541
70	...							
71	68	8,8903	2,6605	-7,8749	-7,9222	-2,2013	12.1057	75.6527
72	69	11,8351	8,6262	-2.7259	-12,8434	8.3877	23.2049	88,7025
73	70	7.4155	-0,3763	-5,152	-10,5124	1.5711	16.3602	75,856
74								
75								
76								
77								

Fig. 2

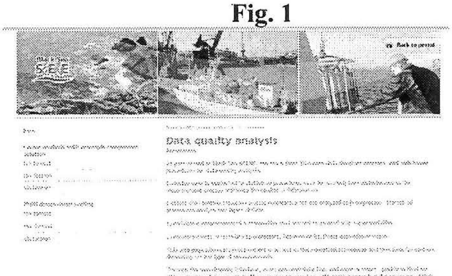


Fig. 3

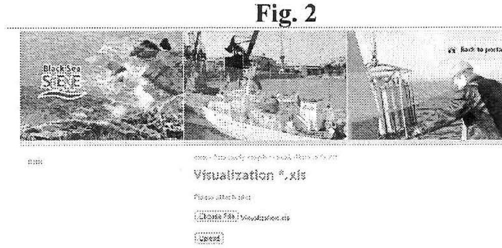


Fig. 4

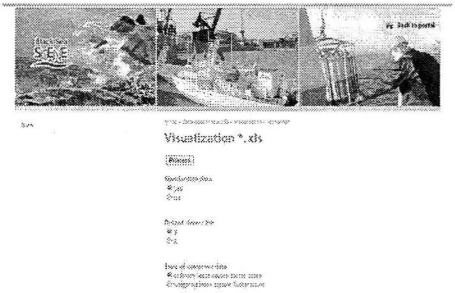


Fig. 5

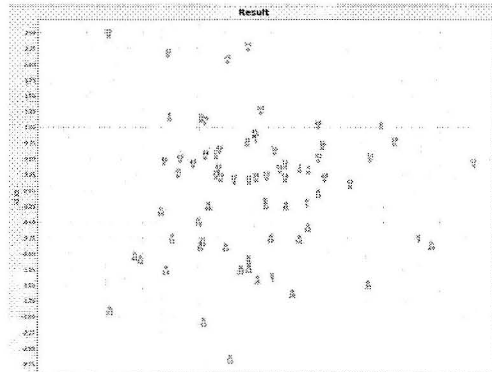


Fig. 6

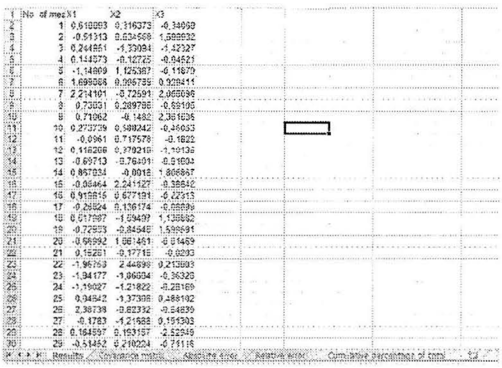


Fig. 7

Fig. 8

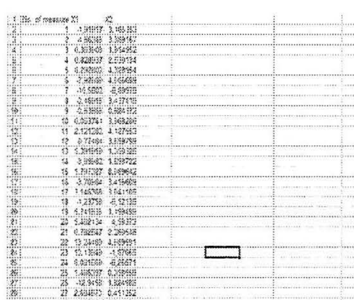
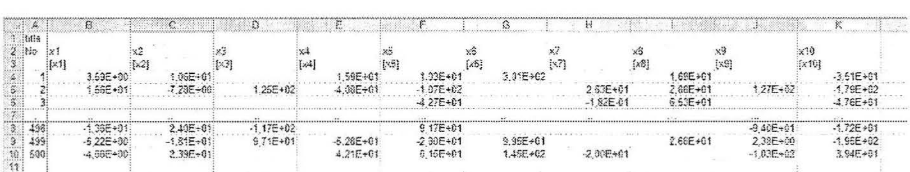


Fig. 9



	A	B	C	D	E	F	G	H	I	J	K
1	tdla										
2	No	x1	x2	x3	x4	x5	x6	x7	x8	x9	x10
3		[x1]	[x2]	[x3]	[x4]	[x5]	[x6]	[x7]	[x8]	[x9]	[x10]
4	1	3,59E+00	1,06E+01		1,59E+01	1,03E+01	3,01E+02		1,69E+01		-3,51E+01
5	2	1,56E+01	-7,23E+00	1,25E+02	-4,08E+01	-1,07E+02		2,63E+01	2,66E+01	1,27E+02	-1,79E+02
6	3					-4,27E+01		-1,82E-01	6,53E+01		-4,76E+01
7	...	...	...	...	...	...	...	...	...	...	...
8	498	-1,36E+01	2,40E+01	-1,17E+02		9,17E+01				-9,40E+01	-1,72E+01
9	499	-6,22E+00	-1,81E+01	9,71E+01	-5,28E+01	-2,30E+01	9,95E+01		2,66E+01	2,38E+00	-1,95E+02
10	500	-4,66E+00	2,39E+01		4,21E+01	6,15E+01	1,45E+02	-2,00E+01		-1,03E+02	3,94E+01
11											
12											

Fig. 10

Fig. 11

Fig. 12

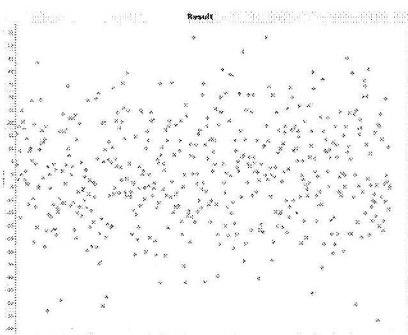


Fig. 13

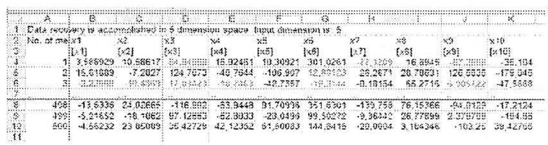


Fig. 14

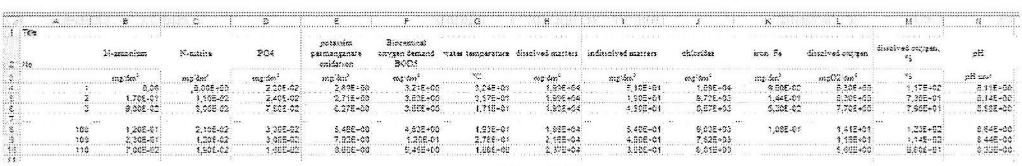


Fig. 15

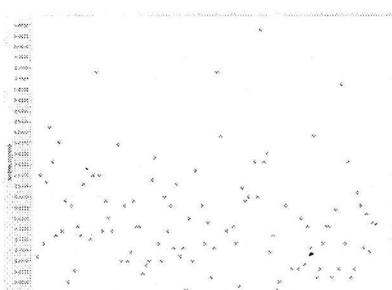


Fig. 16

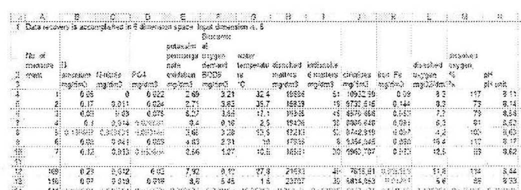


Fig. 17

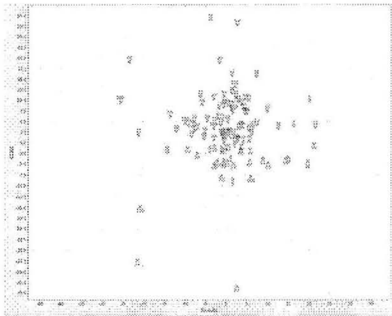


Fig. 18

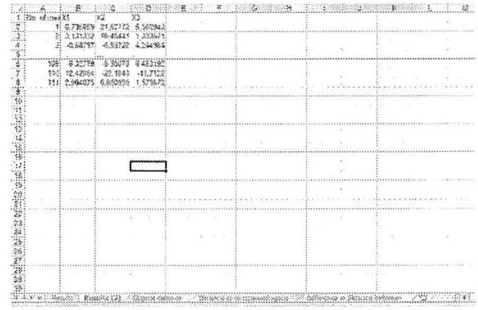


Fig. 19

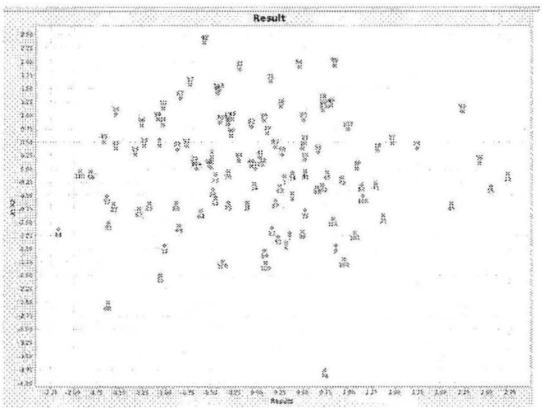


Fig. 20

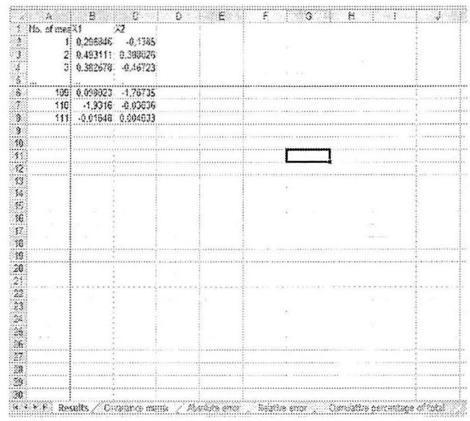


Fig. 21

3. Conclusions

This paper presented the operation of an Internet based tool which solves two interconnected problems – visualization of multi-dimensional environmental vectors and imputation of missing values in such data sets. The procedures use modern algorithms and techniques to generate results. The tool is available free of charge to all users.

4. Acknowledgments

This paper has been supported by the UPGRADE Black Sea SCENE project (project No. 226592, Seventh Framework Program), and the INPORT project (project No. DVU01-0031, Bulgarian National Science Fund).

References

[1] Algorithmic Group, "*MDSJ: Java Library for Multidimensional Scaling (Version 2)*", University of Konstanz (2009)

[2] Bechev, Ch., Nikolova, N.D., Teohareva, M., and Tenekedjiev, K., "Testing the Quality of Environmental Data by an Internet-Based Tool", *Journal of Environmental Protection and Ecology*, Vol. 10, No. 3, (2009), pp. 877-888
[3] Dempster, A.P., Laird, N.M., and Rubin, D.B., "Maximum Likelihood from Incomplete Data via the EM Algorithm", *Journal of the Royal Statistical Society, Series B*, Vol. 39, (1977), pp. 1-39
[4] Duda, R., Hart, P, and Stork, D. "*Pattern Classification and Scene Analysis*", A Wiley Interscience Publication, (1973)
[5] Golub, G.H., and Van Loan, Ch. "*Matrix Computations*", Third Edition, Johns Hopkins (1996)
[6] Johnson R., and Wicherin D., "*Applied Multivariate Statistical Analysis*", 6th ed., Prentice Hall, (2007)
[7] Little, R. J.A., "A Test of Missing Completely at Random for Multivariate Data with Missing Values", *Journal of the American Statistical Association*, Vol. 83, No. 404, (1988), pp. 1198-1202
[8] Nikolova, N.D., Toneva-Zheynova, D., Naydenov, D., and Tenekedjiev, K. "Imputing missing values of environmental multi-dimensional vectors using a modified Roweis algorithm", *International Workshop on Dynamics and Control in Agriculture and Food Processing*, (2012), Plovdiv, Bulgaria, (in print)
[9] Roweis, S., "EM Algorithms for PCA and SPCA", *Neural Informatics Processing Systems, NIPS'1997*, (1977), pp. 626-632
[10] Wu, J., "On the Convergence Properties of the EM Algorithm", *The Annals of Statistics*, Vol. 11, No. 1, (1983), pp. 95-103

The Place Of Women in Constanta Maritime University

Corina Popescu
Lecturer, Constanta Maritime University, Mircea cel Batran Street, No. 104, Constanta, Romania, 900663
corypopescu25@yahoo.com

Anastasia Varsami
Assistant Professor, Constanta Maritime University, Mircea cel Batran Street, No. 104, Constanta, Romania, 900663
anastasia.varsami@yahoo.com

Radu Hanzu-Pazara
Lecturer, Constanta Maritime University, Mircea cel Batran Street, No. 104, Constanta,Romania, 900663
raduhanzu@yahoo.com

Abstract: International work regulations today represent an important component of the international framework and their purpose is to ensure equal profits from the world economy growth for everybody (men and women).

Globalisation created many possibilities and advantages, while millions of workers and employers all over the world were facing new challenges. The Global economy led to dislocation of workers and enterprises, engaging sudden accumulations and migrations of money capital and, in this way, causing a financial instability in certain regions. Despite the optimism from the beginning, globalisation did not represent the dawn of a new era of prosperity for everybody. The inequalities generated poverty, a productivity decrease, social instability and even conflicts. This is the reason why the international community admitted that establishment of fundamental game rules was necessary in the scope of guaranteeing that globalisation gives everybody (men or women) a chance to reach prosperity. IMO produced its strategy for the integration of women into the maritime sector in 1988 and began implementation of the IMO Women Development Programme (WED) in 1989, concentrating on equal access to maritime training through both mainstream programs and gender specific projects. In some countries, the shipping industry offers a way out of poverty for many workers. Employment in the shipping industry provides access to foreign currency and a regular salary with a direct impact on the economic viability of seafarers and their extended families. There is no intrinsic reason why women should not participate in, and benefit from, employment within the shipping industry.

Due to women's acceptance on board merchant vessels, their presence in a maritime

university is no longer looked at with scepticism. For example, in the last few years at Constanta Maritime University it could be easily noticed that the hardest working students during faculty years were women. This is one of the reasons why the great majority of them distinguished themselves as future lecturers. This represents one of the reasons that the university's administration offered them the opportunity to teach various maritime courses. This is why most of the young assistants in our university today are females who fulfil their tasks very well.
In this paper we are trying to show that women represent the new generation of maritime engineering teachers as they are the ones that quit sailing much earlier than men and tried to find a proper "lady like" land job. Due to its influence and special status in the city and because of the high number of students, Constanta Maritime University managed to persuade these women to accept teaching both general knowledge and maritime engineering subjects.
Keywords: shipping industry, equal chances, equal opportunities, equal conditions, maritime university, female work force

1. Introduction

In order to discuss such a sensitive issue as the place of women in a men's world, we should first make reference to the historical background supporting our argument. Therefore, we consider that the first important document related to this subject was the 1919 regulation of the International Labour Organization (ILO). This document set into motion and developed an international regulation work system focused on increasing men's and women's chances of obtaining a decent job in conditions of equity, security and dignity regardless of the working domain. In the worldwide economy today, international work regulations are an essential component of the international framework and their main purpose is to ensure that everybody (men and women) profits from the world economic growth. Due to new technologies, people, goods and money capital circulate easily and fast between countries creating an interdependent world economic network that everybody on this planet should pay attention to.

Globalisation created many possibilities and advantages, while millions of workers and employers all over the world were facing new challenges. One of the greatest challenges brought about by the modern world forced men to give up any prejudices or superstitions and accept women in the shipping industry as their equals. The Global economy led to dislocation of workers and enterprises, engaging sudden accumulations and migrations of money capital. Despite the optimism from the beginning, globalisation did not represent the dawn of a new prosperity era for everybody. This is the reason why the international community admitted that the establishment of fundamental game rules was necessary in the scope of guaranteeing that globalisation gives everybody (men or women) a chance to reach prosperity. Inequalities generate poverty, a productivity decrease, social instability and even conflicts while the guarantee of equal chances meant only the recognition of what was always there for everybody's benefit. Women needed to be allowed to prove how useful they may be instead of being rejected right from the beginning without any previous thought.

2. Equal conditions for everybody

Given that the international legal framework regarding social regulations guarantees everybody equal conditions for work in the world economy, maritime universities should not make an exception. Such regulations helped maritime universities worldwide to give in to the temptation of lowering the working norms in the hope of getting a higher advantage in the maritime society. In the long term, such a practice would not be profitable for anybody.

Because the international working quotas are minimum norms adopted by governments and social partners, maritime universities acknowledged the fact that it is to the benefit of each one of them to adopt all these norms so those who do not apply them would not compromise the effort of those who do.

Lowering the standards of working quotas in universities encourages educational development with a low level of competence, low wages and high rotation of personnel and these may cause, for the specific university, the impossibility of developing stable qualified training services. As a matter of fact, this kind of practices could, if not controlled, put a stop to the economic growth of self supporting universities.

2.1 Female work force

Except for several regions worldwide, women represent at least one third of the world work force. In over 90 countries, more than 50% of the women are economically active. There have never before been so many women working in the whole period of their procreation time, especially because a majority of families depend on both parents' wages as far as the survival point of view is concerned. However, in spite of the importance of women in countries' economy and despite the incomes generated for their families, social protection is very often inadequate for protecting those who work and their families. The shipping industry represents a particular case due to its specific work conditions.

2.2 Equal chances and treatment

All over the world, millions of women and men are refused access to work and formation. They get low salaries or they are quartered in certain jobs only because of their gender (this is still the case in the maritime sector), skin colour, ethnic reasons or religion without taking into account their abilities or qualifications. Thus, in certain industrialised countries, female workers get, for equal work, a wage that might be as little as 25% of that earned by a man. Protection against discrimination is part of fundamental human rights and is indispensable for workers so that they can freely choose their work place and, in this way, develop their potential and pick up the merits of their work. Favouring equality in the workplace is synonymous with important economic advantages. For maritime universities, this would mean more well trained teaching personnel with a better quality in education. For women lecturers it means an easier access to training and, very often, higher chances of pursuing their passion for maritime related subjects without having to go onboard ships.

The benefits of a global maritime educational system are better allocated in an egalitarian society and they generate a higher social stability and a wider support from people in favour of educational development. ILO Regulations regarding equality propose instruments that allow elimination of discrimination from all the aspects of work and society. They equally constitute the basis from which arises the application of integration strategies for equality problems between men and women in the work field.

3. Women's integration in the maritime field

3.1 Women in the shipping industry

IMO produced its strategy for the integration of women into the maritime sector in 1988 and began implementation of the IMO Women in Development Programme (WED) in 1989, concentrating on equal access to maritime training through both mainstream programs and gender specific projects. Employment in the shipping industry provides access to foreign currency and a regular salary with a direct impact on the economic viability of seafarers and their extended families. There is no intrinsic reason why women should not participate in, and benefit from, employment within the shipping industry.

The IMO Women In Development (WED) Programme was launched in 1989 with the following development objectives: to integrate women into mainstream maritime activities; to improve women's access to maritime training and technology; to increase the percentage of women at the senior management level within the maritime sector; and to promote women's economic self-reliance, including access to employment.

In some countries, the shipping industry offers a way out of poverty for many workers. Today, the problem of equal chances in the maritime field represents a challenge for obtaining human progress, respect and recognition of human rights. The maritime educational system also has a moral responsibility to train students to respect principles such as tolerance, solidarity and respect for others. This is done right from the beginning by employing women lecturers in maritime universities and accepting female students for the maritime specializations.

In a specific area such as maritime, gender equality has always been an issue due to the differences that exist among enrolments per gender at maritime engineering universities. There has always been a difference between men's and women's decisions to follow maritime engineering studies in all countries and at all times. For years, women had the false impression that the maritime business is forbidden for them. Men were the ones conducting this business and they have never allowed women access as this would have looked like an intrusion in a sector that for centuries has been exclusively under men's control.

Many countries (developed countries) still restrict women's access to the maritime business (educational system, shipping, port operations). Even maritime students find it difficult to learn from a woman teacher as they do not perceive her as a real seafarer. That means that they will always question her judgement.

The relevance of sea experience for many shore-based jobs means that the resource of women with appropriate skills is limited and will continue to act as a long-term constraint on the representation of women in the maritime sector as a whole.

There may also be some cultural resistance to women working outside their home, but the principal objections to employing women at sea or in maritime-related activities appear to centre on lack of adequate separate facilities for women on board, stringent physical requirements and practical experience.

The perception that seafaring is a man's job can lead to lack of training and work-experience opportunities for women, compounded by employers' reluctance to appoint those women that are trained. To break the cycle, adequate training has a critical role in the integration of women into all spheres of professional life, with special emphasis on improving accessibility at all levels to potential women applicants.

The number of women working at sea is insignificant with women representing just one to two percent of the world's 1.25 million seafarers. Most women at sea are from developed countries. Women on board ships tend to be found in catering and administrative services; therefore, the proportion of women in the crew on passenger ships and ferries is relatively high. Radio communications is another area employing women.

3.2 Women's access to maritime training

Socio-cultural factors are thought to be behind the extremely low proportion of women seafarers in some countries. It is clear that, if women are to be fully accepted in the maritime sector, there is a need for changes in attitude towards employing women as seafarers, recruitment of women in the shipping sector generally including the maritime teaching area, and increased training opportunities for women.

There are over 90 maritime training institutions in more than 60 countries. Many admit only men or just a small number of women. Female lecturers are in a minority and tend to provide expertise in courses aimed at shore personnel, in maritime law and in general subjects such as English language, computer science, maritime and business studies and shipping management.

The shortage of maritime lecturers is in nautical studies and engineering, but lecturers are also needed in maritime law, economics and shipping insurance. This happens mainly due to low salaries involved in education relative to the money earned at sea and in the shipping sector. A solution for the lack of experienced maritime teachers would be to attract women that quit sailing after a period of time towards this career. This is because they are the ones looking for shore-based jobs related to the maritime business in a higher percentage than men who quit sailing only after getting a managerial licence and many years at sea.

4. Women in Constanta Maritime University

Analyzing the maritime labour market, anyone can easily see that it depends on supply and demand of labour. As Constanta is a maritime city with an exit to the Black Sea, there is a high demand for well trained people in all maritime domains (port, shipping, officers and so on). The demand for labour comes from shipping companies, port authorities and administrations, companies that operate inside the port and from companies adjacent to the port operations (pilot companies and tug companies). The maritime labour supply is an attractive one, especially because of the high salaries involved in the maritime business. Because of the status of Romania as a developing country, the maritime sector is still a sector that offers high salaries and, in this way, it manages to attract a lot of young people to follow a maritime related career. Recently, Romanian women have become interested in having a maritime career even if they are aware that they have to overcome the prejudgements that Romanian people have not gotten rid of yet; those saying that women have no place in maritime businesses as these are male businesses. Constanta Maritime University is the first of two maritime universities in the country that allowed female students to apply in this specific higher-education area.

4.1 Ex-students/Future lecturers

Women have been accepted as students in Constanta Maritime University since 1995 and it has been noticed from the beginning that they found a way to adjust to this male environment. Since then, every year, more and more women chose to become students of the University as they realised that the shipping industry might no longer be an exclusively male domain. The first generation of female bachelor degree holders was in 2000 and this was also the year when women became interested in maritime teaching jobs as they had the opportunity of working on land in the same field of their qualification. It was also in the interest of the University to attract more and more women to work inside the teaching departments because men refused to do this since they were interested in going to sea mostly because of the wages involved. At the moment, Constanta Maritime University has 30 women lecturers working in the Navigation Faculty out of a total number of 57 lecturers and 17 women lecturers in the Mechanical Engineering Faculty out of a total number of 41 lecturers. Most of them have been recently hired and they need the University's support to improve their teaching methods, to get proper training in order to do their job properly and to prove that they are as good as men in doing this.

An internal statistic of Constanta Maritime University's employment shows that in the period of 2008 – 2010, the percentage of women hired as assistant professors was approximately 90% of the total number of assistants hired during this period. The conclusion that could be drawn is that the University is actually trying to equal the number of women and men that teach here and that there has been no difference between women's performance and men's performance as far as teaching inside a maritime institution is concerned. So, for the moment, nobody can argue that women or men are better suited for this particular job. There is indeed something that everybody can agree with: the fact that both categories (women or men) need continuous training as the maritime sector is a changing one (every year there are new improvements as far as the electronic aids for navigation are concerned). Let us not forget that there are new methods of teaching emerging every year and every teacher, regardless of their specialty, has to be updated to these.

4.2 European projects for self improvement

Constanta Maritime University is trying to attract more and more women to the teaching staff. What could help the University achieve everything above are the European Projects that provide the necessary funds for the continuous training of maritime higher-education teachers and for supplying improvement programmes according to the maritime market demands. The general objective of such projects is the development of multi-disciplinary research regarding initial and continuous training of maritime higher-education teachers belonging to Constanta Maritime University (especially women that have a Constanta Maritime University bachelor degree) and also the supply of improvement programmes according to the maritime market demands. Women are the ones that can benefit from such projects as, in the past few years, they have been the ones who have been employed by Constanta Maritime University as young assistant professors. This happened mostly because, after obtaining their officer on watch licence and navigating for a couple of years, they gave up on sea-life and decided to work in the education system.

Fulfilment of these projects' main objective will lead to a competitive rise of job opportunities in maritime higher-education and it will manage to attract the new bachelor degree holders towards a maritime teaching career with a high interest focused on women because they are the ones who do not particularly want a sailing career.

The job offer in Constanta Maritime University is not discriminatory with all young assistants, regardless of their gender, being able to benefit from this program for training. As far as equal chances for men and women are regarded, we can honestly say that, in an industry dominated not so long ago mostly by men, the presence of women in Constanta Maritime University is no longer seen as an abnormality. Moreover, it should be stated here that the women in our university also have access to managerial levels occupying all sorts of leading positions in the university's organizational structure.

Women in the maritime engineering higher-education system could be the answer to the lack of good and experienced maritime lecturers that could help students better understand the life at sea and the problems it implies. But this means that these particular universities have to put out an additional effort in promoting their job offers in the city where they have their base and also to help women have an equal access with men to these jobs.

5. Conclusion

First of all we should conclude with the fact that women should be encouraged to apply to national institutions for training in technical maritime subjects. At the same time, national and regional maritime training centres should be encouraged to admit women students with prerequisite educational background.

The paper points out that the availability of more opportunities for women could increase the self-sufficiency of developing countries in their supply of qualified maritime teachers while providing increased visibility of women as role models in a variety of key maritime professions.

Therefore, accepting women in the maritime sector and in all its afferent domains is very important for the development of these areas. It is generally accepted that if women progress then everybody will benefit. After accepting women on board merchant ships the best result would be to accept them in the maritime universities teaching maritime engineering subjects as they now have the proper experience to successfully fulfil these jobs.

Even if Constanta Maritime University had for many years mostly men in the teaching staff, now the situation is constantly changing as more and more women choose such a special didactic career.

References

[1] www.cmu-edu.eu

[2] http://www.cmu-edu.eu/marcon/marcon.html

[3] Bocioc, F.; Dimitriu, D.; Tesiu, R.; & Vaileanu, C., *Gender mainstreaming*, Publisher Neva, Bucharest, 2004.

[4] International Labour Organization, *Maternity at work: A review of national legislation. Findings from the ILO's Conditions of Work and Employment Database. Second edition*, 2010.

[5] International Labour Organization, *ABC of women workers' rights and gender equality*, 2007.

[6] International Labour Organization, *A manual for gender audit facilitators. The ILO participatory gender audit methodology*, 2007.

[7] Pamela Tansey, *Women on board - ten years of the IMO Women In Development Programme*, 2000. http://www.imo.org/inforesource/mainframe.asp?topic_id=406&doc_id=1082

[8] Unterhalter, E., Global Inequality, capabilities, social justice: The millennium development goal for gender equality in education, *International Journal of Educational Development,* Vol. 25, No. 2, 2005, pp. 11 -112.

The Maritime Industry and the Human Element Phenomenon

El Ashmawy, M.E

Prof. Captain, Arab Academy for Science Technology and Maritime Transport,

mohyldin_a@yahoo.com & mohyldin@aast.edu

Abstract: There is no admitted international definition of the term the "Human Element". The human element is an expression commonly used in the context of the maritime industry in which it plays a significant and topgallant role in defining and assigning policy options, and is directly or indirectly addressed in diverse aspects of papers dealing with the shipping industry.

The shipping industry is a services industry in which the human element is the climatic feature of all aspects. The IMO, through its Resolution A. 947 (23) - Human Element Vision, Principles and Goals for the Organization, refers to The Human Element as: "A complex multi– dimensional issue that affects maritime safety, security, and maritime environment protection, it involves the entire spectrum of human activities performed by the ships, crew, shore–based management, regulatory bodies, recognized organization, shipyards, legislators, and other relevant parties, all of whom need to cooperate to address issues effectively".

It is mostly stated that 80% of all accidents at sea are assignable to the human element's errors. Although the human element could be the diametric incentive of an accident, the original cause can mostly be attributed to human influences in the shipping industry. The human element is one of the most important contributory effects to the causation and avoidance of accidents.

In this paper I would like to draw attention to, and raise awareness of maritime professionals in the shipping industry to human element issues and I would deal with all topics relevant to human element phenomenon; focusing simultaneously on the pros and cons of this issue. I will also try to justify why almost all accidents are only attributed to the "human element". This paper aims at highlighting the proper perspective for understanding how far "the human element" contributes value across maritime industry.

Keywords: human element phenomenon, pros and cons, maritime industry.

1. Introduction

The maritime/shipping industry is a services industry in which the human element is a critical element. The human element is one of the most important contributory aspects to the causation and avoidance of accidents. This industry is a truly global market, and it is one that economists prefer to think of as capital intensive due to the tremendous costs of the developed equipment used. The industry is run by people for people. This industry has to reach out to every sector of the community if it is to attract the best people to pursue maritime careers. Effectively, the industry is the facilitator of the global economy as there is no obvious sign of any new technology on the horizon that will replace shipping as the most cost-effective means of transporting goods, components, raw material and others around the world. It seems reasonable to assume that, as the 21st century progresses, the industry will have an impact on the lives of more and more people.

The industry's diverse workforce includes seafaring as well as shore-based professionals coming from around the world. From ship brokers to ship builders, from fleet managers to marine risk managers, from naval architects to shipping analysts, from chief engineers to chief accountants... the choices are as wide and variable as the seven seas and oceans.

2. The Maritime Industry

The maritime industry is much more than the deep-sea merchant fleet. It includes port and terminal operations, shipbuilding and repair, naval architecture and marine engineering, seaman training, tug and barge operations, pilotage, forwarding, chartering, government programs and shipping, intermodal services, maritime law, passenger and excursion services, vessel classification, marine insurance, communications, recreational boating and yacht, and much more.

It has contributed to the progress of nations and the world in that the development of modern transportation systems worldwide and economic globalization has been driven by the maritime industry, the transportation industry leader.

Besides the progress of the world's port operations, shipping and shipbuilding has also contributed significantly to the global economy through its requirement for supporting services such as ship financing, marine insurance, maritime legal and arbitration services, maritime education and training, maritime research & development etc.

The number of ships sailing the seas is progressing quickly. There is also a heyday in the number of larger and more technologically advanced vessels. Is not the human element the one responsible for running the work of all these previous issues with all their pros and drawbacks?

3. The shipping Industry

Worldwide the shipping industry continues to expand to meet the demands of globalization. In broadcast terms, shipping industry includes all enterprises engaged in the business of designing, constructing, manufacturing, acquiring, operating, supplying, repairing, and/ or maintaining vessels, or component parts thereof: manning and/or operating shipping lines, stevedoring and customs brokerage services, shipyards, dry-docks, shipping and freight forwarding services and similar enterprises. Shipping has played a significant role in the development of human society over the centuries.

3.1 Nature of the Shipping Industry

Shipping is certainly the most international of the entire world's enormous industries; it is devoted to moving goods or passengers by water. Shipping is a peculiar, highly competitive business and services industry. It remains today what it has been for centuries; the most important, the safest, the cheapest and the most environmentally friendly way of moving goods over long distances. It has been a crucial link by which commercial relationships have been established. Also, shipping provides a safe, healthy and secure work environment "so that people want to work in shipping, where they can enjoy rewarding careers and achieve their full potential".

The activity of the industry is divided into several categories, namely: liner services, rambler shipping, industrial services, and tanker operation, all of which operate on certain well-established routes. Without the shipping industry, the world's economy would grind to halt. The purpose of shipping is to provide a profitable service which the economists prefer to think of as "capital intensive".

The shipping industry remains a stimulating, hiring and fulfilling vocation; a vocation that can employ human elements almost anywhere. Seafaring is not only a favorable and worthwhile vocation choice in itself, it also permits a vast diversity of related jobs ashore for which experience at sea will make one notably qualified.

3.2 Shipping is a Progressing Industry

Shipping is a progressing industry; turbulent and challenging. It plays an energetic role in world trade and is the backbone of the world economy. Without shipping and the transportation services that ships provide, the world would not be as thriving as it is today and many countries would not be able to participate in world trade.

In recent years, shipping has been shown to be a progressive industry as attested to by the increase in gross tonnage of the world fleet. This progress makes the shipping and transport industry so complex and so exciting to work in. The motives are driven by the progress rate of the trades, the ups and downs of business cycles, as well as by a large number of external innovation triggers. Managing these challenges requires not only professional training of the highest standards, but also a through academic understanding of specialized knowledge domains.

There are different categories of maritime professionals such as port managers, maritime officers, engineers, economists, lawyers, shipbrokers, charterers, and naval architects.

Where does the shipping industry's human element obtain their education and training? A number of them have special maritime education or have been educated in a specialist domain. Another category have been trained on the job. What all people have in general is their inclination for the industry, their international mindset and their commitment to continue working in this highly interesting field of business.

3.3 Treaties and Conventions Related to Maritime/Shipping Industry

Many treaties and conventions have been adopted over the years with the objective of increasing the safety of life at sea. Under the International Load-Line Convention of 1930, ship loading was regulated on the basis of size, cargo, and route of the vessel. The International Convention for the Safety of Life at Sea (SOLAS), which governs ship construction, was adopted in 1948 and again in 1960 and 1974.

4. The Human Element

The human element is the one essential that is extremely difficult to modify since it needs a modification in both intentions and attitudes; it is an expression commonly used in the context of the maritime industry as well as shipping industry. The human element is a complex multidimensional issue that plays a most vital role in the operation of industry, in enhancing maritime safety, security and marine environment protection.

It is human nature that handles what occurs daily at work; from the routine tasks of a ship's rating right through to the policy decisions of the IMO. It embraces the integral spectrum of human activities performed by the crew on ships, shore-based personnel, organizational bodies, recognized organizations, shipyards, legislators, maritime education and training and other related parties, all of whom need to cooperate in addressing human issues effectively. It is recognized that the quantification of the human element in general and its role can influence the methods of upgrading safety management systems. All should cooperate to address the human element.

The human element has a role to play in improving maritime safety:

- Commitment from the top, in every organization
- Effective control and monitoring mechanisms
- Quality standards in force
- Training and updating
- Transparency
- Safety culture: safety can never be taken for granted, permanent attention is required.

The human element remains a basic component for all its strengths and weaknesses that can either cause a disaster or prevent it.

The human element is commonly deemed to be the most significant asset of a shipping management company. The majority of the ship operations look for high quality and well trained staff to be utilized both in the shore-based management side as well as on board ships. This is considered as a benefit in safety, ensuring marine environmental protection from ships and the process of competitive ship management.

Efficient and safe transport systems need to put the obvious focus on contributing to the human factor in all respects. Human centered approaches are encouraged for enhancing transport systems, in particular for those with the highest demand for technological improvement. By centering on the human element generally, the IMO is invigorating the link between management ashore and functioning afloat to enhance the safety culture. The execution of safer, secure and effective shipping on clean oceans will continually be dependent on the human element.

4.1 Women in Maritime/Shipping Industries

Women have an important role to play in maritime administrations of their countries and already work at all levels of national ministries responsible for shipping and ports as well as other maritime authority levels.

In placing the human element and capacity building high on its agenda, the IMO recognizes that the shipping industry must reach out to every sector of the community if it is to attract the very best people to pursue a maritime career. The IMO therefore takes specific measures, through its strategic planning and at the operational level of technical cooperation, to promote the increased participation of women in the maritime sector.

The IMO initiated a strategy for the Integration of Women into the Maritime Sector (IWMS) in 1988 and began implementation of the IMO Women in Developing Program in 1989, concentrating on equal access to maritime training through both mainstream programs and gender-specific projects. The program continues to support measures to increase the participation of, and the establishment of formal regional associations for, women in the maritime industry. The increased percentage of women in students at the World Maritime University (WMU) and the International Maritime Law Institute, Malta, illustrate programs with wider influence at the highest level of maritime training.

During 2005, activities under the program for IWMS included the provision of short-term fellowships and an ongoing series of regional workshops. The Technical Committee was informed that there has been a noticeable increase in the number of women employed at the management level in national maritime and port authorities and this has enabled the Secretariat to work on the facilitation of the establishment of formal networks or associations for women employed in maritime authorities, in ports, and in related maritime employment such as lecturing in maritime institutions.

4.2 IMO and the Human Element

In the IMO, the focus is stronger than ever on the human element and it is continually seeking ways to improve safety at sea. In the 20th session in November 1997, the IMO assembly adopted resolution A.850 (20) on the human element vision, principle and goals for the Organization. The resolution acknowledged the need for increased focus on human-related activities in the safe operation of the ship, and the need to achieve and maintain high standards of safety and environmental protection for the purpose of significantly reducing maritime casualties.

The resolution was adopted by resolution A.947 (23), human element vision, principles and goals for the Organization, adopted by the 23rd Assembly in November-December 2003. If, as is frequently stated, all marine casualties and incidents involve human factors in one way or another, for this reason, IMO has reinforced its focus for the 21st century to place the emphasis on people and has included the human element as a mandatory consideration in the work of all of its Committees and Sub-Committees. This means that matters concerning people, seafarers in particular, will be woven into the context of all international regulatory regimes.

In recognizing what should be obvious: that skilled, educated and qualified seafarers are of fundamental importance, IMO decided to enhance its emphasis on training and certification by accelerating the much needed updating of the 1978 STCW Convention as amended.

4.2.1 World Maritime University "WMU" Graduates

WMU graduates form an exclusive group of highly trained maritime experts who act as catalysts for change nationally, regionally and internationally. They are, in their role as managers of change, very quickly gaining a firm grasp of the direction of future global developments. WMU graduates, male and female, invariably go on to become committed people working for safe, secure and clean oceans.

WMU graduates have returned to their home countries to take up a wide variety of pivotal positions in maritime/shipping industries. Some have high positions in their government while others have pursued career paths that have led to senior jobs in shipping companies, regional maritime organizations and national port and harbour authorities. Still more have become educators and senior surveyors. Many have returned to the IMO as part of their national delegations.

4.3 International Measures Related to the Human Element

The two international measures that are at the core of IMO's commitment to addressing the human element in the maritime industry and directly designed to affect the culture and process of seafarers on board ships and within shipping companies are:

- **First:** The revised Convention on Standard of Training, Certificates and Watch-Keeping for seafarers "STCW Convention" as amended.
- **Second:** The International Safety Management Code "ISM Code".

The two conventions provide a set of practices and a safety system which will enhance continued success for the future of maritime industry. With the adoption of the ISM Code and STCW Convention as amended, the IMO has highlighted the dominant role played by the human element and management in safety at sea and environmental protection.

The ISM Code is the other part of IMO's human element initiative that deals with management. The essence of the ISM Code is its distinct focus on the human element. In the vast majority of cases, accidents happen because somebody, somewhere along the line, did not take the proper action to avoid a problem, or did something wrong, whether through laziness, ignorance, fatigue, negligence or stress. The ISM Code outlines the responsibility and authority of the master of the ship. The Code also deals with other seagoing personnel and emphasizes the importance of training.

The revised STCW convention puts in place the enhanced training and watch-keeping requirements which will continuously lead to a more skilled and flexible labor force. It will provide the framework to ensure that the personnel are appropriately trained and possess the skills to do the job properly. The Convention has highlighted the importance of the qualifications of shipboard personnel and the importance of MET for such personnel.

It is a very important instrument to deal with the influence of the human element and accidents. The Convention certification focuses on the human element including verification that vessel watch-standers have enough rest, basic language ability, safety training and that the crew is competent.

4.3.1 The Characteristics of the STCW Convention and ISM Code

The characteristics of the STCW Convention adopt that the human element is of a crucial significance in any institution and that education and training are vital to improve the skills and competencies of the human element.

The ISM Code sustains the STCW Convention perspective by setting assurances and frequently developing the safety management skills of personnel ashore and afloat, and ensuring that personnel are adequately qualified and certificated. The introduction of competence-based training and assessment has strengthened the steps towards a safety culture and has led to an important strengthening of conjunctions between the training suppliers, shipping companies and their staffs. The challenge of the Convention and the Code is to guarantee that the human element, safety and quality system programs become institutionalized as we go ahead.

4.4 The Human Element and Improving Safety

There are many groups involved in improving safety at sea, including the IMO, member governments, ship owners, insurers and classification societies, but of all involved, no one has greater interest than the seafarers – for if something goes wrong, they are the only ones who risk losing their lives. It is often said that most accidents at sea are caused by human error. The main reasons for accidents may be poor judgment, complacency, disregard of basic seamanship and inexperience.

IMO has emphasized the importance of high crew standards and adopted from early times recommendations calling upon governments "to ensure that the MET of master, marine officers, engineers, and seamen is kept up-to-date and in step with modern technological developments in this field.

5. The Human Factor

The use and operation of any means of transport always involves human individuals. This is often an interactive process, and is strongly influenced by "human factors" such as professional training and behavioral responses.

Human factors can refer to impacts on individuals who are directly concerned with transport systems, such as operators. In this context, an important area is the working conditions of the employees. Conversely, human factors also refer to the impacts of human behavior on the performance of transport systems. Human factors are strongly linked to the themes of safety, efficiency and social impacts of transport.

It has been declared that the overwhelming majority of accidents at sea are caused by the so-called "human factor" of ship operation, whether as a consequence of bad seafaring or poor management on shore, and the vital factor in the successful implementation of an SMS is the selection of the right personnel to fill positions influencing their actions and performance.

Because we frequently see this factor, we tend to attribute accidents to the errors of the individuals responsible for the operation of the ship. It is however a reality that the majority of the accidents are caused by an unfortunate integration of human and organizational errors.

The main fact is that the human factor plays some part in substantially every accident, including those where construction or equipment failure may be the immediate cause.

The most important aspects of human factor related accident causes in shipping are language deficiencies of multi-cultural crews and resulting misunderstandings. Various examples of incidents and accidents are related to communication problems in open seas or under pilotage, covering both ship-to-shore and on board communication. Besides language deficiency, peculiar habits and principal cultural differences do contribute to safety critical situations.

5.1 The human factor in ship safety "Individual error"

- Errors from individuals are also responsible for some accidents. The chain of occurances which can lead to accidents was, for example, originated by some incomplete maintenance duty.
- Errors related to human/system interfacing are considered as system errors. The said error involves layout error, surreptitious errors, wrong alarm, etc. They have to be addressed by the design engineer and the ergonomist.

The role of the human element in secured effective implementation of globally adopted standards should be to secure a common understanding of the responsibilities of flag states and to promote the adoption of best practices by the publication and dissemination of well-researched studies into the cause of accidents. In waterborne transport, human centered system design approaches were identified as a positive factor for job satisfaction of seafarers.

The ship's crew remains the most vital element for safe and efficient work on the ship, despite the development of technology, and no ship is any better than her crew.

On a ship, the human element can provide a weather eye for difficulties ahead, a calm, frumpy and unflinching response to situations as they develop and those indefinable qualities known as good seamanship or it can be feeble, lacking in competence, ability and concentration.

6. The Maritime/Shipping Industry and The Human Element

The shipping industry is run by people and for people. The human element designs ships, builds them, owns them, crews them, maintains them, repairs them and salvages them. Human elements regulate them, survey them, underwrite them and investigate them when some things go wrong or mistakes happen. Human elements work in education and training, and they are at the very center of the shipping enterprise as well as in port management. They are the secret of its progress and successes and the victims of its failures. While those human elements diverge in all modes and mores, they are all, however, human elements with the same imperative set of potentialities and vulnerabilities.

The principle factor in maritime safety is the human element and the term "human element" is normally associated with those at the lower end of the shipping hierarchy such as the crew members, port operators etc. It should be extended to cover everyone involved and it should be professed that shipping safety is not as good as it should be because of matters at the top rather than inefficiency at the bottom.

Senior management should regard the provision of human element suited to the task and provide all the necessary means by which to improve an appropriate Safety Management System (SMS) which complies with the requirement of the ISM Code.

Worldwide regular implementation of SMS "Rules and Regulations" is of high importance. Development of enforcement by flag states and classification societies and augmenting port state control will improve the quality and safety in shipping industries. Consideration of the human element by all players will eventually lead to more cost-effective solutions with long-lasting influences.

A vital factor in the successful implementation of a SMS is the selection of the right personnel to fill positions influencing its actions and performance.

A focus on the human element should be the primary prevention measure. Nationally and internationally, flag states should emphasize the human element in implementing the STCW95 convention and the ISM Code. The human elements are also in focus when it comes to training, certification and watch keeping.

Seafarers as worthwhile human resources are not only directly inclusive in the maritime industry because of their working on board, but are also participating with the employers ashore, which could be considerable for some shipping companies. With the implication of seafarers, the capability of the shipping company could be further scrutinized.

6.1 Some examples of the human element in maritime industry

6.1.1 Science, engineering and technology: Marine science engineering and technology are about future endurable use of the seas. Design of ships, boats and other offshore structures is one key field of activity. Qualified marine engineers excogitate propulsion and control systems for ships, oil platforms, underwater and offshore vehicles and much more such as dynamic positioning "DP".

Other professions include naval architects who specialize in the design, construction, conversion, repair, surveying and decommissioning of ships, boats and offshore structures. Offshore engineers design and produce fixed and floating offshore oil production installations.

6.1.2 Maritime Business: The maritime business employment field includes marine insurers, shipbrokers, accountants, bankers, vessel financiers and charterers, ship managers and port managers.

6.1.3 Sea going and Ports: The port sector provides the vital transport networks which support domestic and international trade. The ports sector includes ports, harbors, container terminals, stevedoring companies and specialist labor supply organizations.

Harbor masters, marine pilots, and operators of vessel traffic services are employed to ensure the safe navigation of ships in harbor waters. Port operators are engrossed in ensuring that freight is moved efficiently from a ship moored at the quayside directly to its intended location. Engineers are employed to ensure that plants, vehicles, boats and infrastructure are well maintained and repaired. Mechanical, electrical and civil engineers work in ports on a wide range of specialist equipment and structures.

6.1.4 In terms of seagoing people:

Deck officer:	With high qualifications, he is responsible for controlling navigation, communications, safety and security using the latest technological systems.
Engineering officer:	With high qualifications, he is responsible for operating and maintaining all the mechanical and electrical equipment throughout the ship at sea.

7. Human Error

One of the common phrases used in shipping is that the most accidents at sea are caused by human error, and the question here is, why highly skilled, well-trained professional seafarers make errors. So, we should find an answer to this puzzle. Human error has remained tenaciously high as the prime cause of accidents and claims.

Whenever a serious shipping accident happens there is definitely turmoil to find someone to place the blame on. The reason why ships fall apart, founder, collide with each other, run aground, break up, catch fire and whatever else may befall them is rarely, if ever, because there is something substantially wrong with the system. In a large number of situations, it is because somebody, somewhere along the line, did not take the proper action to avoid a problem or did something wrong, whether through laziness, ignorance, greed, malice, fatigue or negligence. This, incidentally, stresses how vital it is that IMO's focus on the human element, as demonstrated by the introduction of the ISM Code and the updating of the STCW Convention, must be sustained.

About 80% of accidents are attributable to human element errors or disregard. So most of these accidents can be reduced or impeded if safety is given priority, when the attitudes of seafarers are promoted and if the promotion of these attitudes is an advanced process to which the entire community is committed.

Human error, a complex matter, may include inadvertence, pilot-master relationships, low or poor physical fitness; poor eyesight; high fatigue; high alcohol use; high personnel turnover; high level of estimated risk; improper lights and marks; misuse of radar; uncertain use of sound signals; inadequacies of the rules of the road; etc.

Human error can be classified into 3 major categories with the same approximation of the STCW Code 95 amendments. The 1st category is operational, i.e., based on human error. The 2nd category is the management of human error, and the 3rd category is the combination of the 1st and the 2nd, which might cause considerable accidents or disasters by triggering chain events.

It is stated that errors including characters of the system in shipping lie in the social organization of the personnel onboard, economic pressure, the structure of the industry, and insurance and difficulties in international regulation.

We know that there is scarcely a technical solution that the human element is unable to evade, ignore or fails to maintain or break. The risks associated with human error will continue with the resulting loss of life, injury and pollution. The economic losses assignable to human factors have been shown to be significant.

7.1 Causes of Injuries and Incidents

While human errors are centered on inadvertence or improprieties on the part of the operator more than they are symptomatic profound and complicated problems in the inclusive maritime system, human errors are in general caused by technologies, environments, and organizations, which are discordant in some way with optimum human performance. These discordant factors set up the human operator to make improprieties.

Usually, management has tried either to blandish or forewarn its employees into not making errors, nevertheless adequate motivation could somehow overcome poorly designed management and equipment systems and natural human limitations.

The most common causes were error of judgment and improper lookout or watchkeeping, followed by failure to comply with regulations. The human element, as it is often termed in the shipping literature, has frequently been cited as a cause of these costly incidents. Some example issues for the causes of injuries and incidents are:

- Fatigue: may be because of poor health and also lessened performance.
- Stress: may be as a result of personal health and welfare.
- Health: there is a relationship between health management and safety.
- Decision making and cognitive requirements:
- Communications:

- Language and cultural variance:
- Team work: it is very important as technical skillfulness.
- Safety training:
- Safety climate and safety culture: safer shipping requires a safety culture, and there exists an important relationship between safety climate and performance.

8. Treating The Human Element as Assets or Human Capital

Human capital is the set of skills which an employee acquires on the job, through training and experience, and which increases the employee's value in the marketplace. There is the notion that the human element should be regarded as assets rather than variable costs, in other words, treated as human capital. In my opinion, human resources are valuable and a source of competitive advantage. The human element and their collective skills, abilities and experience, coupled with their ability to deploy these in the interests of the employing organization, make a significant contribution to organizational success and constitute a major source of competitive advantage.

9. Conclusion

It is explicit and indisputable that the human element is the utmost crucial part of the maritime/shipping industry system and the chain will promptly crack in case of destitution of a qualified human element.

The human element in the maritime/shipping industry, and in particular seafarers, should be treated as a human capital who can add worth to the business with preferable protection, indemnity and deliberate investment. In order to improve and underpin the human capital management system in the maritime/shipping industry, the significant element innovating human values should not be forgotten. The correct technological infrastructure provides the materials requisite for ensuring the prosperity of knowledge management exertion between human elements afloat and ashore. Training, improving and incessant learning, inspiration of the human element value and offering a long term career progress are the probable solutions for prospective human capital management.

References

[1] Armstrong M., "Armstrong's Handbook of Human Resource Management Practice", 11th edition, London and Philadelphia, 2009.

[2] Chawla P., "Building the Company Culture. The International Maritime Human Element Bulletin" Alert, 5, 2004.

[3] El Ashmawy M., "Effective Implementation of Safety Management System (SMS): An Overview of the Role of The Human Element", "MET Trends in the XXI Century", Admiral Makarov State Maritime Academy, 2009, page 246- 255.

[4] Etman E.and Halawa A., "Safety Culture, The Cure for Human Error: A Crttique", Proceedings of "World Maritime Excellence" Odesa National Maritime Academy, 2007, page 115-126.

[5] Er Z. and Celik M. Definitions of Human Factor Analysis for the Maritime Safety management system", "Maritime Security and MET", World Maritime University, 2005, page 235-243.
[6] Graveson A., "The Human Element – Success or Failure", Proceeding of IMLA, 2000, page 46- 499.
[7] Hetherington C., Flin R., and Mearns K. "Safety in Shipping: The Human Element" Journal of Safety Research 37, 2006.
[8] International Convention on Standards of Training, Certification and Watch keeping for Seafarers, 1978, as amen (STCW Convention), IMO, 2001.
[9] International Safety Management Code (ISM Code), IMO, 2002.
Sekimizu K. "The human Element in the Work of the IMO. The International Maritime Human Element Bulletin", Alert, 12, 2006.
[10] Kiriyama S., Nishimura S.and Ishida K., "Influence of Human Factor on Marine Casualties", Proceeding of Green Ships Eco Shipping Clean Seas", Gdynia Maritime University, 2011, page 169- 176.
[11] Kostylev I., "Comprehensive Review of the STCW 78 Convention and Code: Some Concepts and Trends", Proceedings of "World Maritime Excellence" Odesa National Maritime Academy, 2007, page 45-55.
[12] Maitland C., The Human Element in Safe shipping: What Sort of Researching is needed? Mare forum from Russia & Central Asia, 2008.
[13] Middleton R. and David G., "Improving the Awareness of the Human Element in the maritime Industry", issue No 1, The Nautical Institute, 2003.
[14] Mitropoulos E., "Technical Cooperation: IMO's Response to the 2005 World Summit", IMO News, Issue 3, 2006, page 4-5.
[15] O'Neil W., "A Personal Perspective", IMO News, Issue 4, 2003, page 55-58.
[16] O'Neil W., "Committed People Working for Safe, Secure and Clean Seas", IMO News, Issue 3, 2003, page 4-5.
[17] O'Neil W., "IMO- Safer Shipping Demands Safety Culture", IMO News, Issue 3, 2002, page 4-15.
[18] O'Neil W., "Raising World Standard in the Maritime Industry", IMO News, Issue 2, 2003, page 4.
[19] O'Neil W., "World Maritime Day 1998", IMO News, Issue 3, 1998, page 9-20.
[20] Payer H., "The Human Factor in Shipping Safety", Bimco Review, 1996, page 145-146.
[21] Petersen S., "The Human element", Bimco Review, 1999, page 66.
[22] Squassafichi N., "RINA, The ISM Code and the Human Element", Bimco Review, 1996, page 147-149.
[23] Squire D, "The Human Element in shipping", Proceeding of IAAST, 7th international conference: The Human Element in Safety and Survival at Sea. Sibenik: Adriamar Maritime Training Centre, 2006.
[24] Tansey P, "Women on Board- Ten Years of the IMO Women in Development Programme", IMO News, Issue 3, 1999, page 33-38.
[25] "WMU Conference to Highlight Women Successes", IMO News, Issue 4, 2007, page 39.

The 13th Annual General Assembly of the IAMU

Expanding Frontiers -
Challenges and Opportunities in Maritime Education and Training

Maritime Security in the Arctic: The threat from non-state actors

Dr. Donna J. Nincic
Professor and Director, ABS School of Maritime Policy and Management
California Maritime Academy, California State University
dnincic@csum.edu

Abstract: This paper addresses what some RAND analysts have termed Tier I national security threats – those from "non-state actors" – in the Arctic region. It explores the credibility of assertions that terrorists, pirates, criminal gangs, and drug and human traffickers could exploit the Arctic region to their ends, and assesses the ability of the Arctic nations to respond to such threats. At the same time, the paper explores other non-state maritime threats, which include natural disasters and accidents (considered security threats because of the economic damage and loss of life they can cause). Using a Probability-Impact Matrix, the paper suggests a preliminary assessment of the non-state threats to the region, noting that maritime accidents should currently be considered of greatest concern for the Arctic.
Keywords: Maritime security, Arctic, non-state actors, accidents, piracy, terrorism, natural disasters, smuggling, trafficking

1. Introduction

Observable climate changes in the Arctic, and predictions for the future, have led to a renewed economic, environmental and geo-strategic interest in the region. The declining ice pack opens up potential new avenues for trade, energy and fisheries exploration and exploitation. Although estimates vary significantly on when, for example, the Northwest Passage will be able to sustain an ice-free summer shipping season, optimistic estimates, including that of Canada's defense agency, place this as soon as 2015 or 2020. Others push this farther back, to 2050. More advanced models presented at a 2007 meeting of the American Geophysical Union anticipated an ice-free Arctic in the summer as early as 2013. Similar expectations exist for the Northern Sea Route, and with the proposed development of an "Arctic Bridge" connecting ports in Russia and Canada, it is clear many nations anticipate the use of the Arctic as a routine seasonal maritime trade route, saving up to 4,000 nautical miles on some voyages.

At the same time economic interests anticipate positive benefits from the opening of the Arctic to trade and economic development, some military and national security strategists worry, for example, that terrorists could use the newly ice-free waterways to infiltrate and attack countries in the region, or that the new Arctic trade routes could become conduits for human smuggling, drug trafficking and organized crime.

This paper will address what some RAND analysts have termed Tier I national security threats – those from "non-state actors" – in the Arctic region. It will explore the credibility of assertions that terrorists, pirates, criminal gangs, and drug and human traffickers could exploit the Arctic region to their ends, and will assess the ability of the Arctic nations to respond to such threats. At the same time, the paper will explore other non-state maritime threats, which include natural disasters and accidents (considered security threats because of the economic damage and loss of life they can cause).

1.1 Maritime security threats: RAND framework

According to RAND analysts, security threats can be categorized in three tiers based on the primary belligerent actor. Tier I threats are non-state threats and include natural phenomenon (such as hurricanes, rogue waves, and tsunamis), criminal activity (including piracy), as well as terrorist movements. Tier I threats are by far the most common threats to the maritime domain, though some feel their economic consequences tend either to be small or transitory

Tier II threats stem from failed, failing, or rogue states (states whose internal and external behavior is considered by most countries to be outside the internationally accepted norm). These states may serve as safe-havens for the types of activities that make up the Tier I threats and, in the case of rogue states, the state may actually be the sponsor of such criminal activity. Tier III threats consist of state-to-state conflict or state-level threats in which national actors may use coercion or force to advance national interests by threatening or using force. Unresolved historic and emerging tensions increase the risk of this type of threat. Tier II threats (failed and rogue states) are not currently present in the Arctic region, and are unlikely to be at any time in the foreseeable future. Tier II and Tier III threats are beyond the scope of this paper, which will focus exclusively on Tier I threats (non-state actors) to the Arctic region.

2. Non-State Threats in the Arctic

While RAND has tended to limit its discussion of Tier I threats to natural phenomenon (tsunamis), criminal activity, and terrorist movements, work done with students in several of my courses at the California Maritime Academy (particularly *GMA 330: Maritime Security*, and *GMA 395: Polar Politics*) has shown that there is value in expanding this definition to include greater levels of criminal activity – including drug, human and weapons trafficking/smuggling – and also including maritime accidents along with natural phenomena such as tsunamis, rogue waves, and hurricanes as well. The rationale for including maritime accidents is that they can be as devastating to human life, economic infrastructure, and the marine environment as many of the other types of events included in Tier I threats. The *Exxon Valdez* oil spill, and the British Petroleum *Deepwater Horizon* tragedy are two recent examples that come quickly to mind.

2.1 Maritime Piracy

The probability of maritime piracy occurring in any region of the world depends on a number of conditions. For example, according to Jon Vagg, maritime piracy is most likely to occur when three conditions are met: 1) "Economic dislocation" due to rapid economic development, 2) a "cultural acceptance" of maritime piracy by people in the region, and 3) opportunity [1]. By economic dislocation he means that periods of rapid economic growth – as might be seen in the Arctic as trade and development increase – are rarely evenly distributed among the population. Those who feel "left behind" by the increase in regional economic wealth may resent those who are doing well by the economic boom. This resentment may turn to theft and crime of all sorts, including the robbing of merchant vessels. While we are used to maritime piracy following the pattern off Somalia, with dramatic attacks on ships far offshore, the reality is that many ships are attacked and robbed while at anchor or in port. Attacks on stationary vessels are much more the norm for piracy in regions of the world such as West Africa and Latin and South America.

"Cultural acceptance" infers that people do not see maritime piracy necessarily as a crime, but may actually be supportive of the wealth it brings to an impoverished community, particularly since robbing a vessel from another country, and from a rich shipping company, may be seen as a "victimless crime;" that is, those who are harmed economically by the act are typically insured and do not bear the full economic burden of the crime. There are very few places in the world where maritime piracy is so pervasive that it is seen as culturally acceptable by the local population. In all cases, it is in regions or countries where the state is generally considered unable to meet the basic demands of its population. That is, cultural acceptance of maritime piracy is more likely to occur in failed or failing states or regions of the world. There is absolutely no evidence that crime of any sort is considered culturally acceptable in any peoples of the Arctic; it is therefore unlikely that there would be any cultural acceptance of maritime piracy at any time in the foreseeable future.

Lastly, Vagg suggests that maritime piracy depends on opportunity; that is, there must be ships to attack to make piracy worth pursuing. While commercial transits of the Arctic are currently very limited, some studies show a rapid increase in maritime traffic by 2030. One study estimates by 2030, of a projected total trade estimate of 3.9 million TEU from the Tokyo hub, 1.4 million TEU could be transported across the Arctic during the sailing season. This amounts to 480 transit voyages (one way) for the summer of 2030. Looking ahead to 2050, the trade estimates rise to 2.5 million TEU across the Arctic, or 850 transit passages. The predicted amount of containers transported across the Arctic could correspond to about 8% of all container trade between Asia and Europe in 2030, and about 10% in 2050 [2] Shipping across the Arctic Ocean]. At this point, if these projected transits for the summer shipping season are realized, there will be more opportunity for maritime criminal activity in the Arctic region with the understanding, of course, that an increased opportunity to rob and attack vessels does not necessarily lead to maritime piracy.

2.2 Maritime Terrorism

The prospect of maritime terrorism in the Arctic has received much attention lately, particularly with the recent release of a declassified document from the Canadian Integrated Threat Assessment Centre, which included analysis from representatives of the Canadian Security Intelligence Service, the RCMP and other agencies. The report, titled "The Canadian Arctic: Threat from Terrorists and Extremists," followed on a January 2009 US presidential directive on US Arctic Policy noting the possibility of security threats from the region. It said Washington had fundamental homeland security interests in "preventing terrorist attacks and mitigating those criminal or hostile acts that could increase the United States vulnerability to terrorism in the Arctic region."

The report notes that the population of the Arctic has climbed 16 per cent over the last decade, and the region draws an increasing number of tourists, with some 15 cruise ships operating regularly in its waters. Security agencies are increasingly wary of threats from both within Canada and beyond its borders, particularly from "issue-based activist groups" protesting in the Canadian Arctic [3].

The report goes on to mention that Al Qaeda has identified Canada as a target on more than one occasion; those familiar with the report note that "foreign extremists" could take advantage of "spotty surveillance" in the region as a means of entering North America [4]. While there was a tendency for the report to be somewhat discounted by other security analysts at the time of its release, it did nonetheless draw attention to the key fact of a lack of security infrastructure in the Arctic region. For example, it noted that labor market shortages in the Arctic have prompted employers to turn to a foreign work force, which is often not subjected to security screening prior to entering Canada [5].

Maritime terrorism can take many forms, some of which may be more or less likely in the Arctic. For example, according to a recent IAMU study [6], maritime terrorist events can be grouped into five different classifications or types: 1) Hijacking and hostage taking for political purposes (ie., not economic gain), 2) direct attacks on vessels (typically suicide attacks), 3) using the ship as a weapon, 4) using the ship as a "vector" to carry goods and materiel on behalf of terrorist organizations, and 5) sinking a ship to block a chokepoint or important trade route.

The likelihood of each of these occurring varies, but given that there are very few terrorist groups operating in the world today with known maritime capabilities, and given that there are no known terrorist groups currently operating in the Arctic, the possibility of many of these events occurring is quite small.

Hijacking and hostage taking is always a possibility, but the hijackers would almost certainly have to be onboard the vessel for this kind of event to occur, given how few active ports there are in the Arctic or places of embarkation for terrorist attacks to originate. Given the heightened levels of security on ships since the 9/11 attacks in the United States – particularly security on passenger and cruise ships – it is unlikely that hijackers could pose as members of the crew or passengers. A similar consideration mitigates against suicide attackers attacking vessels directly; not only would there have to be terrorist groups in the vicinity with maritime capabilities in the Arctic environment, they would have to have mastered the logistics of attacking a vessel in port, or more unlikely, at sea. Both are improbable at the moment.

Using the ship as a weapon – hijacking a vessel then using that vessel to attack a port or critical infrastructure (this is the "weaponization of transportation" scenario developed from the aviation attacks on the World Trade Center and Pentagon) – meets with similar objections; as does hijacking a ship and sinking it in a critical sea lane. There would have to be terrorist groups in the area with the capability of operating in the Arctic marine environment, and sufficient skill to hijack a ship.

While it is not impossible for this to develop at some future point, this is not a likely near-term scenario.

The use of a ship as a vector to carry weapons and/or materiel for terrorist groups is probably the most likely of the maritime terrorism scenarios. Guns, weapons, etc could be loaded on board a container almost anywhere in the world, and placed on a ship destined for the Arctic trade routes. Given that many ships transiting the Arctic in the future are expected to be in transit passage, and not making port calls along the way, the destination of the terrorist cargo is likely to be a distant port well outside the Arctic. Additionally, the "bomb in a box" scenario – a bomb placed in a container, timed to detonate at a certain future place and time – is not wholly unlikely, but again the "target" is more likely to be a port of destination than a sea lane transit. (And it should be noted that while this is one of the "nightmare" scenarios for maritime security analysts, and the focus of many maritime security drills, the bomb in a shipping container has yet – to our knowledge – to occur anywhere in the world, let alone in the Arctic.)

2.3 Criminal Exploitation

Criminal exploitation refers to a broader set of illegal activities that are done for largely financial ends, and are not necessarily related to making a political statement, or achieving a political outcome, as we see in terrorist incidents. The kinds of criminal activities of particular concern to the maritime domain include arms, human, and drug trafficking and smuggling. These represent some of the most pervasive exploitation of the maritime domain throughout the global supply chain. 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 to the present 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. [7].

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. 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 failed and failing states in the developing world 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. [8] To the extent that any of these weapons flows are originating from, or being delivered to, countries that could benefit from reduced shipping times through the Arctic trade routes, the Arctic nations would have to expect that they would do so.

While it can be very difficult, if not impossible, to determine exactly who has bought and who has sold illegal weapons cargoes in all cases, a recent report by Stockholm International Peace Research Institute (SIPRI) has attempted to do so. Instead of using the ship's flag as a means of noting "ownership" of a vessel, they have instead noted the "beneficial owner" of the vessel, considered the ultimate owner of the ship (individual, company, group or organization), and the ultimate beneficiary from its commercial operations [9]. The "beneficial owners" most often associated in illicit arms control seizures between 1991 and 2011 were (in order) Germany, Greece, United States, North Korea, Panama, Iran, Norway, Russia, Belize, Netherlands, Denmark and Japan [10]. Many of these countries are currently using the Arctic trade routes; many more of these countries are expected to do so in the future, leading to the conclusion that Arctic state authorities must be prepared to intercept and encounter illegal weapons trafficking through their northern waters.

Finally, human trafficking is an increasingly tragic example of the exploitation of – primarily – women and children globally, with many transported by sea. Human trafficking is estimated to be the third largest criminal enterprise in the world behind illegal drugs and arms trafficking. According to the CNN Freedom Project, trafficking in humans is believed to generate upwards of $32 billion dollars [11]. Globally, between 600,000 and 800,000 people are trafficked across international borders annually [12]. Major source countries now include Ukraine, Russia, Romania, Bosnia, Brazil, Myanmar and the destination countries are mostly the United States and Western Europe. 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 [13].

The lack of sufficient or routine security patrols, inspection infrastructure, and security infrastructure – coupled with predicted increases in maritime traffic, particularly containerized traffic – mean that the Arctic cannot be considered immune as a transit route for illegal cargoes of all kinds. In fact, the Canadian Integrated Threat Assessment Centre report cited above noted that "In recent years, vessels with links to human smuggling, drug trafficking, and organized crime have attempted to access the Canadian Arctic" [14].

2.4 Natural Disasters

Natural disasters as Tier I threats typically include rogue waves, tsunamis, cyclones and hurricanes in the maritime environment (with earthquakes, forest fires, etc being added as land-based events). Many of these either are, or may become, prevalent in the Arctic, with additional predictions of freak storms, and unpredictable ice movements impacting port infrastructure and/or individual ships. It should be noted that fierce storms – that would be called hurricanes in lower latitudes – have already hit the Arctic. In November 2011 an "historic" storm of "near record magnitude" with winds of 100 mph hit the coast of Arctic Alaska, with sea levels predicted to be three to five feet above normal. This created a substantial problem for coastal erosion in many Alaskan native villages, including the village of Kivalina, already facing severe erosion due to climate change [15]. More such storms – especially if they occur before the protective barrier of winter sea ice forms in the Fall – could contribute to the already precarious state of many villages in the North. It should be noted that Alaska alone has nearly 100 villages deemed "at risk" from climate and weather events, with twenty-six designated as "priority action communities" (including the most threatened communities of Kivalina and Shishmaref) [16].

Rogue waves and tsunamis are not uncommon in the northern oceans, and the largest rogue wave in recorded history occurred in US Arctic waters. On 9 July 1958, an earthquake caused a giant landslide at the entrance of Lituya Bay in Alaska, generating a wave with an initial amplitude of 524 meters (1,719 ft). This is the highest wave ever recorded, and surged over the headland, stripping trees and soil down to bedrock. Three other historic tsunamis over 100 feet occurred in Lituya Bay: in 1854 (395 feet high), 1899 (200 feet), 1936 (490 feet), as well as 1958 (1740 feet). Rogue waves are not uncommon in Arctic waters as well, with some being captured on video [17]. As more and more ships use the Arctic trade routes, they will be increasingly subjected to the possibility of more severe weather events, many of which are currently poorly understood in these waters.

2.5 Accidents

Maritime shipping accidents are considered to be by far the most likely of the Tier I threats due to hazardous and unpredictable sailing conditions and the possibility that some shippers might try to stretch the sailing season (starting either too early or too late in the sailing season). Additionally, there is the problem of delays in rescue due to the scarcity of search and rescue infrastructure in the region, which could further compound the impact of the accident, particularly in the case of an oil spill or other hazardous leak.

According to recent studies, the melting of the ice and the opening of the Arctic to greater levels of maritime shipping is likely to lead to greater probabilities of accidents. Somewhat counter-intuitively to many, the increasingly reliable seasonal melt of the Arctic ice pack may actually create dangers posed by unpredictable and often dramatic worsening in local ice conditions, which can lead to shipping accidents in the Arctic seas. These include "ice compressions, intensive ice drift – ice rivers, narrowing channel behind icebreaker, collisions with stamukhas and icebergs, unusually early freezing of sea areas, intrusion of sever ice into shipping lines, icing of vessels and sticking of snow-ice pillow to them" [18].

Along with ice conditions creating poorly-understood hazards to navigation, mariners and meteorologists point to the fact that fog and poor visibility conditions are likely to increase with the warmer weather. Incompletely charted waters may be a factor as well; especially in those areas where the sea lanes follow the specific pattern of the seasonal ice melt and may not be in exactly fixed locations from year to year. In short, some Arctic consequences of climate change may include:

- Changing physical and mechanical properties of sea ice;
- More calving, leading to more, but smaller (and harder to detect), icebergs;
- Higher waves and more sea spray icing in ocean areas that will become ice free;
- More summer fog;
- Changed tracks of cyclones and anticyclones in the Arctic.

Shipping accidents are not new in the Arctic. In addition to the well-known Exxon Valdez accident (which technically did not occur in the Arctic but is often discussed in the context of the difficulties of oil spill response in remote and frigid waters), there have been several other noted maritime incidents in the Arctic:

- The *Spirit of Glacier Bay*, July 7, 2008: A small cruise ship, the *Spirit of Glacier Bay* ran aground in poor weather at the head of Tarr Inlet (southeast Alaska); no casualties or injuries were reported, and the hull was not compromised. Passengers were removed by air, and the ship was towed back to port without incident;
- The Clipper Adventure, August 29, 2010: Another cruise ship, the Clipper Adventure was carrying approximately 200 passengers and crew on a cruise from Greenland when it ran aground in three meters of water in Nunavut, near the Northwest Territories. The cruise operator claimed the ship ran aground on an uncharted rock. A Canadian Coast Guard icebreaker successful removed all the passengers after taking two days to reach the stranded vessel. There were no injuries or negative environmental impacts reported, although the ship remained grounded for two months before being salvaged;
- The Arctic Rose, April 3, 2001: One of the worst commercial fishing accidents in an industry that routinely kills at least 70 fishermen a year, the *Arctic Rose* sank in heavy weather will all 15 crew on board. In 24 foot waves, it took at least 30 hours to reach the stricken vessel, approximately the length of time an individual can last in a survival suit in the frigid Arctic waters. While there is still some dispute about the exact cause of the accident, it is believe it was due to human error – a back hatch had remained open.

As can be seen by these few short case studies, response time in the Arctic can be delayed due to poor weather conditions and the lack of readily available search and rescue infrastructure. According to a recently-released report by the US National Oceanographic and Atmospheric Administration (NOAA) and the University of New Hampshire, "the existing infrastructure for responding to maritime accidents in the Arctic is limited and more needs to be done to enhance emergency response capacity as Arctic sea ice declines and ship traffic in the region increases" [19].

Specifically, the report recommends:

- Strengthening multinational plans and agreements for all types of responses;
- Improving logistical support capabilities for disaster responders;
- Updating weather data and navigational charts for the Arctic;
- Studying the behavior of oil in cold water and improving technologies for spill response in Arctic conditions;
- Designating potential ports in the Arctic where damaged vessels can be taken to safeguard them against the Arctic's harsh environmental conditions and reduce the risk of harm to the environment.

3. Probability-Impact Assessment

A means of assessing relative severity or importance of a multitude of threats is a "probability-impact matrix." For each event under consideration, a relative (not absolute) probability is determined, along with a relative impact (usually determined by the cost in human lives and economic toll). A brief exercise in my Fall 2011 *Polar Politics* class at the California Maritime Academy assessed Tier I threats in the Arctic; from this assessment, the following matrix was determined (the probabilities and impacts for the specific events appear in Appendix I). Events which cluster towards the bottom right of the matrix are the most severe, and those which shipping companies, government officials, and policy makers should focus on first [20].

	Probability →				
Impact ↓	1	2	3	4	5
1					
2				1	
3	2			8	
4	3, 4, 5		6, 10, 11	9	12
5	7				

According to the assessment done with these twelve events, the following are determined to be of the greatest risk and highest importance:

- Terrorism: Ship as a vector: Event #6, Risk Value 12
- Human trafficking: Event #10, Risk Value 12
- Natural disasters: Event #11, Risk Value 12
- Accidents: Event #12, Risk Value 20

Clearly this is just a very preliminary exercise to give a sense of the relative importance of the various Tier I threats that could occur in the Arctic in the future. To have full value, this exercise should be repeated by those with a clear stake in Arctic shipping and economic development, in order to plan for those threats most likely to occur as the Arctic trade routes are used more routinely by the global trading community.

4. Conclusion

At the moment, accidents are the most likely security threat in the Arctic and can be mitigated by training, given how many maritime accidents are caused by human error. Additionally, the Manila Amendments to the STCW Convention and Code call on additional levels of Arctic training for mariners. However this level of training and preparation for expected increases in Arctic shipping should be extended to maritime education and training (MET) not just for mariners, but for shipping companies, insurance companies, and related industries doing business in the Arctic as well. Most importantly, the Arctic nations should identify the threats most likely to occur in their waters and continue to develop joint mitigation, response and recovery plans. Cooperative effort is essential due to the current insufficiencies in response infrastructure as any incident will likely affect all Arctic nations, and will require joint and cooperative response.

References

[1] Vagg, J. "Rough Seas: Contemporary Piracy in Southeast Asia," *British Journal of Criminology*, Vol 35, No. 1, (Winter 1995).

[2] "Shipping across the Arctic Ocean: A feasible option in 2030-2050 as a result of global warming?" DNV. (2012). www.dnv.com.

[3] "Arctic terror threats real: security agencies," *CBC News*. (November 10, 2010) http://www.cbc.ca/news/canada/north/story/2010/11/10/cp-arctic-security-threats.html

[4] *Ibid.*

[5] *Ibid.*
[6] Nincic, D. "Maritime Terrorism: Case Studies for Teaching and Analysis." Presented to the Annual General Assembly of the International Association of Maritime Universities. Malmo, Sweden (2005).
[7] "Drug Interdiction." *US Coast Guard.* US Department of Homeland Security. (n/d.) http://www.uscg.mil/hq/cg5/cg531/drug_interdiction.asp.
[8] Griffiths, H. and Jenks, M. "Maritime Transport and Destabilizing Commodity Flows." *SIPRI Policy Paper.* Stockholm International Peace Research Institute. (January 2012).
[9] *Ibid.*
[10] *Ibid.*
[11] "The Facts." *The CNN Freedom Project.* (2011). http://thecnnfreedomproject.blogs.cnn.com/category/the-facts/
[12] "Trafficking in Persons Report." *United States Department of State.* (2007). http://www.state.gov/documents/organization/82902.pdf
[13] McGill, C. *Human Traffic.* London, UK: Vision Paperbacks. (2003).
[14] "Arctic terror threats," *op. cit.*
[15] "Arctic 'hurricane' slams Alaska." *CNN.* (November 9th, 2011) http://news.blogs.cnn.com/2011/11/09/arctic-hurricane-slams-alaska/
[16] "Alaska Baseline Erosion Assessment: Study Findings and Technical Report." *U.S. Army Corps of Engineers.* (March 2009). http://www.climatechange.alaska.gov/docs/iaw_USACE_erosion_rpt.pdf
[17] *Rogue Wave Full Version. YouTube.* (n/d.). http://www.youtube.com/watch?v=l_8hOai9hGQ&noredirect=1
[18] Y. Mironov, Y. et al. "Ice Phenomena Threatening Arctic Shipping." Backbone Publishing. (2012).
[19] "Arctic Region Underprepared for Maritime Accidents." *UNH/NOAA Report.* University of New Hampshire/National Oceanic and Atmospheric Administration. January 29, 2009. http://www.noaanews.noaa.gov/stories2009/20090129_arctic.html]
[20] For more details on the construction and use of a Probability-Impact Matrix as a security assessment tool see Nincic, D and Clark, B. "The Utility of Risk Assessment Tools in Maritime Security Analysis," in Wang Zuwen, ed., *Proceedings of Globalization and MET.* Dalian, China: Dalian Maritime University Press. (2006).

Appendix I

Event	Probability	Impact	Risk Value (PxI)
1. Maritime Piracy: Theft at anchor or in port	4	2	8
2. Maritime Piracy: Attack at sea	1	3	3
3. Terrorism: Hijacking and Hostage Taking	1	4	4
4. Terrorism: Direct Attack on vessels	1	4	4
5. Terrorism: Ship as a weapon	1	4	4
6. Terrorism: Ship as a vector	3	4	12
7. Terrorism: Ship closing chokepoints	1	5	5
8. Drug smuggling	4	3	12
9. Weapons smuggling	4	4	16
10. Human trafficking	3	4	12
11. Natural disasters	3	4	12
12. Accidents	5	4	20

Internet-based, multi-media education for classroom and distance learning at MMA

Dr. John J. Bausch III
Associate Professor
Department of Engineering
Massachusetts Maritime Academy
jbausch@maritime.edu

Abstract: The internet is by far the most important development for our last generation of students in the twentieth century. Twenty-First century maritime professionals rely increasingly on electronic hardware (i.e., computers and the network), and more importantly, on the resulting information technology and communication tools (IT-Tech). These tools are an essential part of maritime engineering education. This paper looks specifically at internet-based, multi-media education for both traditional classroom, and long distance learning programs at the Massachusetts Maritime Academy (MMA). The author currently teaches traditional engineering classes at MMA in electronics and computer control. These physical classes, and associated laboratories, increasingly utilize internet-based materials in a variety of constantly changing formats. The paper examines specific internet, multi-media, and engineering software applications in the form of interactive email assignments, internet labs (iLabs), and electronic course-notes. These digital elements expand the universe of traditional classes by adding more current material such as Matlab/Simulink design iLabs, PLC design iLabs, and applied engineering Case Studies. At the same time, engineering classes must continue to teach fundamentals by incorporating non-electronic, but still essential, analog forms of education such as textbooks, written assignments, and interactive lectures. In addition to his "brick and mortar" classes, the author has also developed a non-traditional, internet-based, certificate class at MMA in "Marine Pollution and Vessel Engineering Systems". This BlackBoard-based, distance learning class was taught to 18 maritime professionals located worldwide. There was no physical classroom, no analog communication, and no one in the class was ever in physical contact. Weekly lessons, assignments, and quizzes were in the form of off-line videos and electronic course-notes. As a result, the author has developed a unique perspective on these trends in "modern" marine education. This paper compares these emerging digital information tools to the resulting analog student outcomes, and examines the lessons learned.
Keywords: Multimedia Case Studies, Education, Matlab, Simulink, Electronics, Control Systems, Marine Engineering, Distance Learning.

1. Introduction

Before reading further, it is helpful to have a brief understanding of the author's personal background. The author began his career as a marine engineer (SUNY-Maritime College), and served four years in the Merchant Marine on U.S. Great Lakes bulk carriers. He then spent seven years in graduate school doing active research and teaching in the area of automation and computer control while earning a master's and Ph.D. in mechanical engineering (MIT). After leaving MIT, Dr. Bausch spent a number of years teaching at several engineering schools, and doing applied R&D with companies in the area of design and control for automation. As a result, his career has spanned the diverse ends of the engineering spectrum, from hands-on to hi-tech, during the evolution of "the computer-age".

Most recently, Dr. Bausch teaches two key classes at Massachusetts Maritime Academy (MMA) in the rapidly changing area of *Electronics, Instrumentation, and Control (EI&C).* These classes were specifically developed, based on experience in graduate school and industry, to target the many job opportunities for today's MMA engineering graduates [1]. The career paths for MMA graduates can range from engineering officer positions in the U.S. Merchant Service, to shore jobs in the power plant and facilities industry, to entry level engineering positions in manufacturing and related industries, and even to post-graduate engineering school at some of America's top universities.

1.1 ECI-Electronics & INC-Controls: two core classes at MMA

The speed of development in the area of electronics, and specifically computers, can make the teaching of the engineering subject particularly challenging: the tools and standards used for EI&C hardware and software are improving almost daily. Unlike some traditional marine engineering classes (e.g., boilers, turbines & diesels), the EI&C subject matter is in a rapid state of change. As a result, the two core classes at MMA, *Electronics (EN-3212)*, and *Instrumentation & Control (EN-4223)*, make extensive use of electronic media and software. The media itself is designed for just-in-time delivery to students. These two, upper-level classes are divided along the lines of hardware and software, electronic circuits and system dynamics, and, either PLCs (programmable logic controllers) or PIDs (proportional, integral & derivative control) for real-time applications.

ECI-Electronics covers the broad area of electronics and includes sensor, actuator and controller hardware relevant to marine and power systems. Case studies and problems examine the electronic circuits used for process monitoring and control. ECI provides the foundation for the more advanced INC-Controls class. INC addresses advanced concepts in dynamic systems, and the computer control software used for modern, closed-loop PID design. Case studies focus on single and multi-variable closed-loop systems, and on PID controller design (where the underlying application of electronic hardware and software is understood by the student through their ECI experience).

From the administrative point of view; ECI and INC are standard engineering classes taught three days a week, to a maximum class of 24 students (currently 3 sections in Electronics, and 1 in Controls). ECI and INC are particularly blessed to have a dedicated space specifically designed for use with those classes [1]. The new Electronics and Control Systems (ECS) class/lab was designed and implemented in 2009-10, and includes a lecture area with multi-media projection and sound, eight lab benches with digital instrumentation, and a demonstration space for PLC and PID controllers.

Table 1: Tradition Engineering Educational Tools

- Instructors and Textbooks.
- Lecture-based Course-Notes, and a slate Blackboard or Whiteboard.
- Homework (textbook Problem Sets with required reading), Quizzes and Exams.
- Engineering Example Problems and Application Case Studies.

Table 1 is a non-comprehensive look at the educational tools used every day in a traditional, college level engineering class. These tools are not battery operated; they don't require electricity; they are analog and physical. We've all seen them. They are employed daily by the author, and were a fixture in his own college classes. One might think that listing the instructor is too obvious, but given the emergence of online degree programs and learning software (e.g., the University of Phoenix), distance learning is starting to look like automated teaching. This new technology is changing all aspects of education, and is rapidly evolving along with all the developmental pros and cons.

While MMA still has its share of chalk-based, slate blackboards, all newly renovated classrooms have whiteboards and markers (which, while more expensive, are commonly preferred by most faculty). Textbooks are hugely expensive for engineers with new editions issued sometimes yearly. Huge amounts of time can be spent editing and fine-tuning lecture course-notes as handouts for the class. The author spent a great deal of time this year converting PowerPoint lectures into Apple Keynote, and there is always the danger of "death by PowerPoint". And while in-class, multiple-choice exams can be graded in real-time using the "iclicker" device, there are deeper, critical thinking skills required when students are asked to complete paper & pencil Problem Sets (PSets), short in-class Quizzes, and 50 minute Exams. These, of course, require a lot more faculty time to develop and grade.

1.2 Engineering Educational Trends: ABET & Distance Learning

During the writing of this paper, two recent developments were announced that are worth including. First, a new engineering degree program was approved at MMA. Energy Systems Engineering (ESE), the third engineering degree program at MMA, is an ABET accredited degree [2]. ABET, the Accreditation Board for Engineering and Technology, accredits post-secondary programs in "applied science, computing, engineering, and engineering technology". The class of 2016, entering this fall, will be the first ESE class to graduate. As required by ABET, the ESE program will include an emphasis on engineering design within the classes and laboratories. The ESE degree also requires the completion of a major Capstone Design; an open-ended engineering application project.

On a larger scale, MIT and Harvard recently contributed $30 million dollars each (for a combined total of $60 mega-dollars), to setup the joint "edX" program for distance learning [3]. This latest program has evolved from the MIT Open Courseware initiative; formally introduced in 2002 [4]. MIT Open Courseware now has materials from over 3,000 courses available online - all for free. This trend, the Open Source philosophy, can be traced back to the GNU free-software movement [5]; a project initiated by Richard Stallman and Project Athena back in 1983.

The first MIT online class, MITx 6.002x (Circuits and Electronics) is a core undergraduate class in electrical engineering. Over 120,000 students are currently taking it online in the initial offering [6]. Students are required to take exams and do weekly assignments in this certificate class. The MITx exams are very likely not being graded by hand. As planned, the edX program will run independent of the university operating budgets. Based on a hypothetical calculation, if each student were charged a nominal $10 registration fee, 6.002x becomes a $1.2 million dollar class. Not a bad return on the university bottom line; as with baseball, modern education is now big business.

1.3 Distance Learning at MMA: The Seafarer's Program

In the Fall of 2008, the author signed up to teach a distance learning trial-program at MMA, the Seafarer's certificate program, specifically to develop the online class: Sources of Marine Pollution I: Engineering Systems. This class was rapidly rechristened, Marine Engineering & Pollution, or MEP for short. The first offering of MEP ran for 8 weeks from January to March in 2009.

Week1 was a learning experience for the whole class, especially the instructor. There were 18 students in the class, all with a computer, access to the internet, a high-school degree or GED, and an interest in the maritime world. The program was affiliated with the Seaman's Church, and most of the class had career experience related to the Maritime industry.

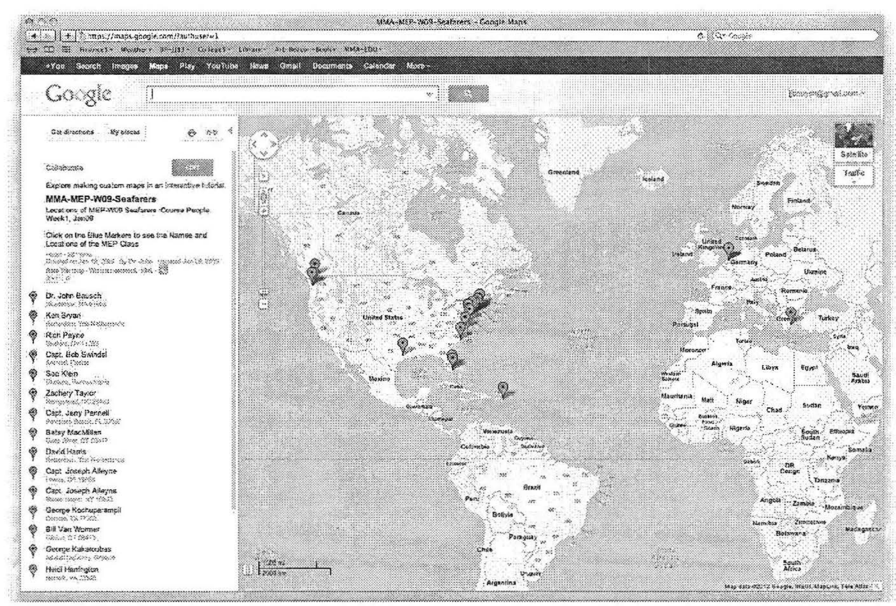


Figure 1: *Distribution of MEP students in the MMA Seafarer's Program (Google Maps).*

As is a challenge in many MMA classes, the 18 students in MEP had a very wide range of experience and ability (especially with regard to computer and internet skills). MEP was the second of five course modules in the one-year Seafarer's program; so students were already familiar with getting online, and using BlackBoard to participate in the class (see next section). The first week involved a number of warm-up exercises. These were designed to introduce MEP, the class and the instructor, and to gauge the internet response times for file size, video transfer rates and image resolutions; to flex the internet muscles. It took the first few days to learn that Quicktime (videos.mov) was the only format that could be viewed by all students on BlackBoard. Then more time was needed to provide instructions to download and install Quicktime on the predominantly Windows computers.

One of the first MEP assignments was to use Google Maps (see Figure 1) to identify the names and locations of all 18 students on an electronic map of the Earth. Additionally, as it was a bad winter in Worcester, students needed to report their daily temperatures. As you can see from the figure, the class was completely spread out over the northern hemisphere, with students on the East and West coasts, on the Gulf and in the Caribbean, and in the Netherlands and Greece. There proved to be a wide range of computer literacy with little technical support available at MMA. One student was even working on a cruise liner at sea, and had internet access only every second or third day.

2. MEP-Marine Engineering & Pollution: MMA Distance Learning

A key element in the MMA Seafarer's program is the use of BlackBoard Software [7]. BlackBoard became a publicly traded company in 2004 in order to "work with our clients to develop technology that improves every aspect of education". Students log-in to their own account on a dedicated BlackBoard server, and then have access to the course materials posted by the instructor. BlackBoard includes its own messaging system, a bulletin board for student posts, and a grading system (primarily for multiple choice exams). The instructor edits the course web page (primarily text-based) using a hierarchical menu system.

In the MEP class, BlackBoard was setup using a main page with links to the weekly pages, and a very similar layout of posts for each of the 8 weeks. The pages for each week were activated on Sunday night (Eastern Standard Time) with assignments due by the following Sunday. The BlackBoard page for Week1 (see Figure 2) is shown here in the Edit Mode. As MEP developed, the instructor tinkered with a number of electronic tools with varying degrees of success (as listed in Table 2).

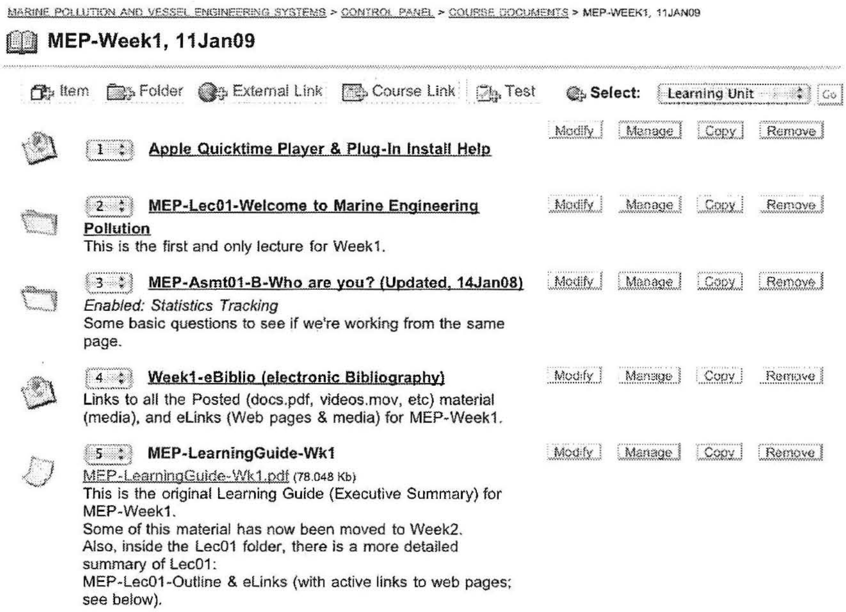


Figure 2: *BlackBoard Course page for Week1 of the MEP Class.*

Once on the MEP BlackBoard page, the student would view any current announcements before being directed to the Weekly page. The main feature each week was the Video Lecture. Theses lectures were a series of PowerPoint slides with an accompanying narration by the instructor. The Video Lecture was typically broken down into 6 or more 10 to 12 minute segments to keep the file size manageable. Lectures were followed by weekly assignments. These would include reading a class research paper, posting responses to topical questions on the class bulletin board, searching the internet for new information, and taking a short multiple choice quiz on BlackBoard.

Some of the early assignments introduced the class to the Wikipedia and the Google websites. It is interesting to note that even three years ago, these were new tools for many MEP students. In addition to the weekly video lecture, an "Outline & eBiblio.pdf" file was posted each week. These files can easily be created using a simple email editor (e.g., MacOS Mail) using only basic formatting (the KISS principle [8]), and keeping the non-multimedia content to a relatively small file size.

Table 2: MEP-Distance Learning Educational Tools

- The Internet (the online library of the information world)
- BlackBoard (the digital software not the analog device)
- Video Lectures (narrated PowerPoint presentations saved as Quicktime movies)
- Snap-Z video capture and Quicktime Pro editing software
- Wikipedia & Google (as primary search sources on the internet)
- eBibio.pdf Posts (detailed electronic bibliography files with live links)
- eNote.pdf Posts (detailed course files with live links as weekly outlines)
- Email & the email editor software (Apple MacOS Mail program)

- Electronic Case Studies on Marine Engineering Systems
- Online MEP Team Research Project (a group PowerPoint or Electronic Paper)

Electronic links (eLinks) were embedded in the file as live or active urls (uniform resource locators; i.e., internet addresses) which, when clicked-on by the mouse, point the student to the article or website. Since all MEP resources needed to be available on the internet, the instructor could easily embed the url address, the webpage location, within the email while creating the lesson plan. The email could then be saved as a more universally read ".pdf" file (portable document format, Adobe).

It was discovered that when copied to BlackBoard, the webpage links (eLinks, the live url addresses) remained active for the students inside and outside of BlackBoard. Internet search results could be saved as an electronic bibiography (an eBiblio.pdf). When in BlackBoard, the students could click on the eLinks (displayed as standard, underlined blue text in BlackBoard, email and other text software) to direct their internet browser to another webpage, and view the material being referenced. More importantly, when saved as a stand-alone .pdf file, the eLinks still remain active outside of BlackBoard. Figure 3 shows one section of the MEP Week4 Outline Notes on Steam Turbines.

2. Week4 Review Paper: Ultra Steam Turbine - Is the Age of (Merchant) Steam Over?
Are the days of mighty Steam Ships (commercial ships, not the nuclear-navy) over? Is this Early 21st Century Age we live in strikingly similar to the Early 19th Century Age of Sail, when Sailing Ships were at their peak. (Again, for commercial sailing ships; the Square Riggers and Clipper Ships of the 19th century. I sail a 25 foot sloop on Narragansett Bay. Modern, non-merchant sailing, for those of us that are wind-energy sailors, is very high performance. Maybe a possible topic for MEP Alternative Energy?).

In any event, 19th Century Steam Ship development clearly ended that Age of Sail.
So right now in 2009, is the Age of Steam Over?

Read/Skim the Lec04 Review Paper on the "Ultra Steam Turbine".
Use this paper for basic Turbine/ Boiler engineering review (as you go through lecture materials).
Then re-read when completing Asmt04 to reinforce understanding of MEP enviro/pollution issues.

Post: Wk4 Paper- Ultra Steam Turbine (5pg).pdf (you may want to print a hard copy for your notes).
Technical Review I Technology I Mitsubishi Heavy Industries, Ltd.

Some background material from the Lecture Slides on Great Lakes Shipping (SS Harry Coulby):
http://www.boatnerd.com/
http://www.boatnerd.com/pictures/fleet/kenterprise.htm

For those of you who are unfamiliar with Steam Plants, if you ever have a chance (before, and if, they are a thing of the past), take a tour of a Steam Turbine Plant with one of the engineers. Have the engineer trace the main Steam Cycle with you. You will be fascinated by the both the complexity, and the simplicity of the Steam Plant; an engineering work of art. I imagine, you would have been similarly impressed a century and a half ago, on taking a tour of a Square Rigger with the Sailing Master.

Last fall, sadly, I finished reading the last book in the Aubrey/Maturin series (Master & Commander) by Patrick O'Brian. Sadly, because no more will follow (Mr. O'Brian died in 2000). I highly recommend these books to anyone who is interested in great historical fiction (but very accurate fiction), and in the "engineering" of the Age of Sail:
Amazon.com: Patrick O'Brian: Aubrey/Maturin Books
Aubrey/Maturin Prints by Geoff Hunt (Patrick O'Brian novel covers)
Patrick O'Brian - Wikipedia, the free encyclopedia
http://www.amazon.com/exec/obidos/search-handle-url/ref=ntt_athr_dp_sr_1?%5Fencoding=UTF8&search-type=ss&index=books&field-author=Patrick%20O%27Brian

Figure 3: *Sample from MEP Week4 Outline Notes (as an eNote.pdf email file).*

As a final project for MEP, students were given an online assignment to create a research document as a team (see Figure 4). A list of 14 project topics was posted, and each of the 18 MEP students picked their top 3 topics (as a Quiz assignment in BlackBoard). Each student was then assigned to the best match of team and topic (with 3 to 4 students per team). Each team had four weeks to organize the project, compile the material, and put together their final result; either a PowerPoint presentation, or an eLink.pdf paper using live links to reference web pages (to be posted in BlackBoard).

Keep in mind that these teams were geographically dispersed across the planet. Communication was done either online through BlackBoard or through direct peer-to-peer email (the preferred method). This was only three years ago. Today they could easily meet and video conference using Skype. Even so, the project results were impressive. It is interesting to note that one of the predominantly older teams (two of three members were retired sea captains) chose to do a PowerPoint presentation, but put it together as a primarily text-based document with bullet points, and long sentences; more like a paper. They, in particular, learned a lot from the project. Generally, all the MEP students felt the project gave them something active and creative to do for the class. After submission, the projects were posted on BlackBoard; then evaluated by the instructor, and the students through a peer review.

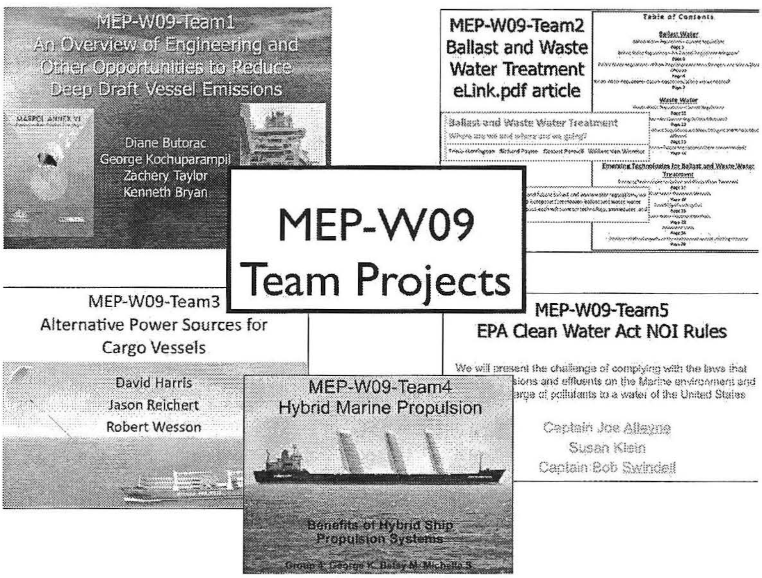


Figure 4: *MEP Distance Learning Team Research Projects (using internet tools only)*

2.1 MEP-Case Study: The HMS Titanic

Case Studies are frequently used in engineering classes to provide a link to "real" applications with real numbers; especially in scenarios involving decision-making and design. In MEP, the assigned research paper readings accomplished much of this. However, as the instructor frequently noted, MEP was not a "real" engineering class. The student backgrounds were too diverse; some not at the college level, and many not engineers by training. MEP case studies also needed to be more diverse.

One MEP Case Study, the good ship HMS Titanic, was useful to tie in many aspects of marine power, the steam cycle, boilers and thermal efficiency, in a more general way. The story of the Titanic is well known, and there are a number of websites and articles available online. The "encyclopedia titanica" site in particular was useful to introduce the steam cycle and boilers (see Figure 5), to show the developmental history of steam propulsion and engine design, and also to illustrate information technology basics [9]. We even came back to it when discussing Coal as a fuel source. And, the movie version didn't hurt either. To illustrate a Google

Search, the class was asked to type only three key words: "Titanic", "30-seconds", and "bunnies". The result is unique and memorable. Try it!

2.2 Lessons learned through Distance Learning

As the saying goes, "the first time a class is taught, the instructor learns a lot, the second time, the students learn a lot, and the third time, no one learns anything." For MEP, this was somewhat true as the author taught the class only once during its two year trial. As it was a winter class, he was able to devote a large amount of time. It was a huge amount of work; to setup, to teach, and to manage.

Much of the work load involved making the course material compatible with BlackBoard, and then posting into the BlackBoard modules. As these modules came online Sunday night, the routine caused some disruption at home. Yes, that may have been better the second year, but the following year saw the instructor on cruise with the cadets for Sea Term training. But speaking as an electronics instructor, the MEP experience was adventurous and enlightening, and I did indeed, learn a lot.

I became adept at producing the video lectures. This involved evaluating and learning many software programs, and developing a uniform production process. As the MEP class developed, the production quality improved enormously as well as the amount and value of the multimedia content. Apple Quicktime proved both easy to implement and relatively powerful, and was used to polish both the video lectures and a number of movie clips (many re-used in the ECI & INC classes). The use of the email editor for outlining and publication was also valuable, and led to the use of eLinks in email and eNotes saved as .pdf files. One note of caution, however, it is understood that information posted on the web is dynamic; it changes rapidly. Web-based information I have cited here may likely be changed or even gone when this paper is read. This places an additional burden on the instructor.

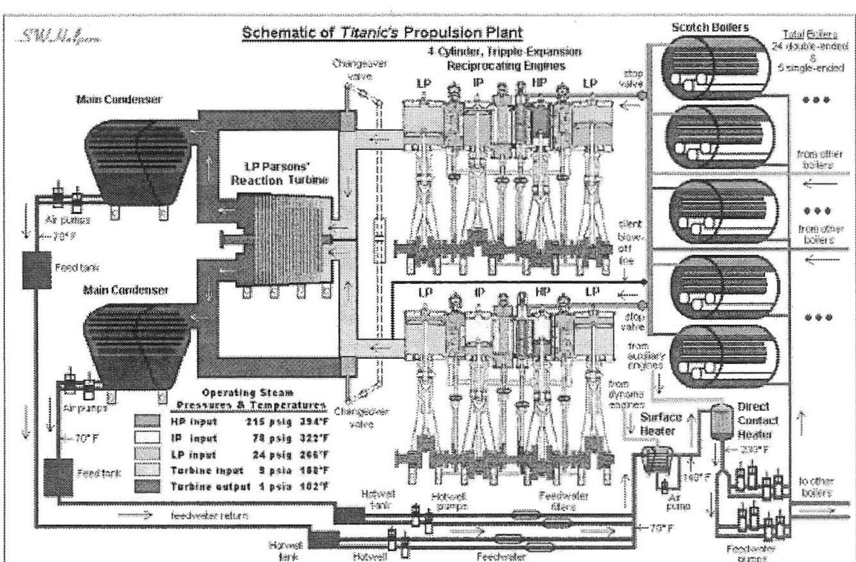


Figure 5: *Steam Plant schematic for the HMS Titanic (electronic media using an eLink)*

3. ECI-Electronics (EN-3212) and Computer Integration

A significant number of MEP internet and multimedia tools have found a home in the brick-and-mortar ECI class. Surprisingly, however, BlackBoard software was the first thing to be discarded. MMA engineering students live on campus, own or borrow textbooks, have access to the MMA library, computers, and the internet, and, hopefully, attend a physical classroom with a living instructor three times a week. In this case, BlackBoard adds a layer of complexity to internet communication without much benefit.

ECI is all about analog and digital electronic hardware, signal processing, and the integration of electronic systems with computers and PLCs (programmable logic controllers). The class includes a one-credit practical laboratory or ELab. The multimedia content of the class and lab, which is substantial, is presented in three ways; either within the real-time lecture with accompanying course-notes, through email-based reading and assignments, or as posted on a simple archival website.

As a result, email, which is easily written and can be read on your iPhone, is used as the main non-verbal communication tool between instructor and student. This is useful for career training as well, as email is the primary information tool in most companies. Many MMA instructors, though, prefer BlackBoard for one stop shopping. Textbooks now include BlackBoard modules with tools for assignment logging, test creation and grading (using multiple choice), and on-line grade posting.

In ECI, however, most quiz and exam questions are open-ended, solved problems, and the primary form of non-electronic feedback to students is in the form of red ink on physical papers that are individually graded by the instructor. The ECI textbook, "Process Control Instrumentation Technology" by Curtis Johnson [10] is the eighth edition; copyright 2006, and not currently in production. This is actually a good thing, as the current text includes a large number of correctly solved problems, and is on-target for non-electrical engineers. This provides a relatively stable foundation for the development of the remainder of the ECI class. Additionally, the sale and re-sale of the same edition of the ECI text in the MMA used-book market, keeps the average textbook price much more affordable for the average student.

Using the textbook as the base, the more dynamic ECI material (i.e., news articles and emerging technology) is developed through electronic media. These include daily lecture course-notes (presented by the instructor), email-based reading and Problem Set assignments (PSets), and scanned solutions for PSets, Quizzes and Exams. These multimedia electronic materials are sent as email, along with eBiblio and eNote attachments. They provide live links to more up-to-date supplemental material. Many of the video tools and techniques developed in MEP, are incorporated into the daily lectures as short video clips and software demonstrations. Digital music demos, for example, are used in a unit on signal processing to actually listen to the effects of gain and filters on sound (music).

Table 3: ECI-Multimedia Tools (in addition to MEP developed tools)

- ELabs-Electronics Laboratories (a 1-credit companion laboratory to ECI)
- Digital Projector (high resolution & large screen) with a quality Stereo Sound system
- Email & the email editor software (Apple MacOS application)
- Webposts (simple to maintain, text-based website @mac.com; see note below)
- iCalendar real-time Syllabus (Apple MacOS application)

Table 3 expands the educational tool list developed for the MEP class to include some additional tools used in ECI-Electronics. As an engineering class, the Electronics Labs (ELabs) add a level of hands-on experience impossible to recreate in a virtual, digital world. The ELabs, however, benefit greatly from training materials and software that are delivered over the internet. The instructor is currently evaluating the use of electronic lab notebooks and data logging for ELabs at MMA.

At this point, for the author, it would be extremely difficult to teach without the use of a high quality digital projector and sound system. All of the ECI lecture media, other than calculations on the whiteboard and equipment demos, are delivered from a computer through a digital projector. One technique that works quite well is to project figure images directly onto the whiteboard. Then colored markers are used to draw circuits and calculations on top of the projection as part of class discussion. This is essentially a low-tech version of smart board technology, but very effective in encouraging the students to take notes, to fill-in the blanks, when providing course-note handouts to the class.

In addition to email, a web-page is used to archive digital information. Originally, the author used his personal mac.com account to setup a text-based webpage to support the ECI course. This provided a simple way to post material without requiring BlackBoard. In addition, mac.com supported the use of web-based iCalendars (based on MacOS built-in calendar software). This allowed calendar events for the ECI class (lecture times and titles, Exam dates, PSet due dates) to be listed on a public website. In this way, the instructor created a real-time, electronic Syllabus for ECI. Apple is now phasing out the mac.com service and replacing it with a cloud-based service more in-line with iPhone and iPad usage. At the same time, however, MMA switched over the campus email and information system over to Google (but managed by MMA). As Google provides the same web and calendar services as mac.com, the author is planning to port these services from Apple to Google for next semester.

3.1 ECI-Case Study: Dr. Smith's Mouse Machine

Figure 6 shows an example of one application Case Study used in the ECI class. This case, Dr. Smith's Mouse Machine, is part of the unit on ladder-logic circuits and PLCs (both the operation and the programming). Dr. Smith is a bio-chemist involved in medical research on sleep apnea. The author worked with him to design, build, and program a PLC-based "machine" to simulate sleep apnea in mice in order to develop treatment therapy for humans.

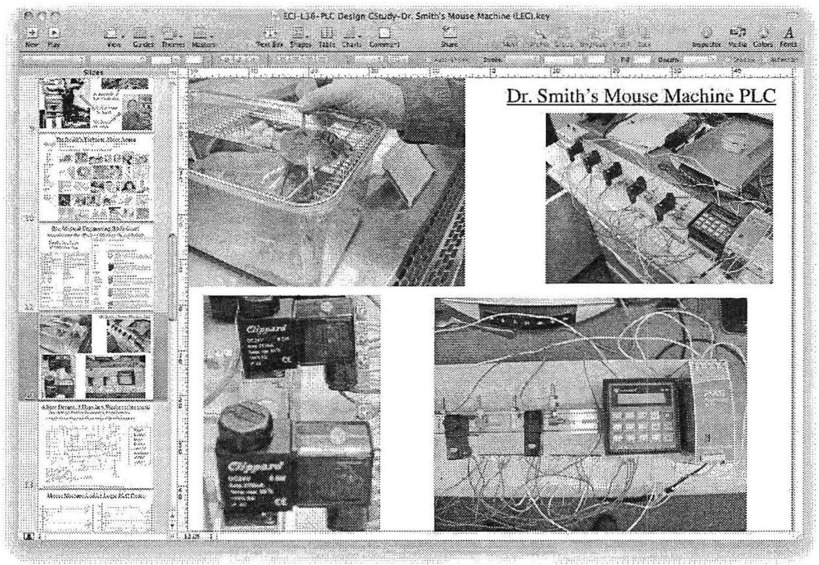


Figure 6: *A PLC-based Control System developed for sleep apnea studies on mice.*

The Mouse Machine, provides a very accessible case study for ECI students that touches many aspects of the class. It is presented as an open-ended design study of the electronics and the machine interface, but also on the use of PLCs and the subsequent logic programming. A follow-up package is sent as an eBiblio.pdf email communication to the class, with live eLinks to relevant on-line material (to broaden the student experience). Figure 7 shows the actual PLC code as implemented. Students are encouraged to try their own "solutions" in an optional LQR assignment (low quiz replacement).

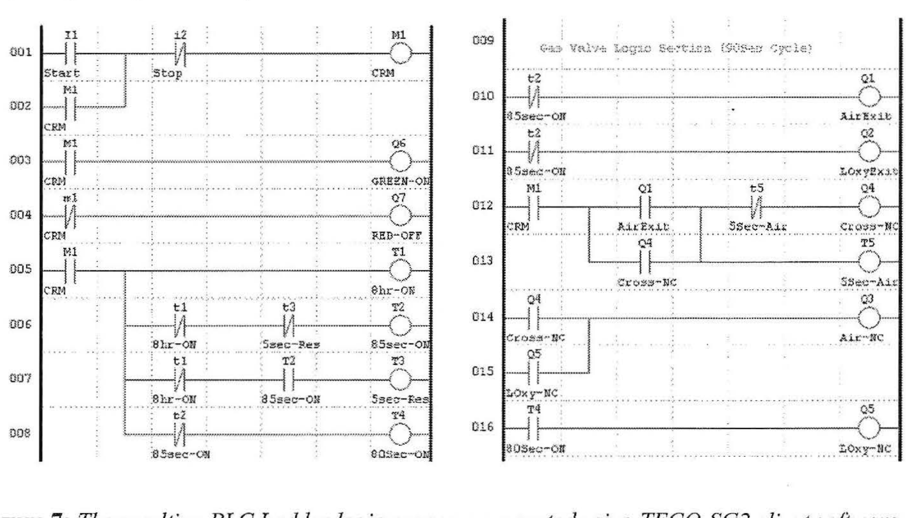


Figure 7: *The resulting PLC Ladder-logic program generated using TECO-SG2 client software. The PLC uses only 2 inputs, 7 outputs, 1 momentary relay, and 5 timer relays to regulate the process.*

4. INC-Instrumentation & Control (EN-4223) using Matlab/Simulink

While the focus of ECI is at the machine level of electronics, the INC class deals with dynamic systems (i.e., differential equations and calculus) and closed-loop PID control (proportional plus integral plus derivative). As a result, the biggest change is the use of Matlab technical software for dynamic system modeling and closed-loop controller design. Whereas the PLC software in ECI is fairly common, and used in a variety of low-end units from many different companies, Matlab is a unique, high-end, developmental "environment". Matlab is one of the most universally applied engineering programs; or, as the marketing people say, "the language of technical computing". Matlab is a standard development environment in both education and industry, and gives MMA students experience in systems programming at the hi-tech end of the engineering spectrum.

As in ECI, the INC class uses a comprehensive textbook to establish the foundation material in the Controls class; "Modeling and Analysis of Dynamic Systems", [11]. As the MMA engineering curriculum does not include a dynamics class prior to INC, the MADS text includes complete sections on dynamic modeling. In addition to a broad treatment of controls, it also includes sections on Matlab and Simulink, with detailed examples using both for PID control applications.

While on appointment at the US Coast Guard Academy, the author developed a similar class for USCG engineering students with similar curriculum constraints. The INC-Controls class is divided into three parts: 1) dynamic system modeling based on LODE equations, 2) control system analysis using Laplace Transforms and Block Diagram Models, and 3) closed-loop PID controller design with Matlab and Simulink. While INC includes many of the electronic tools discussed previously, INC also uses some new ones.

Table 4: INC-Multi-Meda Tools (in addition to MEP & ECI developed tools)

- Matlab & Simulink case studies and software demonstrations.
- Email example programs using Matlab.m files (executable command files).
- iLabs (assignments to teach Matlab, and develop dynamic models and parameters).
- Take-Home Final Exam (Matlab PID Closed-loop Design Final)

At present, INC does not include a scheduled laboratory. As a result, the instructor needs to use class time to introduce and demonstrate Matlab. This is done more efficiently by running example programs and models that are developed off-line (outside of class); these programs are known as M-files (filename.m). After demonstration, these M-files can be sent as email attachments along with eNotes and eBiblios as part of instructional email to the class.

Another tool that has been useful and popular with students are team-based iLab assignments. iLabs are interactive, take-home laboratories also known as the "Coke-can Labs". In these labs, students use physical models (rubber bands and coke cans filled with water) to develop actual parameters for physical models, and then to work together in teams to learn and develop their Matlab skills. These assignments are submitted as email and processed electronically.

INC benefits from a number of PID design case studies found on the internet, and also tutorials within Matlab. While including two paper and pencil exams on Control fundamentals, the INC class needed an evaluation tool that would allow students to demonstrate their command of larger concepts and the use of Matlab for design. As a result, the INC final exam is a PID-design take-home exam where students are given a week to do an open-ended control system design. While challenging (especially for the instructor to grade), the take-home final provides a valuable learning experience as well.

4.1 INC-Case Study: Segway Scooter Human Transporter

Figure 8 looks at one popular case study for INC-Controls: the Segway Scooter. In addition to being a terrific example of a modern, non-military application of a stability compensator, the system is easily grasped by the student. There is also a wealth of online information for eBiblio background: video clips (on youtube), Wikipedia articles, and even dynamic models for the classic "broom balancing problem". The Segway case is used in the first week of INC to introduce the class to dynamic models and MIMO (multi-input, multi-output) closed-loop controllers. Then, later, the controller feedback system is analyzed using the block diagrams included within the Segway patent. The author also has a personal connection to the case. He worked directly with one of the engineers who designed the original control system on the original patent.

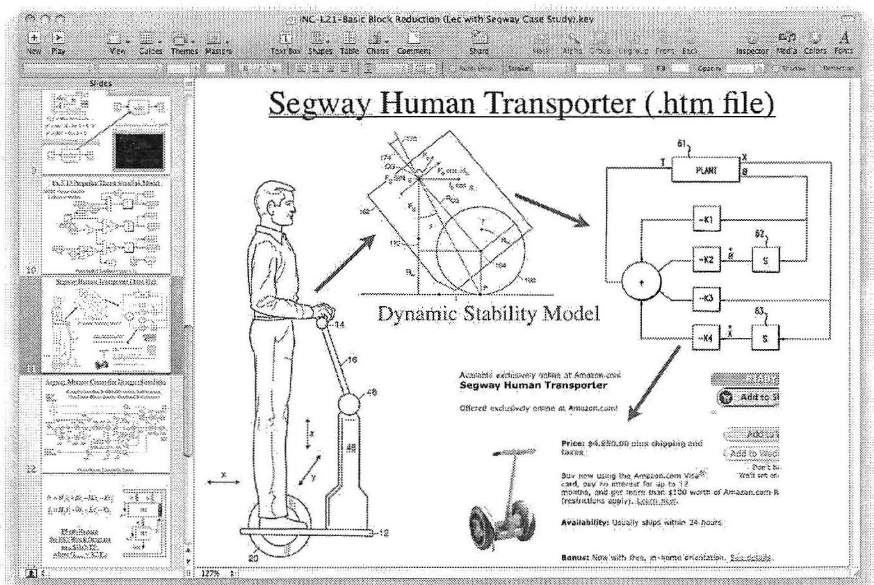


Figure 8: *A sample of multimedia Lecture course-notes for the Segway Case Study.*

Cc: "Dr. John" <jjbausch@mac.com>
3 Attachments, 828 KB

Dear INC,

The Segway Human Transporter (i.e. Scooter) is a great example of mechatronic design using current control system technology (and Matlab!).

FYI-I'm attaching the links and articles I developed for class.
There's some great background information here if you're interested in next generation automation design.

cheers, Dr.B.

Segway Articles-
http://en.wikipedia.org/wiki/Segway_PT
http://www.time.com/time/specials/packages/completelist/0,29569,1991915,00.html
http://www.dailymail.co.uk/news/article-1315518/Segway-tycoon-Jimi-Heselden-dies-cliff-plunge-scooters.html

Dean Kamen & the US First Competition-
http://en.wikipedia.org/wiki/Dean_Kamen
http://en.wikipedia.org/wiki/Woodie_Flowers
http://en.wikipedia.org/wiki/FIRST

Segway Patent-
http://www.google.com/patents/US6651766
http://www.patentstorm.us/inventors/Dean_L__Kamen/701867.html

Figure 9: *A sample of an eBiblio.pdf file sent as email for additional reading in the Segway Case. The file includes eLinks to more detailed background, images & movies, and the original patent.*

5. Conclusion

Hopefully, this paper will speak for itself through the brief examples of multi-media and internet as applied to engineering education. In conclusion, the author feels the need to revert to the first person (i.e., I need to get personal). As I tell my students, I left my service in the merchant marine to go on to graduate school because I wanted to study the emerging world of robotics and computers. I wanted to be a part of the computer generation. That expression is now passé. My students have all grown up with computers and the internet. They are the first wave of the information generation; surpassing even Guttenberg, and the age of the printing press; information on demand.

My children have always known the internet, from our first phone-line modem, the family computer located centrally in the living-room (does anyone remember aol?), to wireless internet, to cell phones, to texting, and now the iPad. They even have their own texting language [12, 13]. This is a very rapid transition, in what, a dozen or so years. This is the information generation. More, and more of my students are responding to my email directly from their smart phones, and while they can at least read the text, they still need to sit down at a desk to work with the software on a computer. They still need to read and absorb the articles and dynamic media, and actually take out a pencil and paper to try out some of the calculations and models for themselves. At least their phones keep them up to date on the assignments and due dates (and at some point they will need wicked smart phones).

The subject area of EI&C is also very dynamic; 10 years ago I was using floppy disks, and just starting to use USB and portable hard drives. This summer, in addition to backups to a hard drive, I will transition to Carbonite; an internet-based backup service. I need to. So much of my life is stored in the digital world. But despite advances in technology and in Distance Learning, I believe firmly in the need for face-to-face teaching in small class sizes. The interactivity of classroom instruction (in real-time), the retention inherent in physical note taking and pencil-based calculations, and the use of hands-on laboratories make a major difference in engineering education. The best students come prepared for class, and participate fully for a challenging 45-minute, interactive experience. The worst students treat the class as a 45-minute T.V. show (and long for a remote channel changer).

Multimedia tools and the internet do provide a much needed supplement to traditional engineering classes, but are unlikely to completely replace key brick-and-mortar resources. This is already seen in the job market with regard to the wider variety of college degrees available. Employers are much more savvy about student credentials. Here is a direct quote heard while providing a job referral, "was that Master's degree from a thesis program or a non-thesis program"? In the long run, the relative quality of degrees, Distance Learning or Brick-and-Mortar will be decided in the competitive marketplace, or in the words of W. Edwards Deming, "the customer will decide".

In my experience, distance learning, while an interesting technical challenge, and a potential source of income (certainly from the administrative point of view), simply removes too much humanity from teaching. It's part of the joy of teaching. I am also convinced that we would do our students a disservice in the long run. I have only a few hard and fast rules for my own teaching. One is to get all quizzes and exams graded and returned by the following class. Another is to learn and use every one of my student's names, in class, in real-time. That way I can call them by name as they start dozing, and before their heads hit the desk.

References

[1] Bausch, John J., "Computer-integrated Course Design for 21st Century Marine Engineers", Proceedings, Teaching & Learning in the Maritime Environment, California Maritime Academy Conference, 28-30 March 2007.

[2] MMA-Bachelor of Science in Energy Systems Engineering. http://www.maritime.edu/index.cfm?pg=4006

[3] MIT and Harvard announce edX - MIT News Office, 2 May 2012. http://web.mit.edu/newsoffice/2012/mit-harvard-edx-announcement-050212.html

[4] MIT launches online learning initiative - MIT News Office, 19 December 2011. http://web.mit.edu/newsoffice/2011/mitx-education-initiative-1219.html

[5] GNU Project - Wikipedia, the free encyclopedia. http://en.wikipedia.org/wiki/GNU_Project

[6] First Offering of MITx Online Courses: 6.002x Circuits & Electronics (Mar-Jun12). https://6002x.mitx.mit.edu/

[7] BlackBoard Educational Software. http://en.wikipedia.org/wiki/Blackboard_Inc.

[8] kiss principle - Google Search. http://www.google.com/search?client=safari&rls=en&q=kiss+principle&ie=UTF-8&oe=UTF-8

[9] encyclopedia titanica: RMS Titanic facts and history. Titanic's Prime Mover - An Examination of Propulsion and Power. http://www.encyclopedia-titanica.org/titanic_prime_mover.html

[10] Curtis D. Johnson, Process Control Instrumentation Technology, 8th Edition, 2006

[11] Close, C.M., Frederick, D.K., and Newell, J.C., Modeling and Analysis of Dynamic Systems, 3rd Edition, 2001

[12] The Urban Dictionary. http://www.urbandictionary.com/define.php?term=paw

[13] The Beloit College Mindset List for the Class of 2013. http://www.beloit.edu/mindset/2013/

The role of teamwork abilities and leadership skills for the safety of navigation

Radu Hanzu-Pazara
Lecturer, Constanta Maritime University,
hanzu@imc.ro

Corina Popescu
Lecturer, Constanta Maritime University,
cory_popescu25@yahoo.com

Anastasia Varsami
Assistant, Constanta Maritime University,
anastasia.varsami@yahoo.com

Abstract: Today it is well known that almost 80 percent of maritime accidents are based on human factors and human failures in managing different activities onboard ships. At the same time, experts have recognized the importance of teamwork in almost all activities realized onboard ships. As an extension of this principle, the teamwork needs a leader in order to be well done. So, we can consider that failure or missing teamwork and leader skills onboard ships can lead to accidents. Consequently, the following question arises, when is the right moment for development of teamwork abilities and leadership capabilities for a person who wants to work at sea? According with some studies in the field, teamwork concept can be seen as a cognitive human behavior, more or less recognized by the person involved in such activities. This cognitive behavior is given by the social nature of human beings since people do not live or work alone. Leadership is a skill possible to be cognitive to some persons, but in most of the cases it must be cultivated in order to bring maximum results.

Starting from actual attention give by International Maritime Organization through the 2010's Manila Amendments to teamwork and leadership and from considerations presented before, we tried to realize a study about the level of presence of these abilities in our students. For the aims of the present analysis we used students from the last year of study, and simulation techniques to generate situations which required work in team and leadership skills. The evaluation of these capabilities have been made through observation of different usage levels of knowledge, communicative skill, personal behavior, interpersonal relationship, commands and response time and adherence to team principles, something like "one for all, all for one". For leadership evaluation, one student from every team used in the study, was nominated as team leader and was observed to see if he or she had the skills to coordinate and conduct the team to achieve the designated application target.

The results that will be presented in this paper will show how students understand the teamwork principles, how they take decisions as a team, and, how much everyone's personality affects the team activity. The results will also show how the role of a leader is preceived, how every person develops his/her own leadership skills and how to apply these skills in the conduction of a team on the bridge of a ship. These results allow us to create a percentage statistic for every type of leader according to the studied person abilities, and to tabulate, also in percentages; the problems appearing in a teamwork activity.

Keyword: human factor, teamwork, leadership, ability, skill, STCW Convention, safety

1. Introduction

"Safety first", a well known expression onboard all ships, must be treated as a principle, not only as advice. It must be the main concernment of all seafarers during their activity. Making reference to the working on sea, we can say that "Safety will bring you back home". Onboard ships the safety concept can be developed under many aspects like: safety on the bridge, safety in the engine room, safety of navigation, safety on deck, safety at maneuvering, safety operation and in all activity with supposed human participation. Some of these safety concepts are more than simple actions to prevent unforeseen events, they are complex activities in order to assure protection against all possible dangerous events for persons, ship and environment.

Many of the activities which take place onboard are collective activities and suppose the participation of more than two of crew members. Also, safety onboard is an individual and collective matter, because any imprudent action of an individual can affect all crew members. From this point of view, the expression about safety to be used onboard must be "What is safe for me is safe for others". This opinion can be seen at the same time as the basic support of the teamwork and as main principle of collective activities.

With all these considerations regarding safety, accidents which involved human factors still happen. Thus not only the development of safety concepts help in accident prevention. An important aspect which has to be take account when talking about people is the social nature of human being which means that humans are more attracted by the collective working tasks, than by sole ones.

When the work is done by a team, a leader has to exist to control and coordinate the entire activity. In this situation, according with rules and procedures, the leader is nominated by rank - the person with the higher rank is considered to be the team leader. But, the rank doesn't give leadership skills, these must be achieved and proved. To be a leader means to be appreciated and respected by the others and to be able to coordinate their activity in a safe manner.

If teamwork can be considered as a cognitive behavior of human beings, leadership is a skill which has to be developed in time for most of the people. In activities which take place onboard ships both are important and have to be well known and applied.

Studies about human behaviors have shown that teamwork ability is in a close relation with each individual's personality. Personality will determine the interrelation with other people, interpersonal communication and reaction to the actions of other. Knowing the personality can offer the possibility of knowing how to create a team, or what people can stay together to form a team. In many situations, knowledge about each individual personality and own social interaction style can lead to avoidance of conflicts. On ships is important to know how to form a team for a particular activity and how to manage each member's personality in order to reach the team target. The leader, as part of the team, is subject to the same personality conditions. But beyond this the leader needs to be able to interact and communicate with all team members, in all situations, and to be able to lead the team in difficult moments, during distress or dangerous situations.

In order to state the importance of these abilities during onboard activities, the International Maritime Organization [1] has decided to introduce specialized training to encourage the development of these abilities in seafarers, especially for officers at the management level. For this reason, during the 2010 Manila Conference, one of the subjects discussed was the introduction of the new requirements for training of knowledge about teamwork and leadership. At the same Conference, assertiveness training for all seafarers was also included, given its importance not only for those who have to direct operations but also for those in lower grades who may have to communicate on safety matters with senior officers and Master of the ship.

As part of the maritime training system, and of the maritime industry, universities have to know and to introduce in their curricula the requirements stated by International Maritime Organization and by other bodies of the maritime sector. Training on these matters has to give the future officers the capabilities to understand the meaning of team work and to be able to manage activities in collective organizations. A rigorous development of these skills through training will contribute to the increasing of the level of safety for all aboard ship activities.

2. Role of teamwork aboard ships

The human society is based on cooperation and interaction. Without these characteristics it will not be possible to generate development and wellbeing. Through bringing of this concept onboard ship, it can be considered that the ship is the society and seafarer is the individual who needs to add value at the wellbeing of the entire society. Inside of this consideration, onboard, is born the idea of "one for all and all for one". This idea leads to the unity of the crew and to the principle of teams working. Working together means teamwork and the successfully applying of this principle depends by the rules respected.

Studying the entire activity which takes place onboard ship it is easily seen that it is almost entirely based on teamwork, or, that every activity requires a supposed minimum two people for completion. In a working environment like ships, teamwork can be the way for a safe activity. When an operation is covered by more than one person, the safety level has increased through a second or more peoples involvement.

The complexity of most of the onboard operations places them beyond the control of one individual, and the only efficient way to tackle process improvement is through the use of teamwork. Teamwork has many advantages [4], like:

- a greater variety of complex issues can be tackled by pooling expertise and resources;
- problems are exposed to a greater diversity of knowledge, skill and experience;
- the approach boosts morale and ownership through participative decision making;
- improvement opportunities that cross departmental or functional boundaries can be more easily addressed;
- the recommendations are more likely to be implemented than if they come from an individual.

In order to generate improvement and to increase the safety onboard, teamwork must be driven by a strategy, have a structure and be implemented thoughtfully and effectively. The crew members will not engage in continuous improvement activities without commitment from superior officers, including the Master, a culture for improvement and an effective mechanism for capturing individual contributions. From this point of view, the officers have a great responsibility in the development and correct application of teamwork principles, being directly involved in supervision of all activities. The ship Master has also an important role in development of the teamwork environment; using the power of examples he can inspire and direct the teamwork activity in a safe manner. In many of the ship operations, the Master's presence is compulsory, for the supervision of the entire operation and to stimulate the crew to complete their tasks according with the safety principles [5].

When properly managed and developed, teamwork improves operations and produces results quickly and economically through the free exchange of ideas, information, knowledge and data. It is an essential component of a building trust process, improving communication and developing a culture of interdependence, rather than one of independence.

A team, like any other organization form, needs to have a structure to comply with the targets. The general structure of a team comprises the following components: co-ordinator, shaper, plant, monitor-evaluator, implementer, resource investigator, team worker and finisher. This structure can be modeled according with the team target and activity field. It is not essential that a team comprise eight people each fulfilling one of the positions above, but the people who are aware and capable of carrying out these positions should be present. In small teams, people can, and do, assume more than one position. Studies about team structure and performance, using these position concepts, can lead to improvements, as example:

- underachievement demands a good co-ordinator or finisher;
- conflict requires a team worker or strong co-ordinator;
- mediocre performance needs a resource investigator, innovator or shaper;
- error prone teams need an evaluator.

Different positions are important in different circumstances. For example new teams need a strong shaper to get started, competitive situations demand an innovator with good ideas, and in area of high risk, such as ships carrying dangerous cargoes or during operations which involve risks, a good evaluator may be needed. Teams should, therefore, be analyzed both in terms of what team positions members can take, and also in relation to what team skills are most needed. Despite having well defined positions within a team, the interaction between the different personalities of individuals can be a frequent source of friction. However, this can largely be avoided by understanding and valuing people's differences. [4]

Teams with a well defined structure and members' personalities and behaviors known should be characterized by:

- clear objectives and agreed performance goals;
- openness and confrontation;
- support and trust;
- co-operation and conflict;
- good decision making;
- appropriate leadership;
- review of the team process;
- sound inter-group relationships;
- individual development opportunities.

3. Leadership styles and ship safety

In general terms, leadership can be defined as the art of motivating a group of people to act towards achieving a common goal. For some people leadership is a cognitive behavior, but for most of the people it needs to be acquired. For both groups, leadership behavior is influence by the leadership style, which is categorized in four types, but modeled by each individual according with own personality. In order to decide what kind of leader a person is, it is necessary to include this person in a leadership style. Developing this appreciation about leader type through leadership style, it might be possible to deduct how the nominated person will approach the safety matters.

According with the researchers, the most basic leadership styles are: autocratic, bureaucratic, laissez-faire and democratic [2]. These are the main leadership types which can be applied to all human activities, including the maritime sector. Taking into account the particularities of the maritime activities it is important to be known how these classifications can be used for those persons who work on ships. In this way, to start with it we need to define every leadership style, including characteristics, effectiveness and ineffectiveness, and after to be modeled for ship working environment.

The first, autocratic leadership style, is considered in most of the cases as the classical approach. In it the leader retains as much power and decision-making authority as possible. The leader does not consult the team members, who are not allowed to give any input. In this case the leader asks to the team to obey orders without receiving any explanation. Motivation is produced by creating a structured set of rewards and punishments [3]. According with these considerations, autocratic leaders:

- rely on threats and punishment to influence the team;
- do not trust the team members;
- do not allow for others input.

On the other hand, sometimes this style is not complete bad and can be most effective in situations when:

- team members are new onboard and not-familiarized with the ship and do not know tasks to be performed or procedures to be follow;
- for a successfully operation it is necessary to provide effective supervision through detailed orders and instructions;
- the team members do not respond to any other leadership style;
- a decision is necessary to be taken in a short period of time;
- the teams have a multicultural structure and leader's authority is challenge by a member of the team.

Anyway, leaders who adopt this style have to know there are situations when the autocratic style is not recommended, like: the team becomes tense, fearful or resentful; team members expect to have their opinion heard; or, members of the team begin depending on their leader to make all their decisions.

The second style, bureaucratic, is where the leader make everything like in the manual or strictly following the procedures. In case a situation is not covered by the procedures or policies, the leader refers the decision to the next level above him. This type of leader is more like a "police officer" who enforces the rules.

This leadership style proves its effectiveness in situations when:

- the team is performing routine tasks;
- team members need to understand certain standards or procedures;
- the team operates with dangerous or hazardous materials or delicate equipment;
- conducting onboard training on safety or security;

This leadership style can be ineffective when:

- team members lose their interest in their jobs
- team do only what is expected of them and no more.

The democratic leadership style is called the participative style and is characterized by [2]:

- involving the team members in planning and carrying out operations;
- asking before telling, valuing team discussion and input;
- promoting a sense of teamwork, encouraging participation and wise delegation, but never losing sight of responsibilities as a leader;

The democratic leadership style is most appreciated in all activities, including those on-board ships, and it stimulates the team to improve their capacities and helps to increase ship operability and safety as well as allowing a team to function in the absence of the leader [6].

This leadership style is effective when:

- the time for the operation is not limited;
- team members have some degree of skill or knowledge;
- the leader is well familiarized with the operation and wants to create a strong team;
- the team is motivated and the sense of team exists to gain more commitment.

This style is ineffective in situations when:

- team members lack skill and knowledge;
- motivation is missing;
- between team members is a conflict state.

The last leadership style, laissez-faire, is known as "hands-off" style, in which the leader provides little or no direction and gives team as much freedom as possible. In this situation, all authority is given to the team and the members must determine goals, make decisions and resolve problems on their own [3].

The effectiveness of this leadership style has been proven in situations when:

- team members are highly skilled and experienced;
- team members have pride in their work;
- team members are trustworthy and experienced.

In opposition, this leadership style is ineffective when:

- it makes the team feel insecure under the leader command;
- the leader cannot provide regular feedback;
- the leader is unable to thank team members for their good work;
- the leader doesn't understand his responsibilities and is hoping the team can cover for him.

Considering the different leadership styles is supposed that each leader will adopt one of these and as a result, his actions will be influenced by his leadership style. Putting this in the context of ship operation, it can be observed that the safety of each operation which takes place onboard ship is dependent on the personality and behavior of the leading person. , This means that safety of the ship might depend on the persons in charge of leading of various operations onboard. In conclusion, according with the style adopted by the leader it possible to analyze what the safety level for each operation will be. Supposing the team is the ship crew, and the leader is the ship Master, we can talk about ship safety, and, as a direct consequence, the safety of navigation.

In the next chapter we will considered these styles to determine how many of the students involved in the study can be grouped in each of leadership styles and, also, to find how these aspects influenced the teamwork environment.

4. Maritime student's position towards teamwork abilities and leadership skills

Teamwork and leadership are components of human resource management and contributes to the global understanding of the ship safety concept. The importance of these skills has been recognized also by the IMO, which issued a recommendation about compulsory inclusion and study of these in the maritime training curricula. The IMO vision, expressed through the 2010 Manila Amendments to STCW Convention [1], made reference to the study of these especially at the management level, but is important to be mentioned at operational level too. As a general vision, all seafarers need to be trained about teamwork because it is a skill required at all activity levels and in teams composed of crew members from different departments and different levels of competency.

Taking into consideration the Manila Amendments requirements for deck and engine officers training in the field of teamwork and leadership, Constanta Maritime University has included in curricula references training for these fields of competency. During training students receive knowledge about teamwork principles and what it means to be a good leader. At the end of this training, students will be able to organize the team and to manage the team activity, understand basic principles about human personality and how it affects a teamwork activity, have knowledge about the minimum level of skills for a particular activity, know what competencies needs to posses the members of a designated team, know and apply the rules of a good leadership and to deduct and correctly understand what types of leaders there are.

During training there are opportunities to observe how the trainees comply with the training requirements and how they react in some situations, considered to be unusually. This is one of the reasons which stay at the origin of consideration that training is one of the best periods for development and improvement of the skills related to teamwork and leadership.

Starting from these considerations, a group of lecturers, including the authors of the present paper, have initiated a study to see how the students understand the teamwork principle and how they lead a team when are in a leader position, inside of ship bridge activities. This study used the classifications described before both for teamwork and leadership skills. Also, it used the simulation techniques for creation of the situations for student's behavioral study. Students from the last year of study, who have experience in working onboard ships, who have experience gained during the cadet practice, and who are very familiar with the shiphandling simulator, were invited to take part in the study.

During simulated exercises, teams of three students were used, each of them having a position on bridge, like Master, Officer on the Watch (OOW) and helmsman. From the beginning of the study it was stated that they will work as a team regardless of the positions they occupy. Thus, the student who takes the Master's position has to consider the team and act accordingly and not only command and supervise the bridge activities.

These positions were followed to see how the future officers understand the teamwork principles. It has been observed that there were some difficulties in adopting the necessary attitude during the exercises according with position occupied. Many students who took the Master's position felt that they are not able to satisfy the requirements of this position in a team context because they were trying to be exclusive a leader. This fact comes from a misunderstanding of team leader position versus a "supreme" leader, with the first situation supposing collaboration and communication with the team and the second situation supposing only order obeying and rejecting collaboration.

At the end of simulations, it was observed that the students were becoming open to the team concepts, they demonstrated an acceptance of team principles inside of ship bridge activities and an increased receptivity to new challenges for the team. Also observed was a changing of attitude toward team working, and some of the students who had some reservations at the beginning started to interact more and more with the team and to increase their involvement in team activities. It was more difficult to study how each student's personality affected the teamwork and how the personality is manifested according with the position occupied inside of the team. Anyway, without usage of a specialized study, might have observed that the personality of each student involved has an influence on the entire team activity. In this way, students with a more powerful personality have imposed their opinions more easily than those hesitant who were unable to communicate correctly their ideas or to convince their team colleagues about their intentions.

From the leadership point of view, in the study found what the student percentages for every leadership style are, and how they adhere to the principles and characteristics of these styles. The data analyze show that most of the students adopted the autocratic style, what that means is that they wanted to be treated as a real ship's Master and expected the team to execute what they ordered. In second place , was the democratic style. This situation can be considered as a result of friendly relationships between team members, the leader being a colleague with the other team members and finding it not necessary to be so authoritarian.

The entire image of the leadership styles adopted by the students during the studied situations, in percentages, is presented below, in figure 1.

Anyway, regardless of the leadership style adopted by the team leaders. all the exercises were completed and the targets were reached. The differences noted were about the time of completion, teams with autocratic leaders realizing better times than teams with laissez-faire leaders.

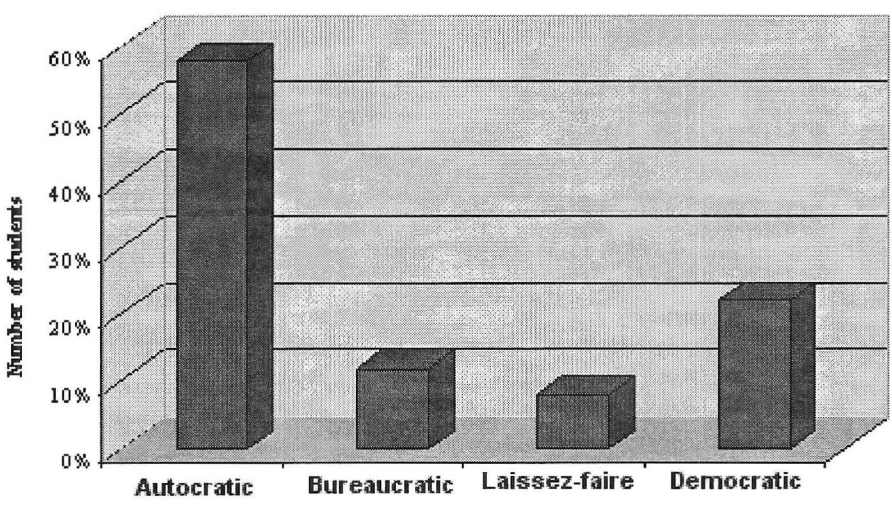


Figure1 Leadership styles adopted during simulations

The results obtained at the end of the study have allowed us to have an image of how our students will be as leaders on different type of ships. We don't appreciate this result as a general standard, but is important to known to illustrate in the future the aspects regarding the teamwork and leadership to the students. It will be difficult to establish a better way to follow the matter of leadership style, or how to model the personality of a future maritime officer in order to interact naturally in a teamwork environment. Regarding the present state in the field of leadership in the maritime industry, the increasing number of autocratic leaders can be seen as a response to the actual style adopted by the Masters in ship leading.

The final result of the study have been presented to the participant students also, to let them to know and to possibly decide themselves about what they want to do in the future, what is necessary to be done related to their personality and teamwork behavior.

5. Conclusions

Every year accidents are the first cause of financial loses in the maritime industry. With all the investments and innovations to increase safety and accident avoidance, they are still presence, and main causal factor is the human factor. The last 30 years have been marked by studies and research in order to find the best way to increase the safety of navigation and to limit the human factor impact on it. Due to human factor complexity, this target is still far away. There are still problems which have to be solved before reducing the human factor impact to below the critical level.

In the great diversity of the human factor problems to be studied, teamwork and leadership are important ones. Both of them are part not only of the human factor, but, also are related to human resource management. This situation put them at the border between purely human factor study and management concepts of human resources.

In the present paper the authors tried to explain what the fundamental principles of teamwork concepts are and how these can influence, in a positive matter, the safety of the ship and of navigation. The teamwork is the most common form of organization activity onboard ship, and to be sure that the team reach the activity targets it is necessary to have a team leader, the person who organize and supervise the entire activity.

If humans have the capacity to work together the ability to lead other persons is a cognitive skill which has to be trained. Leadership is the skill to organize and lead people and to perform the requested abilities it in a good manner.

Not all persons have the same personality and the same life principles, so, the leadership style will depend on each individual. Leadership style is the characteristic which express how the team will be organized and conduct the activities and also, how will be the communication and brainstorming inside the team.

Onboard ships both teamwork and leadership are important to implement the ship's safety policies and we consider it essential to have knowledge about the abilities of the persons in charge related to these problems.

This study of teamwork and leadership can be seen as a small step toward a complete study about the future involvement of the human elements in activities with high impact on navigation safety. Teamwork and leadership are just a part of the aspects which have to be known in order to reduce the number of maritime accidents based on human factors.

In order to have a strong teamwork environment onboard ship is necessary to understand the human nature and how this can be influenced by different factors, like, individual personality, individual culture, nationalities interactions and opening to multicultural environments.

Any team will reach the targets with a good leadership. Like the teamwork, leadership also has factors which can influence the results.

Today, the international institutions with an interest in safety matters are paying more attention to the subjects of teamwork and leadership so it becomes more important to know all of the factors which influence both teamwork and leadership in the context of multicultural crews and the diversification of ships operations.

References

[1] International Maritime Organization, "Conference of Parties to the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978", Adoption of the Final Act and any Instruments, Resolutions and Recommendations resulting from the work of the Conference, Attachment 2 to the Final Act of the Conference, Resolution 2 – The Manila Amendments to the Seafarers' Training, Certification and Watchkeeping (STCW) Code, 2010

[2] PennState University, "Personal Leadership Skills", http://pubs.cas.psu.edu/freepubs/pdfs/ua416.pdf, accessed 02.05.2012

[3] "Styles of leadership", http://www.essortment.com/styles-leadership-36149.html, accessed 05.05.2012

[4] Department of Trade and Industry, "People development and teamwork", www.dti.gov.uk, accessed 22.04.2012 <www.dti.gov.uk/quality/people>

[5] B. Blagovest, R. Hanzu-Pazara, C. Nistor, „Strategic human resources management in the maritime knowledge based organization", *Proceedings of „15th International Conference The Knowledge-Based Organization"*, Sibiu, Romania, Knowledge Based Organization International Conference, Vol. 2, (2009), pp. 35-37

[6] Felicia S., Cristina D., „Leadership development training as method to increase seafarer competitiveness", *Annals of DAAAM for 2010 & Proceedings of the 21st International DAAAM Symposium*, Volume 21, Zadar, Croatia, (2010), pp. 1443-1444

The 13th Annual General Assembly of the IAMU

Expanding Frontiers -

Challenges and Opportunities in Maritime Education and Training

Recruitment and retention of seafarers – what calls to and keeps individuals in a career at sea?

Paulica Arsenie
Assoc. Professor, Constanta Maritime University,
arseniep@imc.ro

Radu Hanzu-Pazara
Lecturer, Constanta Maritime University,
hanzu@imc.ro

Felicia Surugiu
Lecturer, Constanta Maritime University,
surugiufelicia@yahoo.com

Abstract: Many times, ships are seen as dangerous places where risks are everywhere and daily activities are performed under constant pressure. From this point of view, there are not many people interested in developing a career in this environment. From another point of view, a career at sea is seen as a continuous trip between different places around the world or as a constant "adventure". The reality is somewhere between these views; there are risks and there is a little "adventure" but, most important, there are responsibilities and knowledge in all activities.

Achieving the necessary level of responsibility and knowledge is one of the principal concerns of shipping companies, and this has a direct impact on company personnel management. Many aspects included in the responsibilities and knowledge are part of seafarers' training and familiarization with the ship. To have both, it is necessary that shipping companies establish a firm policy regarding recruitment and retention of seafarers. The basis of this policy must be guided by considerations about what attracts people to a career at sea and what stimulates them to remain in this field with the same company. The training level can also be achieved after recruitment through company involvement in a seafarer's continuing update of knowledge and skills however, a satisfactory level of familiarization can only be achieved through a long period of practice onboard the same ship.

Starting from these considerations, in this paper we intend to present the results of a study completed with the participation of local shipping companies, seafarers, and future seafarers (actually students) who were questioned about their positions regarding recruitment and career development principles. The study was based on questionnaires and free interviews with all participants. The questionnaire items and interview questions were focused on considerations of each participant about what is important in the recruitment process and what has to be offered, or is expected to be offered in future, to retain seafarers.

We included students in this study because we consider that recruitment from school will possibly become an important step for future retention in these companies as a fealty program can be started from cadet sea practice. Results show that students appreciate companies where these types of programs are available.
The final results of the study allowed us to have an understanding of what is important for seafarers when they choose to develop a career at sea and how the companies can retain them for "multi-year contracts", putting together seafarer's expectations and companies requirements.
Keywords: shipping, seafarers, training, recruitment, retention, career

1. Introduction

The idea to work at sea is not new. This idea first appeared from the beginning of the sea "adventure", when humans started to use seas and oceans for trade and social development. Today, work on board ships requires a specific level of training and compliance with a large variety of knowledge. In the past, the most important ability was the courage for, and the knowledge of, facing the risks presented by sea journeys. Actually, that risk still exists, but technology used for navigation and ship building methods make them less dangerous for human life. Also, technology minimizes human involvement in the usual onboard activities, reducing both physical and mental efforts. To reach these objectives, it has been necessary to implement the human-machine interaction concept.

A number of particular courses have been introduced in order to effect a harmonious human-machine interaction. These courses have the intention of creating a safety environment onboard of every ship.

With all of these advances in technological enhanced and personnel training today, we observe a shortage of qualified personnel in the field. In many cases, this shortage has been generated by the departure of seafarers for other onshore activities or by the economical crisis which just has passed. If this situation continues in the future, there will be a real problem to assure the necessary personnel for all active ships.

For this reason, the shipping companies need to start to retain seafarers in the company and onboard of their ships and, at the same time, stimulate the recruitment of new personnel with which to cover the empty positions. This process will not be an easy one as time is required to get a competent seafarer. On the other side, this personnel problem comes when the requirements for having a competent seafarer, including a longer time required for training, are higher than before.

Studying the shipping market in the field of personnel management, it has been observed that recruitment and retention of seafarers is a generalized problem with many companies having difficulties in this matter. Previously, shipping companies had developed a number of strategies in order to recruit more competent seafarers and to retain them in the company for a long period of time. These strategies included fidelity programs, bonuses for the period spent onshore, different methods to help seafarers to complete their training and many others.

The seafarer situation is not only a problem for shipping companies. Many other actors in the shipping sector are affected by the shortage of seafarers, including maritime administrations, regional training centers and universities. Therefore, the problem of seafarer recruitment and retention has to be addressed by most of the entities involved in the maritime field.

Being a maritime university, we are interested in contributing to this process by helping the maritime industry from our position. One of the most important contributions will be to determine what future seafarers' aspirations are, what their expectations from this job are and what we can do to make them more attached to the idea of a sea career. This point of view comes from the idea that universities are not only professional training centers, but are also career advisors.

A group of teachers from Constanta Maritime University conducted a study into the recruitment and retention of seafarers by shipping companies in order to determine the future University position in these matters. The results of the present study will help us to adopt an appropriate position regarding the development of a career at sea.

2. Recruitment of seafarers – what calls an individual to a career at sea?

Recruitment is the process through which a company tries to have their own personnel to meet the legal requirements and work needs. Through this process the company intends, as far as possible, to cover its personnel needs with competent people who want to stay for a while in the company, not just for a short period of time. In this context, during recruitment, shipping companies will be interested in knowing the intentions of their future employees, what they expect and how long they are likely to stay with the company. Answers to these questions will represent the basis of the company personnel policy in the future.

Personnel recruitment in the maritime sector has to comply with international and national requirements regarding the compulsory training levels associated with every position intended to be occupied by a seafarer. Also, for some ships, special training requirements can be stipulated that are in direct connection with the ship's operational characteristics.

Before any consideration of personnel recruitment, it is important to remember the international and multicultural characteristics of the maritime industry. Accordingly, during the recruitment process, officials of shipping companies have to know which nationalities will be onboard their ships and to try to generate a friendly environment between crew members. In most cases, owners try, as much as possible, to have a homogeneous crew onboard a ship. This means they have to bring together people with close cultural characteristics. Sometimes it is difficult to achieve this condition because the crew structure is dictated by different conditions such as ship characteristics, flag of the ship, owner's needs, and, most important, pay levels.

Multiculturalism is considered as an important factor in decisions about the development of a career at sea, especially to those seafarers who are on their first employment contracts. According to different studies made around the world, almost a quarter of younger officers who have given up a sea career have taken this decision after a bad experience as part of a multicultural crew.

Other aspects that have to be taken into consideration at recruitment are related to pay levels according to rank, working conditions and how the ship owner considers them, ship trading waters especially if these waters include piracy or other dangers and the company policies regarding retention of seafarers and programs developed for this reason.

Salaries are part of the attractiveness of a career at sea. In many parts of the world, including Eastern Europe, onboard payment represents an important objective in the decision to take a job at sea. The attractiveness of the salary is doubled by the possibility of seeing the world as part of your job. The importance of these two considerations in the opportunity to develop a career at sea is affected by the part of the world from which the seafarer comes. Making reference to these matters in 2009, the former President of the IMO, Efthimios E. Mitropoulos, stated that "a recent survey of seagoing personnel, revealed that pay was not the most popular reason for going to sea. The most quoted reason was that seafarers actually wanted a career at sea; then, proving that, even in the age of air travel, romance is still alive, was "a desire to see the world". Only after these, came the financial considerations." [1]

On the same problem regarding seafarers' attraction to a career at sea, a report on Mapping Career Paths in Maritime Industries [2] concluded that location of home, family influence, good career prospects, long-term interest in the sea and travel as main attractions for seafarers hailing from European Union countries. In addition, the OECD project [3] report on availability and training of seafarers career at sea covering European Union countries concluded that pay and conditions, job satisfaction, independence and attractive prospects were the main reasons for attraction to a career in this field.

Another aspect which completes the calling to a career at sea is represented by the work conditions onboard ships. Seafarers' interest in working conditions is driven by the particulars of all activities onboard ships. They will be interested in the work schedule, whether there is overtime required, what kind of extra duties are required, if any, and in many other aspects which are connected with employment contract activities. From the company point of view, it is important to answer all addressed questions and to convince the seafarer that onboard working conditions are at international levels according to international requirements expressed by IMO and ILO. Also, seafarers can have existing interest about the protection offered by the company for their employees including protective equipment and insurance coverage. Many seafarers are interested in a company's insurance; what is covered and how they are protected in case of any incidents onboard.

In recent years an increased interest among seafarers about waters where the ship navigates has been observed. These concerns come as a result of an increased number of piracy incidents which have involved a large number of seafarers from different nationalities. Therefore, during recruitment discussions, it is necessary to explain to seafarers about the ship trading areas. If the ship trades inside of these known piracy areas, the measures that are taken onboard to prevent and combat piracy attacks will be explained and, if there was any incident of this kind, how the company treated that situation. On the other hand, piracy risk must be treated as part of seafaring.

Some of the considerations presented above are part of the study conducted with different shipping companies from Romania, which has tried to see how they approach and treat the recruitment process. Companies involved in this study are crewing companies who are a ship owner's interface. However, the approach methods and requirements used are those expressed by the owners.

An important part of the study regarding the recruitment process has been dedicated to shipping companies' programs for cadets. The cadet problem has become delicate in view of the latest context of shipping markets, when owners had been forced to reduce their onboard personnel and to suspend any cadet training programs. From our point of view, cadets represent the future seafarers and all companies need to consider this aspect in respect of the good tradition of continuity. This aspect has to come as a result of the seafarers' aging process which is observed in many of the world fleets. To prevent the problems generated by the aging process, owners have to start to renew their crews; possibly through a new consideration of cadet programs. An advantage of the cadet programs is the possibility to stimulate cadets to remain inside the company for a while after completing the cadet practice period. A stimulus for cadet recruitment could come from training institutions, such as universities, through agreements between them, crewing companies and owners that offer guarantees for the training level of the cadets. In this way, Constanta Maritime University has developed agreements with a number of local shipping companies, through which some of our students have covered their practical training.

3. Retention of seafarers – what keeps a person in a career at sea?

In addition to recruitment, retention of seafarers is another important aspect for all shipping companies including ship owners, ship managers and crewing companies. All these companies want advantages from retention of seafarers with the company for as long a time as possible. However, in order to realize this long time retention with the company, it is necessary to know and to manage correctly those seafarers' considerations which make them seek a 'long term contract".

Studying the most common seafarer's expectations, the following aspects have been noted as important: company branding, a happy and healthy environment onboard, a safe and secure working environment, decent working and living conditions, quality of life onboard ship, health protection for seafarers, medical care, fair terms of employment, seafarer family support by the company, working on high tech and usable ships and systems, opportunities for career development, good career prospects and the possibility to have a position with the company until retirement.

Starting from these considerations, we were interested to know the attitudes of Romanian shipping companies and seafarers towards these aspects, how the companies are able to satisfy these expectations and the ways used to accomplish this.

The importance of knowing this information have arisen from the general perceptions on the part of seafarers about some companies such as bad employer, badly run ships, offering poor working and living conditions, poor pay conditions, no interest in career development or no prospects for a career.

Analysis of the data obtained from seafarers' interviews has shown that only a small part of them have a negative opinion about the last shipping companies where they worked. Most of these negative opinions resulted from the poor working conditions onboard ships, payment levels that showed a difference between the contract amount and the paid amount, and by bad relations with seafarers of other nationalities.

An important aspect of retention is represented by the generation of a career path for seafarers, a fact which allowed a more easily controlled evolution of seafarer careers. A career path is an important element within bigger shipping companies, where advancing in rank is possible after examination of a seafarer's career evolution and verification of his fidelity and respect for the company.

Also, when the decision to remain onboard the same company's ships is taken, the seafarer takes into consideration many other aspects such as company policies regarding personnel training, support for improved training, support for their families, sustaining of seafarers' family members who intend to follow in their parents career. Seafarers need to feel that a company takes care of their problems and assures them a safe and healthy environment onboard ship.

The most important question when studying retention of seafarers in the maritime system is "what keeps them in a career at sea?" During the interviews with seafarers having a number of years of experience onboard ships, they declared that their decision to remain in the same company has been influenced mostly by the working conditions, good communication onboard and with company officials and company involvement in their retention. Seafarers also consider that a company requirement for a higher standard of training is a useful position in this matter.

At the same time, shipping companies should start to develop and implement programs for retention of seafarers which provide the opportunity for good career development. These programs are important, especially in situations where it is intended to build a firm fleet in which it is necessary to cover the personnel requirements for all managed vessels from the beginning.

In this way, shipping companies offer bonuses to seafarers for the period spent onshore and stimulate them to remain loyal to the company. Sometimes this is the best option for seafarer loyalty because they consider this to be like a 12 month contract. In this system, both the company and the seafarer have advantages where the company is sure about personnel coverage and seafarers are sure of their positions with the company. An advanced system of personnel rotation that is supposed to rotate the same seafarers on the same ship inside of 3 or 4 months contract requires 3 or 4 crews for each ship.

Another important aspect in the retention of seafarers is represented by the insurance and retirement programs offered by the company. In many countries, seafaring is treated as a part-time job without a formal employment contract or not under national social services. Seafarers will be more interested in remaining with a company that has covered the two essential costs of insurance and retirement. Seafarers who were questioned declared that companies that cover these costs are more highly rated than those without these benefits. In any case, seafarers' interest in these subjects appears after time spent at sea when they realize their importance; possibly after a medical problem or when they start to think about retirement. Among Romanian seafarers these aspects are seen differently by the officers and seamen, the former being more interested in insurance programs and the latter in the retirement programs.

With all of these, the retention of seafarers has become a difficult task for shipping companies and the situation has been emphasized by the recent economical crisis. Due to a reduction of activity, many companies lost some of their seafarers and are now forced to come up with more attractive offers to cover their personnel needs. At the same time, companies that were able to manage the economic crisis now have the advantage of recruitment and retention of seafarers from other companies. Our study indicated that many seafarers appreciated the companies that took care of them during the last three difficult years and accepted less favorable payment conditions in exchange for a stable workplace and the possibility for continuity with the same company; possibly on the same ship. According to some opinions expressed by the shipping companies' staff personnel, the actual crisis made the labor market in the maritime industry more stable. Therefore, seafarers are less receptive to changing companies for a minimum salary increase. In the future, other considerations will be important to seafarers when they decide to remain with a particular shipping company, than considerations of the past or present.

4. Maritime universities role in the student's career development

It is better to begin recruitment of seafarers from the earlier stages of training. Recruiting of future seafarers from their training period creates opportunities for development of a career in a shipping company.

Recruitment during school is beneficial both for students and shipping companies. Students have the possibility to decide if a career at sea is what they want to do in the future; companies can recruit their future deck and engine officers while, at the same time, having the opportunity to model them according to the company needs.

From a career point of view, maritime universities have to be seen as career advisers and developers with an important role in helping students to make the right decision on their future development. From the first to the last study year, students need to be advised about what a career at sea means and implies, what are the advantages and satisfaction levels and, in addition, what are the risks.

The universities role in development of a future career at sea is underlined at the moment when graduates give up their sea career as a result of wrong information and communication during their training period. As part of the study about what calls and keeps them in a career at sea, students have included many aspects. In order to have a clear picture of what calls people to maritime studies and their expectations of a future seafarer career, we initiated interviews where we tried to touch most of the important aspects from this point of view. The discussions were therefore with students from first year or close to graduation.

The questions addressed with the first year students focused on what they took into consideration when they decided to become a maritime student and what their expectations from a future career at sea were. Thus, when they were asked "What they have been taken into account when deciding to choose maritime training for a future career at sea?", the most usual answers were those represented by the financial and traveling opportunities. In any case, many of the interviewed students said that attraction to a career at sea came from their family tradition with one of the parents or brothers being seafarers. During discussions, an optimistic attitude about the future development of a career in the field with a period of five to ten years as a minimum time spent at sea was observed.

Comparing these answers with those received from students in final years, a change in the considerations about the expected period for onboard activity was observed. Reasons for this change have come from different levels of dissatisfaction over time which have been pointed out very clearly by the students.

Thus, in the last year of study students are more interested in cadet practice which produced a major dissatisfaction because of shipping companies lacking interest in cadets. Taking into consideration that cadet practice is compulsory for future certification as deck or engine officer, the students' disappointment becomes understandable.

Problems generated by the absence of cadet positions onboard ships and the impossibility to satisfy the certification requirements for graduation, led some of the students to find a job in other sectors; many of these without any connection to the maritime field. Analyzing this situation it can be said that, for some students, initial expectations are lost at the end of their study period because more than half of the students who gave up at a career at sea after graduation have not returned to continue their option for a career at sea.

On the other side, the students who found a cadet position with a shipping company which had implemented a cadet program declared their intention to remain with the same company after graduation and certification if the company expressed the intention to keep them in a junior officer position and give them the possibility for career development on the company's ships.

Starting from these considerations and accounting for universities positions in the shipping market, we consider that the maritime training system needs to show an active involvement in their students' career development and to help them to success in this way. Universities do not have only the role of transmitting information and knowledge to the students but are also responsible for the development of their career path. For this reason, they need to support the successful compliance with all national and international requirements for certification as deck or engine officer. In our opinion, the creation of cooperative programs between universities and shipping companies can offer the possibility of fixing some of the problems related specifically to recruitment of students and junior officers and, in the second stage, their retention in the maritime industry.

5. Conclusions

Seafarers are, and will be, an important element of the maritime industry. With all the technological development, the human element will remain the main decisional factor onboard ships. From this perspective, the processes of recruitment and retention of seafarers will always be points of interest for shipping companies.

Recruitment is the first step for retention of a seafarer and the possibility to develop a career as part of a shipping company. For this reason during recruitment, it is most important for the shipping company to know the seafarer's expectations and future plans and for the seafarer to know what the company is looking for and what perspectives that will give to him. When all these aspects are completely covered, the recruitment process will be the basis of a "long term contract" between the shipping company and the seafarer.

References

[1] Eftimios E. M., "Go to sea! A campaign to boost shipping industry recruitment", *The International Maritime Human Element Bulletin,* No. 19 (2009), pp. 3

[2] Precious Association Limited, *Availability and training for seafarers-future impact,* OECD project prepared by Precious Associates Limited in association with Knightsmart limited, (2003)

[3] Solent University, The mapping of career paths in the maritime industries, A Project by Southampton Solent University for the European Union Shipowner's Association and European Transport Workers Federation and European Commission, (2005)

IMPACT – Innovative Maritime Training Products

Koivisto, H.
Captain, Satakunta University of Applied Sciences,
heikki.koivisto@samk.fi

Ziarati, R.
Professor Doctor, TUDEV Institute of Maritime Studies,
rziarati@tudevedu.com

Ziarati, M.
Doctor ,Centre for Factories of the Future,
martin.ziarati@c4ff.co.uk

Acar, U.
Mr ,Centre for Factories of the Future,
ugurcan.acar@c4ff.co.uk

Abstract: The IMPACT project partners are five major European Maritime Education and Training (MET) organisations. These are C4FF's Maritime Education based in the UK, TUDEV Institute of Maritime Studies from Turkey, Satakunta University of Applied Sciences in Finland (member of IAMU), the National Maritime College of Ireland and Spinaker based in Slovenia. The partners have many years of experience in developing programmes for the education and training of merchant navy officers based on the international standards.
The IMPACT project aims to promote the results of a number of completed maritime education and training projects which directly address particular problems or deficiencies in MET throughout Europe, and represent innovative use of ICT in lifelong learning. Initially, IMPACT will disseminate and transfer the innovative practices developed in several of these selected EU funded LifeLong Learning projects to MET providers across Europe and worldwide in order to support their valorisation. The long term vision for IMPACT is to expand its reach and valorise other innovative maritime based ICT projects developed for MET through its network and beyond. The IMPACT project has been supported and funded by the European Union through its Lifelong Learning Programmes.
The NetOSKAR project promotes vocational training, learning and competence evaluation for seafarers with a knowledge development and assessment tool based on a database of multimedia questions.
The EGMDSS project provides online training courses for the Short Range Certificate (SRC), which is mandatory for mariners operating vessels of up to 300 GT within 30 nautical miles from the coast. Access to GMDSS learning materials is limited and often

expensive, and this restricts the regular refreshing of knowledge. EGMDSS encourages life-long learning by providing a GMDSS e-learning web site, which is available in many languages, and now has over 27,000 registered users.
The E-GMDSSVET project completed the EGMDSS learning tool by adding long range certificate (LRC) courses, and simulators of commonly used GMDSS equipment. With these online simulators and professionally produced tests, users can learn about VHF radio, NAVTEX receivers, SART and EPIRB.
These EGMDSS projects have been award winning e-learning tools which have a number of animations and real life simulators included.
The MarTEL project developed Maritime English tests for seafarers in response to concerns expressed during the IMO's 82nd Maritime Safety Committee meeting (2006) that there was considerable need for an International set of Maritime English standards. With a significant number of accidents taking place at sea due to poor communication, it is hoped that the creation of these new Maritime English standards will not only help to save lives; but also reduce material and financial losses.
Keywords: online learning, e-learning, Impact, gmdss, netsoskar, mep, mareng, assessment, maritime English

1. Introduction

The European shipping industry now faces fierce competition from the Far East, and a shortage of 27,000 seafaring officers is predicted by 2015. For the waterborne sector to remain competitive, the quality of European standards must not be allowed to fall. The project consortium believes that by raising standards in the field of European MET, and providing institutions with tools to improve the quality of the education that they provide, the employability and mobility of European seafarers will be increased. All of the LLP projects to be valorised were developed according to international standards such as the International Maritime Organisation's (IMO) Standards of Certification, Training, and Watchkeeping (STCW). As the IMO is the United Nations specialized agency responsible for the safety and security of shipping and the prevention of marine pollution by ships, it is essential to follow the standards that they set. All the IMPACT products promote competencies specified to these standards, and some lead to internationally recognised qualifications.

The partners have a clear vision for developing MET in their countries and throughout Europe. C4FF, together with other partners, established maritime education partnerships and networks called MariFuture (www.marifuture.org) and MarEdu (www.maredu.co.uk). MariFuture and MarEdu have established programmes of cooperation to improve education and training practices in Europe, and go about the harmonisation of merchant navy officers' education. The MariFuture and MarEdu networks have instigated several European and EU funded projects to address specific deficiencies or problems in the maritime sector. IMPACT embraces these principals, and will support the development strategies that are already in place. The extensive knowledge base generated by partnerships working on maritime projects will be shared with the awarding, accrediting, and licensing bodies as well as the policy decision makers in governments and in the EU.

The main aim of IMPACT is to gather the results of innovative 'best practice' projects in the field of maritime education and training (MET), and encourage their use across Europe and in the whole maritime world. Case studies will identify best practice in these projects, and this will be applied to identify similar projects for promotion in the future. These projects directly address current deficiencies in MET and are developed according to international standards, based on the innovative use of ICT-based content and services. The consortium has many years of experience in developing such projects. The consortium believes that ICT can improve the quality of teaching and learning in MET, and can help raise standards and provide institutions with tools to improve the quality of their educational programmes. Thus the employability of European seafarers and the future employability of those embarking on maritime training courses will be increased. IMPACT will identify best practice in innovative ICT based projects for MET and promote them fully and widely to the target groups. This will support quality and innovation in MET. IMPACT will promote collaborative projects in the field of MET, and will set quality criteria for projects to be included in its dissemination platform. This will encourage high quality work and co-operation between partnerships and allow them to develop good working relationships with other relevant bodies working towards the same objective of improving MET in Europe and in the whole maritime world.

The IMPACT consortium and other good European partners have co-operated successfully on a number of past and currently running LLP projects. You can read more at www.maritimetraining.pro and contact the project partners for possible co-operation.

2. MarTEL (Maritime Test for English Language)

MarTEL has launched a novel set of Maritime English Language Tests. MarTEL has been designed to test mariners' Maritime English through a series of online tests designed to cater to seafarers of different ranks and types. The MarTEL Phase 1 Test aims to assess the English language proficiency level of cadets entering a maritime training institution. This test handles the testing of the English language in maritime contexts with the aim of making the seas safe.

The MarTEL Phase 2 Test for Deck and Engineering officers aims to assess the English language proficiency of Deck and Engineer officers who have recently graduated from a maritime academy or are already serving on board a ship and holding an officer position. It is designed to test English language usage in maritime contexts and professional discourse.

The test is designed to measure the English language proficiency of sea-going Deck and Engineering officers in a realistic and vocation specific context with specific maritime vocabulary directly, such as SMCP. The test is directly related to their field of work and the English Language skills needed for their roles and duties.

The MarTEL Phase 3 Test for Deck and Engineering officers aims to assess the English language proficiency of senior Deck and Engineering officers who are already serving on board a ship and holding a senior position. It is designed to test English language usage in maritime contexts and professional discourse. The test is designed to measure the English language proficiency of senior Deck and Engineering officers directly related to their field of work and the English Language skills needed for their roles and duties.

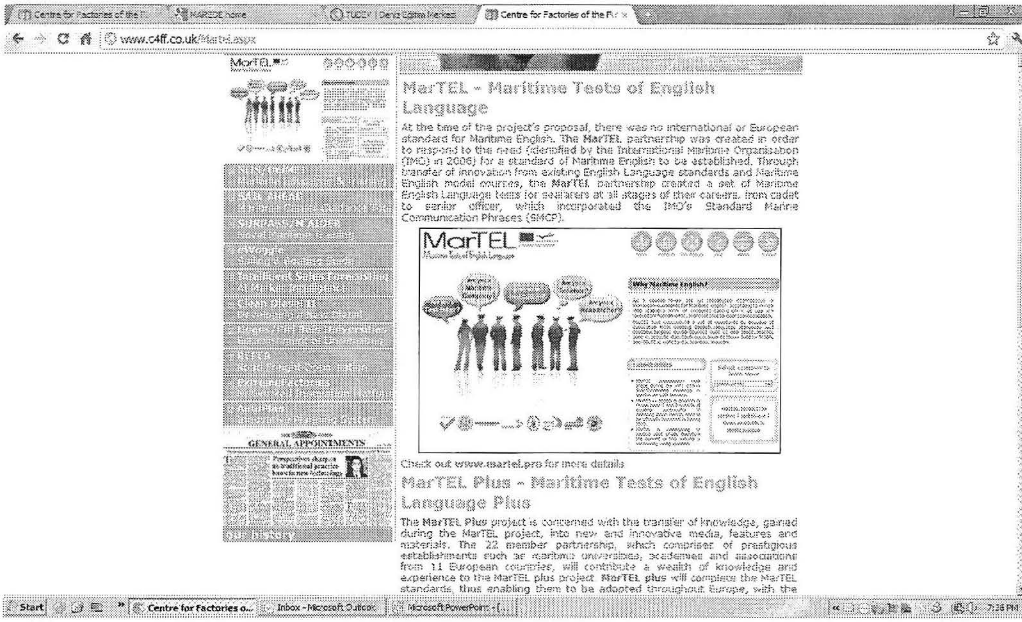


Figure 1 MarTEL homepage www.martel.pro

There is also the ongoing MarTEL Plus project and at the end of this year the new MarTEL Plus products will be available. These new features include an Enhanced Oral Test (with examiners), a Phase R (Rating level test) and a Mobile Application (for IPhone and Android). All these features and functionalities will make this tool an effective product for enhancing standards in Maritime English. More information about MarTEL and MarTEL Plus can be found at www.martel.pro (see Fig. 1).

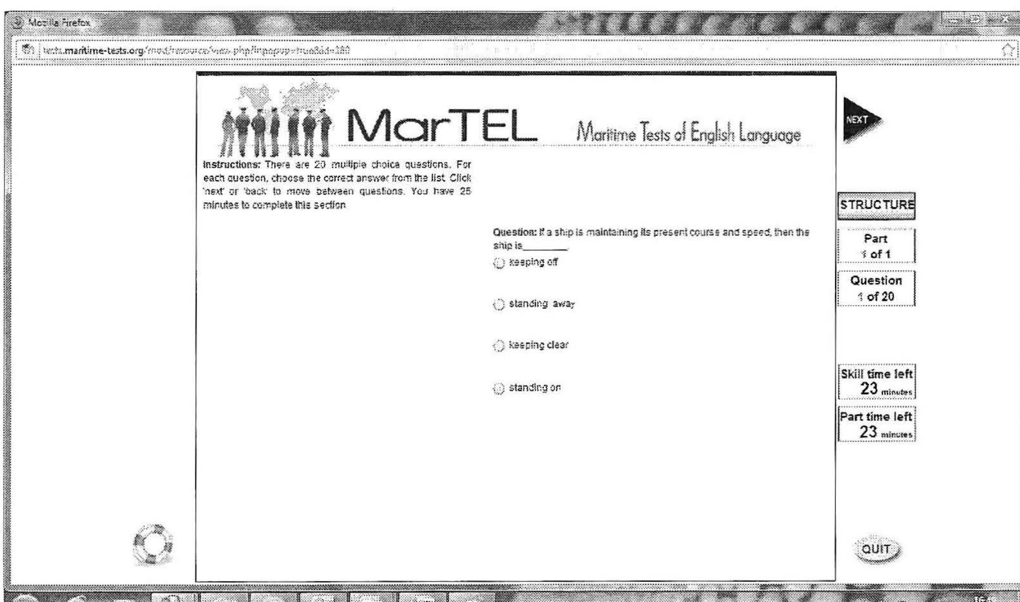


Figure2 Example from MarTEL

3. MarENG (Maritime English)

The MarEng project concentrated on creating an innovative Web-based Maritime English Language Learning Tool. The project was partially financed by the Leonardo da Vinci Programme of the European Union. The tools can be downloaded from http://mareng.utu.fi/learningtool/index.html (see Fig. 3)

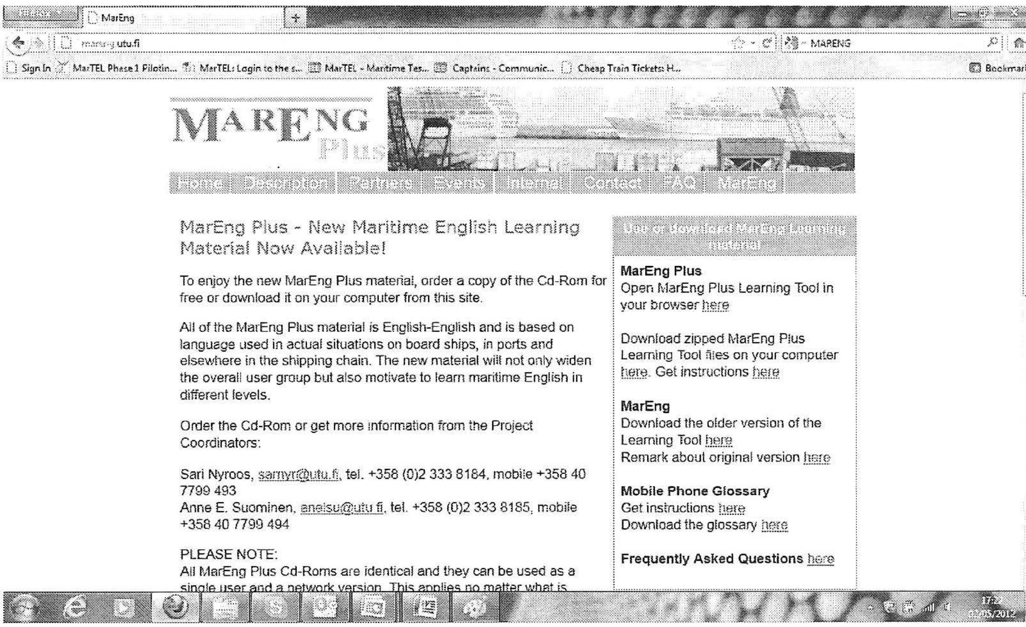


Figure 3 Homepage of MarEng (www.mareng.utu.fi)

4. MarEng Plus

The original MarEng Learning Tool consists of intermediate and advanced level learning material on different maritime topics. Based on the feedback by different user groups all over the world, the usability of the original Tool has been improved. As a result of the MarEng Plus project, two new topics, Maritime Security and The Marine Environment, as well as elementary level learning material, a Teacher's manual and a mobile phone application of the glossary, have been added in the Tool. MarEng Plus provides more learning materials and all of the MarEng Plus material is English-English and is based on language used in actual simulators on board ships, in ports and elsewhere in the shipping chain. The new material will not only widen the overall user group but also motivate to learn maritime English in different levels.

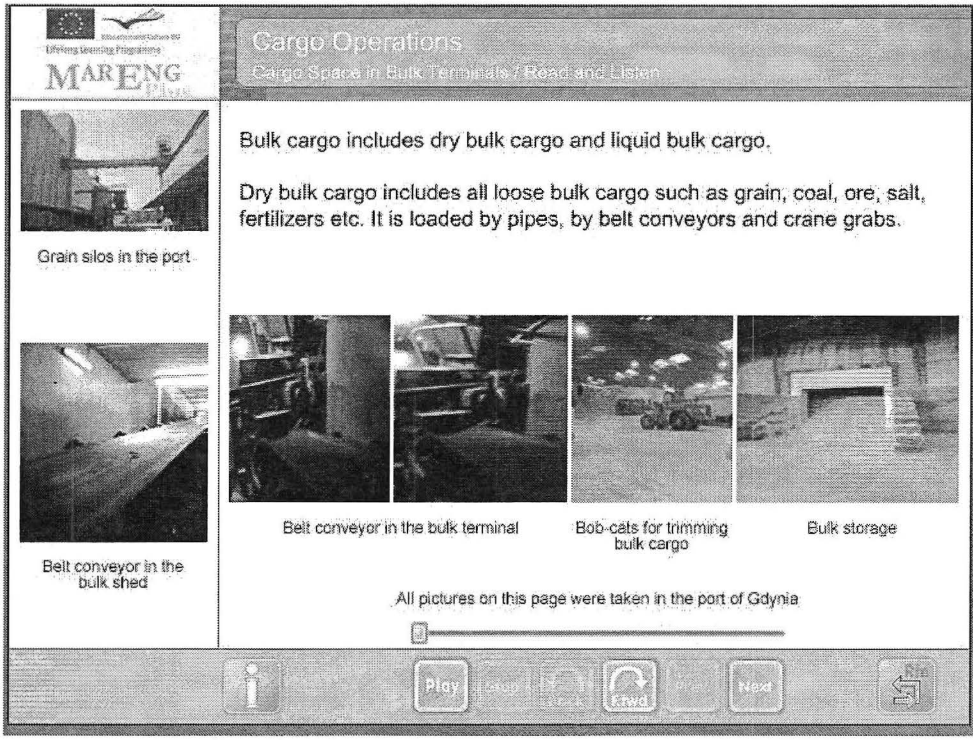


Figure 4 Example of MarEng

5. MEP (Maritime Education Platform)

MEP project provides high quality educational materials in e-learning platform on certain subject. The project provides improvement in the quality of maritime educational material, co-operation between maritime educational institutions and an innovative virtual learning space filled with high quality e-learning sources.

The project has a set of learning materials available online to improve competency of seafarers in maritime subjects across Europe. Lecturers and maritime students in maritime institutions update their knowledge continuously from relevant media.

Learning materials are available at www.mep.stc-r.nl.

6. EGMDSS (Global Maritime Distress Signalling Service)

The Global Maritime Distress and Safety System (GMDSS) has been fully implemented worldwide since February 1999, specifying the GMDSS communication equipment for marine vessels and rescue procedures for vessels and humans at sea with the objective to maximise safety at sea. People working in marine areas i.e. mariners, seafarers, fishermen, yacht captains, sailing boat skippers, marina workers, nautical science students/cadets, etc. must be qualified through different MET to operate the specified equipment.

All mariners must obtain the appropriate type of GMDSS certificate; however, access to the required knowledge is limited (traditional MET is expensive and distance learning is not feasible except for the SRC course) which doesn't encourage regular refreshing of knowledge – lifelong learning. Keeping the GMDSS skills up-to-date is crucial because emergencies at sea rarely occur. The knowledge and skills should be regularly refreshed to ensure safety of the crew, passengers and freight (even though this is not a legal requirement).

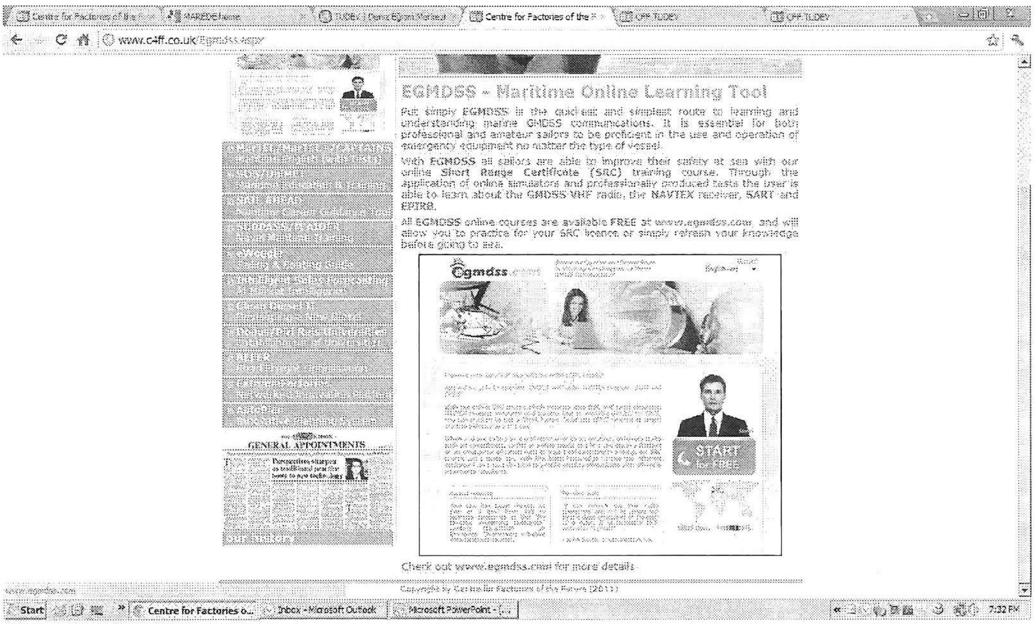


Figure 5 The beginning page of EGMDSS

EGMDSS includes the GMDSS communication device simulators (MF/HF DSC radio and Inmarsat-C terminal) putting the learner into an active role where, instead of answering questions, the learner actively practices and verifies his/her knowledge on a simulator.

EGMDSS is available in English, Slovenian, Turkish, Italian, French, Polish, Finnish, Spanish, Norwegian and Dutch. It includes a real-life animation of the GMDSS communication device operation (conveying to the learner how a device operates) with separate quizzes for each chapter.

EGMDSS was developed considering the harmonised examination procedures for maritime radio operator's certificates (CEPT/ERC/RECOMMENDATION 31-05 E) issued by the European Radio communication Office.

This online platform provides the quickest and easiest route to obtain knowledge about GMDSS. The course includes two sections;

- SRC (Short Range Certificate) course
- LRC (Long Range Certificate) course

All ranks of seafarers are able to practise on these pieces of equipment at anytime and in anywhere.

Learning materials are available at www.egmdss.com

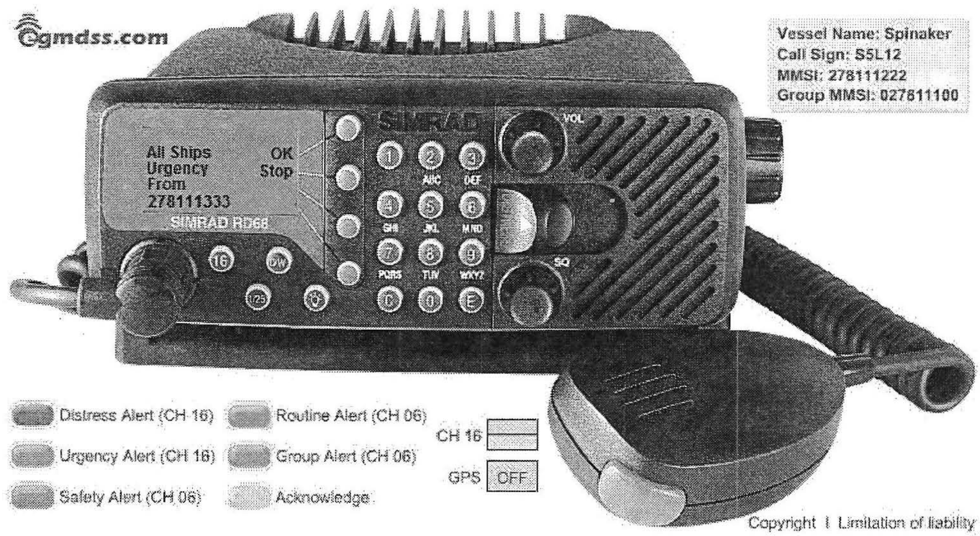
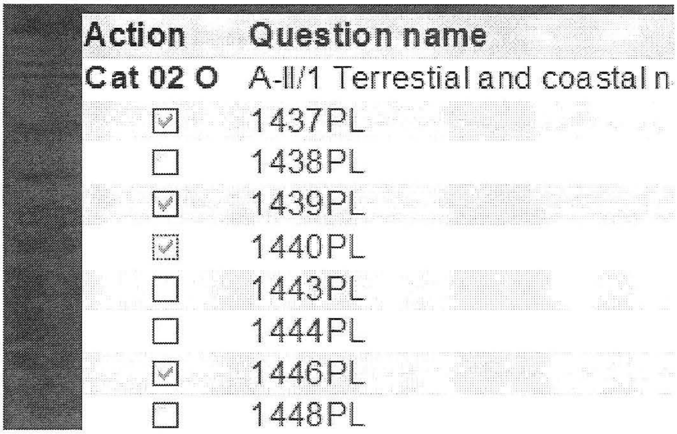


Figure 6 Real equipment in use

7. NetOSKAR

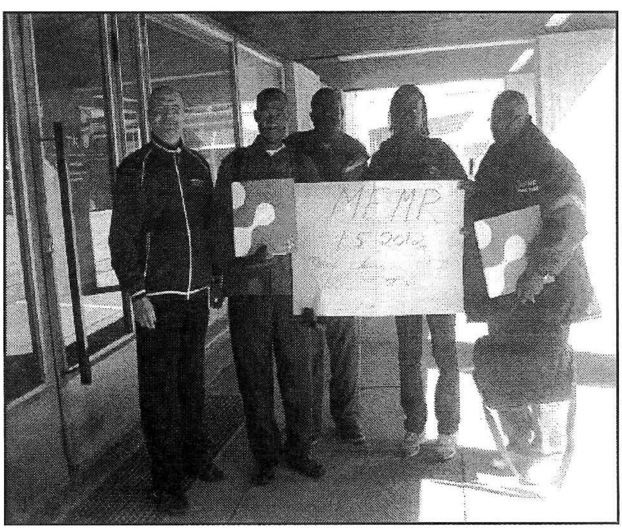
A national pilot project for development of a STCW 95 question database has been carried out by Satakunta University of Applied Sciences in co-operation with five Finnish shipping companies. Experiences from the pilot project were encouraging and it has gained much interest among organisations of the international shipping industry. The competence assessment method based on a question database was found useful for further development. Experiences from the pilot period made it clear that establishment and development of a large high-quality question database should be done on a larger scale by a network of experts in international co-operation. The partner group of the NetOSKAR-project was formed from maritime training institutes located in different parts of Europe, complemented by a leading Finnish shipping company and a maritime authority. The role of each partner was defined by its expertise, varying from mechanical engineering to navigation and from project management to quality assurance. All partners participate in evaluation and dissemination activities. The Moodle platform was first used and found to be a very useful tool to produce the questions into the editing bank and from there to the final bank of approved questions after a double assessment phase.



Action	Question name
Cat 02 O	A-II/1 Terrestial and coastal n
☑	1437PL
☐	1438PL
☑	1439PL
☑	1440PL
☐	1443PL
☐	1444PL
☑	1446PL
☐	1448PL

Figure 7 Category 02 operational level STCW A-II/1 terrestrial and coastal navigation

NetOSKAR is heavily used by the International maritime training community and it is specifically this OSKAR-method (OSaamisen = Knowledge KARtoittaminen = Assessment), which has been used as the fairway knowledge assessment of pilots and VTS operators. Together with the STX Shipyard in Rauma, Finland, the testing of the crew of the newly built vessel RV MIRABILIS was partly done with the NetOSKAR questions in May 2012.



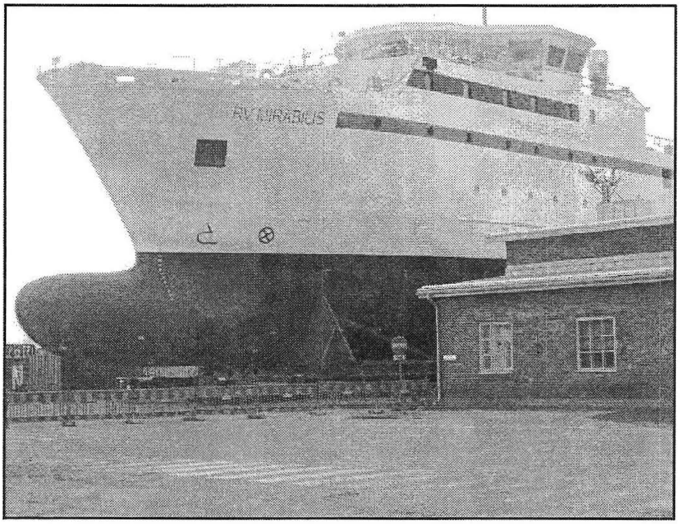


Figure 8 Testing the crew of the RV MIRABILIS in May 2012 with NetOSKAR

8. Conclusion

All these products, MarTEL, MarEng, MEP, eGMDSS and NetOSKAR are being widely used and have been found to be very useful in maritime training by the International Maritime Training community. These products support the lifelong learning of seafarers and cadets using the latest training tools and methodologies, as well as meeting new requirements and standards. It is highly recommended for everyone to use these products in Maritime Training, with over 30000 persons registered to use these tools.

References

[1] MarENG Plus (2008-10), EU Leonardo Project No: 2008-1-FI1-LEO05-00459
[2] www.mareng.utu.fi 15.5.2012
[3] Maritime Education Platform (MEP) (2008-10) LdV ToI No: NL/08/LLP-LdV/TOI/123006
[4] Maritime Test of English Language (MarTEL) (2007-09). EU Leonardo Project No: TOI0492007
[5] www.martel.pro. 15.5.2012
[6] Short Range Course Certificate course (EGMDSS), 2006-08, EU Leonardo Pilot Project No: 1760062006
[7] Long Range Course Certificate Course (E-GMDSSVET) (2008-10), Leonardo Pilot Project, No: 142173SI08
[8] www.egmdss.fi 15.5.2012
[9] NetOSKAR 2003-05, EU LdV ToI No:2003-FIN-03-B-F-PP-160016
[10] www.samk.fi/netoskar 15.5.2012
[11] IMPACT 2012, EU LdV ToI No:518314-LLP-1-2011-1-UK-LEONARDO-LAM
[12] www.maritimetraining.pro 15.5.2012

Developing A Culture of Attentiveness

John Cross
Faculty, Marine Institute of Memorial University

John Tucker
Faculty, Marine Institute of Memorial University

Abstract: In 1998 Mr. William O'Neil, the then Secretary-General of the International Maritime Organization (IMO), stated that human error is the biggest threat to people working at sea. [1] Since then, the technology involved in operating ships has improved tremendously, but human error is still at the root of most safety issues that arise. The Manila amendments to the STCW Code set out certain safety concerns that contribute to human errors. Specifically it identifies lack of training, new technology and fatigue as areas that contribute human errors. [2] However this paper focuses on another error– that of making inadvertent errors.

It is the intention of the authors to use our teaching experience and tools that we have developed to adjust our teaching pedagogy. The goal of this effort is to encourage students to reorganize their approach to problem solving with the goal of reducing the commonly observed inadvertent error. Pedagogical content knowledge includes

> an understanding of what makes the learning of specific topics easy or difficult: the conceptions and preconceptions that students of different ages and backgrounds bring with them ... If those preconceptions are misconceptions, which they often are, teachers need knowledge of the strategies most likely to be fruitful in reorganizing the understanding of the learners. [4]

The purpose of this project then, is to develop a teaching strategy that will promote a reduction in the observance of these careless errors.

1. The Inadvertent Error

Numerous sources cite human error as the largest singular cause of accidents at sea. There is an abundance of literature demonstrating how human error resulted in major accidents and how what appear to be small or innocuous human errors can be critical contributing factors to a sequence of events resulting in catastrophe.

There are also errors that occur that have much less dramatic outcomes but are still very significant, such as the case of human error causing a cruise ship to tilt abruptly during calm seas resulting in furniture and debris flying about and passenger injury. [3] Even minor human errors resulting in incorrect fueling or incorrect parts being stocked or incorrect measurements being taken can result in financial, operational and/or safety concerns at sea.

Many of the aforementioned human errors can be attributed to either mental or manual errors in calculations. It is the authors' belief that inadvertent errors in calculations are promoted by evaluation methods employed in administering many of our post-secondary courses. The authors believe that making inadvertent errors can become habitualized and result in complacency and inaccuracy in both the solving of problems involving mathematics as well as the development of solutions to other types of problems.

When teaching trivial mathematics such as that learned in elementary school, much of the instruction and practice of the math skills is rote. The simple and correct calculation method is demonstrated through repetitive practice and continuous feedback as to whether or not the answers given to problems are correct, students learn to give the correct answer when posed with that type of question.

As one advances through the education system, problems become increasingly complicated and challenging. The case where a student is asked a simple question requiring a one-line answer becomes increasingly rare, and more common is the case where students are asked to solve problems in which evaluations require successive calculations and even pages of workings to arrive at a single final answer.

As educators of applied math problems, the frequency with which we observe students actually submitting the correct answer to a complex question on either a test or assignment has become minimal. This has been encouraged and promoted through the granting of part marks for solutions based on the correct method being used. Indeed, part marks have been granted for many if not all of the evaluation devices used in many of the courses delivered. Students have come to expect part marks and have become accustomed to earning a passing grade in an assignment or a course even when most of the final answers to the evaluation devices are wrong.

The authors believe that the attitude that this reinforces through the evaluation method promotes complacency towards calculations, and ultimately towards decision making. The authors have adopted a new method of administering applied math courses which re-introduces the importance of the correct answer and which we expect will demonstrate improved calculation accuracy and precision.

2. The Inadvertent errors in calculations

The inadvertent error came to the authors attention over the last few years when students were given relatively simple and routine questions as part of a final exam. The performance on these questions was strikingly poor. The students were forewarned that they would be seeing a number of simple questions on the final exam which would only require the selection of the appropriate equation and the use of the right number or numbers in the equation. However there was a catch - *the questions would be evaluated only on whether the answer was correct or incorrect (i.e. no part marks).* Even with the simple nature of the questions and advanced warning of what to expect, students did not perform well. Table 1 summarizes the questions and response rate for the questions for a class of 24 students.

Question	No. of Correct Respondents [/24]	% Correct
You have a force of 7.8 N acting on each square mm of a metal block. What is the stress in that metal block.	14	58
You need to weld a bracket to the middle of a bulkhead. The bracket is 15 cm wide and 7 mm thick and will carry a load of 75,000 N. If the weld material is ASTM A36, what length of weld would you need?	13	54
You have a riveted connection made of 3 rivets (AISI3102, 6mm in diameter). What is the allowable stress on the connection using the condition of shear?	14	58
A steel S380x64 beam is used as a cantilever 5 m long with a uniform load of 11,000 N/m. What is the deflection at the free end of the beam.	12	50

Table 1, Results from simple questions given to 24 marine engineering students

Contrary to what might be expected, it was observed that students actually did worse on the less difficult questions than on the more difficult ones. This was demonstrated by the fact that the average mark on the exam from which the above questions were taken was over 60% but the average score on the easy questions was 55%.

The above questions may or may not seem easy to the reader depending on their background, but for the class in which they were administered, they would be considered as trivial. At this level, the student would have already passed a course in mechanics as well as an introductory course dealing with stress. In addition, students would have completed two relevant physics courses, 2 previous math courses and a course on the properties of materials. Students at this level should have enough background knowledge to solve these questions. Subsequently, it is hypothesized that inadvertent errors come into play.

3. Current Treatment of the Inadvertent Error

While the inadvertent error has always existed, it is becoming more prevalent as more of the work done either on ships or to support ships is based on precise mathematical relationships where a small calculation error can have a potentially large impact.

With highly technical courses it is very common to differentiate between an error in principle and a careless calculation error with the former being penalized much more heavily than the latter. This is natural since as instructors we are interested in teaching and assessing what is relevant to our course. Consequently it can be argued that a small slip along the way should count as a minimal reduction in marks if any at all. However, taking the larger view it can also be argued that a wrong answer is still a wrong answer. It does not matter if the error is a small one or a major one if it causes the ship to run out of fuel or to capsize.

Thus instructors are placed in a quandary. Do we mark what is relevant to our course or do we grant marks based on the consequences of the impact of the answers (both good and bad) in the workplace?

While this dichotomy has always existed, the impact of it is becoming more pronounced in modern shipping for a number of reasons. To begin with, if we compare a marine officer's job as it is now to what it was 50 years ago, there is so much more technical knowledge involved that educational institutes are now forced to teach new areas of theory, and indeed more theory than at any previous time. While the deck side has undergone significant changes in regards to technology, the engineering officer's job is almost unrecognizable from what it was 50 years ago.

Another reason for the increasing importance of precision is the technology being employed on ships today. With an increased reliance on digital and automated systems, a instruction based on a small error can multiply into a catastrophe easily.

4. How to Emphasize Accuracy while still Rewarding Knowledge of Principles

There are a number of barriers to emphasizing a correct answer as opposed to a correct principle. One was mentioned above (i.e. courses are set up to teach a particular skill set and test the knowledge gained in that course). However a second is that a focus on the end result leads to an increase in students plagiarizing from each other or, if available, other sources.

To address this issue the authors are taking advantage of a tool called Maple TA. In 2010 the authors received an Instructional Development (ID) grant from the Office of the Vice-President (Academic) of Memorial University of Newfoundland (MUN) to purchase a software package called MapleT.A. This software is a web-based application facilitating the creation of algorithmically generated and knowledge-based questions and administering them to students in the form of homework, quizzes and tests. This means that while students will receive similar assignments with similar questions, the numbers will be different, and of course the answers will be different.

Questions can be formed into assignments using a variety of delivery options. In addition the amount of feedback students receive can be authored to be very complete and detailed and issued to the students working on the assignments in a variety of ways through these same options. The courses in which the authors intend to perform this study lend themselves to long and rather complex applied mathematics type questions for both assignments and tests. Through the multi-year development of the question database, the authors have developed a set of questions and assignments that encourage students to be careful and meticulous in their calculations and require that they give the correct answers at the end of the assignment to receive full marks.

The problem shown in Figure 1 is a challenging, yet typical problem taught in a course called Strength of Materials. The student would plot a graph by calculating the parameters labelled 'V' and 'M' at several prescribed locations along the diagrammed beam. The student is required to provide these final calculated values in the answer fields of the software application to a precision of ±1.0% in order to have that answer marked as correct. The comprehensive feedback solution for this question is as shown in the appendix.

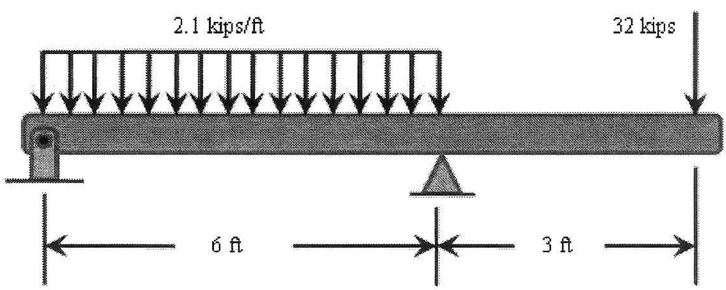
MapleT.A. Grade Refresh Close

Description: *Q5 Distributed and Overhang W15*

Jump To: Question | Information Fields

Question:

Problem 5 {Problem Value = 15}



For the beam and loading shown,complete the table below necessary to draw the shear force and bending moment diagrams (each answer in this question is worth [1/20] of the question value, NOTE that the required units for each column are given in square brackets unless you are required to put in the units yourself.), and draw the shear force and bending moment diagrams. All calculations are performed with 4 significant figures.

The reaction force at support A is: kips

The reaction force at support C is: kips

x	V [kips]	M [kip ft]
0		
2		
4		
6		
6		
9		

Rows for cut 1 are Green and rows for cut 2 are Blue.

{Please note that you may retry this assignment up to 5 times. Click grade after you have put in answers for all of the assignment questions, and then you will be able to view the worked solution following each attempt. The grade of your best attempt is the one that will be recorded for this assignment.}

Figure 1, A typical Maple TA Question

The policy employed in administering an assignment to a group of students is that the students each receive the same set of algorithmically generated questions. The question shown above is one of a set of three questions that the students would receive for this particular week long assignment. There are five attempts permitted on this assignment. An attempt is defined as a student submitting the complete set of questions for grading. The assignment may be printed for offline work, and the randomly generated elements of the question will remain unchanged until the student submits an assignment attempt. When a student submits an assignment attempt, they are shown the complete set of comprehensive solutions in the form of feedback. They may save and review these solutions at any time, but when they obtain a new version of the assignment after submitting an attempt and reviewing feedback, the randomly generated elements in the question have all changed.

The correct solution method is demonstrated in class and reinforced through the feedback, but student consideration of the problem and calculation accuracy and precision are reinforced through the requirement of the correct set of answers for full marks in the assignment.

This software has been in use at the MI for two years and some clear observations can be made at this point. Firstly, students are spending more time on their individual assignments. There may have been plagiarism on assignments in the past, but now the instructors who use this tool promote student collaboration in the form of discussion of methods to solve the assignment problems. This is a good thing since much of shipboard work requires working in teams. However, where each student receives the same question set but with a randomly generated set of numbers for their personalized assignment, it can be trusted that each student performs their own workings for their own assignments.

It is felt that this software can be used to increase the care a student takes in their work with the goal of making the quick accurate performance of relatively simple tasks a habit. Qualitatively this was observed in the class results from last year's students . After using Maple TA for their assignments, student performance appeared to have improved on the same type of questions as shown in Table 1 with an average score now being 61%. It should be noted that this is a subjective result and not the results of a prepared trial and lacked baseline data for comparison. However it indicated that there would be benefit in performing a formal study.

5. Methodology for Testing the Improvement in Inadvertent Errors.

The intent of this study is to gauge the effect of the instructional method and evaluation of the accuracy and precision of manually performed calculations. To this end, for each group of students we consider we will first have to determine baseline data to evaluate how precise and accurate they are in performing calculations before we begin our course. Then we will teach the course and use tools and evaluation methods which will require them to be accurate and precise in order for the students to obtain marks for the evaluation tools being used. Finally we will administer a similar test to that which was given at the start of the course in an attempt to assess the impact of the course delivery method on calculation accuracy and precision.

How assignments are administered can be controlled (using MapleT.A.) by the instructor, but the authors have chosen to have up to five attempts at each assignment granted to the student. When a student submits an assignment the student will receive immediate feedback as to their score on the assignment and will have access to the complete correct solution to the assignment as it should have been submitted for full marks. If the student is not satisfied with their mark, or if they simply want more practice, they may make another attempt at the assignment.

The primary theme of the assignments delivered in the course is to reinforce solution methods for applied math type problems that were taught and demonstrated in class. The underlying theme of the assignment philosophy is to train students to apply the correct methods, but just as importantly to reinforce with the students that precision and accuracy in calculations must be consistently maintained in order to receive the full grade for that course element.

During the applied math course being taught, the students will be coached and instructed in the use of MapleT.A. to receive and submit their assignments. Student will be fully informed on the policies programmed into MapleT.A. and all assignment questions will have a clear statement regarding the precision required in their calculations as well as a margin of error that is programmed into each question to define what is acceptable as a correct answer by the software.

In point form, the assignment policy is:

1. Questions in assignments will include a statement of the required number of significant figures to be carried in order to obtain the correct answer.
2. A small margin of error, typically on the order of ±0.5% will be acceptable from the answer calculated perfectly using the stated number of significant figures.
3. Each assignment submitted shall be graded independently of the assignment submissions before it. To obtain a perfect score of 100%, all questions in the assignment must be submitted with correct answers within the previously stated criteria in the same submission.
4. The solution to each assignment question shall be made available following the submission of each complete set of assignment questions.
5. All assignments shall be algorithmically generated and the numbers in each question shall be randomly generated. All assignment questions will have at least 10 000 possible permutations.
6. The highest grade achieved on any of the submissions of an assignment will be the mark awarded to the student for that assignment.
7. Part marks for assignments will not be granted based on workings but some questions may have multiple parts and marks may be awarded for each part independently.

Questions for mid-term tests and the final exam for the course shall be developed with the same requirements of accuracy and precision, but part marks will be granted based on workings.

6. Evaluating the Improvement:

At the start of each course where student performance will be measured for this study, the authors intend to benchmark the students. A test will be administered consisting of a series of short math and applied math questions based on material that was taught in previous courses and in high school. An example of such a question might be to calculate the area of a complex geometric shape made up from simple shapes and appropriately dimensioned. The skills are trivial but logic must be employed and both precision and accuracy have to be employed in order to get the correct answer. Accuracy must be good in the sense that the correct numbers must be used in the calculations in order to obtain the correct final answer. Precision will also be evaluated by offering similar questions multiple times, such as the case where the complex shape is used in several questions but the dimensions vary each time.

Each student will receive a test consisting of 30 such questions and the test will be administered through MapleT.A.. A time limit of 50 minutes will be applied to the test which will force the students do their best to work quickly yet with accuracy and precision.

The same test (with different randomly generated numbers) will be administered to the students at the end of the course with the intention of measuring the students calculation accuracy and precision before and after the course.

7. Conclusions:

The shipping industry, more so than most, is unforgiving when it comes to making errors. This includes small inadvertent errors that appear inconsequential as well as major misunderstandings. While these errors tend to fall into the category of "human errors", it is felt that their cause is not fully captured by the traditional factors involving human errors such as fatigue or insufficient training.

Instead it is felt that developing a habit in students to calculate quickly, but more importantly accurately, will help to reduce these errors. This will be done by emphasizing the importance of having all stages of a solution correct.

The authors have outlined a methodology that will be applied to evaluate the effectiveness of emphasizing the importance of accuracy in student work. It is expected that accuracy will improve and provide students with a valuable skill that they will use throughout their careers.

References

[1] O'Neil W. (1998), Address on World Maritime Day 1998. Retrieved from http://www.imo.org/knowledgecentre/referencesandarchives/documents/wmd 1998 message.pdf

[2] International Maritime Organization (2010) , International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978 (Manila Amendments), Retrieved from http://www.imo.org/ourwork/humanelement/trainingcertification/pages/stcw-convention.aspx

[3] Travis Reed, Cruise Ship Tilt Blamed on Human Error. Retrieved from http://www.redorbit.com/news/general/587947/cruise_ship_tilt_blamed_on_human_error/ (July 25, 2006)

[4] Shulman, L. (1986). Those who understand: knowledge growth in teachers. Educational Researcher, 15(2), 4-14.

Appendix

Maple T.A.

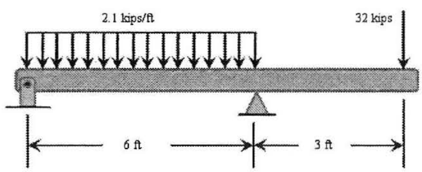
Back | Close

Description: Q5 *Distributed and Overhang W15*

Grade: 0.0

Your response	Correct response

Problem 5 {Problem Value = 15}



For the beam and loading shown,complete the table below necessary to draw the shear force and bending moment diagrams (each answer in this question is worth [1/20] of the question value, NOTE that the required units for each column are given in square brackets unless you are required to put in the units yourself.), and draw the shear force and bending moment diagrams. All calculations are performed with 4 significant figures.

The reaction force at support A is: ____ (0%) kips

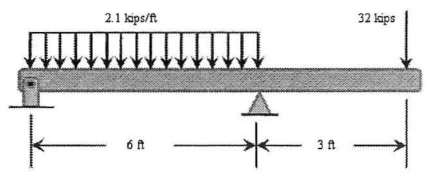
The reaction force at support C is: ____ (0%) kips

x	V [kips]	M [kip ft]
0	____ (0%)	____ (0%)
2	____ (0%)	____ (0%)
4	____ (0%)	____ (0%)
6	____ (0%)	____ (0%)
6	____ (0%)	____ (0%)
9	____ (0%)	____ (0%)

Rows for cut 1 are Green and rows for cut 2 are Blue.

{Please note that you may retry this assignment up to 5 times. Click grade after you have put in answers for all of the assignment questions, and then you will be able to view the worked solution following each attempt. The grade of your best attempt is the one that will be recorded for this assignment.}

Problem 5 {Problem Value = 15}



For the beam and loading shown,complete the table below necessary to draw the shear force and bending moment diagrams (each answer in this question is worth [1/20] of the question value, NOTE that the required units for each column are given in square brackets unless you are required to put in the units yourself.), and draw the shear force and bending moment diagrams. All calculations are performed with 4 significant figures.

The reaction force at support A is: -9.7 ± 1.0% kips

The reaction force at support C is: 54.3 ± 1.0% kips

Incorrect

x	V [kips]	M [kip ft]
0	-9.7 ± 1.0%	0 ± 1.0%
2	-13.9 ± 1.0%	-23.6 ± 1.0%
4	-18.1 ± 1.0%	-55.6 ± 1.0%
6	-22.3 ± 1.0%	-96 ± 1.0%
6	32 ± 1.0%	-96 ± 1.0%
9	32 ± 1.0%	0 ± 1.0%

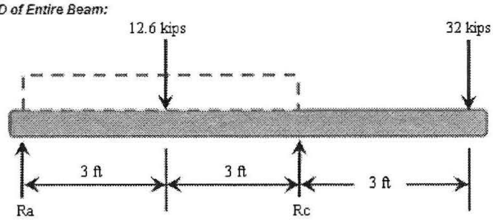
Rows for cut 1 are Green and rows for cut 2 are Blue.

{Please note that you may retry this assignment up to 5 times. Click grade after you have put in answers for all of the assignment questions, and then you will be able to view the worked solution following each attempt. The grade of your best attempt is the one that will be recorded for this assignment.}

Total grade: 0.0×1/14 + 0.0×1/14 + 0.0×1/14 + 0.0×1/14 + 0.0×1/14 + 0.0×1/14 + 0.0×1/14 + 0.0×1/14 + 0.0×1/14 + 0.0×1/14 + 0.0×1/14 + 0.0×1/14 + 0.0×1/14 + 0.0×1/14 = 0% + 0% + 0% + 0% + 0% + 0% + 0% + 0% + 0% + 0% + 0% + 0% + 0% + 0%

Comment:

FBD of Entire Beam:



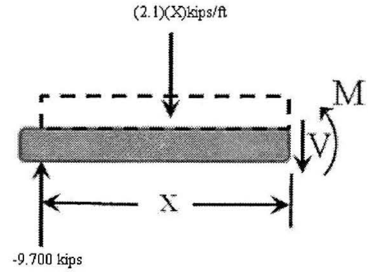
Calculate Reactions at Supports:

$\overset{+}{\circlearrowleft}\sum M_A = 0$ $\qquad$ $+\uparrow\sum F_Y = 0$

$6 \cdot Rc - (3)(12.6) - (6+3)(32) = 0$ $\qquad$ $Ra - 12.6 + 54.30 - 32 = 0$

$Rc = 54.30\ kips$ $\qquad$ $Ra = -9.700\ kips$

Cut 1:

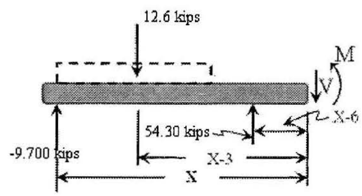


$$+\uparrow\sum F_Y = 0 \qquad\qquad \overset{+}{\circlearrowleft}\sum M_A = 0$$

$$-9.700 - 2.1\cdot X - V = 0 \qquad\qquad (-9.700)(X) + (2.1\cdot X)\left(\frac{X}{2}\right) + M = 0$$

$$V = -2.1\cdot X + (-9.700)\ kips \qquad\qquad M = -1.05\cdot X^2 + (9.7)\cdot X\ kip\cdot ft$$

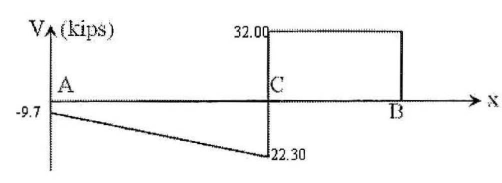
Cut 2:

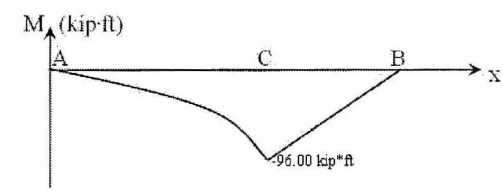


$$+\uparrow\sum F_Y = 0 \qquad\qquad \overset{+}{\circlearrowleft}\sum M_A = 0$$

$$-V + (-9.700) - 12.6 + 54.30 = 0 \qquad\qquad M - (-9.700)(x) + (12.6)(x-3) - (54.30)(x-6) = 0$$

$$V = 32\ kips \qquad\qquad M = 32.00\cdot x - 288.0$$





Simulating the Engine Room of a Hydrogen Powered Cargo Ship

Yaqub M. Amani, PhD
Professor of Electrical Engineering, SUNY Maritime College,

Catherine K. Strez
Professor of Marine Engineering, SUNY Maritime College,

Abstract: The main objective of this paper is to present a basic model for simulating a hydrogen-powered cargo ship engine room and monitor the dynamic parameters related to operation of the engine using suitable simulation techniques. The modeling of a hydrogen powered ship engine room is important and will open a new direction in comparative studies of this new technology and combustion type engine room. The knowledge obtained from hydrogen cars shows interesting results in two particular aspects; the efficiency improves drastically and hydrogen powered cars have about 74% less parts. This in turn will drastically reduce the weight of a vehicle. Since hydrogen has half the energy density of gasoline and heavy oil used in shipping, hydrogen powered ships will require more storage space for long distance journeys. Hydrogen storage technology research shows promising alternatives for safe and compact storage. Onsite, on- demand hydrogen generators are available and could be utilized for future ship design. The results of the simulation are compared to a combustion engine room and also we look at the number of parameters monitored in a typical combustion engine. An attempt is made to estimate the size of a hydrogen powered engine room based on latest commercially available fuel cell, other electronic components and electric motors. The outcome of simulation will be analyzed for the operation simplicity and environmental impact. In our first attempt to demonstrate the virtual operation of a hydrogen powered ship, we will build a model based on input-output characteristics of each component and will include the monitoring of some basic physical functions, such as temperature, hydrogen intake pressure, volts and amperes delivered to load. The torque –speed characteristics of the electric motor used in our model will be integrated into simulation

Keywords: Hydrogen powered ship, cargo ship, maritime, marine environment, hydrogen ship simulation, LNG

1. Introduction

There is no doubt that electric propulsion for ships has many advantages, which include low pollution, low noise, less space and maneuverability. A typical electric propulsion system consists of a number of subsystems shown in Fig. 1. This scheme requires a number of components that have been designed for DC ships and the latest class of electric AC ships [1[i], [ii]2, [iii]3]. Due to weight, size and maintenance, DC ship designs were abandoned for AC powered ships. A great number of warships employ electric propulsion where maneuverability is a factor and electric propulsion is desirable for cruise ships because of low noise.

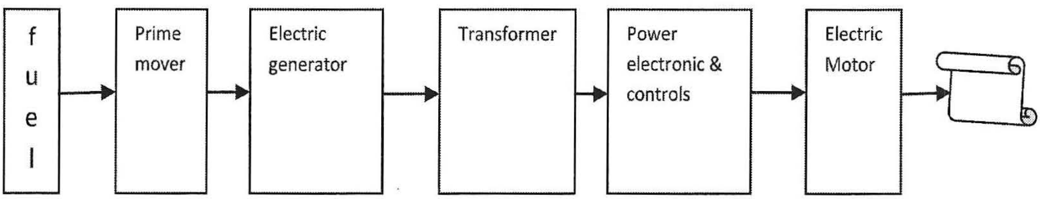


Figure 1 Typical Electric Propulsion

DC propulsion is common in submarines where the power source is a hydrogen fuel cell or nuclear power. The latest developments in hydrogen fuel cell technology, hydrogen generation technology and power electronics make hydrogen fueled electric propulsion system an attractive alternative for commercial ships. The idea of hydrogen propulsion should be coupled with hydrogen economy proposed at IAMU AGA11 and AGA12, [4, 5, and 6] which details the issue of hydrogen economy and comparative analysis of combustion cargo ship verses hydrogen powered cargo ships. To demonstrate the operational characteristics of a hydrogen powered ship, we have used Math-Lab, Power-Sim program. The basic assumption for our design is that hydrogen powered ships can be built by using a modular design concept. The idea is to deliver power to the main shaft by integrating a number of low powered motors synchronized and controlled by a central computer. This scheme can be implemented by a variety of designs and has many advantages, such as reliability and use of modular low power fuel cells and hydrogen generators or storage for hydrogen supply. The use of mobile Marine Energy producing and Refueling Platforms (MERPs) will make implementation of this approach for future ship design possible, since these ships will require minimal storage capacity.

Mathematical Model of for Hydrogen Fuel Cell

The mathematical model for Proton Exchange Membrane (PEM) hydrogen fuel cell is based on diffusion of hydrogen gas in the electrodes. There are a number of assumptions for (PEM) type fuel cell, listed in [7]. In this paper we outline the parameters we have included in our simulation model of fuel cell. The output voltage for a single fuel cell is obtained from:

$$\mathbf{E_{cell} = E_{0Cell} - K_E\,(T - 289)}$$

Where, K_E is an empirical constant when calculating Eo in volts/Kelvin at 289 degrees and one atmosphere.

Stacks are formed by layers of individual cells and the detailed model for a particular cell stack is constructed when a number of parameters such as pressure, fuel composition and hydrogen air flow rates vary. The open circuit voltage, current and Tafel slope are expressed as:

$$E_{oc} = K_c E_{cell}$$

$$I = [ZFk\,(P_{H2} + P_{o2})\,e^{-\Delta G/RT}]/Rh$$

$$A = RT/Z\alpha F$$

C is stack voltage constant, Z- number of electrons, F= 96845 is Faraday's potential, k – Boltzmann's constant, P_{H2} and P_{o2} are partial pressures of hydrogen and oxygen inside the stack, ΔG activation barrier size, R -8.3145 J/ mol-Kelvin , T – operating temperature, h- Plank's constant and α- charge transfer coefficient.

The hydrogen and oxygen utilization are given by:

$$U_{H2} = \frac{60000RTNI}{ZFP1\,V\,(x\%)}\ ;$$

P_1- fuel pressure, x% percentage of hydrogen in fuel

$$U_{O2} = \frac{60000RTNI}{2ZFP2OV(y\%)}\ ;$$

P_{2} - absolute supply air pressure, y% - percentage of oxygen in the oxidant.

The hydrogen fuel cell and induction motor basic models are used from the components of Sim-Power but the entire auxiliary circuits and subsystems are designed in order to achieve the desired results for the simulation of hydrogen powered ship engine room. We have limited the scope of this paper to an introductory level simulation just to demonstrate the idea.

The Simulation Process

The block diagram of the simulation circuit is depicted in Fig.2. There are three main blocks in the circuit. The first block is the hydrogen fuel cell. In our simulation we have selected only hydrogen as input to the system. The model does not represent system temperature variation, air flow pressure, fuel pressure and many other parameters that will give us a detailed view of the engine room monitoring system. The motor block measurement circuit contains a number of subsystems for conversion of motor complex variables to real and also subsystems to measure motor RPM and other related parameters. The intermediate block is an inverter circuit using IGBT type transistors and is driven by pulse width modulator.

To see a drastic change in the values of simulation parameters, we have chosen to vary the mechanical torque as input to the drive system. Hydrogen supply regulator was designed to take the power demand by reading current delivered by fuel cell to the induction motor, the per phase rms value of the stator current which is representative current delivered by fuel cell was programmed to simulate hydrogen flow rate and utilization. The result of simulations must be considered to be the case for an ideal system, since we have assumed forward voltages of IGBTs to zero and also all losses incurred in induction motor are not represented in this model.

To simulate a more realistic engine room, one must take all the losses, temperature dependence of hydrogen fuel cell and hydrogen supply pressure which we will present in the future.

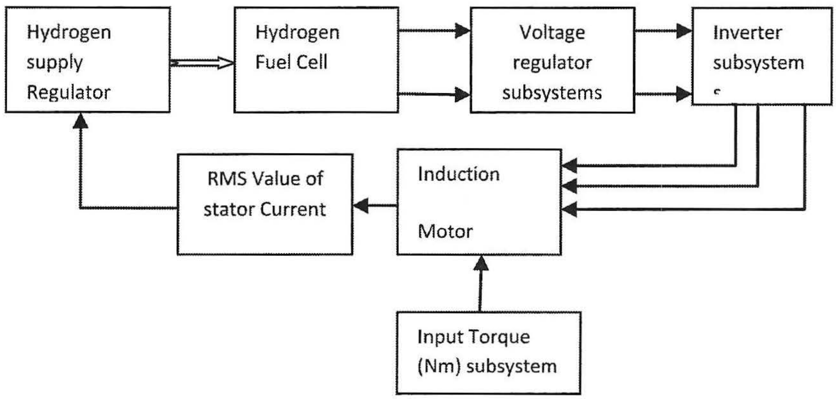


Figure 2 Block Diagram of Simulation

The Math-lab simulation model is complex, it requires many sub systems each containing secondary and sublevel systems. A simple first level component and subsystems is presented in fig. 3. There are a number of monitoring screens which can incorporate detailed monitoring of a large number of variables. We have limited ourselves to four monitors. Figure 3 from left to right the first top monitor display gas flow and utilization of HFC, the second displays electric output parameters of HFC, the third monitor displays inverter input and output variables and the last on the right displays the motor electric and mechanical characteristics.

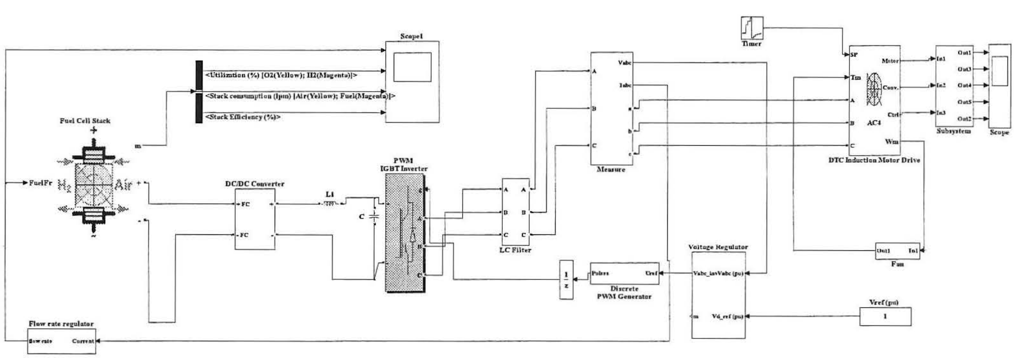


Figure 3 Actual Power-Sim Simulation Block Diagram

To present a complete picture of simulation analysis is out of the scope of this paper; therefore, only a few parameters are presented to emphasize the importance of this type of research in maritime related industries. The first graph in Fig.4 displays volt-ampere characteristic of the fuel cell employed in simulation. The result of simulation is within the range of these characteristics. It is important to point that the reason for selecting a low power fuel cell and motor is because the drive is considered to be a modular drive system. The preference would be a 300KW fuel cell driving 300KW motors running at 60Hz and sixty poles and producing 120

RPM max. Sixty motors integrated into a modular drive system will for our simulation result in a 3MW drive and for300KW HFC to 18MW power needed for this purpose.

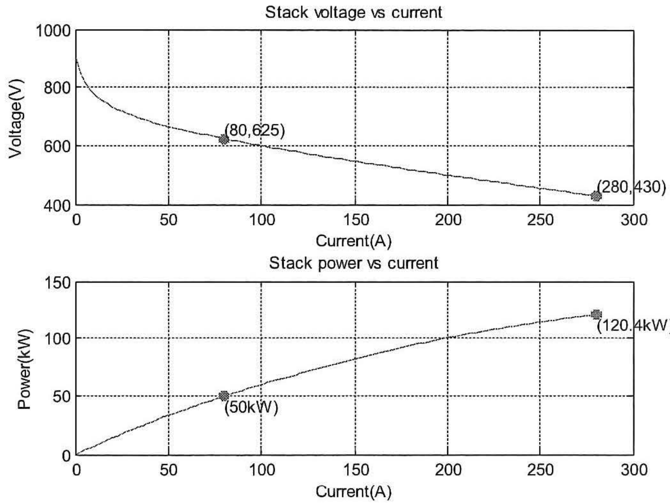


Figure 4 HFC Characteristics

The operating characteristics of the hydrogen fuel cell in Fig. 5, shows that it responds to power demand by the motor. The nominal characteristics of the fuel cell we have used for this simulation are;

Stack Power: 50,000W max 120.4KW
Resistance =0.66404 ohms
Nearest cell voltage = 1.1342 V
Utilization H_2; 99.25% $O_{2;}$ 70.4%
Consumption $H_{2;}$ 501.8 slpm, air 1194 slpm
Fuel composition %x = 99.95 % %y = 21%
Hydrogen flow rate 417.4 lpm max 1460 lpm
Air flow rate 2100 lpm max 7350 lpm

Fig. 5 shows the result of simulation for some these parameters. The nearest volts goes to zero once a large torque is applied to the motor, the fuel cell current jumps to a very high value exceeding the operating maximum of 280A because of large starting current of induction motor but stays around and below 280 A.

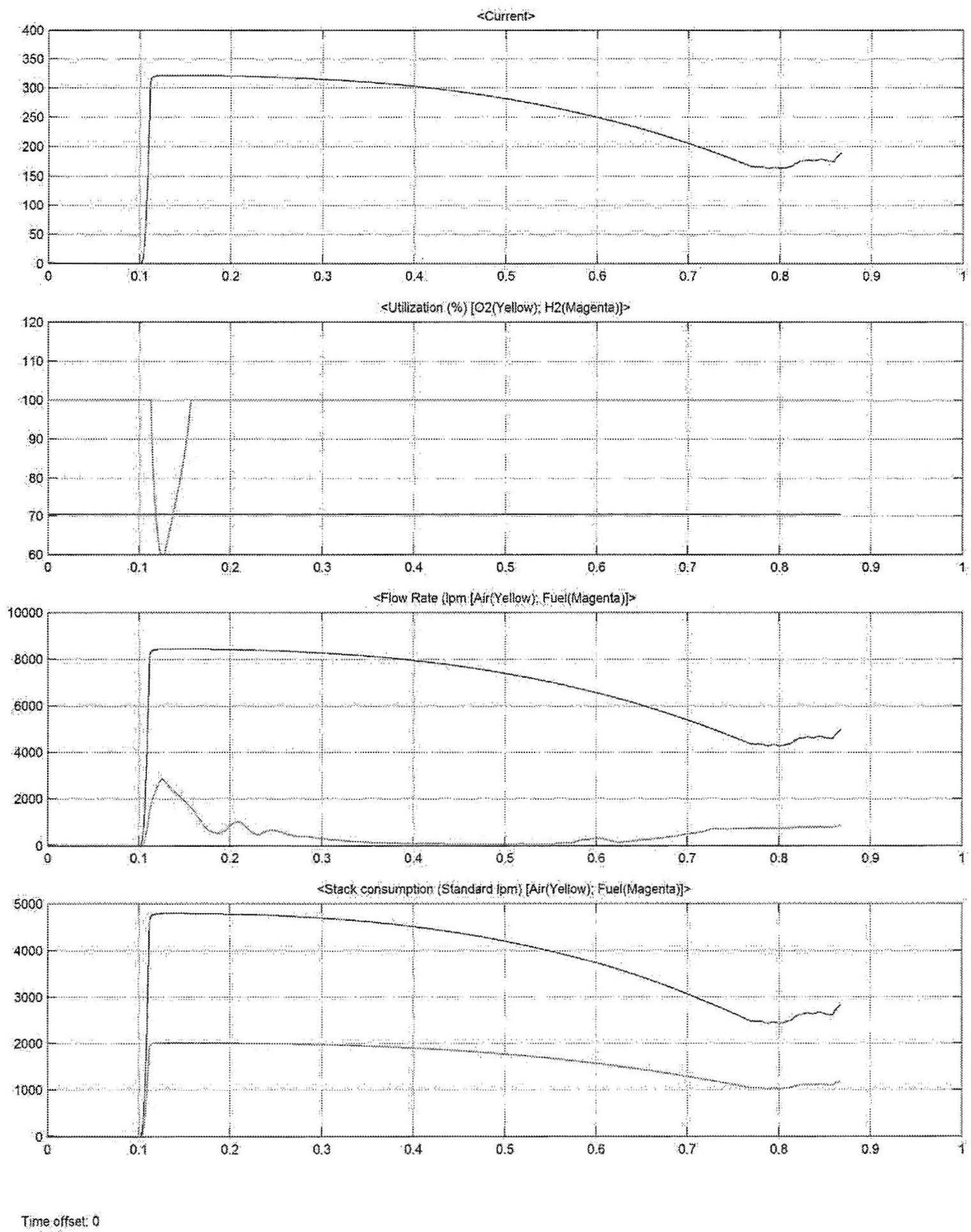


Figure 5 Fuel Cell Response

The flow rate for fuel and air stays within range after the induction motor transition period ends and reaches steady state.

Fig.6 is the response of the induction motor powered by fuel cell. The output of HFC is connected to the input of an inverter, which produces sixty Hertz sinusoidal three phase voltages and currents. The RMS value of the motor current is defining the behavior of the fuel cell

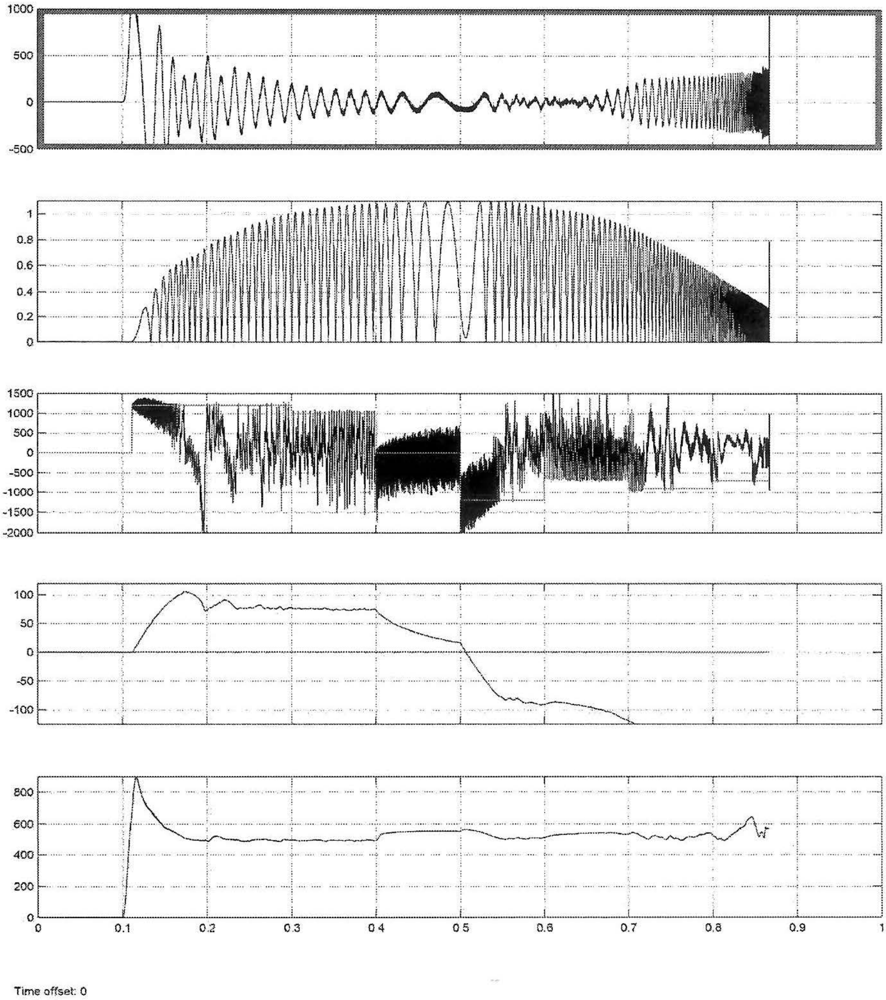


Figure 6 Induction Motor Response

1. Stator Phase Current (A)
2. Magnetic Flux (Wb)
3. Input torque (N-m)
4. Motor RPM
5. RMS value of bus voltage

2. Discussions Conclusions

This simulation is a model calculation for further development of the modular hydrogen powered ships. There are many reasons to think about modular drive system which first time was introduced at AGA11 in Pusan South Korea.

First it is more reliable design since the failure of one module will not compromise the integrity of the total drive system.

Second requires low power electronic components leading to lower prices for construction.

Third it allows the employment of small size Methane Steam Reformer modules for onsite on-demand hydrogen production, thus reducing criteria emission.

Fourth it will use LNG as fuel to produce hydrogen and the technology for transporting and storing LNG is already developed.

Fifth the sensors and powerful electronic compact mechanisms pave the way for synchronization of all modules and therefore creating possibilities for a number of ways to apply the concept of modular drive system.

Here we presented the simulation for only one module. To integrate a number of modules, the computing facilities must be large and requires the collaboration of at least five field of engineering which we hope to achieve for complete demonstration of this idea. The electrical engineers, to oversee the design of realistic modules presented here and to see the integration of these modules through a complex control system, marine engineers, naval architects and, mechanical engineers and computer engineers.

The perfect model ship for future will be a hydrogen powered ship with the use of renewable resources integrated in the design and having auxiliary LNG and Steam Methane Reformers on board. This will eliminate one of disadvantage of hydrogen for ships which is low energy density, a quarter of HFO. LNG having a higher energy density will reduce relative storage needed for hydrogen powered ships.

References

1. J.M. Prousalidis, N.D. Hatziargyriou, B.C. Papaddias "On Studying Ship Electric Propulsion Motor Driving Scheme" National Technical University of Athens
2. Alf Kare Adanes, Maritime electric propulsion and Diesel Electric propulsion, ABB AS Marine
3. Chee Mun Ong " Dynamic Simulation of Electric Machinery Using Mathlab Simulink, Prentice Hall, 1998
4. Y.M. Amani. 2010.Hydrogen Based Shipping Industry, AG11 Presentation, Pusan South Korea.
5. Y.M. Amani .2011, A Pioneering Hydrogen Fueled Cargo Ship. The First Global Conference on Innovation in Marine Technology and the Future of Maritime Transportation
6. Y.M. Amani, C. Strez, and C.Munsch. 2011.Comparative Analysis of Combustion verses Hydrogen Fueled Cargo Ship" IAMU, Gdynia Poland

Author Index

MARINE INSTITUTE

MEMORIAL UNIVERSITY

iamu

The Nippon Foundation

www.iamu2012.com

ISBN: 978-0-88901-439-8