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15th Annual General Assembly
International Association of Maritime Universities

IAMU AGA 15

Looking Ahead

Innovation in Maritime Education, Training and Research

Editors:
Dev Ranmuthugala
Barrie Lewarn

Australian Maritime College
an institute of the University of Tasmania

27 - 30 October 2014

Welcome

The Australian Maritime College (AMC), an institute of the University of Tasmania, is particularly honoured to host the 15th Annual General Assembly (AGA15) of the International Association of Maritime Universities (IAMU) in Launceston, Tasmania, Australia from 27 - 30 October 2014. AMC is particularly proud to have been selected to be the first member institution to host the AGA for a second time. The first occasion in 2004 was a resounding success and on behalf of the AMC's staff and students we look forward to making this a pleasant and productive occasion for all who participate.

The theme of AGA15 is:

Looking Ahead
Innovation in Maritime Education, Training and Research

This assembly aims to consider important issues including:-

- Changes to shipboard tasks and skills, and innovative shipboard organisational structures to meet these challenges.
- The relevance of STCW and its 'traditional' certificate of competency approach/structure for existing and future seafarers.
- Innovative approaches to learning and teaching, scholarship and research now and into the future.

As a group of some 50 plus of the world's maritime education and training universities/faculties it is incumbent upon us to question what is, consider what could be, and look forward. We at AMC believe that for IAMU to achieve its goals it is timely to look to the future and to take the opportunity to turn our collective thoughts to addressing some of the challenging issues.

We have over 50 presentations, 7 project reports and presentations, as well as a vibrant student program during AGA15 and we sincerely hope that AGA15 will provide the opportunity to share and discuss issues of mutual concern as well as being a catalyst to increase networking between member institutions.

On behalf of AMC's staff and students we look forward to welcoming you to AGA15. Please enjoy the AGA and take the opportunity to stay a little longer on our beautiful island home. Finally, I would like to acknowledge and thank all involved in ensuring AGA15 is a success; speakers, students, participants, the Local Executive Committee, and particularly the IAMU Secretariat and the Nippon Foundation for their continuing and valuable support.

Professor Neil Bose

Chair of the AGA15 Local Executive Committee
Principal, Australian Maritime College
University of Tasmania

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Session 1A
Seafarer Training

Innovative Approach to the Design of Business Games of Maritime Specialists Training

Irina Makashina

International Education Center of Admiral Ushakov State Maritime University

Development of a modern transport infrastructure capable of providing enhanced movement of cargoes and passengers, reduction of transportation costs and establishment of conditions for growth of the national economy and strengthening country positions in the world market requires well educated and trained maritime specialists, capable to cope with it. Professional development of modern maritime specialists according to the International Convention STCW-78/95 and amendments adopted at the Manila Conference, 2010, supposes acquiring new theoretical knowledge and practical skills. In this connection the offered article presents the scientific concept based on the new methodological approach – poly-profile one – to the development of the content of professional business games for future maritime specialists and proposes a method of designing of the training content and development of maritime specialists' professional competences.

Key words: pedagogical support, poly-profile communicative competence, maritime specialist, poly-profile and communicative approach, business games, integrated course.

1. Introduction

Maritime transport is considered as the backbone of the world trade. The role of it continues to grow. Maritime transport is fundamental to sustaining economic growth and spreading prosperity throughout the world, fulfilling a significant social as well as an economic function. Maritime transport as all other branches is served by people, who must be well trained and educated.

At present modern maritime universities are focused on the principal directions of the maritime education, including the objectives on creating a new competitive image of the merchant shipping industry, supporting maritime industry through scientific and technological development in order to improve work in the field of merchant shipping. The result of set tasks first of all depends on professionals working in the branch, on their educational and cultural level. In order to fulfill the requirements of the modern marine industry a number of international purpose-oriented documents and programs have been developed. A number of amendments to the International Convention for the Safety of Life at Sea (SOLAS), the International Convention for the Prevention of Pollution from Ships (MARPOL) and the 1988 Load Lines Protocol which entered into force or took effect from 1January 2014 must be observed. Another important document is STCW (Standards for Training, Certification and Watchkeeping) Convention and newly proposed changes admitted at Manila and famous as Manila amendments.

It is impossible to know everything. It is enough to understand. In this connection the notion «Profile» is of great importance. Profile is the set of significant for specialist fragments of branches which he/she deals with in his/her professional activity.

The modern state of merchant shipping is characterized by need for the specialists possessing poly-profile knowledge and corresponding skills. Poly-profile competence provides competitiveness of both specialists and branches in which they work [2].

The concept «profile» includes a set of the typical features describing a profession and determining requirements to professional training of the future specialists. Poly-profile competence is understood as the integrated ability consisting of a number of competences, necessary for specialists of different professions, including organizers of the collective actions acting in integrated unity, adequate to the decision of poly-profile-communicative tasks [1; 2].

We consider a poly-profile profession as a system of poly-professional problems, forms and kinds of professional work which content is characterized by complexity and variety of the objects from different profiles included in it.

Existence of poly-profile professions dictates the necessity of development of adequate system of pedagogical support for training of specialists capable independently to analyze the unity of profile structures in certain industrial activity. It causes the necessity of creation of the new scientific concept of construction of a system of pedagogical support for training of the specialists possessing with poly-profile competence. Pedagogical support means a set of different resources and conditions, necessary for the arrangement of efficient educational process [2].

We would like to emphasize, that poly-profileness means knowledge of profiles of different professions, and communicativeness is the ability of the person providing efficiency of his communicative activity and psychological compatibility with participants of communication. Set of profile knowledge and communicative abilities represents integrated unity, development of which is provided by the system of pedagogical support of poly-profile training of specialists.

Activity of specialists, working in merchant shipping is considered as poly-profile one, training for which is stipulated by the strategy of development of maritime transport, defining priority problems of development of branch of merchant shipping and representing a system of various projects and programs.

The analysis of activity of specialists working in branch of merchant shipping, has shown, that the knowledge got within the limits of training on a certain specialty (navigation, technical operation of transport radio equipment, marine and coastal environmental issues, maritime administration, maritime commercial law, logistics, marketing and port management, etc.), is insufficient. Specialists working in the field of sea transport should have knowledge, skills for providing carriage of goods by sea; realization of actions on complex and balanced development of fleet; safety of fleet, timeliness of delivery and safety of cargoes, etc. The range of profiles included in a field of their activity is wide enough, and knowledge of the basic profiles promotes increase of competitiveness both a specialist, and the enterprise at which he works.

Modern specialist must possess professional erudition and the competence based on cultural, communicative, administrative, foreign language speaking, pedagogical, legal, economic and special knowledge and skill to solve complex industrial poly-profile issues and problems [3; 6]. It will help to comply with the top priority of the transport policy, i.e. the formation and development of a modern transport infrastructure capable of providing enhanced movement of cargoes and passengers, reduction of transportation costs and establishment of conditions for growth of the national economy and strengthening country positions in the world market.

2. The system of pedagogical support of poly-profile training

Maritime Education represents a key component in the system of measures providing development both branch, and the country as a whole, that is expressed in constantly growing requirements to quality and a level of future sea specialists training. As a guide we can apply to Manila amendments, which stipulated a list on competences, necessary for seafarers.

There is a contradiction between objective need of branch of merchant shipping in expansion of profiles of training of the future marine specialists, formation competences of specialists of different professions and earlier system of their training focused on narrow profile area of professional work.

Due to this issue, we have worked out and theoretically proved the model of the system of pedagogical support of poly-profile training of marine managers, and conditions of its implementation [2]. An initial position in creation of this system was the substantiation of a model of the person of the expert-professional, his social and professional status in the field of merchant shipping, and its implementation in didactic system of professional poly-profile training. The social need in marine specialists also finds the reflection in experience of their training, which assumes interactivities of participants of educational process: the teacher, his (her) assistants and trainees.

The main methodological requirement to the system of pedagogical support of poly-profile training of marine specialists is the consideration of its integrity in view of interaction of components and connections among them, influencing on development of the system, and branch in which they will work.

In a basis of construction of the system of pedagogical support of poly-profile training of marine specialists external and internal regularities are laid down. *External regularities* include: interconditionality of poly-profile training and social and economic need of the branch; a poly-profile-communicative orientation of the contents of training; interaction of pedagogical and industrial processes; developing character of poly-profile training. *Internal regularities* reflect: relations among individuals of educational process; variability of application of means and methods depending on the content of kinds and forms of their activity. The allocated regularities characterize it as complex structure and reflect steady interrelations and interrelations of the basic components of the system that allows predict its development.

The system of pedagogical support of poly-profile training of marine specialists was constructed on the base of the principles (systematic, integrativeness, poly-profile focusing, the social conditionality, modularity, continuity, the technological effectiveness, culture interrelations), conformation with which provides not only the integrity of construction and interrelation of the components included in the system, but formation of poly-profile competence and interrelation of the content, methods and forms of teaching and educational process.

The offered system of pedagogical support of poly-profile training of marine specialists carries out the following functions: *synthesizing*, providing integrity of poly-profile training and providing interrelation of all subsystems; *projecting*, providing use of the significant information for definition of prospect of formation of poly-profile-communicative competence; *constructive*, defining construction of the content of the training adequately reflecting in educational process, poly-profile focusing of the content of industrial activity, communicative character of interrelations with subordinates and partners, pedagogical character of activity in preparation of executors for the solving problems new to them, features of activity in long time voyages, the importance and opportunities of English language in professional activity of specialists and in their training; *information-educational*, reflected in technology of the doctrine; *organizing*, which is realized in a choice of educational technologies, and their applications in view of the poly-profile information on activity of a marine specialist and his possible partners; *communicative*, providing participating of students in set of various situations of the communication adequately reflecting activity of a marine specialist; *socially-pedagogical*, stipulating social role of poly-profile training of the future specialist, its dependence on social and economic development of a society; *poly-profile focusing*, expressed in the fact that training of the future marine specialists is defined by professional, educational, social, economic and cultural factors. This fact causes choice and development of technologies of poly-profile training [2].

The specified regularities, principles and functions provide penetration into essence of the investigated system which consists in revealing the steady links mediating integrity of educational process and its orientation to perspective needs of the market.

The offered system of pedagogical support of poly-profile training of marine specialists includes the following components: normative, scientifically-informative, social and psychological, scientifically-methodical and technological support. Each component has its own structure and the content defining its purpose and functioning:

Normative support provides duly granting and studying of normative documents. S*cientific and informative support* assumes collecting and preparation of information on results of researches in the field of merchant shipping and involving students in creative and scientific activity. S*ocial and psychological support* assumes the use of actions connected with conditions of maritime branch. S*cientific and methodical support* covers analysis of a professional field of a marine specialist's activity, development of forms, methods of poly-profile training, a substantiation of principles of content construction, providing formation of poly-profile communicative competence. T*echnological support provides* the arrangement of the educational process [2].

Due to recommended volume of the article, it is difficult to consider all mentioned components of the created system, therefore we shall stop only on the two – scientifically-methodical and technological components, which have a practical direction and stipulates choice of the content of maritime education.

3. The poly-profile communicative approach

It has been abovementioned, that the overall performance of merchant shipping depends not only on technique, but also on correct management and activity of specialists, therefore it is necessary to improve the content of their education constantly. While designing the content of training of the future marine specialists it is necessary to point out, that their training should be both subject to social and economic needs of a society, and also to be directed to development of individuality of the person and his self-actualization. The content of education of the future marine specialists must provide adequate reflection in educational process such aspects of their activity as poly-profilness of subject content, communicative character of mutual relations with subordinates and partners, features of activity in long-period navigation, the importance and opportunities of English language in their professional activity.

In this connection, developing scientifically-methodical support as a component of the system of pedagogical support, we have defined a complex of characteristics of marine specialists' professional work. They include: often removed territorial arrangement of objects of management; interaction with representatives of speaking another language culture; decision-making; knowledge of economic and legal features of the countries of partners; knowledge of the international conventions, free knowledge of foreign language; knowledge of objects of partner's interaction; the communicative competence and formation of emotional intelligence. Taking into consideration these characteristics at designing the content of marine specialists' education we are able to improve a level of their training.

Professional poly-profile activity of a specialist, working in the field of shipping is sated by the complex content having not absolutely usual connections among its components. It resulted in necessity of development of the poly-profile-communicative approach, the support on which at selection of the content of their education will allow to improve process of their training and to realize professional training as complete structure, strengthening a poly-profile direction.

The innovative poly-profile-communicative approach developed by us and applied to designing of the content of education and construction of educational process, assumes: the analysis of poly-profile cognitive problems, industrial and cultural features of activity of partners, including, foreign, and the organizations of communicative actions of all participants of the decision and realization of professional tasks. Poly-profile-communicative approach means the set of relations and methods of organization and educational process arranging as in view of character of the future poly-profile activity of a specialist. Its application to future marine specialists' training provides: arranging of all educational process of training aimed at formation of poly-profile competence; generalization and ordering of the content of training, its components reflecting poly-profile essence of communications of marine specialists; continuity at all stages of education; effective utilization of inter-subject connections at construction of the integrated program for training; formation of complete system of poly-profile knowledge, ways and the kinds of activity necessary for future marine specialists.

The main principle of construction of the content of education of future marine specialists is the principle of poly-profile competence. The grounding on the specified principle allows form at the future the unity of adequate understanding of essential profiles of branch to which it is necessary to adjoin in future activity, and it also promotes construction of the theory of training to complex educational meta-courses.

4. The organization of educational process

The quality of Maritime Education and Training system is an issue which strongly impacts worldwide the competitiveness of the shipping sector. However Maritime Education and Training system is a really expensive as it requires high investments and incurs high running costs. Owing to evolution of technology, increased globalization in economy Maritime Universities have to catch up with the technologic advancements and to improve the quality standards in order to remain viable and competitive. In this connection the following component – technological support of the system of pedagogical support of poly-profile training of the future seafarers is considered. Here, we offer to consider two models, necessary for educational process arrangement: procedural model and conceptual model.

The procedural model of formation and development of poly-profile-communicative competence of students represents the educational situation considered by us as a set of conditions which performance is necessary for existence of educational process. It should be arranged on the basis of the analysis of professional poly-profile activity of specialists [3].

Functional blocks (readiness of students for actions on formation their poly-profile-communicative competence; readiness of a teacher for formation poly-profile-communicative competence of students; means of formation poly-profile-communicative competence of students) are allocated as components of the system of activity as structures reflected in them are components of real activity.

During formation of a situation, its component structure is defined, functional interrelations among components are established and there is a development of separate components by way of providing achievement of the purpose – readiness of process of competence formation. At functioning process, this situation continuously changes owing to enrichment of a current condition of erudition of students.

The precise organization of educational functional system during training of future seafarers allows correspond to changes of requirements for a level of the specialists in connection with constant development of the branch, and to rate of mastering of a material. Influence of separate components can be changed under different circumstances, nevertheless, this is a self-organizing system which, finally, leads to formation of poly-profile communicative competence.

While creating the conceptual model of poly-profile training of future marine specialists on an example of foreign language studying on the basis of integration of the content of their education, we were based on a fact that specificity of the complex system including integration of various areas (professional, cultural, economic, legal, pedagogical and speaking another language), is not settled by features of components making it, and roots, first of all, in character of connections among key components. Result of such integration is the formation of poly-profile-communicative competence. Also as an innovative approach we offer to consider use of process of foreign language studying not only as mean of training, but also as the integrating factor, which can lead to change of character of cognitive activity of students (fig. 1).

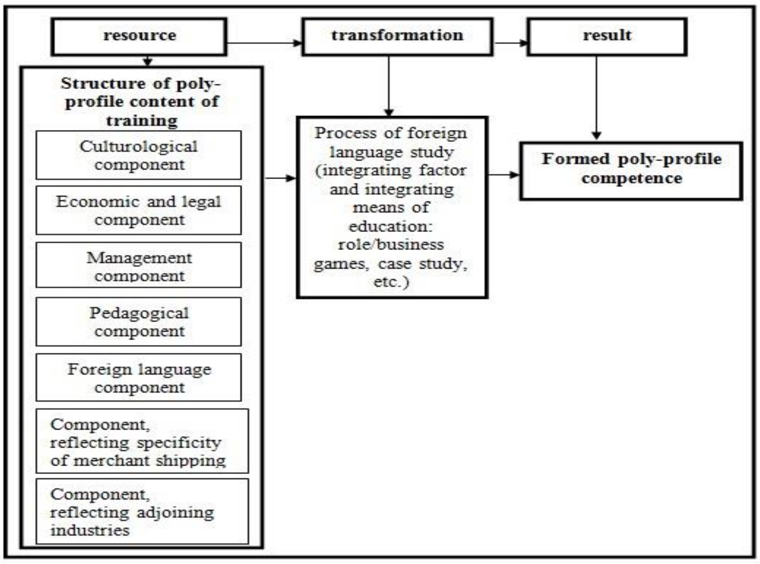

Figure 1. A model of poly-profile training of future marine specialists.

Admiral Ushakov State Maritime University (Novorossiysk. Russia) through all members of the academic community, promotes the concept of innovative university, with specific interests towards practices allowing educational activities to focus on students' needs. As an example let's consider educational functional system used during training of marine specialists on one of levels of concreteness, for example, at a level of studying of an integrated course.

The integrated courses consist of a number of educational situations, the role games, case study, constructed in certain sequence and reflecting activity of future specialists. The system of purposes is formulated in the form of a list of qualities and ways of performance of activity which should be generated while any lesson, at the integrated courses studying. Gradual study of a content of each subsequent course, filling them by poly-profile information provides the process of transition of a trainee from the position of object of influence of the teacher to the active subject (individual) of educational process.

Mastering of the integrated courses helps to reveal a non-standard thinking, to stimulate cognitive interest that leads to development of ability to analyze the industrial situations resulted from circumstances, peculiar to objects of activity of specialists, working in different sectors of merchant shipping. The integrated courses filled by poly-profile information, can be considered as a part of direct connection of the educational process with future practical activities. Studying of the integrated courses in foreign language has a double effect, promoting increase of a competence level. Using the process of foreign language studying as means of training of the future poly-profile activity extends cogitative activity of a trainee. Enrichment of professional and skill of foreign language speaking takes place.

5. Business games for maritime specialists training

At a stage of structuring of an integrated content of business games potential poly-profile communications are laid down. There is a selection of a material chosen for study, i.e. material, relevant to different circumstances, typical for different spheres and professions, involved in one professional field – maritime business. Moreover, necessary educational conditions of poly-profile-communicative competence formation are created. The method widely applied during training of future specialists is the case study method, which assumes transition from a method of accumulation of knowledge to active, real practice [7; 8]. It is often considered as one of the most popular approach in a world practice of improvement of professional skill. The purpose of the given method is the formation of skills to analyze available information, to reveal the basic problems, to see alternative ways of the problem decision, to estimate risks, to make the optimum decision and to formulate the program of actions. The practical situations usually offered for discussion, include following stages: acquaintance with a situation → revealing of problems → the analysis of an available information → a formulation of alternative decisions → an estimation of the offered alternatives → representation of decisions. Application of the given method has special value for business games arrangement [4; 7].

It is well known, the business game, based on case study, used in educational process as didactic means, possesses a number of the features overcoming lacks of traditional methods of training. It provides system of representation of an educational material, approaching students to real conditions of generation of needs for knowledge and their practical application that develops intelligence of the educational process, personal activity, opportunity for transition from cognitive motivation to professional one.

Secondly, the business game permits to recreate structure and functional parts of the future professional activity in a game training model that gives set of training and educational effect due to maintenance of transition from the organization and regulation of activity by the teacher to self-control and self-organizing of activity by student.

At last, it has enough ample opportunities to use information in function of means of regulation quasi-professional activity that transforms this information into knowledge. These advantages of business game should be considered at didactic games used during professional training. The most exclusive fact is the connection of personal and operational aspects of student's activity in game therefore the Subject of a game – a student – finds adequate personal sense in educational activity.

However, it is necessary to consider social and psychological complexities and difficulties objectively arising out during business game arranging by virtue of inconsistent character of development of relations in groups, the complexities, connected with the organization of a game, with knowledge of specificity of a future professional work of a student. This fact acts as one of the specific pedagogical condition of training process arrangements. Namely, the business game provides opportunity to design and modeling of future poly-subjective relations, communicative connections with involving of representatives belonging to different spheres that lead to formation of poly-profile competence of a future lawyer.

Usually business games are realized while group work, that requires involving all participants of a game in communication. This method of training is considered as the form of communication and can be used as means of training activity.

While realization of business games students (we consider it on example of future maritime lawyers training) learn to:

– understand thoroughly characteristics of the major IMO conventions and regimes of maritime zones under Conventions;

– understand the rules of international law interpretation and compare them with domestic rules of statutory construction;

– identify and discuss trends, developments and challenges presently facing the maritime industry;

– analyze factual and legal issues relating to current maritime security threats by critically examining past decisions and predicting future ones;

– understand the legal obligations of coastal states to establish and maintain effective forces to respond to various accidents on its coastline;

– gain an understanding of the different types of maritime crime and acts of maritime violence;

– understand the different historical, legal, political, economic, and other issues of maritime industry and so on.

The formation poly-profile competence demands serious preparation of a tutor, as carrier of the poly-profile information and intermediary between a field of activity of maritime law and the future lawyers, capable to work in this branch. The erudition of the tutor defines success of the used method. In business games arrangement the tutor is no longer the giver of knowledge, the controller, and the leader, but rather a facilitator and a resource for the students to draw on. Of course their (tutors') role may change from one activity to another and if they are fluent at making these changes their effectiveness is greatly enhanced [2; 3].

As an example we provide the scenario of the business game, designed for lawyers' training.

1.	*Case Name*	Responsibility for unsuitable container
2.	*Key events*	Three containers containing 950 cases of black tea were carried from Shanghai to Hamburg. Due to the fact, that one container was not clean, 350 cases of carried tea were damaged. The container was provided by the carrier and stuffed by the forwarder. The Plaintiff was the cargo insurer, the defendants were the carrier and forwarder respectively. At first instance both defendants were found liable. The carrier appealed, but the appeal was dismissed.
3.	*Main points in the case*	1. Nature of the container (whether it is cargo, an article of transport or part of the ship has never been settled). 2. Responsibility for unsuitable container (having determined that the container is part of the ship, it was difficult for the court to hold that the carrier was liable for the suitability of the container and this was part of the carrier's obligation of seaworthiness). 3. Unsuitable container and liability limitation.
4.	*Contributing factors (N.B! These factors are not listed in order of importance).*	1. Under Chinese law, containers provided by cargo owners are a kind of goods. 2.The Maritime Code says nothing about containers provided by the carrier. 3.The cargo owner should usually inspect the container before filling it. 4.A clause in the contract evidenced by the B/L contained a clause «if a container has not been filled, packed, stuffed or loaded by the Carrier, the Carrier should not be liable for loss of or damage to the contents and the Merchant shall indemnify the Carrier if such injury, loss, damage, liability or expense has been caused by the unsuitability or defective condition of the container which would have been apparent upon reasonable inspection by the Merchant at or prior to the time the container was filled, packed, stuffed or loaded». 5.Under the Hague Rules the seaworthiness liability is the minimum obligation of the Carrier, and cannot be derogated from. 6.The «period of responsibility» of the Hague Rules provides for the time at which «loss of or damage to the goods» happens, not the reason why the loss happens.
5.	*Possible causes*	– human factors (failure to comply with regulations, negligence, etc.); – environment factors (adverse weather, etc.); – technical factors (structural failure, etc.); – mechanical failure (electrical failure, inadequate maintenance, etc.).
6.	*Assessment*	1. The experts record the work of each individual and working groups on each stage. 2. Self-control.

Students need to know how and for what they are being assessed. It will help them to have clear ideas of what they need to concentrate on in future. So, feedback encompasses not only correcting participants of the game, but also offering them an assessment of how well they have done.

The feedback lets participants reveal and come over the difficulties which have arisen out from interpersonal communicating. Use of a feedback allows them achieve high efficiency in work.

The idea of the feedback should be used at creation of model of future lawyers training. During carrying out of role and business games students often appear in inconvenient position, in front of alternatives and, to help them to estimate carried out actions, the tutor's assistant who in this case carries out a role of «approbatory push» is necessary.

The term «approbatory push» in pedagogics for the first time has been offered by E. Malinochka, who marks, that «Owing to realization of «an approbatory push» there are conditions promoting the further course of a dialogue. The trainee comes to condition of satisfaction by the executed action. Positive emotions promote the approach to following action with good mood. Doubts in correctness of made conclusion disappear. The trainee relies on it while other actions performing» [5].

The role of the «approbatory push» is carried out either by the tutor, or other participants of a dialogue. The essence of the feedback is that information on correctness of the decision during educational games, about influence of behavior of a person on other members of a group let them see the correctness of the made decision.

The feedback acts as means of individual development and self-actualization. The task of the tutor is to watch a chain of events during educational games, solving, what amendments need to be brought. The interpersonal dialogue during role games encourages the participant of the group to formulation of own assessment [2].

Of course, while performing roles in a business game, students can make different decisions. It's necessary to remember, even if the decision is different to the expected one, or it is not well grounded, its significance cannot be ignored. Business games are effective when they give opportunity to students to be more forthright in their opinions and behavior than they might be when speaking for themselves, since they do not have to take the same responsibility for what they are saying. Moreover, by broadening the world of the classroom to include the world outside, they let students use a much wider range of language than some more task-centered activities may do.

Business games in the process of training enable students to reflect on the significance and inter-relationships between issues of maritime policy through reference to practical examples and a range of sources. It will also give them an enhanced critical awareness of the factors influencing the formulation and implementation of policy, and teach them to use sources, with critical insight.

6. Situational and functional approach to training

Next model we are going to describe is *the conceptual model* of training of marine specialists. It can be considered as a technological component, based on kinds of future activity adequate forms of the organization of educational process and technologies of training, connected with educational process [1].

Carefully selected scenario and role and business games give opportunity for the tutor to initiate a discussion, to support students while games arrangement. Students will no doubt discover that different options and outcomes are possible. This may give rise to a detailed exchange on different issues, relating to marine practice. It might lead to consideration of what a lawyer's role is when appearing for the prosecution or defense. After detailed debate the business game could be re-run.

For this strategy, special emphasis is given to the Situational and functional approach to constructing the process of the training course [2; 3]. Under this approach conditions of the organization of process of the future specialists training include:

a) creation of the situation developing imitation of a poly-profile and communicative industrial issues, current erudition of a student, readiness of a program and means of quasi-professional actions performance;

b) performance of these actions, tracking of their current results, correction and the further development on their basis of carried out actions;

c) use of modern forms, methods, means of educational process (material and ideal means, information technologies, distant training, creation of the conditions simulating the future industrial poly-profile relations) (fig.2).

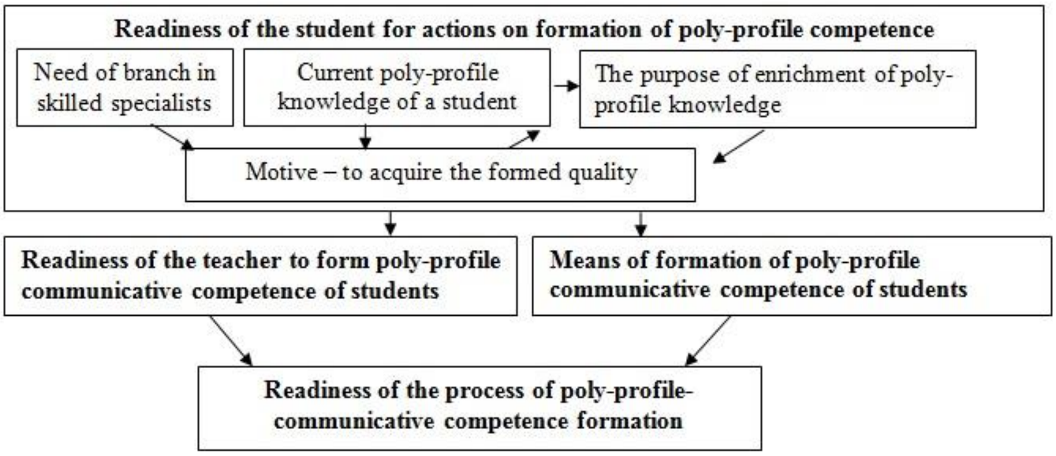

Figure 2. Situational and functional approach to constructing the process of the training course.

Transition of participants of the training process from a simple educational situation to a situation on the basis of integration of the content of training has inconsistent character. On the one hand, it is carried out to provide readiness of process of formation of poly-profile communicative cognition at students. On the other hand, this transition consists in increase in quantity and complication of the processed facts and theoretical knowledge about various objects of activity of lawyers and objects of activity of his partners with the purpose of change of its quality, creation of cumulative integrated ability – poly-profile and communicative competence.

Business games arranged on the base of educational situation are developed on the ground of the analysis of the future specialists' activity, having poly-profile character. During formation of the educational situation its component structure is defined, functional interrelations among components are established and there is a development of separate components in view of achievement of the purpose – readiness of the process of formation of the competence. While the process occurs, this situation continuously changes owing to enrichment of a current condition of students' erudition [2]. Learning on base of business games, reflecting poly-profile functional nature of the maritime branch challenges students to learn through engagement in a real problem.

7. Conclusion

The spectrum of marine specialists' activity is very wide. It covers shipping, navigation, forwarding, logistic, agency organizations and so on. Besides, the international carriage of goods includes accompanying works and services: warehousing, preparation of a cargo for shipment, loading, unloading, handling, care of cargo, information service of clientele, etc. Structure of profiles dictates necessity of poly-profile training of specialists for service of the branch. Conditions, in which it is necessary to realize these tasks, are characterized by a great variety and complexity that define requirements to quality of marine specialists training. In this connection the the offered innovative methodological approaches – poly-profile and communicative – to the design of content of maritime education and situational and functional approach to constructing the process of the training can be considered as a ground for successful learning outcome – poly-profile and communicative competence.

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Formation of Professional Analytical Competence of Specialists in Maritime Transportation during the Training Process through Business Games

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The paper considers the use of gaming methods as a means to improve the efficiency of formation of the analytical competence and systems thinking of students and specialists which are among key objectives of specialists training. The actual task is to elaborate innovative methods and models for formation of the analytical competence.
A design approach and methods of game simulation experiments are the basis for organization of professional competence development. The set of professional games was worked out for this purpose. Such set is based on Organizational-Active Games (OAG), simulation models and business games. Elements of the set are logically correlated in time and space and include interdisciplinary links. The set orients both to development of the analytical competence and the professional preparedness in general. The training experiment has been conducted since 2010 at the “Transport organization” department of the Baltic Fishing Fleet State Academy. Those students who study subjects: "Transport Logistics", "Fleet management ", "Port management" and "Methodology of transport processes and systems designing" took part in the experiments. An analysis of experimental results showed that the use of the set of OAG and simulation models in the training process allows to improve significantly the quality of specialists’ preparedness.

Keywords: professional analytical competence, game experiments, simulation models, designing games, quality of specialists’ preparedness

1. Introduction

One of the key limiting factors of the problem of improvement of the efficiency and safety of the maritime transport is the level of the personnel professionalism. The relevance of the problem is emphasized in some papers published in proceedings of various conferences carried out by such international societies as International Association of Maritime Universities (IAMU), International Association of Maritime Lecturers (IMLA), International Association of Engineering Pedagogy (IGIP), etc. [1,2,3,4,5]. Many documents (Conventions, Codes, International Standards, Recommendations, Circular letters) of the International Maritime Organization (IMO) are devoted to these problems. Even the IMO slogan sums up its objectives: “safe, secure and efficient shipping on clean oceans”. The important document which is called “A concept of a Sustainable Maritime Transportation System (SMTS)” was presented at the World Maritime Day in 2013 [6]. According to the concept, the maritime transport exists in conjunction with the many shore-side infrastructures, services and personnel for cargo handling and delivery and for the financial and support services essential to maintain an efficient i.e. cost effective, reliable and seamless operation. SMTS is a vital link in an international logistics chain, moving cargo across the world at the service of global trade, economic development and growth. By the same token, all actors in the chain are equally essential for SMTS to work cohesively. The concept pays the special attention to education and training in maritime professions and support for seafarers. The document emphases that SMTS will require training, education and capacity-building of maritime professionals for the broader system including engineers, lawyers, port personnel, ship managers and senior policy administrators. SMTS requires properly trained and educated seafarers.
Results of the above mentioned problem’ analysis show that there are contradictions between the growing volume of information, improvement of technique and technologies, the level of knowledge required for effective professional activity and limited possibilities to develop and update this knowledge within the period of study at a higher institution [7].

Business and simulation games are used for a long time in a training practice [8,9,10,11]. But most of games are focused on the development of skills and abilities for standard professional tasks solutions. Scenarios of such games are usually premeditated to a strict algorithm. In fact, they are a kind of professional training. A lot of simulators have now developed in the maritime industry in order to train practice skills of specific professional activities. The term "gamification" uses now as an educational tool for the maritime industry [12]. The maritime community is well accustomed to simulation as a feature of Maritime Education and Training (MET) and would recognize full mission simulators for competency training and assessment. But would it recognize a "serious game", perhaps played out on the decks of a virtual ship as simulator training? Or would it associate full mission simulation with serious gaming which, as noted above, is about the creating an environment in which to develop specific knowledge or skills? [2].

But to find solutions in unusual situations specialists with well-developed systems thinking are needed. They should be able to analyze such situations that requires to use knowledge in various subjects and to find solutions that do not have (in most cases) prototypes or samples. Therefore the analytical competence of specialists is considered as a basic one. Training such kind of competence it is possible significantly increase the effectiveness of specialists' preparedness and development of professionalism in the field of maritime transport.

The analysis of the current practice of specialists' training in the field of maritime transport [1,4] enabled to draw the following conclusions:

- the main attention is paid to studying disciplines of the professional cycle during the training process, i.e. to develop professional competences;
- the contradiction between the need to integrate knowledge in different disciplines and the differentiation of the teaching of the subject knowledge within each disciplines taking into account the final goals of education at a higher institution;
- insufficient level of knowledge and skills in configuration of interdisciplinary knowledge in order to analyze problems and solving complex tasks (e.g. in the field of transport logistics);
- due attention is not paid to the analytical competence formation, which is a necessary condition for the development of skills to analyze and solve complex production tasks;
- a significant obstacle for development of the maritime specialists' analytical competence is the lack of methodological training in the integration of interdisciplinary knowledge for the analysis of production situations and solving non-standard tasks.

It was hypothesized that the use of the set of business games and simulation models during training will significantly improve the quality / level of formation and development of the analytical competence and development of professionalism of specialists in the field of maritime transport. To test this hypothesis we have developed such a set which is focused on developing skills and abilities to analyze and solve complex situations / problems (e.g. designing transport and logistics systems without prototypes, optimization of design solutions, risk assessment, etc.).

2. A gaming technology approach

2.1 A practice of business games

In this context the issues related to the development and implementation of innovation methods and models of formation of analytical competence of specialists in a learning process, both at higher institutions and in the system of continued professional education, become quite relevant [7].

For a long period authors have been carrying out studies to assess the effectiveness of "gaming technologies" in the process of training and improvement qualification of maritime professionals [4]. In particular, business games were used for training specialists in the field of maritime transport. A content of such games was oriented on actualization of professional knowledge during the study of some subjects such as "Transport logistics", "Fleet management" and "Port management".

The main objective of the games was the development of algorithms for the solution of logically related local tasks and communication links between participants of the game.

Such an approach gave positive results in terms of learning techniques and technologies of solutions of standard situations and tasks. However, students had serious difficulties when solving the complex situations and tasks.
In particular, participants were asked to respond to several theoretical test questions in the fields of theory of ships, cargo transportation, fleet management, etc. Test results showed that they answered all the questions. Further, the participants were offered a complicated task which is quite rare in practice. A wrong solution in this case can lead to negative outcomes (accidents, cargo losses, loss of the ship). Unfortunately, only five participants (from three groups of 25 people) coped with the task. Obviously, these participants had a higher level of professional training and personal analytical skills, i.e. they had the so-called "quick mind". The paradoxical nature of this result is that for the analysis of the suggested situation and finding the correct solution of the task was enough knowledge that students have shown during testing.
This example and other results of the educational technologies evaluation have shown that the main reason of difficulties in analyzing complex situations and solving non-standard problems are disadvantages of methodological training and the development of analytical competence both of students and of specialists.
The other conclusion is that gaming technologies in the learning process are effective for updating knowledge and skills for solutions of professional standard tasks. At the same time it is necessary to develop business and imitating games with a target set for the development of systematic thinking and formation of analytical competence. Also development of professionalism is the actual goal of training.
Results of such organization - activity games (OAG) have shown their high efficiency. However, there are difficulties of such games using at the university (academy) due to time constraints in the curriculum. At the same time the use of OAG in the system of advanced training and continued education is a necessary part of the learning process.
Integrated Professional Business Games (IPBG) and OAG are among the most effective methods of formation students' and professionals' skills to integrate interdisciplinary knowledge in order to solve complex professional tasks and to develop their systems thinking.
IPBG can be considered as an integrating course and a method of intensifying actualization of knowledge. Results of such games are: the analytical competence formation; the effective method of developing professional competence and the practical experience to solve the complex, unusual situations; a method of testing and evaluating the professional competence of specialists.
The Baltic Fishing Fleet State Academy (BFFSA) trains specialists within the speciality "Organization and management of maritime transport".
The project approach and methods of game simulating experiments described above are the basis for organizing the process of the students' professional analytical competence development [4].

2.2 The set of integrated professional business games

The set of Integrated Professional Business Games (IPBG) and OAG was worked out for this purpose by authors of the paper. Such a set is based on OAG, simulation models and designing games. Elements of the set are logically correlated in time and space and include interdisciplinary links. It means that every game has integrating character covering all the processes related to maritime transportations. It requires the use of knowledge in many special disciplines. The set orients for both the development of analytical competence and the development of the professional preparedness in general.
The goal of IPBG is development of analytic preparedness of students to solve the complex tasks in the field of transport organization and management.
Short contents of games included in the set are given below:
1) OAG "Analysis of problems of the regional transport complex development" is oriented on the development of systems thinking and studying methods of a problems' analysis. The game scenario includes the following stages:
- goals statement and game set; self-organizing game groups of participants;
- work in groups, i.e. a situation analysis, identifying and formulating problems, structuring problems and their analysis, etc.;

- elaborating the programme of the regional transport system development;
- group reports and discussions;
- summing up the game and preparing recommendations for postgame activities of students and professionals.

2) Simulation models "Forecasting probabilistic estimates of the state of the transport system", "Organization and evaluation of the port terminal activity", "Evaluation of the investments effectiveness in strategic planning" are oriented on the development of skills of analytical works. These models have been successfully used to study the behavior of transport systems in terms of a change of probabilistic parameters and factors affecting the functioning and development of the system;

3) The business game "Designing Transport and Logistics Systems (TLS) of goods delivery" is carried out with the purpose to give students practical skills of interdisciplinary knowledge integration to solve integrated design problems, to develop skills of an analysis and design solutions optimization. Figure 1 shows a block diagram of the game.

First stages are traditional for business games, but stages 2.7 – 2.18 have specific transport-logistic contents.

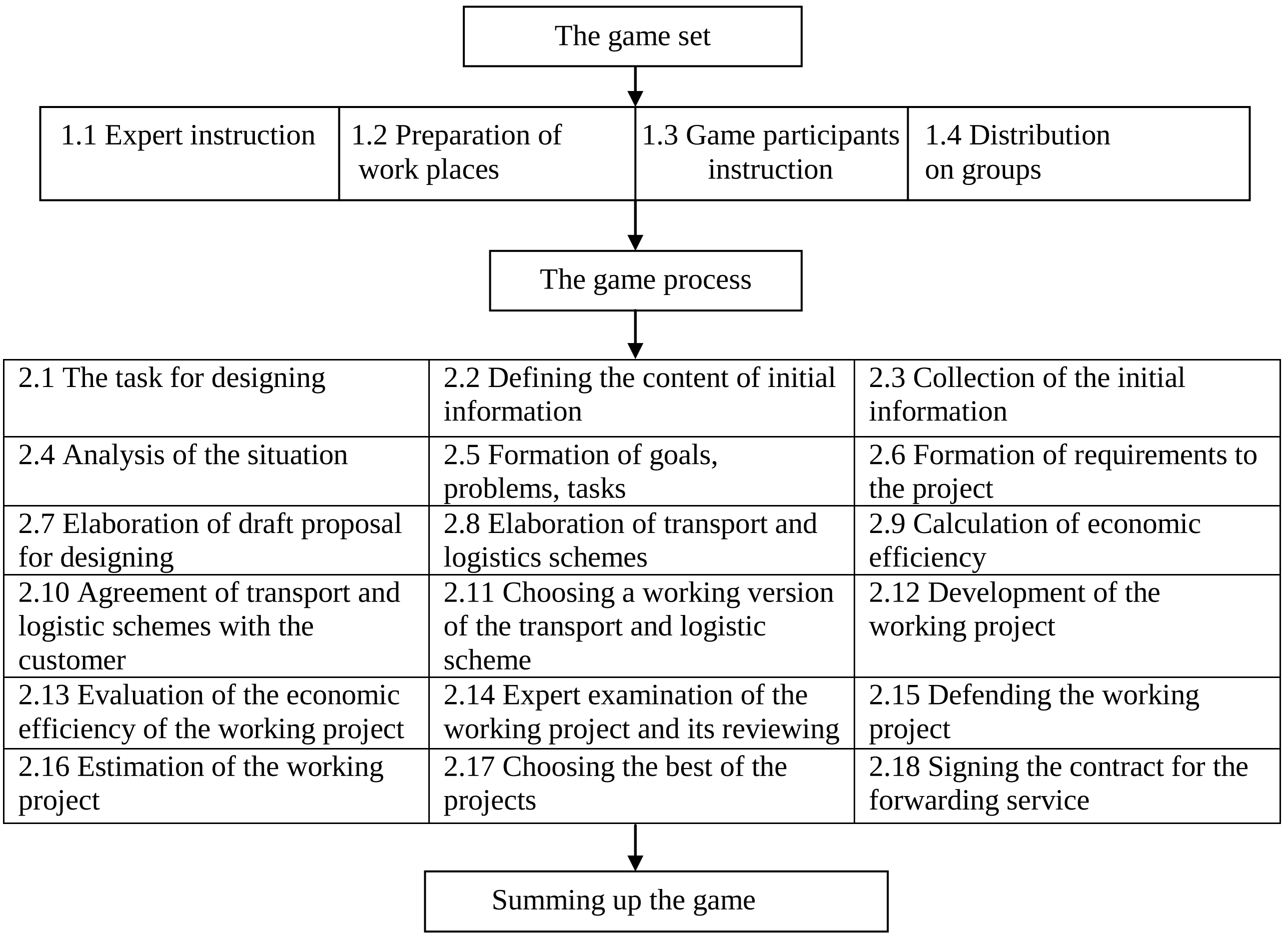

Figure 1 Structure of the business game
"Designing Transport and Logistics Systems (TLS) of goods delivery"

4) Integrated business game "Development of Transport and Production Logistics System (TPLS)". This game was work out by authors taking into account the special field of training in BFFSA. The game is based on a simulation model of the fishing and fish-processing system.

2.3 The simulation model

This model simulates the following processes:
- transportation fish/bioresources from fishery grounds to the port;
- unloading and warehousing cargo in port refrigerators;
- delivering fish/bioresources to the processing plant;
- warehousing and storage of raw materials stocks;
- production of fish products;
- warehousing and storage of finished products;
- shipment and delivery of finished products to the domestic and foreign markets.

The structure of this simulation model is presented in Table 1. The production processes which will be simulated are considered at each stage of the structure and appropriate simulation methods are suggested.

The integrated simulation model includes several modules interconnected between themselves and the external environment. Modules are designed on the principle of community processes.

These modules: transportation; production; storage and stocks management; sale and delivery of products to consumers; information and analytical support for the design and management of transportations and basic tasks that have to be solved are presented in Table 2.

Volumes of raw materials transportations and production of fish products shipments to the domestic and foreign markets; the capacity of technological lines and cargo handling are considered as the controlled variables in the simulating model. Probabilistic estimates of the products demand, the impact on the transport processes of natural factors, probabilistic assessment of failures of vehicles and technological lines are considered in the model as uncontrolled variables.

Table 1 Structure of the simulation model of transportation and production systems and methods of the processes simulation

Stages	Simulated processes	Methods of the processes simulation
1	Transportation of raw materials from fishing grounds to the port.	Mathematical methods and heuristic techniques of the types of ships and routes selecting.
2	Unloading and storage of raw materials at the port	Technological schemes of cargo unloading and storage.
3	Transportation of raw materials to processing plant	Mathematical methods and heuristic techniques of determining the rational delivery routes.
4	Warehousing and storage of raw materials stocks at the plant.	Warehousing technological schemes of finished products. Technological conditions of products storage. Optimizing stocks.
5	Production of fish products.	Methods of optimization of production plan.
6	Warehousing and storage of finished products.	Technological schemes of warehousing finished products. Technological conditions of products storage. Stocks management.
7	Shipping and delivering products to the domestic market.	Methods of optimization of routes delivery of products to consumers.
8	Shipping and delivering products to the foreign market.	Designing transport and logistics systems of products delivery.
9	Paper work.	Information technologies.

Development of the simulation models for various activities of specialists in the field of the transport organization is the quite complex and time-taking task.

In this regard, it is considered two main approaches to the creation of practice-oriented simulation models:

Table 2 Simulating modules and basic tasks

№	Module	Basic tasks
1	Transportation	Optimization of ships types selection; Optimization of transport routes; Optimization of loading and unloading; Minimization of transport costs; Risk minimization.
2	Production	Forecasting the demand and proposals on the products market; Optimization of production plan (e.g. fish production); Calculation of the need for raw materials, technological and other kinds of supply; Production quality management.
3	Storage and stocks management	Optimization of products warehousing; Stocks management of raw materials and finished products; Quality control.
4	Sales and delivery of products to consumers	Concluding contracts for products delivery; Selecting transport modes and optimization of supply routes; Minimization of transport costs; Designing TLS of products supply to the external market.
5	Informational - analytical support of designing and management of transportations.	Monitoring market, transportation and production; Forecasting the demand for transport services and products; Solution of optimization tasks given by customers (transport, production, warehousing, sales and delivery of products); Formation of databases; Conducting research.

1) a method of scenarios with reference to computer programs for tasks solving that can be formalized;
2) designing an automated system transport and production logistics systems, which may be used as the simulation model.

In the case of the first approach it becomes possible to create a simulation model and then to use it in the training process. All the modules are sequentially checked by the practice, a material (positive results, shortcomings, guidelines, etc.) is accumulated for analyzing the content of the module structure and methods of conducting gaming simulations. The results of such analysis will be useful when creating an automated system/imitating model.

The simulation model and some its modules are used in the training process to study such subjects as “Transport logistics”, “Port management”, “Fleet management”, "Design methodology of transport processes and systems". Monitoring the effectiveness of the use of simulation modules in the training specialists in the field of organization of transportations and transport management shows a steady tendency to improve the quality of learning and the ability to apply interdisciplinary knowledge for solving practice-oriented tasks.

2.4 The training experiment

The training experiment was conducted at the department of transport organization with students of the fourth and fifth years. They study above mentioned subjects. Students were divided in two groups: the first is “a control group”, the second is “an experimental group”. Classes were held on the following methodological schemes:

1) students of the first group have to solve tasks by traditional methods (in accordance with the lecture material);
2) students of another group carried out gaming simulations using models of the modules:
- "Transportation of raw materials from the fishing ground to the port",
- "Unloading and warehousing of raw materials at the port" and
- "Delivery of raw materials to the processing plant".

An input testing of each subject in both groups was conducted in the beginning of the study. Tests included questions on different subjects, because knowledge of them is needed to successfully solve the practical tasks both students and future professionals. Then each group worked on its program of classes. After completion of the subject "Transport Logistics" study both groups received the task to design a transport and logistics system (TLS) of the goods delivery.
The results of verifying the implementation of the task by students of the 1st (control) group showed:
- the work was carried out without a proper analysis of the situation and factors affecting the transport process;
- the internal logic of the work not clearly expressed;
- routes optimization, a choice of transport means and technologies of cargo processing at ports have not been conducted;
- alternatives TLS were considered perfunctory;
- an influence of risk factors was not taken into account.
The results of the work of the (experimental) group that used the simulation modules have shown:
- the task was fulfilled almost twice as fast the 1st group;
- students performed an analysis of the situation and formulated goals and optimization tasks;
- TLS of goods delivery was developed and several alternatives with optimizing design solutions were considered;
- the project was examined on the steadiness when the values of controlled variables are changed and the influence of random factors.
The training process for students who have studied subjects "Fleet management", "Port management" and "Design methodology of transport processes and systems" was the same, but the composition of the solvable tasks was changed.
Solutions of tasks in the "control" group were made on specific examples.
In the "experimental" group using simulation modules, the statement of the general problem was initially formulated. Then an analysis of the situation was performed, "problems of bottlenecks" were defined, goals and structure of tasks including optimization ones were formulated.
Further the plan of the game simulation experiment and designing TLS were developed.
During the game simulation experiments the main attention was focused on optimizing the design solutions and the research of "behavior" of the system when changing the inputs, controlled and random variables, on the analysis of risk factors and their minimization.
The final estimation of this students' practice-oriented work made by consideration of the course projects on the above mentioned subjects. The experiment is carried out since 2010. Comparative assessments of the level of students grounding are: “experimental” groups – 5.0 (excellent); “control” groups - 3.3 (a bit more than satisfactory). Thus, the use of integrated business games in training gives a possibility to develop analytical competence of participants in the experimental groups and their readiness to solve complex practical problems. There was no such effect in the control groups.
The analysis of the experimental results showed that the use of simulation models and integrated business games in the training process allows, ceteris paribus, to improve significantly the quality of specialists grounding.

Conclusion

1. Using the traditional approach to classes' organization students who solve particular tasks get only "samples" of knowledge, abilities and skills. It does not develop enough the analytical component of knowledge. Students do not know how to configure their knowledge and skills to solve complex problems of organization of transportations, as well as problems related to the analysis and research of problems of the transport management.
2. Elaborating simulating models and integrated business games and their implementation in the practice of specialists' training allows to solve such important tasks as:
- development of analytical abilities of students / professionals and their preparedness to make the analysis of complex systems and problems of the transport processes management;
- development of skills for designing transport processes and systems, optimization of design solutions;

- formation of skills for research of "behavior" of the system in the changing conditions.
3. Using simulation models in the design of transport and production systems allows to optimize many decisions and to improve the quality of projects.
4. Methods of simulation models and integrated business games in training processes can be successfully implemented in the advanced qualifications and the distance education systems.

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The Impact of Modern Technologies on Maritime Training and Research

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Today we need safer seas and for that we need better trained seafarers. The seafarer's training process starts during university years and continues at sea during training onboard vessels. The training process is based on theoretical and practical knowledge in various university lectures.
The former educational system had a ratio of theoretical and practical knowledge favouring the first. Today, the main objective is to improve practical knowledge or to apply theoretical knowledge into practice. An important role for this transition is played by the use of modern technology, including specialized computer programs and simulated applications performed during the training process. By using simulators, real conditions can be created concerning real work on the ship's bridge and ship's engine room even before being actually there, and in this way, the first encounter with real situations will be more easily treated and managed with adequate skills for the necessary activities of their future duties.

At the same time, the use of research methodologies based on modern technology provides a projection of safety at sea. Many of the actual brilliant ideas dealing with the protection of maritime environment or for new propulsion types were born during different research programs. In our university, most of the PhD students use in their research activities' simulation and specialized programs to study different situations developed in their theses. In this way, there have been developed and studied many ideas and opportunities related to maritime transport and its challenges. Therefore, modern technologies were used for studying the feasibility of the off-shore terminals in the Romanian Black Sea and the impact of environmental conditions on ships in different operational conditions, possibilities to use innovative propulsion systems were studied, such as the kite, and the effects generated by it on ship's stability and governance, and, another purpose was to see what new and improved solutions can be used for ship's refloating.

In this paper we intend to present which is the importance of the latest technology in the training process and research activities in the field of maritime transport and education. Results of these areas of interest are seen every day, and their quantification is expressed by the constant improvement of ships and maritime safety. We want to emphasise that the success of future activities is the result of today's research and training activities.

Keywords: technology, research, training, opportunity, MET, safety

1. Introduction

Nowadays, the maritime training system uses two methods of teaching and training, the traditional way, based on printed texts and courses and the modern way, using computerized technologies, such as simulators, virtual reality and online courses. Both concepts are useful, because not all types of information can be communicated using only the traditional or the modern one.
First, there is the fundamental information, which is better transmitted using the traditional way, where the teacher clearly explains terms, definitions, and formulas and interacts with students for a better understanding.

The main goals of any scholar system are to provide a better training for future jobs and to provide opportunities for innovation through research activities. Both goals can be reached by using the appropriate technology. For training purposes, technology offers the possibility to acquire knowledge in different fields by using practical applications.

Maritime training has reached a great advance in technology which is used in training in the last years. Nowadays training process involves simulators and computerized programs for 90% of the onboard equipments and activities.

Navigation, engineering, cargo handling, pollution prevention and many other maritime related activities are based on the use of simulators for acquiring knowledge and competencies' development. The technological advance helped students to get to know onboard equipments before the direct physical contact, which leaded to a better understanding of their functioning and an easier accommodation with them onboard.

Technological training has the role to improve the trainees' skills and capacities of reaction in dangerous situations, which is difficult to be provided through the classical ways of training.
When it comes to research activities, the last years' changes in the concepts and the principles of maritime activities, leaded to new opportunities for research. Most of the developments in the fields such as ship propulsion, ship stability, and integrated navigation, have started from a research idea.
The future successful activities are developed through research programs and training processes today.

2. The Connection between Technology, Training and Research

Nowadays, computers and computerized programs are a very important part of our life. The computerized technologies are becoming indispensable for many activity fields, computers being part of the educational processes, or even the essence of these.

Various technologies such as simulators, computerized programs and many types of virtual learning such as web platforms and virtual campuses are used today for training purpose in the maritime academic field.

All these have their own history and evolution, some faster, other in time, but all, as single or combined, help to reach the final goal, better trained seafarers for more and secure oceans.

From all these training procedures, the first were the specialized training programs, based on computerized technology and used mostly for designing and studying different processes. Being the pioneers, these programs did not have a very expressive way of revealing the results and in fact, the procedures for obtaining these results were difficult. Having a poor data base, it was necessary for applications to know the entrance data and all usable variables as user. In time, these programs have been improved and in a short period of time they became indispensable for training courses regarding ship design, engine design and engine internal processes, and liquid cargo transfer or in situations that request a detailed study of thermal and tensional processes inside different parts of ship's body.
The next step in the technological development of the training process has been marked by the advanced computerized programs, more complex, with a more realistic presentation of processes and operations - the simulators. Basically, the simulators consist of computerized programs, but the graphical expression is more evaluate, the images offered are closer to reality and in this way, they allow the user to interpret easier the information.

The use of simulation in providing solutions to the problems of risk and crisis management and the optimal use of crew resources has a long established pedigree in maritime training. [1]
The early simulators consisted of real radars, located in a set of cubicles, and fed with simulated signals. Individuals or teams could learn the skills of radar plotting under the guidance of an instructor working at a separate master console. Other navigational aids in the simulator were fairly basic and certainly did not include a visual scene.

Bridge simulators with a nocturnal visual scene made their appearance later and allowed teams to conduct simulated passages in a realistic environment but with only a few lights available to indicate other vessels and shore lights.

Simulator-based training courses were introduced primarily to train the skills of passage planning and the importance of the Master/Pilot relationship. [6] This training initiative developed into the Bridge Team Management courses that are conducted today on many simulators world-wide and contain many of the elements to be found in Crew Resource Management courses developed in other industries, such as aviation. These courses were developed to focus on the non-technical skills of flight operations and include group dynamics, leadership, interpersonal communications and decision making.

The 1980s saw the introduction of Engine Room simulators and towards the end of that decade, cargo operations simulators also became available. These types of simulator have primarily been used to train officers in the handling of operations, including fault finding and problem diagnosis, and increasingly to train teams in the skills of systems, resource and risk management.
Many types of simulator: bridge, engine and cargo control room, have tended to emphasise a physically realistic environment in which these exercises occur, although in the PC-based simulators for training some tasks are increasingly widespread. [9]

In some parts of the world, there have been developed simulators which have very high levels of physical fidelity, for example, multi-storey engine room mock-up and bridge simulators including features such as 360 degrees day/night views, pitch and roll, full vibration and noise effects.
The only mandatory requirements in the maritime domain for the development of the non-technical skills of crisis management are those of the International Maritime Organization's (IMO) Seafarer's Training, Certification and Watchkeeping Code. Table A-V/2 of this code specifies the minimum standard of competences in crisis management and human behaviour skills for those senior officers who have responsibility in emergency situations.

The simulators used in the maritime officers' training are a compulsory request of the STCW Convention and Code in order to provide an increased safety of maritime activities.

The competence assessment criteria detailed within the Code are not based on specific overt behaviours, but rather on generalized statements of performance outputs, and as such are highly subjective and open to interpretation.

Although these standards of competence indicate that IMO recognizes the need for non-technical management skills, both the standards and their assessment criteria are immature in comparison with the understanding of non-technical skills, and their assessments, within an industry such as civil aviation.

The use of simulation and modelling in the innovation cycle demand a higher degree of flexibility in simulation technology than required for the training function. Simulators need to be able to accept input from a variety of model data, and need to be able to interact with other simulators in unusual and unique situations.

Open systems with modular and recyclable components are required in order to mobilize the broader academic, scientific, engineering and corporate communities to integrate simulation and modelling into the innovation process.

Last but not least, the technology used in the actual training process uses the virtual techniques through its components as on-line teaching and web based applications.

The incorporation of the elements of information and communication has been highly accepted and renowned as valuable aspects in the formation process of engineers and technologists.

The advent of on-line technologies coupled with an emerging recognition of the importance of effective teaching are acting together as catalysts to change the face and nature of teaching and learning across all sectors of education. Significant changes appear to be emerging in higher education and in many components of school education. Through on-line technologies, we finally seem to have the means to create the learning environments that we know work best. The classroom of tomorrow is starting to emerge and it is quite different to the classroom to which many are accustomed. Perhaps the most noticeable difference is in the roles of the participants. Everyone seems to have to do things a bit differently. [8]

On-line learning can be an active and engaging experience. There's not much room for spectating in a well-designed on-line learning environment. Students are encouraged to collaborate and work together. The environment is usually one of a shared learning space with learners attentive and receptive to others in the class.

Move to on-line is coinciding with moves to more authentic learning settings. The on-line technologies encourage and support such strategies as problem-based learning, case-based learning and even work-place learning. The concept of a classroom as a place of learning is expanded as the classroom loses its boundaries. [8]

Learning on-line encourages and supports the development of a range of students' key and generic skills. There are many useful skills that can be developed through networked learning including information literacy, task management and working with others. Learners become self-sufficient and aware of their own role in influencing what is learned. It's all about whom takes responsibility for what is learned.

As educational systems move to embrace new environments and new roles for learners, all with the learners' best interests in mind, teachers and administrators must be aware that change processes are complicated and often fraught with difficulty. Many learners are often not prepared for willing to be self-directed and independent just yet. [3] Learners often need to be encouraged and induced into the changed roles and need to be consulted and negotiated with to gain their cooperation and consent. [7]
Today it is difficult to talk about research activity and not to involve any technology. Many of the engineering processes are able to be studied because of advanced computerized and simulation programs. The research activities involve in many sectors the use of simulators and/or modelling programs. If research represents the advanced frontier in knowledge, simulators and virtual environment represents the top of technology.

3. Modern technology impact on maritime training process

The use of the latest technology during the training process in the maritime field has a good impact on increasing safety and security overseas. This impact, as a result of training, is seen in time and evaluated from feed backs received from companies where graduates work after graduation. Another method to evaluate the impact, as general evaluation, is represented by the reports of international organizations regarding safety at sea and from them to extract the percentage represented by our graduates. Either way, using one or another way for finding the impact of the latest technologies used for training, the result is comparable, these technologies proving their role in the most important aspect at sea, increasing safety. [2]

The main technology used for specialized deck and engine officers is represented by the simulators and specialized computerized programs. In this category there are four important simulators, the ship handling simulator, the engine room simulator, crisis management simulator and liquid cargo simulator. Each of them has its own characteristics, allowing the interconnectivity and complex applications creation. For use in interactive situations some requirements must be covered, the most important being to have operational system compatibility, mostly if made by the same producers.
Nowadays simulators cover many requested functions for a proper training of maritime officers, as ship handling in normal and dangerous situations, operation of ship engine and auxiliary equipments, land and maritime operations in case of environmental disaster after maritime accidents in coastal waters. All these trainings are compulsory for a properly trained maritime officer, offering options to perform and react according to the situation.

During training, students have the opportunity to practice on simulators during many specialization courses. These applications help them to improve their skills and to reach the proper knowledge level for their future daily duties.

When it comes to the interest raised by simulators, according to the last years' university's statistics, the number of students passing through the simulator training process increases, with good results in their future activity and also with good appreciation received from the shipping companies.
According to shipping companies' feed-back statistics, younger officers with duties regarding safety in navigation, trained on simulators more than two years, are able to react faster in over than 50% of the dangerous situations, then their colleagues trained under the classical style without training on simulators.

In the engine department, this percentage is over 70%, due to simulation applications during training and use of other computerized programs specialized for the use of engine systems.
In the field of online training our university experiences this option through a course for familiarization training for oil tanker ship operation. In this online course, students and already certified seafarers interested to attend a job on a tanker, have the possibility to visualize simulated applications regarding different operations necessary to be known on a tanker, previously reading and learning the correspondent theoretical modules. [10]

Analyzing the results after one year of training in this way, we may conclude that the students who attend this course benefit from a higher understanding than from the classical one, the explanation being in the access possibility from home or from onboard ships by students during the cadets' practice or by the already certified officers on duty. The success is based also on the option to see simulated applications and to be familiar with particular installations and operational procedures characteristic for oil, chemical and gas carrier ships.

In the same way, tankers operating companies increase their interest to take onboard cadets from our university, cadets who prove to have the necessary knowledge and skills in order to work onboard these ships and offering them the opportunity to develop a future career inside these companies with great professional and financial perspectives.

4. Use of the latest technology in research activities

In Constanta Maritime University, the technology is used successfully in the research activities and in the training process. Many of the research programs that request specialized programs or simulators are realized involving both teachers and students. Three quarters of the doctoral studies are based on the latest technology in different proportions. Doctoral theses about innovative ship propulsion systems, reduction of liquid free surfaces effect, new ideas to refloat a grounded ship, offshore oil terminals risks and advantages, were completed by using simulators and research computer programs.
There is no favoured simulator used for research activities. All existing simulators in the university at this moment are used for different research programs. Some of the research ideas developed and finalized due to the use of simulators will be presented below.

One of the research ideas involving simulators for the final results was to determine innovative solutions for refloating ships after a grounding event. The principal subject developed in this project was to found solutions for refloating ships totally different from the actual procedures, based especially on the ship's own means.

During the simulation, it is presented the ship's movement towards the area where the grounding event is going to take place. The water depth decreases gradually, and initially, in deep water, the ship maintains her course but suddenly, due to a decreasing depth and shallow water influence, the ship's course has a deflection towards one of the boards, in this case towards portside. [12]

The bottom of the sea chosen for the grounding event is an argillaceous one and it implicates one of the worst situations for a ship to ground on, because it is very difficult for the ship to recover her floatability and to reinstate her floating status due to argil's density and the fact that it is very adherent material.

During the simulation sessions it was noticed that, in spite of all efforts, the ship did not manage to refloat herself by using her own means of propulsion and manoeuvring. During the simulation sessions the engine was used up to 'full ahead' and 'full astern' and the rudder was sequentially used from 'hard to port' to 'hard to starboard'.

A series of parameters regarding elements of aerodynamic resistance have been selected. Initially, the influence of surface wind was not taken into consideration and so, the values of the parameters seem to be influenced only by the lateral force and longitudinal forces created due to the existence of shallow waters that push the ship away from its course. [11]

Another interesting subject developed using simulators was related to the possibility of implementing an offshore oil terminal in the area of Constanta harbour. To obtain clear results regarding the risks for the ship during operation in an offshore terminal, under the particular conditions of the Black Sea, there were used both the ship handling simulator and the liquid cargo handling simulator.
The simulation was developed for different situations met during operation and in concordance with the geographical and weather conditions for Constanta area. There were made five simulations, based on the most frequent winds in the region, for five different loading conditions.

The analysis of simulation results allowed to determine the risk situations that can appear and what operational actions must be taken onboard ship's in order to reduce the environmental factors' effects on the ship during operation and to prevent ships' positioning in a dangerous, possible disastrous situation.

Results of the studied situation led us to the conclusion that the case scenario can be dangerous, because of the wind force and wave height, but also operable if the trim and heel of the ship are strictly supervised and properly corrected, in order to avoid the situation of higher tensions in mooring lines and, in case of more extensible lines, to reach the broken force value. [5]

In the field of innovative propulsion for pollution reduction there is a subject developed using simulation programs, the pollution reduction by using the kite as complementary propulsion.
From the foregoing results it is clear that kite propulsion has good results and its use together with the main engine propulsion means a new opportunity, until now considered unconventional.

This method has been tested and the results were considered satisfactory. A dynamically flown kite can generate up to 25 times the force of a static aerofoil or kite of the same plan form area. A kite attached to a relatively low mast also generates a much smaller heeling moment than a conventional sailing rig and occupies much less deck area – making it suitable as a retro-fit also. The uplifting forces of the towing kite also mean that the hull slices more smoothly into the waves, thereby increasing safety.

There are three major advantages of kite rigs as compared to conventional sailing rigs. First, since a kite flies approximately 150 – 200 meters above the water, it works above the turbulent boundary layer of wind over water that conventional rigs must deal with. As power derived from the wind varies with the square of the wind speed, 25-70% more energy is available to the kite.

Kites can power a boat without the dangerous overturning moments inherent in masts and sails. Kites can fly high up in the sky, far from the effects of the waves and of the boat hull, in steadier and stronger wind conditions. Current kites can achieve a lift-to-drag ratio of about 6 to 1, which can sometimes give a boat more versatility and more power than is possible with masts and sails.

Wind technologies are used on ship as assistance to the main engine because the power produced by the wind alone is not enough to move the ship at the contract speed. [4]

5. Conclusions

A successful training is supposed to use all necessary means to reach the goals and competency objectives. The last years' technological evolution imposes changes in the academic training system, more precisely requesting the inclusion of these technologies in the training process as compulsory.
In the maritime academic training field, this necessity has been imposed by the crewing market which was interested to have better trained people and at the same time more competent for the new challenges brought by the technological changes arisen on board ships. Not only the maritime field requested applying innovative teaching methods during training, but also connected activity fields, such as port operators, traffic control and maritime business sectors have shown their interest in the use of the latest training procedures.

Applying the latest technologies during the training of future maritime officers with applications in the connected activities will lead in time to a significant reduction of dangerous events at sea, such as accidents or oil pollution, in a percentage of 40 to 90. The most important reduction has been already seen in the pollution area with direct result in the state of the environment, statistics of the last years showing only accidental pollutions with small quantities without significant impact on the marine and shore environment.

Studies conducted by our university regarding the impact of usage of high technology in the training process show a considerable increase of safety conscience compared with the time when training was based only on classical methods. The confirmation of these results has been given by the feed backs from partner shipping companies, which appreciate favourably the present trend in the training process.

We think that in the future the technology will have a higher position regarding safety at sea. The actual technology will be more easy to use by the persons in charge and the results obtained in this way will increase the level of safety and will give a much more profound trust in personal capability to offer a safe environment for others.

The future of the research activities will be focused on the use of the highest technology. This technology will allow researchers to have results impossible to be gained by the classical methods. The research studies in the field of maritime transport are possible to bring, in the near future, totally new solutions for ship propulsion and navigation, with an increased level of safety for the ship, people and environment.

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Application of the Keller Plan to Marine Education in the 21st Century

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The Keller Plan (sometimes called The Personalized System of Instruction or PSI) was developed by Fred Keller and his associates in the mid 1960's as, among other things, an alternative to conventional classroom teaching as had been practiced for thousands of years. Since then, the Keller Plan has received very positive evaluations by students and in well-designed experiments, grades on both quizzes and final exams were "significantly and considerably" higher for Keller Plan participants as compared to students in lecture sections.

At the Marine Institute, our experience with marine education has led us to develop an instructional method very similar to the Keller Plan. This paper will outline the benefits of the Keller Plan and how these benefits are transferable to the current model at the Marine Institute. It will also report on the implementation of the Keller Plan and its favorable reception by current students. Based on the experience so far, it is anticipated that students following this model will enjoy above average success in the government set exams.

Key Words: Keller Plan, Teaching Methods, Marine Education, Applied Mechanics, Distance Education

1. Background to the Keller Plan

The Keller Plan (KP), or as it is sometimes called the Personalized System of Instruction (PSI), has been developed and known for almost 50 years. Discussed by Fred S. Keller in his paper "Engineering Personalized Instruction in the Classroom" [1] and then refined and presented in the paper "Good-bye Teacher" [2], the KP was based on his experience in teaching in the Signal Corps during World War II. In that position he noted that the training was highly individualized in spite of large classes and that there was a clear progression for students to follow with a demand for near perfection at every step combined with clear terminal skills. The result of the program was to graduate people with high levels of competency.

He first put the KP into use in a number of universities in the early 60's and during this time formalized the KP as having the following criteria.

1) Self-pacing where the student works through the course at their own pace. The course material is broken into units which present specific related topics.

2) Unit mastery requirement which allows students to only progress if they meet some established criteria demonstrating mastery of the unit.

3) The use of lectures and demonstrations as motivational material, as opposed to delivering critical material.

4) A stress on the written word which in this case actually means a stress on presentation of material in a non-lecture format.

5) The use of proctors which permits repeated testing, tutoring and a personal-social aspect of the education process.

Since first proposed, the KP has undergone remarkably little refinement and the five criteria given above are still at the basis of any KP course, but perhaps altered slightly depending on circumstances.

These criteria can be grouped into two themes; the first allowing students to cover material on their own, the second ensuring mastery of a topic. The self- pacing feature of the program is enabled by having prepared units which are provided to students as they progress. Such units have traditionally been written (as mentioned in criteria 4 above) but can easily include video material or some other computer based format. Lectures are not essential to the course and, when they are given, are usually to emphasize points covered in a unit or to enrich the course through an outside entity such as a guest lecture.

Mastery of a topic is demonstrated by a test or quiz at the end of each unit. If the student achieves a predetermined score on the quiz, they are allowed to proceed to the next unit. Traditionally, mastery scores are quite high and usually above 80% indicating that the student has a strong knowledge of the material before moving on to the next unit. If the student does not achieve the mastery mark they are given some guidance on where they can improve and after reviewing the material they can take the test again.

There is no penalty for having to retake the test and students may have to repeat a module several times. It is rare for a student to make it all the way through a typical course without repeating at least some of the topics. However, each test must be sufficiently different to again test the knowledge of the unit. Another feature of the KP is immediate feedback provided by the proctors who evaluate and return tests usually while a student waits.

2. Advantages of the Keller Plan

The remarkable thing about the KP is the success with which it is met in a variety of course types using varying criteria. This created a fair bit of interest in the method and as Buskist [3] says:

> Because grade distribution in PSI classes fall mostly within the A range and bear little resemblance to those found in traditional teaching formats, teachers and administrators alike have shown interest in empirical based comparisons of PSI and traditional lecture methods.

Taveggia [4] reported that over 350 studies conducted between 1924 and 1965 showed no demonstrable difference between different instructional methods. Methods such as lectures, group discussion, tutorials and educational media such as television were generally equal when evaluated on the results of student performance on final examinations. They then went on to compile research where the KP was evaluated against traditional teaching methods. They found 14 studies between 1969 and 1973 which reported on 28 courses ranging from Cultural Anthropology to Nuclear Engineering. The result was that all 28 favored the KP.

A “meta-analysis” study by Kulik [5] reviewed the KP along with Bloom’s Learning for Mastery [6] method using 103 studies carried out in college level courses. As an aside, Bloom’s Learning for Mastery (proposed in 1968) is another program which emphasizes mastery of a topic before progressing. However, there is a difference in the focus of the two methods; Bloom looked at mastery in the context of a public school system, as opposed to the KP which has been implemented mainly at the college and university level.

The papers used in the meta-analysis were reviewed prior to being selected and judged suitable for inclusion based on criteria defined by Kulik (such as reporting results from examinations at the end of the course). Of the 103 studies, 96 reported that the mastery approach has a positive effect on performance in examinations.

While this is an impressive statistic, the even more impressive feature is that the average effect size was 0.52. In this case, the effect size is the increase in student scores as measured by standard deviations (i.e. the mastery based courses had scores that were increased on average by 0.52 standard deviations). In more concrete terms this means an increase in final exam scores on average from the 50^{th} percentile to the 70^{th} percentile.

Kulik was also able to create subsets of the 103 studies that looked at other features important for student success. Eighteen of the studies assessed student attitude towards instructional methods and found an overall positive effect size of 0.63. Fourteen of the studies looked at student attitude towards the subject and found a positive effect size of 0.40.

The only area where the KP based courses suffered in comparison to conventional courses was in the area of course completion (there was no data for the Learning for Mastery method available). Here there was a small negative effect size of -0.14, indicating that there was a slightly higher drop-out rate in the KP based courses.

The KP also does better regardless of the evaluation format. Buskist [3] reports that students who take KP courses do better on:

(i) Multiple choice examinations,

(ii) Final examinations,

(iii) Essay examinations,

(iv) Examinations designed to measure recall and

(v) Follow up examinations given several weeks after the end of a course.

Kulik [7] went a step further and did a component analysis of the features of the KP to identify which features of the plan were the most important. He found that frequent quizzing, immediate feedback and requiring a mastery of the material were critical. In addition he found that another feature (not part of Keller's initial plan) which was important was the inclusion of review quizzes given after every 4 or 5 units.

While these studies are somewhat older, recent studies show similar results. For example, in 2012 Mackie [8] looked at the implementation of an electronic engineering course using the KP. He reported that students appear more interested in the subject matter and that the percentage of students passing the course had increased. Although he cautions that the way the KP was implemented means that final grades are not able to be compared, or as he puts it "In Keller courses the grades tend not to sort students into well nuanced bands of achievement, they simply indicate who has reached the required level".

Interesting and relevant for people engaged in teaching nautical science and marine engineering is that while the KP was initially created for psychology and other social sciences courses, it has been found to be well suited for more technical courses. Grant [9] states that "PSI achieved many of its initial successes in physics, engineering and the sciences".

3. Disadvantages of the Keller Plan

The clear benefits of the KP method of teaching present something of a paradox when compared with the adoption of KP courses. It would be logical to conclude that since it is a demonstrably better instructional process the adoption would be high and increasing where as the opposite is true; the adoption is actually low and decreasing. Why this is so is interesting and has been commented on by several authors.

Many cite the cost incurred for the traditional KP based course as one of the impediments to integration. This cost represents an investment by the faculty involved in setting up the course in addition to a dollar cost since it requires a number of proctors to run which is generally a paid position given to an upper year student.

The investment by faculty setting up a KP based course is significant and is more than either a distance delivery type course or a lecture based course. As Herzberg [10]says "The Keller Plan is a complex system and a good deal of commitment to it is necessary to implement and maintain it in its full form. Such commitment does not come without cost…" The starting point of the development is the creation (or organization and clarification if already created) of learning objectives for the course. The learning objectives must be grouped into appropriate units and then material can be developed which cover the learning objectives. Also, for every unit, multiple tests must be made so that students can have multiple attempts. All of this must be done before the course begins since it can be reasonably assumed that some students will work through the material very quickly.

There is also a cost due to the use of proctors who interact with the students after every unit to assess their quiz results and recommend remedial action. These are paid positions, but a sufficient number must be available to give students fast feedback. Herzberg [10] claims that in the 25 years he has run a KP based course he has employed 267 proctors.

However, if cost was the only restriction funds could probably be found; after all in laboratory courses it is common to have upper year students or full time staff assigned to help out in the laboratory itself. In fact a more serious problems exists in the present "culture" of the traditional educational institute. The lecture format has a number of beneficial features. It creates a structure and platform for the instructor to discuss their topic of expertise. It also imposes a convenient time frame for the institute which can have all courses run the same length with precise start and stop dates. In fact, the only entity that the lecture based course does not benefit is the student (Buskist [3]). Thus a move to a KP type course would require some flexibility on the part of both the institute and the instructor.

Another impediment to the adoption of the KP is surprising in that it is based on the success of the students. As Buskist [3] says "Many PSI instructors must also contend with colleagues and administrators who complain of too many A's". This is also echoed by Tyree [11] who states that in his KP implementation of a law course, about 80% of the students did well enough to achieve a "high distinction" when guidelines indicate that between 2% and 8% should.

It would be fair to assume that the high marks were due to the criteria that students must achieve a very high mark on each unit in order to progress (and must retake tests until a high mark is achieved).

If these marks were then used as part of the final assessment, it would be logical to assume a skewness towards higher marks. However this is not the case as was discussed previously in this paper since the improvement is also reflected in final examination grades and in post-course examinations. While this may be a real impediment, it is hard to justify since essentially the students are being poorly judged for doing too well.

The one real problem identified is that of student withdrawal. The authors feel that the recent drive towards standardization of education is generally good and necessary, but has created a very structured framework in which classes and consequently students are used to operating. In a KP based course, the student is at the center of the process and drives it. While there are the necessary supports, it is ultimately the student who must review the material and decide when they are ready for a unit quiz. It is easy for a student to think that this week is a busy one and they will catch up next week, but of course the next week is even busier and thus they never catch up. Facing working through a term worth of material in half a term is daunting enough to make even dedicated students withdraw.

The following table summarizes the main impediments to a KP based course along with our assessment of their validity.

Table 1: Impediments to adoption of Keller Plan courses

Impediment	Assessment
Cost	Valid
Cultural Change	Valid in that it will result in a change of culture but if this results in serving students better it should be considered.
Marks too high	Not valid
Student withdrawal	Valid

4. A Sample Course

The authors have been active in the area of distance education and educational technology for several years. Experience gained through previous courses emphasized the advantages of breaking material down into smaller manageable units as well as the benefits of allowing repeat assignments (Tucker [12]). In one notable case (a course dealing with engineering economics), the application of these ideas turned a course which was difficult for students and frustrating for the instructor into one which has become popular and in which students achieve considerable success.

The application of this knowledge resulted in the construction of an applied mechanics course to prepare students to write the Transport Canada Applied Mechanics Exam for watch-keepers (the extension of this course to the exam for Chief's is currently on going). This work has drawn heavily on our experience in teaching distance courses while taking advantage of the most advanced technology we could get our hands on. This section describes how the Applied Mechanics course was initially designed.

A flowchart describing the course is shown in Figure 1. A new learner starts a course and after being given some introductory information about how the course works is given Module 1 to review (in the applied mechanics course the first module is Forces as Vectors). The module consists of a carefully prepared presentation which can best be described as a narrated PowerPoint presentation. Essentially, what the student sees is a series of PowerPoint slides but each one is narrated by the instructor who presents the theory and goes over examples to clarify the points made.

The PowerPoint presentations have been developed based on the learning objectives that comprise the Transport Canada requirements for the applied mechanics course. They also have what we call engagement questions which are simple questions which "pop-up" throughout the presentation and are based on the presented material. They are intended mostly to act as "speed bumps" to fast forwarding through the lectures, forcing students to slow down and ensure they are absorbing the material.

An important part of the process is the support cloud. In a course like this there is a huge amount of potential support which must be in place. Student issues can range from technology problems accessing the course material to lack of (or forgotten) background material. The support cloud is in place to help with anticipated issues and consists of technical support and recommended web based material to help students understand the prerequisite material.

Once the student has completed Module 1, a quiz automatically becomes available. Up to this time the quiz has been hidden but upon completion of the Module, it is now visible and the student can proceed to take it when they feel ready. The quiz is intended as a diagnostic tool and is not used in a prescriptive way. If the student does not achieve the mastery mark (in our case set at 80%) it will not

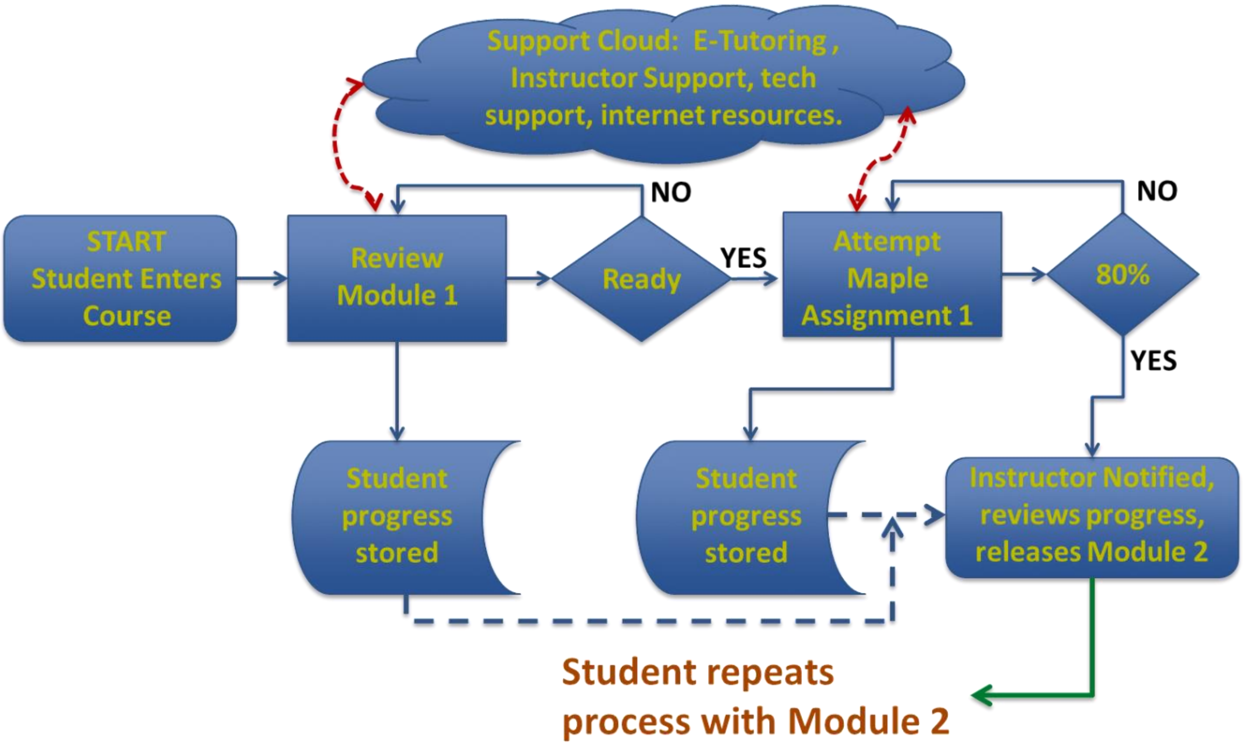

Figure 1: The course flowchart as first developed

reflect poorly on their record. They are expected to make an honest attempt at the assignment. While there is no restriction on the tools the student can use (i.e. notes and texts can be used) the test is timed so the student cannot take too much time looking up solutions.

If the student scores 80% or more, the instructor is notified who can review the work. If the instructor is satisfied with the work they can open up Module 2 and the student continues to progress. If the student does not achieve the 80%, they are forced to review the material before taking another quiz. The quizzes are designed in Maple TA and draw from a collection of appropriate applied mechanics questions. Also, the specific numbers for each question are changed every time (our current rule of thumb is that each question must have at least 100,000 possible permutations).

The Applied Mechanics course has over 30 units but we feel that there is a very large amount of material to be covered in the it. Twenty four units would be more appropriate for a standard length course. This is in line with Williams [13] who recommends 20 to 30 units for a standard course.

Upon completion of all the units, the student is prepared to take the Transport Canada exam. Also, since the students now have access to all the units, they can review as they wish. The online course exams are also open in case the student wishes to practice on certain topics.

5. Bringing a course in line with the Keller Plan

It should be noted that the initial online version of the applied mechanics course was developed without any knowledge of the KP. It was designed based on our experiences and what we found that "worked" and what the technology allowed us to do. In retrospect it fits quite well with the KP. The material is broken into manageable units, the material is not lecture based, and the student is able to progress at their own pace but must show mastery of a topic before progressing. However, after becoming aware of the KP method of teaching the authors were able to make some slight changes to the model to bring it more in line with the traditional KP model. The changes are shown in Figure 2.

Most of the changes have to do with the instructor's role in the course and some of this is enabled by new technology being adopted by the Marine Institute which will integrate results from the Maple TA program directly into the learning management system, D2L. In the previous version of the course, the instructor had to manually release the next module, but now the module becomes visible upon the student obtaining mastery automatically. In a world where education is global and not restricted by a 9:00 to 5:00 workday, the advantage is significant.

The other important change involves the migration of the role of the instructor from someone who releases new material when mastery is achieved to someone who becomes active when a student does not do well. In the previous case the instructor was more active as a manager of the system, but now the instructor, while still maintaining their management role, acts as the traditional proctor (minus the marking of multiple quizzes). They can review all the work up to that point and identify specific problem areas and then recommend remedial action. This specific and unique feedback for each participant is much more inline with the role of the proctor in the traditional KP approach. It also provides a personal interaction with the student to keep them interested and supported.

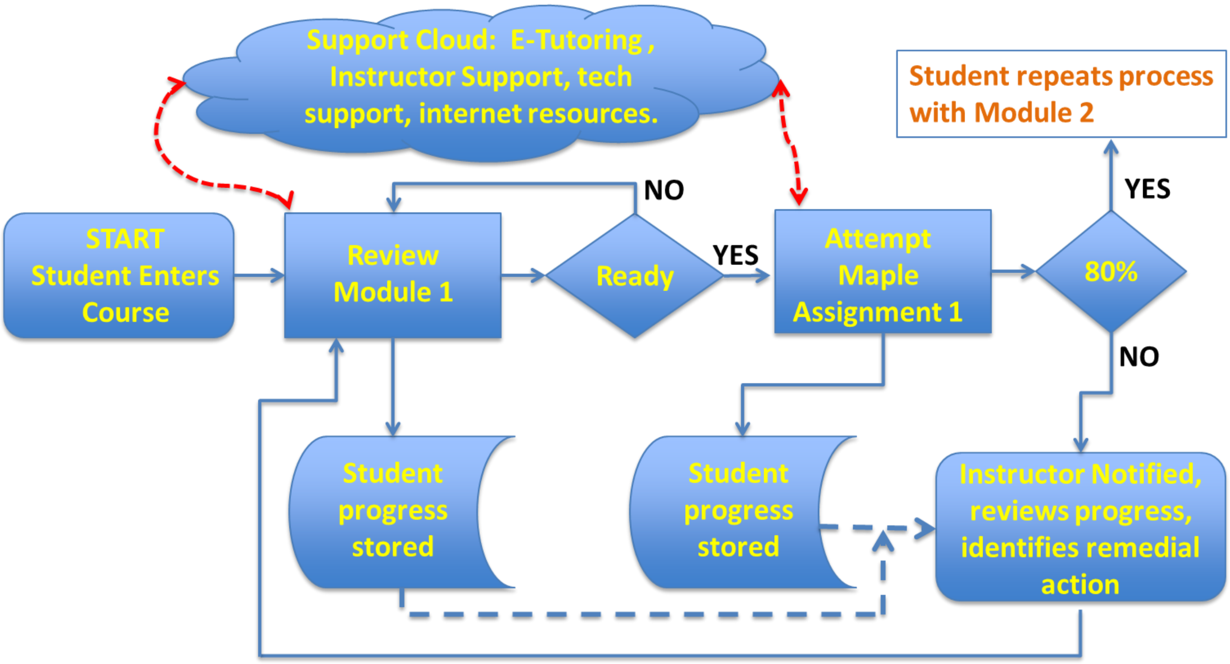

Figure 2: The applied mechanics course with a Keller Plan focus

A new feature, which we are considering adding, is based on Kulik's component analysis. He identified the importance of having reviews after every 4 or 5 units. The material in the Applied Mechanics course is suited to being grouped, although logical groupings may mean that some reviews only cover 2 units. Using the Maple TA quizzing process, such a review would be easy to set up and still provide students with instantaneous feedback.

6. Benefits of the electronic Keller Plan

The authors feel that the redesigned course offers an electronic version of a Keller Plan course. While taking advantage of the benefits offered by the KP method, it addresses the problems outlined in Table 1.

For example, while the cost of developing the applied mechanics course was significant, with the materials in place it becomes relatively easy to administer. To elaborate, to reach this point has taken two faculty members working on and off for two years to develop the necessary material. This includes a basic set of narrated powerpoint slides, a set of quizzes coded in Maple TA, identification of material for the support cloud and even the development of integration software which is currently only available at Memorial University and one other location in the world. This represents an approximate cost of a half man year excluding software development costs. But it should be noted that this course is an unusually large course; approximately 1 ½ regular courses. In addition, it should be noted that this course was created using new tools and techniques and the learning curves in places were somewhat steep.

However with the materials in place, the instructor becomes not only what Keller envisioned when he used the phrase "managers of learning" but also an active and focused participant, dealing with specific student issues when they have trouble with the material. The instructor does not need to correct multiple quizzes, but they do need to review quizzes where students have not done well and come up with specific remedial actions that are individualized for each student. They are there to explain difficult concepts but do not actively lecture. Essentially, they are there to enable students to learn the material.

The course outlined here is also able to overcome the cultural issues surrounding higher education due to the nature of the intended clients and the instructors interested in the work. Generally, since the course is new in several aspects, the professors interested tend to self-select to be open to formats other than lectures. Also, where the learners are probably active mariners , the timing of the course can be fit around their needs. For example, the current course is given as a preparatory course (one which prepares the mariner to write the Transport Canada examination). As such it does not need to follow the regular scheduling system found at Memorial University.

The issue of students being too successful tends to be an issue where a class result is envisioned to be a normal distribution. In fact since we are preparing our students to write an exam administered by others we expect and hope that a very large percentage are able to pass the set exam. A 100% pass would be a more than acceptable result.

The final issue of students falling behind is a real one but since the students know they will be facing a critical, career dependent examination after completing the course the motivation is high. In addition, the instructor is better able to assess progress with this course than in other KP based courses since the learning management system keeps track time and length of student activity. If an instructor sees that a student has not been active for 2 weeks, they can make reasonable attempts to contact the student and determine if there are specific course related problems.

Parts of the applied mechanics course have been given to students over the last two years. Feedback has so far been very positive. Students feel that the current method has turned a course which was previously feared into a course which they can do. As instructors, the authors feel that the students gain more from this method and are better trained to challenge Transport Canada exams.

7. Conclusions

The authors feel that the course developed follows the KP system which is a demonstrably better instructional method. The course allows students to work at their own pace through complex applied mechanics material, slowed down only when they start to go wrong and need help in certain topics. However it has distinct advantages over the old Keller Plan in that, once in place, the cost to run the course is relatively low while specific targeted instructor student interaction is high.

While the course is good, there are potential improvements which can be made in the future. For example, there is the potential for “branching” in a presentation based on student responses to engagement questions. Thus an initial layer of feedback is in place in the lecture but only becomes available if a problem is exhibited.

While it has been offered in parts to two previous student classes it is expected to run a full KP based course starting this fall. The subsequent experience gained and student feedback will continue to craft the applied mechanics program into a strong course for marine engineers.

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Session 1B

STCW and Regulations

The Annual General Assembly at 15: A Look Back and a Look Forward

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This year marks the fifteenth Annual General Assembly of the International Association of Maritime Universities. According to the institution, its mission reads in part: to "seek participation of as many qualified maritime universities/faculties as possible; to maintain regular and ongoing communication and exchange among members; to pursue measurable and worthwhile outcomes on specific subjects primarily through Working Groups; to hold a General Assembly annually, and to publish through Editorial Board academic periodicals, news and summaries of activities, and research papers" [www.iamu-edu.org]. While the published proceeding of the Assembly represent only the tangible deliverable manifestations of the conference (there are many other ways in which the assembly could be evaluated) it does provide a material record of the assembly that can be assessed by quantitative and qualitative means. I argue that through the use of data visualization software and specialized search engines we can gain a strong picture of the relevance, popularity, and critical reception of the hundreds of articles that have been published since 1999. The IAMU General Assembly (and its various autonomous annual organizing committees) understandably struggles with the binary of inclusivity and exclusivity. On the one hand, all member institutions are encouraged to participate, and the General Assembly should democratically be representative of all regions; on the other hand the papers of the highest caliber, regardless of origin, are necessarily valued for the reputation of the organization. Moreover, the subject matter across the published proceedings runs the gamut from the highly technical shipboard operations to pedagogical practices and theories to policies and politics of maritime education administration. A valid assessment of the papers and their reception may point the way to a different and better selection process: one which does not sacrifice breadth of analysis and geographical representation for narrow, but more refined fields. Such suggestions may be used in the future to improve the quality and organization of publications, and in turn raise the stature of the IAMU as a whole.

Keywords: IAMU, Annual General Assembly, Published Proceedings, Assessment

1. Introduction

The Annual General Assembly of the International Association of Maritime Universities will celebrate its fifteenth Annual General Assembly in 2014. Quindecennials may be arbitrary but often symbolic occasions upon which to take stock of progress, assess growth, celebrate accomplishments, and measure success. As an assessment coordinator and one who has had the privilege of participating in a majority of the General Assemblies, the time feels right to review the work of the past assemblies in order to make the most of our future. First, the mission of the organization is for members to cooperate with each other toward common goals, which may be attained through the following activities: "to seek participation of as many qualified maritime universities/faculties as possible; to maintain regular and ongoing communication and exchange among members; to pursue measurable and worthwhile outcomes on specific subjects primarily through Working Groups; to hold a General Assembly annually, and to publish through Editorial Board academic periodicals, news and summaries of activities, and research papers" [1]. Certainly many of these objectives have been implemented, and IAMU is an organization whose influence far transcends the work accomplished at the General Assembly. Membership has grown considerably, IAMU contributes to the maintenance and development of STCW regulations, the work generated by various projects has helped improve Maritime Education and Training across the world, and increasingly IAMU has extended its educational, social, and political influence to myriad aspects of the seafaring industries. The specific concern of this paper, however, is localized to the AGA itself, and specifically to the published proceedings of the Assembly.

It must be acknowledged at the outset, of course, that the intrinsic and extrinsic value of a conference cannot be solely measured by a critical assessment of the papers it produces. While the published proceedings of the Assembly represent the tangible deliverable manifestations of the conference, there are many other ways in which the assembly could be examined. Ideas are exchanged informally, friendships are formed, partnerships are developed, educational networks are created, and the exchange of knowledge occurs across and through many rhizomatic pathways. Furthermore, many people attend and participate in the annual conference without presenting a formal paper: their contributions and networking strategies should not be underestimated.

However, published proceedings of the delivered formal presentations do provide a material record of the assembly that can be assessed with quantitative and qualitative means. Through the use of data mining software and the application of scholarly-based search engines we can gain a strong picture of the relevance, popularity, and critical reception of the hundreds of articles that have been published since 1999. The IAMU General Assembly -- and its various autonomous annual organizing committees -- understandably struggles with the binary of inclusivity and exclusivity. On the one hand, all member institutions are encouraged to participate, and the General Assembly should democratically be representative of all regions; on the other hand the organization necessarily seeks papers of the highest caliber, regardless of origin. Moreover, the subject matter across the published proceedings runs the gamut from highly technical shipboard operations to pedagogical practices and theories to policies and politics of maritime education administration. A valid assessment of the papers and their reception may point the way to a different and better selection process, but one which does not sacrifice breadth of analysis and geographical representation. Such suggestions may be used in the future to improve the quality and organization of publications, and in turn raise the stature of the IAMU as a whole.

A three-pronged approach was taken in the literature review of the aggregated published proceedings, and the methodologies deployed in this approach are detailed in the next section. First, keyword search software was utilized to investigate the content of the essays themselves. Have the focus and orientation of the papers evolved over time? Has a particular subject matter become more dominant than others? Given the broad nature of the assembly, can any trends be identified over the past fifteen years based on language in the proceedings? Second, papers were categorized by country of origin, and by region of origin. Over time, is one country or region represented more prominently than another? If so, is this significant? Does it matter for IAMU's mission of inclusivity? Finally, papers were examined via Google Scholar (which can track the number of citations for each article published, as well as its re-publication history). Such an exercise helps to reveal a paper's global impact beyond the realm of the conference itself.

2. Methodology

As noted above, three different strategies were conducted. Some limitations of the study must be acknowledged at the outset: due to workload issues and time constraints, for this study only the abstracts -- not the entire articles – were used for the keyword analysis. Also, data was collected from the archives of the IAMU website itself which is missing some of the proceedings. AGA 2, 4, and 5 were not included in this study. Should the findings of this analysis prove interesting and worthy of further exploration, those data points should certainly be included.

2.1.1 Keyword Analysis

The abstracts from the Annual General Assemblies from 1999 to 2013 were extracted from the IAMU website, and from hard copies from the holdings of the library of the California Maritime Academy [2]. Because of the different mediums and configurations of these texts, they were uniformly scanned into PDFs using Adobe Acrobat X Pro and then filtered through its Optimum Character Recognition (OCR) software. As many of the suspicious OCRs were corrected as possible. The files were then converted into plain text and run through VoyantTools, which yields a total word count of all terms used in the abstracts, a visual word cloud of most common terms, a corpus reader linked back to the text files themselves, and a word trend chart to see word use evolution throughout the published proceedings [3]. An example of a dashboard layout of this program can be seen in Figure 1.

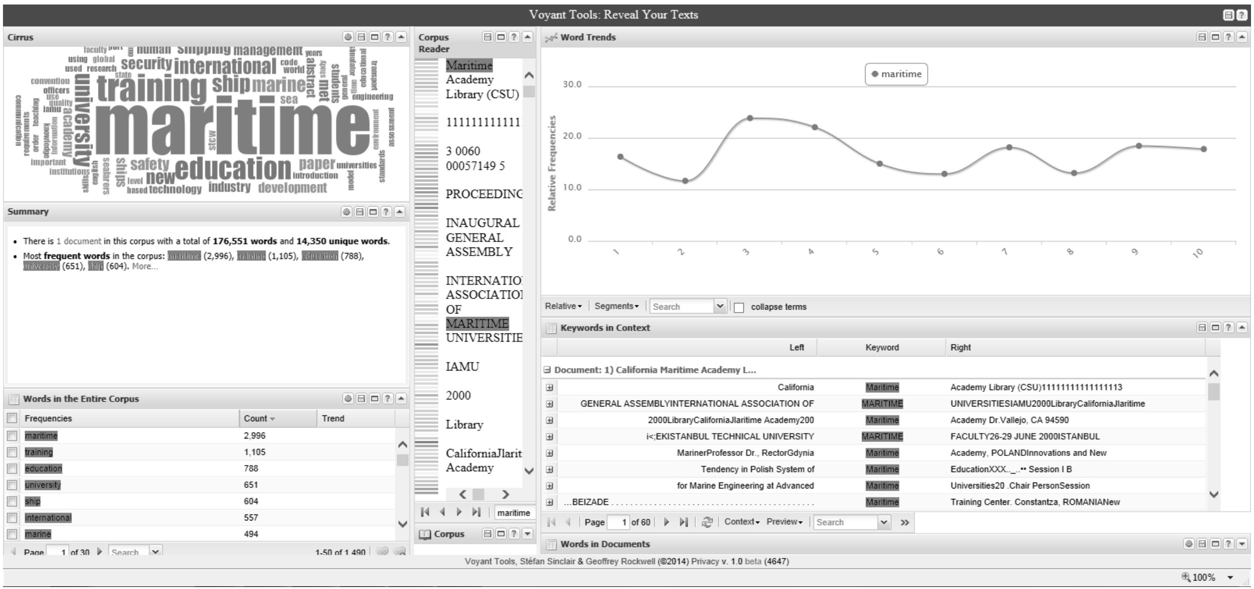

Figure 1. VoyantTools Dashboard for Corpus of IAMU AGA abstracts

2.2Published Proceedings Catalogued by Country and Region of Author

The published proceedings were then organized by author's home country. This was done manually be cross-checking the author's name with affiliated institution. 423 papers were reviewed and placed into charts according to country. Papers were not organized by specific institutions. For example, papers from the United States were not disaggregated by California Maritime, Maine Maritime, SUNY, etc. Papers which had more than one author and whose authorship stretched across two or more nationalities were only counted by the country of the primary author. Papers published under the aegis of the World Maritime University were counted under Sweden.

2.3 Examining Published Proceedings via a web search engine for scholarly works.

The abstracts of the published proceedings were then inputted into Google Scholar. This particular engine (as opposed to CiteSeer or Scopus) was selected because of its ease of use and comprehensive searching power. Google Scholar not only searches for digital and scanned physical scholarly works on the web but also through library databases and its own collection of Google Books. A significant feature of the engine is its "cited by" feature, which provides access to titles and abstracts of texts that have cited the article being viewed. This feature of citation indexing provides an evaluative metric by which scholarly works can be assessed. Put simply, Google Scholar tabulates the number of times a given article has been cited by other articles. The higher the number of references, the more valuable that article is in knowledge production and dissemination. There are many criticisms and methodological limitations here – both in Google Scholar itself and its application to the IAMU General Proceedings, and these will be articulated in subsequent sections. The papers and authors were uploaded manually into the search engine.

3. Findings

Given the three-stage methodology articulated above, the findings of this analysis conform to the same format, and are broken into three parts.

3.1 Key Words

Using VoyantTools as a software program to scan for key words, it was discovered that in the 423 abstracts inputted, there were 176, 551 words with a total of 14,350 unique words. Common terms were then manually eliminated from the data base – definite and indefinite articles, prepositions, conjunctions, etc. Not surprisingly, the most frequent words in the corpus are: "maritime" (2,996); "training" (1,105); "education" (788); "university" (651); and "ship" (604). "Safety" was the 8th most common word, with "security" in 10th place. In descending order, "industry" was the 13th most used term, with "management" at 19, "sea" at 20. Interestingly, the term "student" only appears in the 21st position, with "technology" in the 22nd place [4]. Because the abstracts were set into the corpus in chronological order from date of publication, it was also possible to chart the commonality of words through time. Given that some of the proceedings from the past fourteen years were missing, a segmentation value of ten was selected. As an example, when the word "environment" is ran through the system, it is revealed that this term had a relatively low usage in the beginning years of the General Assembly, but spiked by the 8th segment before tapering down again. [See Figure 2].

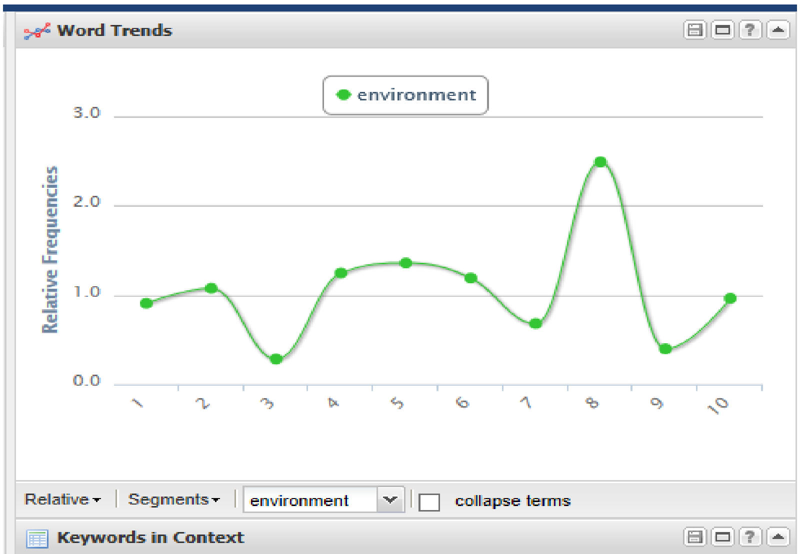

Figure 2: Relative Frequency of the term "environment" across a chronological scan of IAMU Conference Proceedings.

To draw any valid conclusions from this process, however, is fraught with complications. First, as noted above, only the abstracts were reviewed, not the papers themselves, and perhaps the larger texts would produce different results. Second, in the words of Raymond Mooney, "to truly understand language, an intelligent system must be able to connect words, phrases, and sentences to its perception of objects and events in the world. Ideally, an AI system would be able to learn language like a human child, by being exposed to utterances in a rich perceptual environment. The perceptual context would provide the necessary supervisory information, and learning the connection between language and perception would ground the system's semantic representations in its perception of the world" [5]. In other words, the extraction and identification of key words and patterns of repetition over a corpus may provide a snapshot of trending themes and issues, but this process has obvious limitations. For example, just because "security" appears 34% more frequently than the term "student," this doesn't necessarily mean that security is valued at that greater percentage over students. There are causal relationships and hidden relationships in the syntactical data that are not uncovered. Also, the density of the denotative and connotative properties of language cannot be fully expressed in this matrix. Given the example term discussed above the term "environment" could, in different contexts, refer to the natural world, a shipboard environment, a campus community, etc. Each of these valences is important to differentiate when conducting aggregated literature reviews.

This doesn't mean that the exercise is meaningless. As the IAMU evolves, grows larger, and potentially draws in more publications (through the journal, through the published proceedings, and through other venues), data mining of language – particularly as the algorithms in these programs are also becoming more sophisticated and powerful – can prove to be a powerful tool to chart developments in the organization and in MET as a whole.

3.2Proceedings Catalogued by Country of Origin

As noted in the methodology section, the 423 papers were manually sorted by country of origin. The purpose of this exercise was to determine how effective the individual organizing committees over the past fourteen years were in fulfilling the institutional mission which seeks "participation of as many qualified maritime universities/faculties as possible." A breakdown of AGA papers by national origin is articulated in Figure 3.

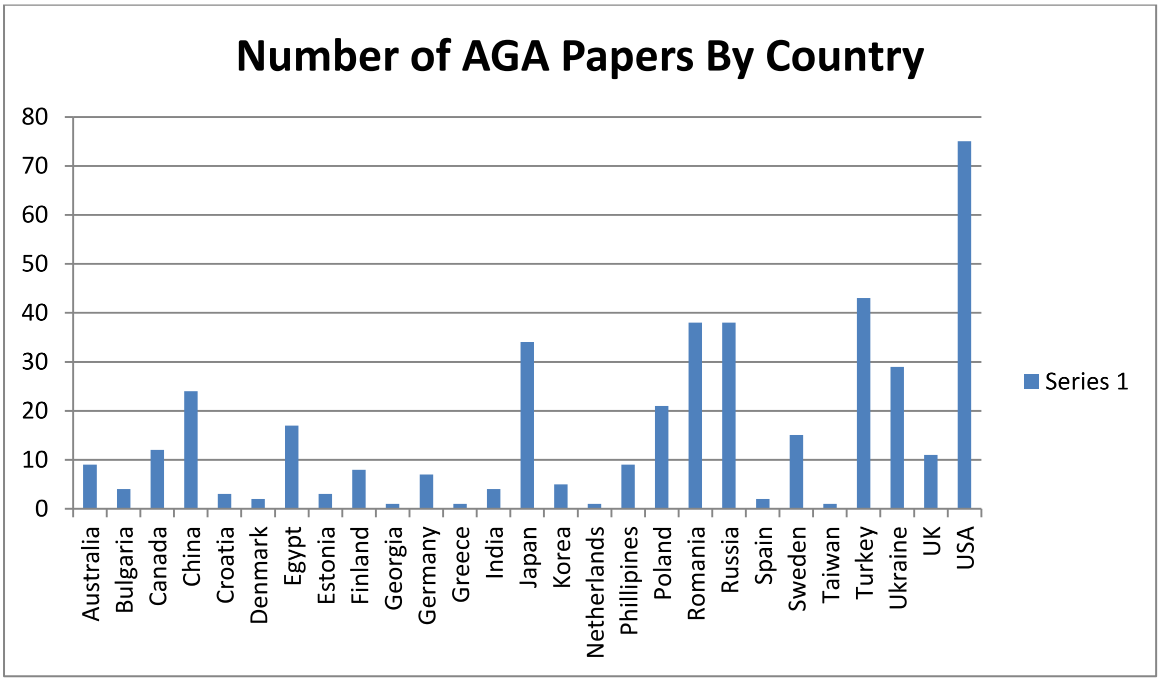

Figure 3. Aggregated Number of AGA Papers 1999-2013 by Country of Author

This data, originally formatted in a simple Excel spreadsheet, was then uploaded to StatPlanet, an interactive and visual mapping software system which can customize national and world maps to create feature-rich infographics [6] Mapping the number of papers-by-country into a visual format with color codes for number of data points, a different conceptualization of global representation is realized.

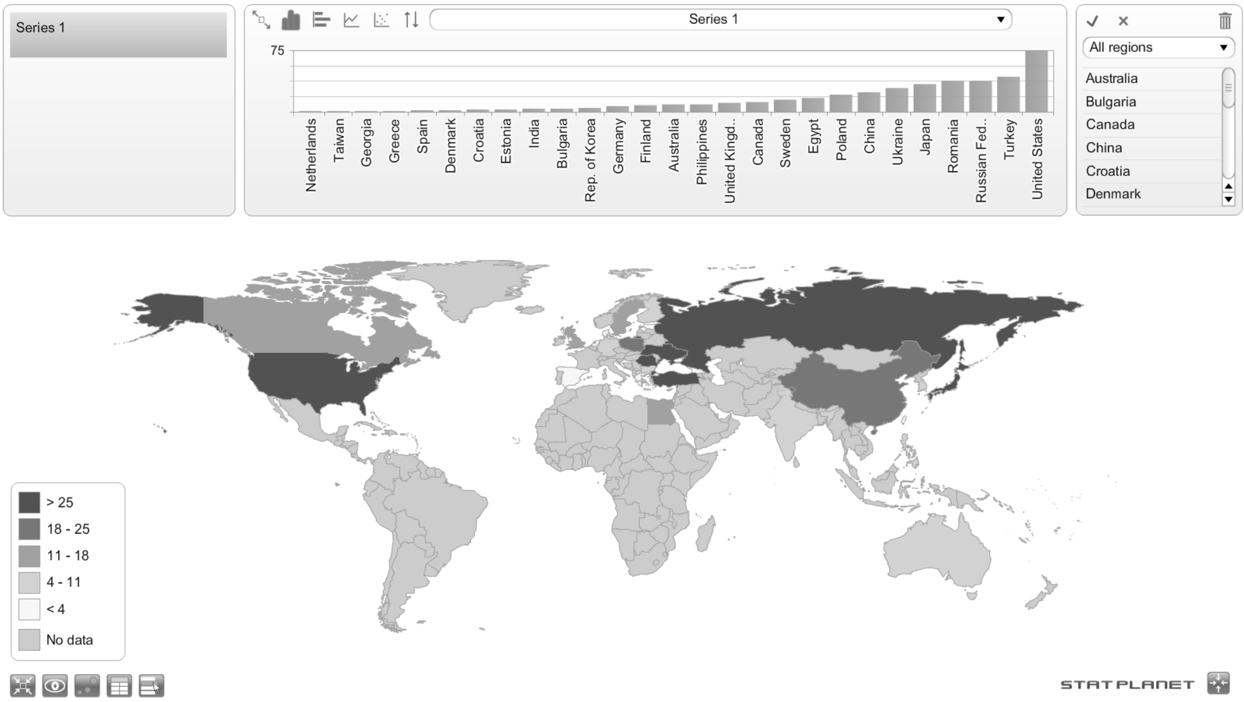

Figure 4: Aggregated Number of AGA Papers 1999-2013 by Country of Author in Map version

From both the simple bar chart and the StatPlanet representation, there appears to be a relatively broad, but unequal distribution of papers delivered at IAMU. The United States has the highest number by a significant margin, followed then by Russia, Romania, Turkey, the Ukraine, and Japan. To correct for the seemingly disparate distribution, the papers were then sorted by region, and crossed with the number of IAMU member institutions in each country. For example, while the U.S. has produced 75 out of the 423 papers in the analyzed proceedings, the U.S. is also home to six IAMU institutions, the most of any single country. When sorted by region (North America, Europe, Asia, etc.), the relative distribution is evened out. [See Figure 5.]

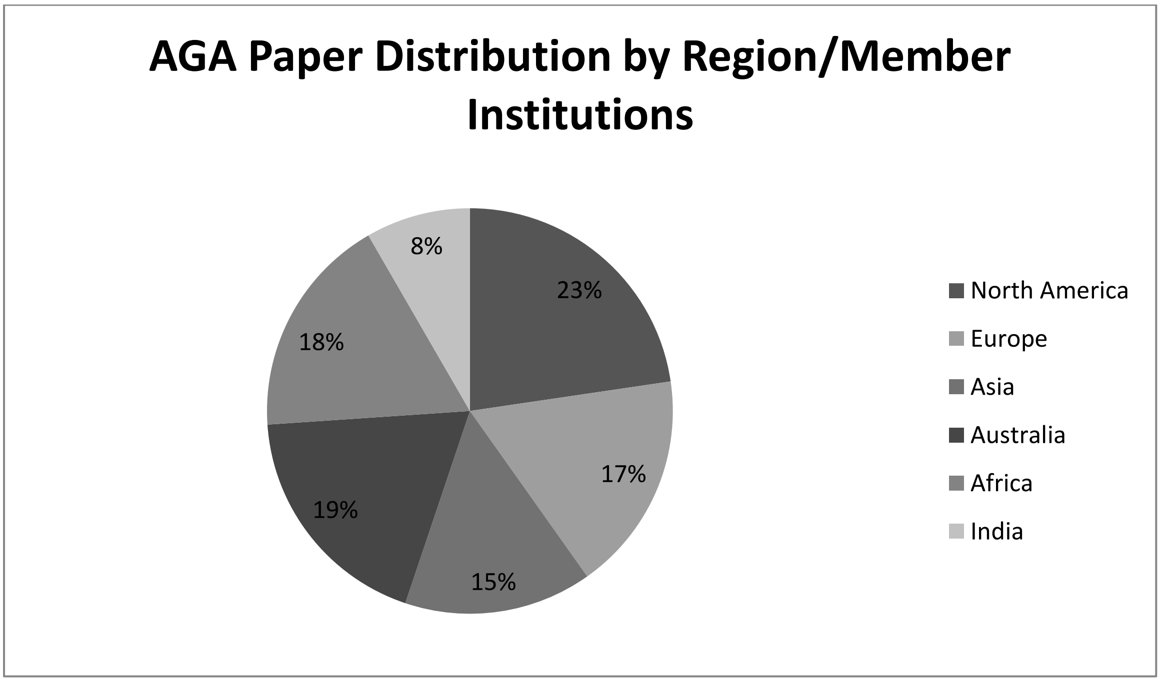

Figure 5 Aggregated Number of AGA Papers 1999-2013 by Region of Author

While this distribution appears to confirm the IAMU's commitment to the participation of as many qualified maritime universities/faculties as possible, it is also interesting and important to note that of the IAMU's 53 member institutions; only 28 have contributed to the General Proceedings. There are, of course, many factors which determine this participation level, including internal funding resources, the publicity measures given to the conference on each campus, and the perceived significance of contributions to the IAMU from individual faculty and universities.

3.3 Proceedings and Value as Determined by Citation Records

Finally, the General Assembly papers were ran through Google Scholar to assess value through a particular, but inexact, metric. Essay titles and authors were fed into the search engine, and tracked by the number of citations attached to each article. Increasingly, citation tracking has become a recognized way of assessing the impact of scholarly articles. For each volume of AGA Published Proceedings, the number of citations is represented in Figure 6.

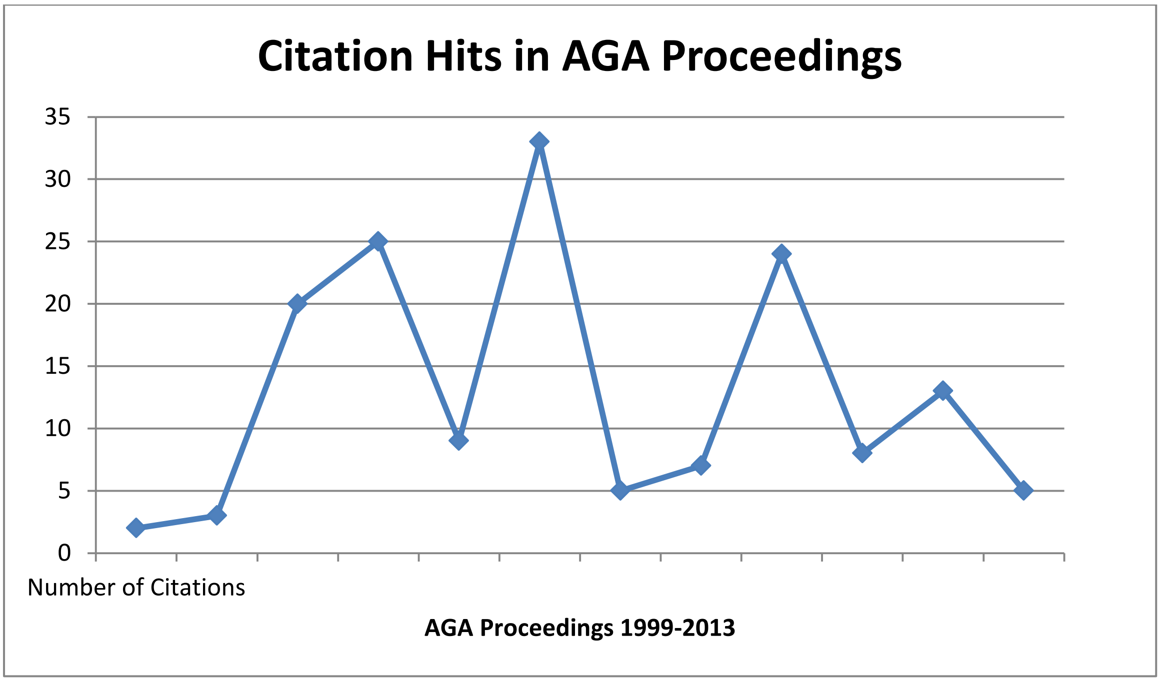

Figure 6: Number of Citations per AGA Proceeding Volume

A few caveats and observations: first, there are some inconsistencies in the data collection. Some AGA articles were republished in different journals (including the *IAMU Journal*), which necessitated a different search for those re-publications. Second, many articles were revised and/or retranslated back into a faculty member's host language, which is not captured very well by Google. Also, while the citation records may appear to be low, it must be acknowledged that these are published proceedings, created in-house by each conference host committee, and then disseminated and distributed in many (or often not) different ways. From year to year the proceedings may not be included in many of the databases that Google mines. Finally, given the length of time to publish a scholarly article the more recent published proceedings are under-represented in citation-tracks, but this may change in due course.

Beyond this, there are methodological issues with citation-tracking as a measure of an article's "popularity" vs. its intrinsic worth. The "Benjamin Effect" is in play, which means that as an article accrues more citations, it is pushed to the front of the selected search items, where it in turn accrues further citations while other, potentially significant scholarly articles languish lower on the search lists. Also, given the complex international nature of the publication process of these proceedings, coverage and incorrect field detection can come into play and interfere with the search process.

4. Observations and Recommendations

As with any initial attempt at a quantitative analysis of something as slippery as language and literature reviews, considerations for improving the methodology are the first to materialize. If this project warrants further development, forthcoming analyses may mine entire papers, not just abstracts. Perhaps the entire corpus of IAMU publications could be included – the *IAMU Journal*, the conference proceedings, and other texts. While it is beyond the scope of this current study, an inquiry into the use-value of the IAMU projects (via distribution platforms, questionnaires regarding cross-institutional implementation, external assessment measures) may also prove to be significant.

To my mind, the motivation for this information and the evaluation of the results raise two philosophical questions which themselves harbor a political element. First, how is one to balance a mission-driven need for inclusivity ("to seek participation from all member institutions") with an academically-principled commitment to rigor and excellence which may hinge on exclusivity (only those articles of the very highest scholarly quality shall be accepted and published)? There is a very deep need to recognize and embrace the internationalism of the IAMU – the organization will fail without the mutual cooperation and participation of all member institutions. But is there a point where representation for representation's sake dilutes the power and efficacy of the General Assemblies? Conversely, should efforts be taken to limit the scope of those institutions or nations who may appear to have a larger role in the conference proceedings?

Second, the content of the papers themselves are voluminous and latitudinous. Though this issue doesn't neatly fall under the purview of this particular analysis, there's a sense that highly technical essays (on, say, the wiring of consoles for radar instruction) compete with, or are placed amidst, essays on pedagogical theory, essays on STCW interpretations, essays on industry salaries and employment figures, and essays on maritime cultural, social, and political issues. Certainly the topic of Maritime Education and Training is as immense as the seas which produced it, and the tributaries between subject matters are just as fluid. Perhaps the table is large enough to hold it all, but at times the disconnect between one panel and another, or even between papers in a single panel are significant enough to impact cohesion and impede an ability to draw connections from one paper and another.

That said, a valid assessment of the papers and their reception may suggest a means toward a different and better selection process – and these steps have already begun to be implemented. Opting for a two-tier system of refereed and non-refereed papers can allow for broad representation and quality -- a process which does not sacrifice breadth of analysis or geographical origin for narrower, more limited fields. The possibility of blind submissions for the refereed papers may serve to refine the process further.

Furthermore, relationships with other journals should be cultivated and used as pipelines for the IAMU in general and the AGA proceedings in particular. The agreement between IAMU and WMU for the inclusion of an IAMU section in the Journal of Maritime Affairs is a profoundly important one. As Glen Blackwood writes, "the opportunity for members to also publish their work in a dedicated IAMU section of the *WMU Journal of Maritime Affairs* is viewed as further enhancing the aims of IAMU. The IAMU section will follow JoMA current policy and contain peer-reviewed articles, peer-reviewed issues of contemporary interest, reports and comments, and book reviews" [7]. Likewise, the IAMU Journal should continue to be used as a vehicle through which conference papers are revised and re-published for a wider audience. The AGA Proceedings could be more readily available to the larger public, but this recommendation is given with some reservations: conference papers are more often than not a means by which faculty can test out ideas with their peers and rehearse their ideas in a comfortable setting before revisiting them for further analysis. All these suggestions are meant to make the fine work of the IAMU more present in the larger world.

5. Conclusion

The overall intention of this analysis was to assess the IAMU General Assembly to see where its strengths lie, and where it might be improved. It is worth repeating that the conference itself cannot be measured solely by the weight of its published conference papers, any more so than the institution as a whole can be measured by the conference. There is much to be gained in the unmeasurables – the contacts, the solidarity across MET faculty and administrators, and the fertile soil for the free exchange of ideas. Yet if IAMU is to continue to strive to be a world-class organization – one that is respected, valued, known, and admired – it is worthwhile to take stock every 15 years or so to see how far we've come, and to see what lies ahead.

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Compliance to Philippine Coast Guard (PCG) Standards Among Motorboats Plying Iloilo and Guimaras Islands: Response to International Sea Safety and Security Requirements

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Abstract The study determined the compliance on standards set by the Philippine Coast Guard (PCG) in the Panay Island, Philippines in response to Sea Safety and Security Requirements (SSSR) among motorboats plying Iloilo and Guimaras Islands, Philippines. Quantitative-qualitative research design was applied in this research. The researchers utilized secondary data and information taken from the PCG Office, Iloilo City. Frequency count, percentage, and rank used as descriptive tools to determine the quantitative data of the study. Interview was utilized as strategy to gather information regarding the compliance of standards among PCG officers and motorboat crew plying Iloilo and Guimaras Islands. Moreover, the study presented the compliance on standards concerning safety and security requirements. The results of the study were used to generate future discussions, talks, and conferences to draw strict compliance as stipulated by the international standards. Data obtained from this study were utilized as basis for policies implementation and monitoring among concerned government agencies on sea security and safety of the passengers and visitors who wish to explore Iloilo and Guimaras Islands in the Philippines.

Keywords: *compliance on standards, sea safety and security requirements, motorboats, and PCG (Philippine Coast Guard)*

1. Introduction

The Philippine Coast Guard (PCG, in some parts of this study) is the government regulating agency for motorboats – both recreational and commercial. In this premise, the Coast Guard issues boating safety recommendations and ensures the proper compliance with government boating safety laws and equipment requirements. Every motorboat is responsible for knowing and adhering to Coast Guard boating laws and regulations, and laws specific to the country in which the vessel is registered or operated. This includes carrying at least the minimum safety equipment, registering and numbering of the motor boat properly, and the safe operation of the vessel.

Thus, this paper was conceived to find out whether or not the motorboats plying the waters of Iloilo and Guimaras adhere to policies and requirements imposed by the PCG. To ensure that these motorboats comply to sea safety and security requirements, the researchers deemed it proper to conduct this inquiry.

2. Statement of the Problem

This paper aimed at finding out the compliance to PCG standards of the motorboats plying Iloilo and Guimaras Island. It also looked into whether or not these motorboats adhere to international sea safety and security requirements. This sought to address the following questions:

(1) Do the motorboats plying the waters of Iloilo and Guimaras Island have available life jackets?

(2) Do the motorboat operators at least master the basics of seamanship?

(3) Are the motorboat operators able to take boat safety courses, whether formally or informally?

(4) Are they knowledgeable of navigational rules?

(5) Are motorboats equipped with radio and other safety devices?

(6) Do motorboats have their periodic vessel check up before they are allowed to sail?

3. Conceptual Framework

This study looked into the interplay of the variables involved in this investigation. Firstly, the researchers consider the motorboat operators as the core of this inquiry. Their practices as well as the many facets involving their work are the starting point in which all the rest of the study emanate from. The data generated from the motorboat operators were then gauged utilizing the Coast Guard Standards. Then, after finding out their compliance, the implications as response to international sea safety and security requirements were generated. Figure 1 shows the schematic presentation of the interplay of the different variables.

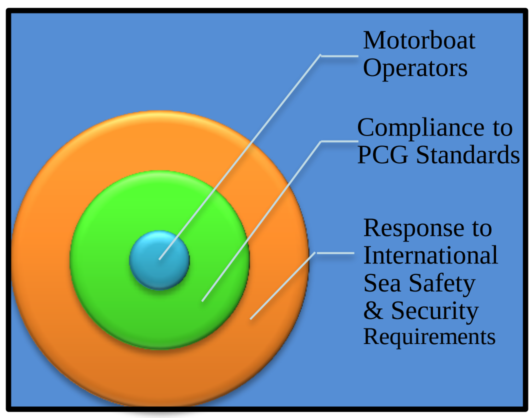

Figure 1. The Schematic Presentation of the Study

4. Research Methodology

Mixed method of research was utilized in this paper. It is the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative approaches (e.g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the purpose of breadth and depth of understanding and corroboration.

Mixed methods research is a research design with philosophical assumptions as well as methods of inquiry. As a methodology, it involves philosophical assumptions that guide the direction of the collection and analysis of data and the mixture of qualitative and quantitative data in a single study or series of studies. Its central premise is that the use of quantitative and qualitative approaches in combination provides a better understanding of research problems that either approach alone (Creswell & Plano Clark, 2011).

In this study, the researchers had chosen the explanatory sequential design as one aspect of the mixed method. In this design, methods are implemented sequentially, (QUAN QUAL). This is used by the researcher if he/s wishes to use qualitative findings to help interpret or contextualize quantitative results. Figure 2 shows the research design.

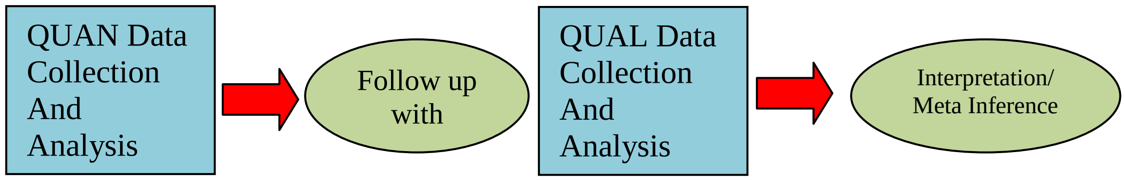

Figure 2. The Mixed-Method of Research by Creswell (2011)

5 Results

5.1 Motorboats Plying the Waters of Iloilo and Guimaras Island: Availability of Life Jackets

Out of the 21 motorboat operators, 18 indicated "yes" and 3 only indicated "no." In terms of the ratio of the life jackets per passenger, 19 answered "yes" and 2 indicated "no." In terms of whether passengers use lifejackets at all times, 14 indicated "yes" and 7 said "no."

Figure 3 indicated the data.

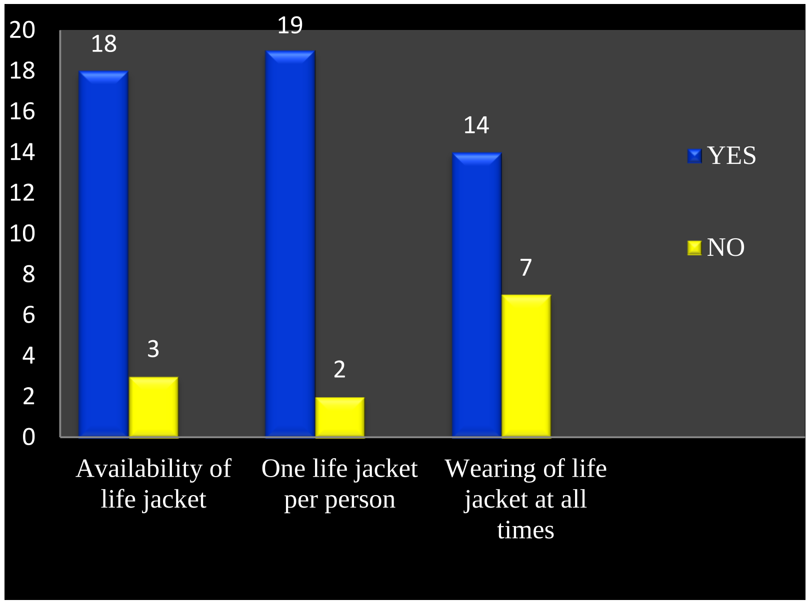

Figure 3. Motorboats Plying the Waters of Iloilo and Guimaras Island: Availability of Life Jackets

The researcher also proceeded to the qualitative data and arrived at the following responses in support to the quantitative data. Figure 4 has the data.

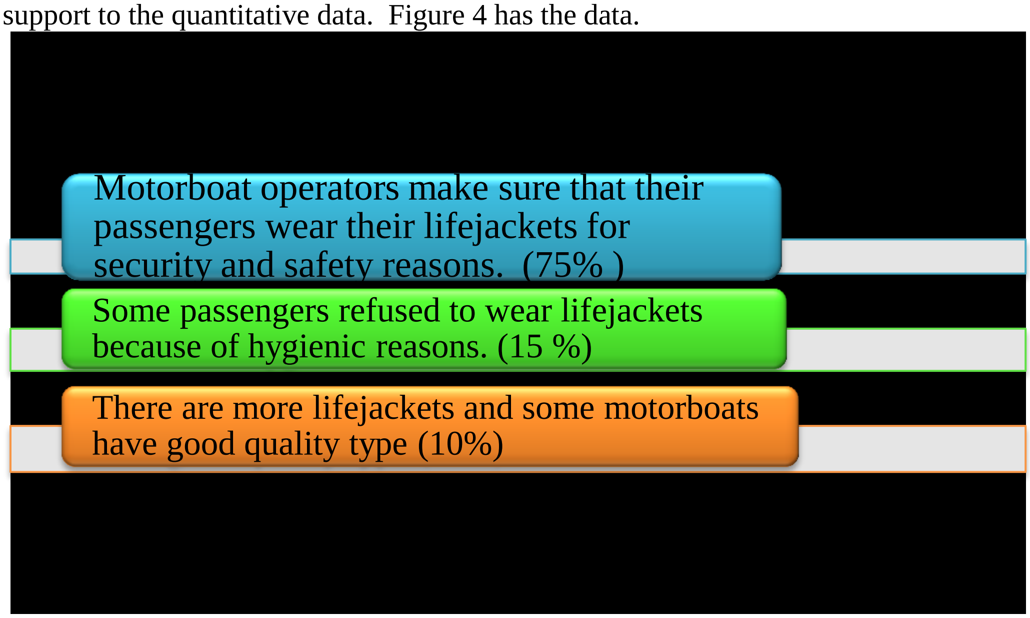

Figure 4. Observations on the Availability of Life Jackets

5.2 Motorboat Operators: Basics of Seamanship

Seamanship is the art of operating a ship or boat. Seamanship means Safety onboard and this is managed through continuous training and implementation of good working practices. The practice of good seamanship should be the goal of all.

When the motorboat operators were asked whether they know their boats or good seamanship in terms of skill of managing a boat and navigation, 20 indicated “yes” and 1 indicated “no,” boat handling (19 for yes and 2 for no), line handling (19 for yes, 2 for no), anchoring (18 for yes, 3 for no), troubleshooting engine problems (17 for yes, 4 for no), and emergency response (20 for yes, 1 for no). Figure 5 has the data.

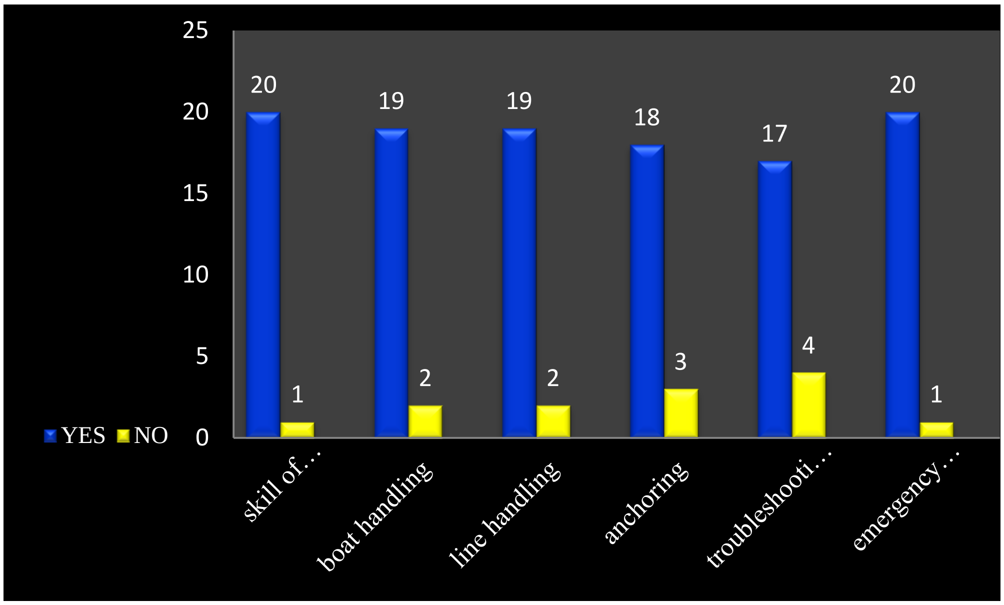

Figure 5. Knowing the Basics of Seamanship

The motorboat owners were also asked their observations and comments about the imperative of knowing their craft, three responses emerged. Figure 6 has the data.

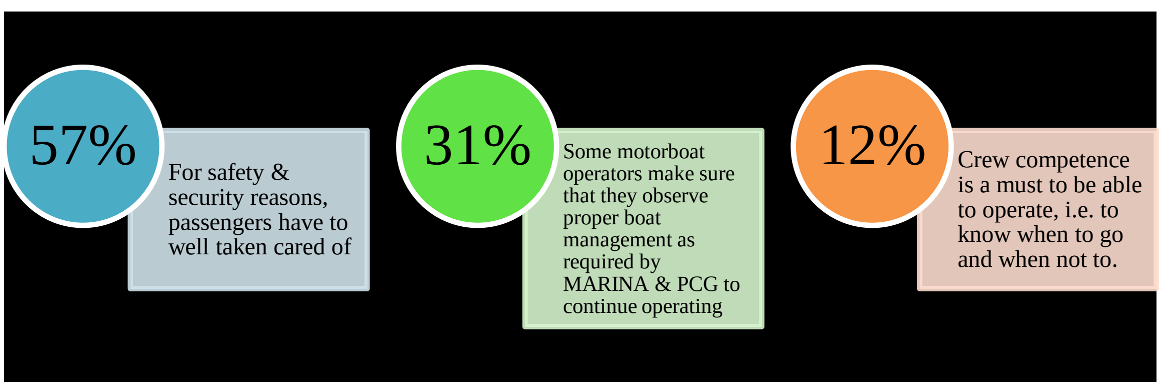

Figure 6. Observations on the Basics of Seamanship

5.3 Motorboat Operators and Boat Safety Courses

Out of the 21 motorboat operators who were asked whether they had taken formal boating education, 11 indicated "yes" and 10 only indicated "no." In terms of the basic of seamanship, 11 answered "yes" and 10 indicated "no." Figure 7 has the data.

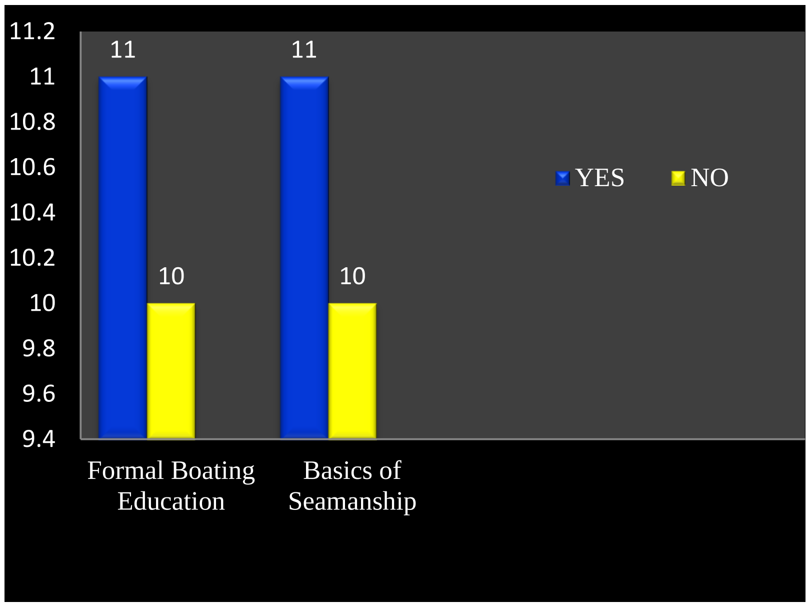

Figure 7. Motorboat Operators and Boat Safety Courses

The qualitative data revealed that the motorboat operators 52 percent of them had formal boating education and know the basics of seamanship. The researchers also gathered their responses and had the following observations as shown in Figure 8.

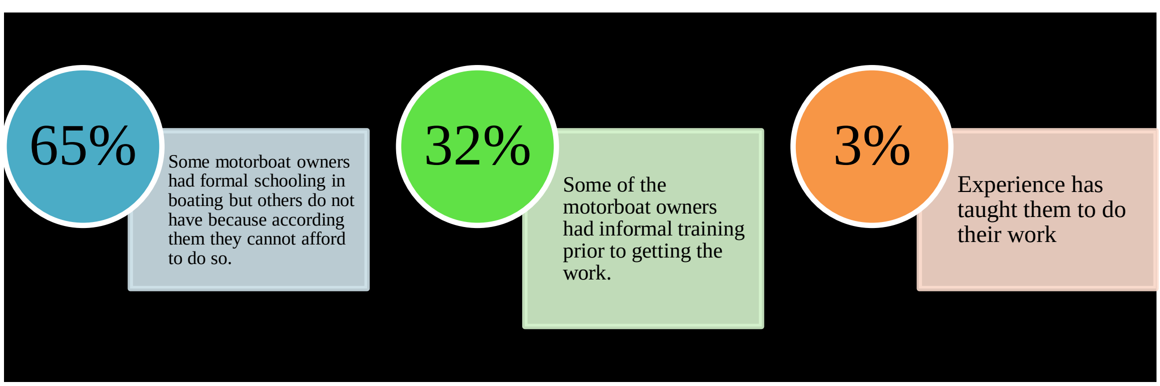

Figure 8. Observations on Motorboat Operators' Boat Safety Courses

5. 4 Motorboat Operators and the Navigational Rules

Out of the 21 motorboat operators who were asked whether they the navigation rules like the aids to navigation using buoys and day boards, 13 indicated "yes" and 8 indicated "no." In terms of whether they know the navigating gadgets as charts, GPS, RADAR, and a compass, 9 answered "yes" and 12 indicated "no." Figure 9 has the data.

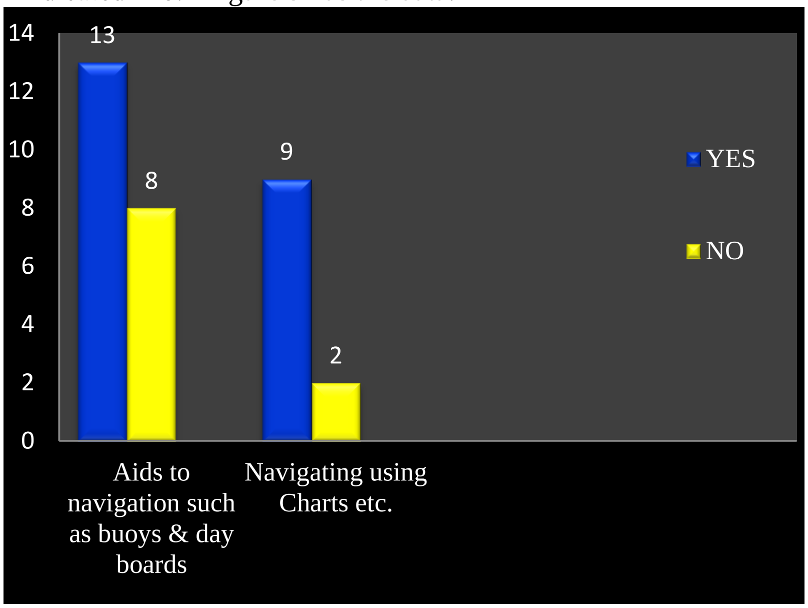

Figure 9. Motorboat Operators' Knowledge of Navigation Rules

The qualitative indicated that motorboat owners have these gadgets but a bit old already (5%). They also said that the find these gadgets expensive (45%). They feel that motorboats only ply Iloilo and Guimaras thus no need for these gadgets (40%). Other motorboat owners did not comment on this (10%). Figure 10 has the data.

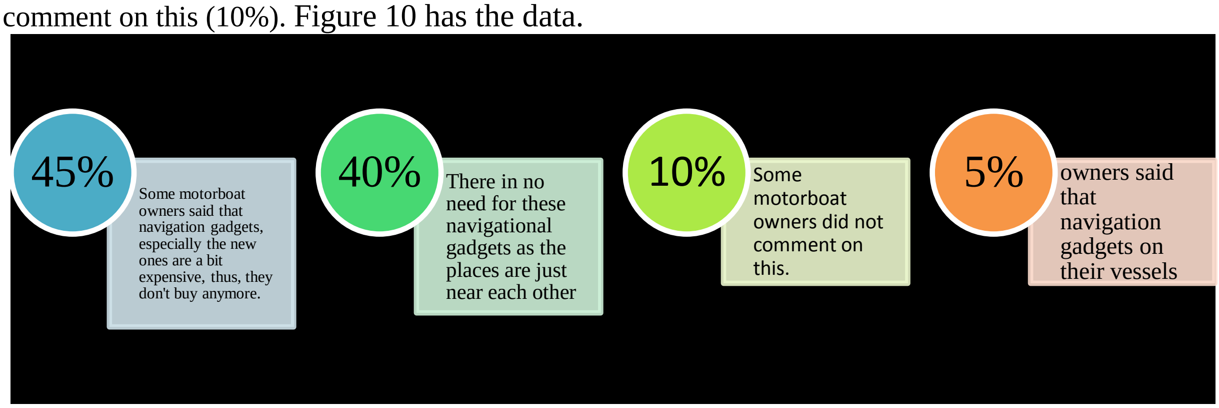

Figure 10. Observations on Motorboat Operators' Knowledge of Navigation Rules

5. 5 Motorboats Equipped with Radio and other Safety Devices

Out of the 21 motorboat operators who were asked whether their vessels are equipped with VHF radio, specifically availability of primary distress signaling device and A VHF radio equipped with DSC connected to the coast guard for quick emergency response, 11 indicated "yes" and 10 indicated "no" and 8 indicated "yes" and 13 indicated "no." Figure 11 has the data.

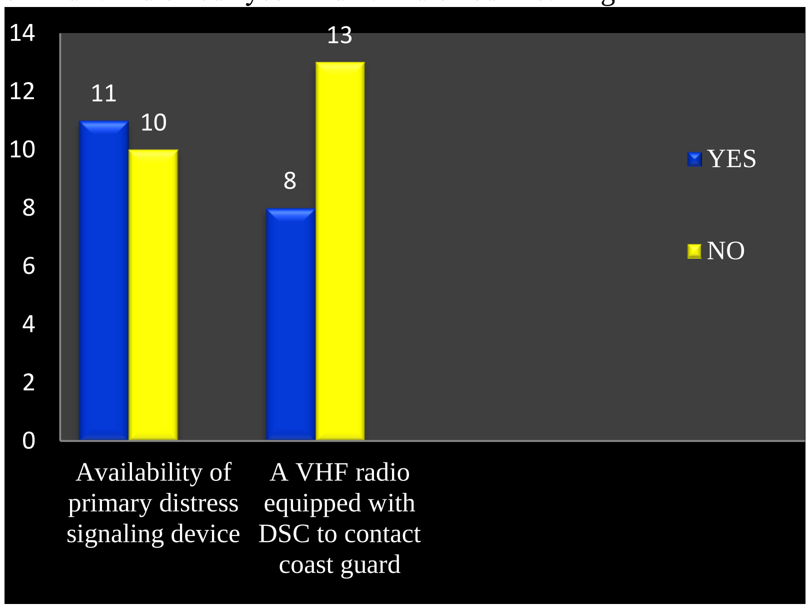

Figure 11. Motorboats Equipped with Radio and other Safety Devices

When interviewed, the motorboat operators' said that some signalling device are too expensive to acquire (55 %), boats have two-colored lights to signal an emergency (37%) , boats are small to have such devices (8%). Figure 12 has the data.

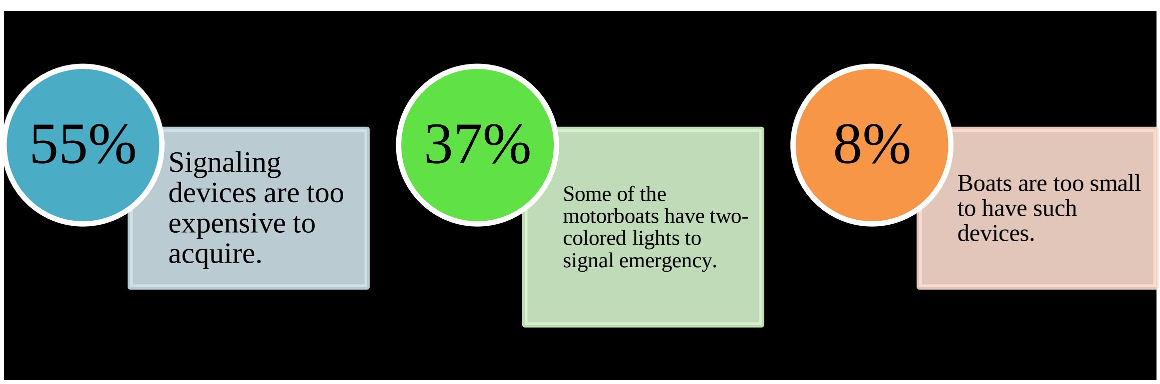

Figure 12. Observations on Motorboats Equipped with Radio and other Safety Devices

5. 6 Motorboats and Vessel Check Up before they are Allowed to Sail

It is an international mandate that all vessels are supposed to be sea worthy before they are allowed to sail. When asked whether their motorboats are having the periodic vessel check-up, specifically checking whether the vessel has met the minimum safety requirements, 76% said "yes" 20% said "no" and 4% refrained from answering. Figure 13 has the data.

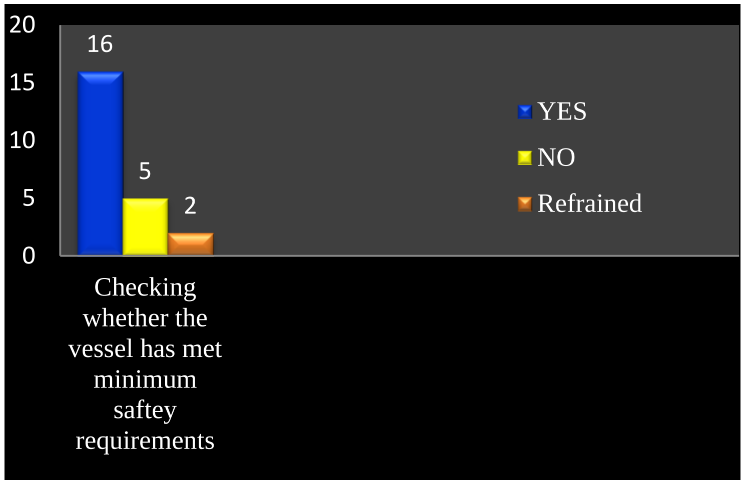

Figure 13. Motorboats and Vessel Check Up before they are Allowed to Sail

The qualitative data further reinforced the quantitative data on meeting the minimum safety requirements. Majority of the motorboat owners believe that meeting the safety requirements helps them sustain the business (82%), not meeting the minimum requirements because they cannot go beyond the allowable number of passengers (12%), and they do not have check up however they have their own maintenance (6%). Figure 14 has the data.

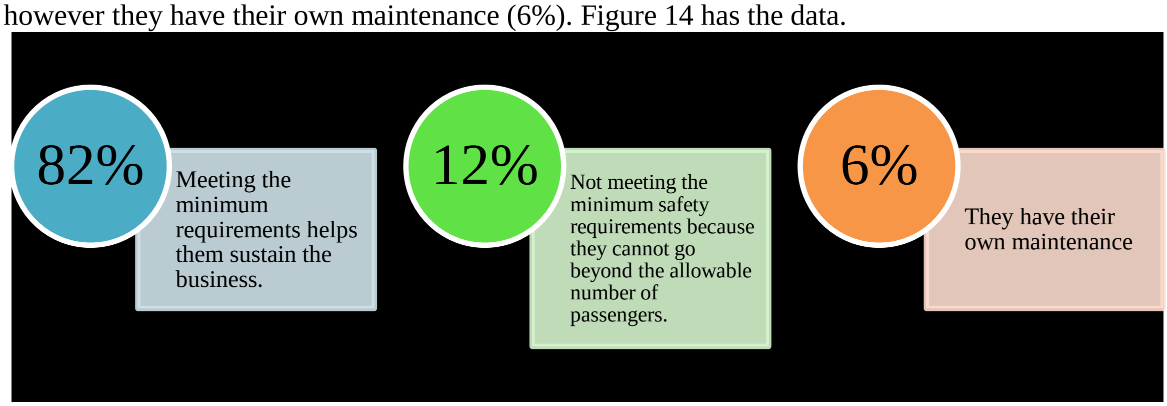

Figure 14. Observations on Motorboats and Vessel Check Up before they are Allowed to Sail

6. Findings

The findings are:

Majority of the motorboat operators comply to the requirements of having available life jackets on board. Although, some passengers refuse to use lifejackets because of hygienic reasons.

Majority of the motorboat operators possess the foundation of good seamanship as navigation, boat handling, line handling, anchoring, troubleshooting engine problems, and appropriate emergency response. Generally, they are also cognizant of their passengers' welfare.

Majority of the motorboat operators have undergone formal boating education though the number is not significantly higher than those who have not taken. Getting a formal education in boating and seamanship is expensive for them.

Majority of the motorboat operators have awareness of navigational rules and other devices.

A majority of the motorboat operators equipped their boats with signalling device but to others, provision can be expensive.

Majority of the motorboat operators have periodic vessel check with a few refusing to do so for fear that they might not be able to meet the guidelines for sea security.

7. Conclusions

The following are the conclusions:

(1) Motorboats still remain to be equipped with the necessary life saving devices.

(2) Passengers' welfare is the main priority of the motorboat operators.

(3) Formal boating education must be one of the considerations among motorboat operators.

(4) Experience remains to be the best teacher in terms of motorboat operation.

(5) Equipping motorboats of signalling devices is an imperative for motorboat operators.

(6) Periodic vessel check assures sea safety and security.

8. Recommendations

The following are recommended:
(1) The results of the study must be disseminated to the members of the motorboat operators plying Iloilo-Guimaras Island so as they are informed of their compliance to the coast guard and MARINA's guidelines.

(2) The school community must be aware of the results of the investigation to be able to use them as baseline data for future studies of similar nature.

(3) Conduct more parallel studies to address compliance to sea policies and sea security.

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Human Rights at Sea: Exploring an Agenda for the Future

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While human rights protection has been promoted on land with greater or lesser degrees of success, there is little conversation about human rights at sea at the national, international or corporate level. A number of recent security developments in the maritime domain such as maritime piracy and its impact on seafarers and those who protect them, human trafficking at sea, illegal migration, and human slavery in some maritime industries have raised this issue to greater prominence.

Consequently, there is a need for highlighting human rights issues towards the end of protecting and respecting individual human rights in the maritime context, as well as mitigating and providing remedies for "human rights violations in the daily running of the maritime industry and for workers in the maritime environment."

Keywords: Human rights, armed guards, piracy, illegal migration, human slavery, fishing industry, human trafficking

1. Introduction

A number of recent security developments in the maritime domain, coupled with our increased knowledge about abuses of the maritime industry by criminal elements, have raised the issue of "human rights at sea" to a greater level of importance than has been seen in recent years. Examples include – but are not limited to: Maritime piracy and its impact on seafarers and those who protect them – specifically privately-contracted armed security personnel (PCASPs); human trafficking at sea, illegal migration, and human slavery in some maritime industries.

The goal of this paper is to highlight some of the human rights issues as they occur at sea, and to present the global debate that is currently emerging on this issue.

2. Human Rights and Human Rights at Sea

According to the United Nations, human rights are those rights "inherent to all human beings, whatever our nationality, place of residence, sex, national or ethnic origin, colour, religion, language, or any other status" [1]. Detailed in the United Nations Universal Declaration of Human Rights, they include (but are not limited to) the right to "life, liberty and security of person," and "freedom of speech and belief and freedom from fear and want" [2]. More specifically, and directly applicable to the maritime industry, this includes the provisions that "no one shall be held in slavery or servitude; slavery and the slave trade shall be prohibited in all their forms" (Article 4), and that "no one shall be subjected to torture or to cruel, inhuman or degrading treatment or punishment" (Article 5).

While human rights protection has been promoted on land with greater or lesser degrees of success, it has been noted that there is little conversation about human rights at sea at the national, international or corporate level. Consequently, there is a need for highlighting human rights issues towards the end of protecting and respecting individual human rights in the maritime context, as well as mitigating and providing remedies for "human rights violations in the daily running of the maritime industry and for workers in the maritime environment" [3]. As has been stated by the founder of the Human Rights at Sea initiative, "human rights apply at sea, as equally as they do on land" [4]; additionally, "considerations of humanity must apply in the law of the sea, as they do in other areas of international law" [5].

2.1 The maritime dimension of human rights

Human rights concerns at sea are both a cause of, and a product of, the increasing criminal exploitation of the maritime and shipping environment. For example, maritime trade routes have long been used by criminal traffickers – Figure 1 shows maritime routes currently in use for the illegal movement of drugs and human beings around the world; the red and green lines are the routes used to move cocaine and heroin, respectively; while the purple line shows current movement of illegal migrants, and the blue line shows illicit trafficking in women and children.

Figure 1: Current world illicit trafficking: 2014 [6]

The global trade in illegal weapons exploits the maritime domain to a similar degree in that weapons traffickers use the same trade routes as all other trade – both legitimate and illegitimate. According to some estimates, up to one-quarter of all trade in small arms may be illicit, or not recorded as required by law [7].

The ability of criminal elements to commit human rights abuses at sea with far greater impunity than on land, stems from the fact that much of the maritime domain is what is known as an "ungoverned geographical space" which means it is ripe for abuse, given the lack of international or even national oversight in many cases. More specifically, an ungoverned geographical space is a social, political, or economic area where states do not exercise 'effective sovereignty' or where state control is "absent, weak, or contested" [8]. At sea, this includes nearly all of the high seas given the absence of a monitoring and enforcement mechanisms in much of the world's oceans. Ungoverned geographical spaces can also unfortunately include the territorial waters of some states. In these cases, the national government is unable or unwilling to exercise effective judicial control over its maritime boundaries thereby effectively allowing criminal elements to conduct illegal activities – including human rights abuses – relatively unchecked and often even unobserved by local authorities or the international community.

2.2 Why does this matter?

Apart from the intrinsic value of the right to dignity of every individual, an attention to human rights in employment is increasingly seen as good business practice. Initiatives supporting "corporate social responsibility" have been shown to create loyal customer bases, and even increase profitability. Negligence of basic human rights has equally been shown to lead to boycotts in highly visible cases such as the Tazreen factory fire in Bangladesh that killed 112 workers, and current efforts to boycott fish products from Thailand due to the extent of forced labour used in the industry.

Looking now more specifically at a number of human rights issues; we will focus on the following cases: Human rights issues in maritime piracy; human trafficking at sea; human slavery at sea; and the human rights dimension of illegal maritime migration. It should be stressed that these are not the only human rights concerns at sea; rather these cases have been selected to illustrate how pervasive human rights abuses can be on the world's oceans.

3. Maritime Piracy

Three separate dimensions of human rights concerns can be identified within the very complex issue of maritime piracy. First, seafarers are often taken as hostage by pirates; their status as hostages and unfortunately their treatment by some employers during and after their time as hostages, is often a direct human rights abuse and is in direct contradiction to many elements of the Universal Declaration of Human Rights. Second, those that are increasingly hired by shipping companies to protect crews and vessels in waters where pirates are known to be active have faced problems of "criminalization" due to ambiguities in international law. For example, in a few high-profile cases, privately-contracted armed security personnel (PCASPs) have successfully fended off pirate attacks only to be arrested for weapons possession in their next port of call. Thirdly, those who are actually committing acts of piracy may also be victims of human rights abuses themselves.

3.1 Seafarers taken as hostages

Maritime piracy has been a significant concern off the coast of Somalia for some years. Although these numbers are now in decline due to the success of the UN-sanctioned international task forces operating off the Somali coast and into the Indian Ocean, and the use of armed security guards on board vessels, the United Nations estimates that about 40 people are still being held by Somali pirates [9].

While this is a welcome decline from the peak of their activity some three years ago when more than 700 seafarers were held hostage on more than thirty ships, it still is a critical problem. Many of these crewmembers have been held hostage for years while ransom negotiations languish. Understandably, the longer hostages are held the greater the risk of physical danger and long-term distress. As reported by Oceans Beyond Piracy, the average duration of captivity was 369 days for all seafarers held captive in 2013 [10].

The dire conditions of seafarers held in captivity are well-documented. During their time as hostages, seafarers are often may be subject to torture, beatings, lack of access to critical medical care, and other forms of physical and emotional abuse, coercion and intimidation. Frequent threats of death are not uncommon. As reported by a seafarer from the *MV Orna*, released in January 2013 is typical of the kinds of conditions experienced by hostages in Somalia:

> "We were starved and tortured. The pirates would remove all our clothes and hit us with sticks covered with thorns and kick us. They would tie us up with thick rope, almost stopping our blood circulating. We could not move after the ropes were removed. The nights were cold and the days were scorching hot." [11]

Release from captivity is rarely the end of distress for the seafarers who may continue to have significant problems when they return home. Post-traumatic stress disorder (PTSD) can be an ongoing debilitating problem, affecting their not only their health and relationships, but their future employment prospects as well. Because of the nature of their employment, it can be extremely difficult when they are released, as they get no welfare back up or support. Back wages from their time in captivity are rarely paid and they may be ostracized if they complain. Additionally, some seafarers who have been held by pirates find they may be considered "bad luck" when they seek work again.

3.2 PCASPs

One of the reasons attacks by Somali pirates have declined so significantly is the increasing use of armed guards (more formally, "privately contracted armed security personnel – or PCASPs). In 2013, 100 vessels out of 145 reporting suspicious approaches by suspected pirates in the Indian Ocean had security teams on board, as did ten of the nineteen vessels reporting attacks. Twenty-seven of the 100 vessels with security (27%) aboard during suspicious approaches reported firing warning shots to deter suspicious approaches, and eight of the ten vessels with security on board during attacks (80%) reported exchanging fire with pirates [12].

While successful in helping to mitigate capture of the vessels and hostage taking, The use of privately contracted armed security personal (PCASPs) onboard ships has clouded the issue of liability and responsibility for the individual guards, the ship's master and the shipping company – who is responsible should someone – pirate or crew – die in the armed defence of the vessel? The "100 Series Rules for the Use of Armed Force" meant to establish internationally implemented rules and procedures for the use of force that will be accepted in a court of law, are an effort to address this problem and are in use by some PCASPs, but have not yet received full international acceptance. On a related note, what obligation does the ship have if pirates are severely wounded by PCASPs during an armed defense of the vessel? Are the captain and crew required to render medical assistance or perform a rescue at sea if the pirate's ship has been permanently disabled during the armed exchange?

While these may not seem *prima facie* to be human rights issues, the realities at sea for some PCASPs might suggest otherwise. PCASPs legally hired to protect vessels from pirate attacks have been jailed when entering the waters of some countries, and absent clear international law on their rights, responsibilities and status, have been accused of piracy or terrorism themselves, or languished in jails abroad. Similar situations have occurred with merchant ships who have chosen to carry weapons to protect themselves.

For example, at the height of Somali piracy in 2010 off East Africa, several British security guards were accused by the Eritrean government of terrorism and sabotage after they were found with weapons inside Eritrea's territorial waters [13], October 9, 2013]. In another case, several Russian sailors onboard the *MV Myre Seadiver* were accused by the Nigerian government of weapons trafficking when arms were found onboard their vessel in Nigerian waters. The vessel belonged to the Russian security firm Moran which claimed the *MV Myre Seadiver* had all the required permissions to carry arms, and was in Lagos only to change crew on its way from Madagascar to Conakry [14].

The situation in Nigeria – where pirate attacks continue to increase – is proving to be complicated for ships wishing to protect themselves from pirate attacks due to the fact that the Nigerian Army and the

Nigerian Marine Police do not agree on the use of PCASPs onboard vessels. As reported in June 2014, the Nigerian Army has begun to begun to detain and/or arrest vessels with armed security guards on board even if they have been provided by the Nigerian Marine Police. The issue is one of jurisdiction – even though the Nigerian Army's role in anti-piracy operations has been confined to the provision of escort and patrol boats, it has claimed enforcement jurisdiction over the territorial sea and EEZ [15].

According to Peter Cook, CEO of the Security Association of the Maritime Industry (SAMI), these incidents are part of a "worrying trend" on the part of some government authorities towards the "criminalization" of maritime security operatives. Specifically, "Maritime security professionals should not be used as makeweights in political disputes, nor be seen as scapegoats in commercial quarrels" [16] He goes on to add,

> "…it is deplorable that such individuals are being made to suffer the indignity, uncertainty and distress of arrest and incarceration, especially as the maritime security industry has been at the forefront of efforts to protect seafarers and world trade from piracy." [17]

3.3 Children in Piracy

While it may be difficult for some to feel compassion for the perpetrators of maritime piracy, the reality is that human rights abuses do occur within pirate gangs, specifically the use and exploitation of children[1]. The first significant attention given by the media to the use of children in piracy was as a result of the *Maersk Alabama* attack in the Gulf of Aden in April 2009, when the sole survivor among the pirates claimed at various times to be 16, 18, 19 and 26 years old. Despite the confusion over his age, he was subsequently tried as an adult.

This was not a unique situation – the Indian Navy discovered that 25 out of 61 pirates that they arrested were under the age of fifteen years, four of whom were estimated to be just eleven years old [18]. And in 2011, of the 87 pirates on trial throughout the world, 50 were under the age of 18, or just over 57%. [19]

The use of children as pirates by criminal gangs raises a number of concerns, first among which must be the deprivation of a proper childhood for these children. They are not educated in anything but criminal activity that makes it difficult to consider rehabilitating them or even providing them with a proper education. It also raises concerns at a more practical level – people are known to hesitate if they believe their actions might kill a child, raising concerns for the efficacy of armed guards in some situations. And if the children are captured as pirates, are their rights as children throughout their detention and subsequent trials properly protected in all parts of the world? These questions and concerns have implications for the future stability of Somalia as a viable country, or indeed any society where children are routinely exploited in criminal activity (as often seen in militias and terrorist organizations as well).

The use of children in piracy also has implications not only for the defence and security of vessels, but the protection and safety of the world's seafarers. Anecdotally, sailors held captive by Somali pirates often report that the children may typically be the ones that treat them the worst and are the most abusive in their behaviour, presumably in an effort to please or impress the leaders of their pirate gangs.

[1] According to the United Nations Convention on the Rights of the Child (UNCRC) Article 1, the term 'child' means every human being below the age of 18 years, unless under the law applicable to the child, majority is attained earlier.

4. Human Trafficking at Sea

Human trafficking is estimated to be the third largest criminal enterprise in the world behind illegal drugs and arms trafficking. According to the United Nations Office on Drugs and Crime, trafficking is defined as the acquisition of people by improper means such as force, fraud or deception, with the aim of exploiting them [20].

The CNN Freedom Project has reported that trafficking in humans is believed to generate upwards of $32 billion dollars [21]. Globally, between 600,000 and 800,000 people are trafficked across international borders annually [22]. Major source countries now include Ukraine, Russia, Romania, Bosnia, Brazil, Myanmar and the destination countries are mostly the United States and Western Europe. Most of those trafficked each year are women and children, primarily for the sex industries.

As is clear from Figure 2, the illicit movement of human beings is clearly a maritime issue:

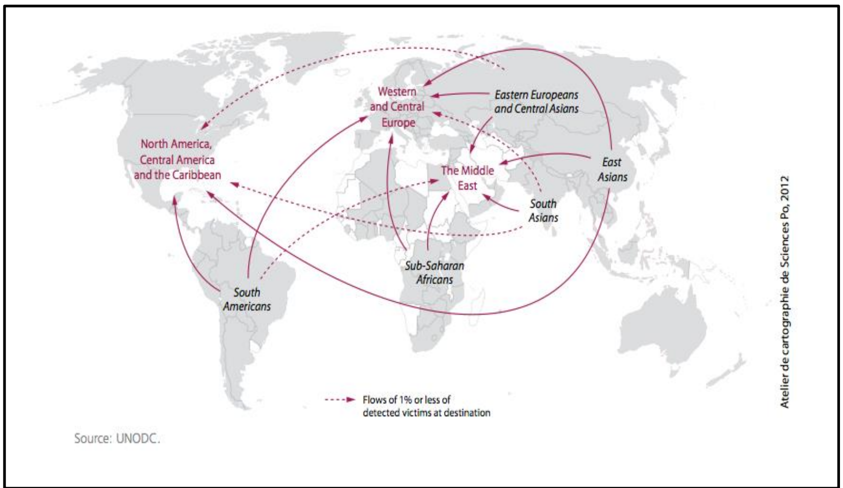

Figure 2: Human Trafficking – Transnational Flows, 2007-2010 [23]

Human trafficking has two maritime dimensions: 1) the movement of people on the water across geographic regions and sub-regions, and 2) the illicit entrapment and movement of people for use in the maritime industry. More commonly known now as “human slavery,” this element of human trafficking will be covered in the next section, with this section focused on the illicit movement of people by sea.

The methods used to traffic human beings 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 onboard vessels or packed into shipping containers. Smugglers and traffickers have also been known to use passenger ferries as a way to transport people across bodies of water, hiding them among crates to avoid detection from officials [24].

Only a small percentage of human trafficking occurs by air due to the high risk of detection and the fact that traffickers can only take one to three people at a time. For those routes that are not exclusively land-based (where trucks are the preferred means of transportation), boats are the primary means of transportation. Hiding individuals in ship cargos is often used, but is also high risk due to inspections at ports. Usually a more common method of transporting people illegally is by rickety fishing boats or other derelict vessels, crammed and overcrowded, seeking to exploit weaknesses in maritime boarders by transferring the trafficked human beings onto unpatrolled beaches and shores at night where the chance of detection is relatively low.

5. Human Slavery at Sea

As noted by Dr. Mark Lagon, Professor at Georgetown University and expert on human trafficking:

> "Human trafficking is not limited to activities on land, and increasingly evidence indicates that labor and even sexual exploitation are occurring at sea, and particularly on fishing vessels that exist largely unnoticed by the rest of the world." [25]

The fishing industry is often easily exploited as fishing vessels are exempt from the vessel safety standards and monitoring requirements of the International Maritime Organization (IMO). The result is that fishing vessels are regulated only by the vessel's flag state fishing vessels and often much less carefully regulated than other ships. Additionally, as fishing vessels may operate at sea with complete autonomy months or even years at a time, they are often geographically well beyond the jurisdiction of even the most conscientious state.

The typical crewmember employed by the fisheries sector in many countries is often a relatively low cost migrant worker. Without a network of supportive friends, family and community, migrant workers are vulnerable to forced labor and human trafficking. They are typically low skilled, lacking training and often have inadequate language skills to understand their rights and legal protections in environments where the enforcement of safety and labor standards may be lacking.

A typical scenario may be as follows: Migrant workers are eager to sign onboard vessels as fishermen due to typical promises of high wages. Either that, or they are tricked by agents believing they are agreeing to become gardeners or construction workers, only later to find out that they are being sent to sea. Fishing company agents may rush these men into signing misleading contracts, with the workers only finding out later that the company can withhold their salaries until the completion of the voyage, and that collateral assets may be collected from their families. Any personal identification papers or documentation they have may be confiscated or held for "safekeeping" until they completion of their contracts.

Once onboard the vessel they live in cramped and unsanitary conditions, often with the daily threat of physical violence and sexual assault. They can be assessed fines for not working; there have even been anecdotal cases of fishermen being killed and thrown overboard if they refuse to work, or complain about the working conditions. When the ship makes port calls, they fishermen are usually reluctant to complain, for fear of retaliation. At the end of their voyage, they may not even be paid and their passports and identification papers (if there were any) not returned to them. They will then incorrectly be told that they are illegal workers and if they complain to the authorities, they will be thrown in jail.

6. The Human Rights Dimension of Maritime Illegal Migration

As we see in human trafficking, illegal migration also has a maritime dimension; indeed it may often be difficult to distinguish between migration and trafficking as many people who begin as migrants often end up trafficked by unscrupulous individuals they have hired to help and assist them. What begins as a promise of safe passage by sea and illegal entry into another country may end up as forced labour on board fishing vessels, as we have seen as well.

For trafficked individuals and migrants alike, transportation by sea – typically on dangerously maintained boats – if fraught with peril. The boats in which these migrants travel are not properly manned, equipped or licensed for carrying passengers on international voyages. Migrants transported by sea generally travel without documents, in crammed conditions, facing severe weather at sea and often even death. The result has been several tragedies of overcrowding, capsize and sinking in recent years:

- On 26 August 2001, the Norwegian cargo ship *Tampa* responded to a distress call issued by the Australian Rescue Coordination Centre and rescued over 430 Afghan asylum seekers from a sinking migrant boat. The Australian government refused to permit the *Tampa* to offload the rescued asylum seekers on Christmas Island, the closest place of safety. The *Tampa*'s captain eventually declared an emergency and entered Australian territorial waters, upon which they were boarded by Australian SAS special forces who took control of the ship. The asylum seekers were eventually transferred to a naval vessel and sent to Nauru where they were detained;

- In May 2007 a small and overcrowded boat apparently full of migrants was spotted in some distress by the Maltese Air Force. Over fifty people were on board and at the time they were spotted, they were apparently trying to bail out water from their vessel. Boats dispatched to render assistance found no trace of these individuals, and they were all presumed lost at sea;

- On 3 October 2013, a boat carrying migrants from Eritrea, Somali and Ghana to Italy sank off the Italian island of Lampedusa. The Italian Coast Guard responded and were able to rescue 155 survivors of the reported 500 migrants on board;
- A second shipwreck occurred just over a week later in the same area. In this incident, the boat was reportedly carrying migrants from Syria and Palestine, and at least 34 individuals were later confirmed dead;

- In June 2014, Italian rescuers attempting to assist a fishing boat from North Africa with almost 600 people onboard found 30 people dead of suffocation in the hold of the vessel. This occurred on a weekend where the Italian Navy rescued over 5,000 individuals at sea fleeing the conflicts in North Africa and the Middle East.

These are but a few examples of incidents that have occurred recently. Migrants lost at sea is not new but the increasing frequency of reported shipwrecks and losses has resulted in renewed attention to this humanitarian concern, and to the difficulties subsequent to rescue of individuals who are undocumented, often fleeing significant danger and harm, but who were nonetheless attempting to enter other countries illegally.

7. Conclusion: Next Steps and the *Human Rights at Sea* Initiative

This paper is not meant to be an exhaustive discussion of human rights concerns at sea; nor it is meant to rank-order or prioritize human rights concerns in any definitive manner. Rather, the goal has been to introduce issues that have been treated independently as part of a greater whole of human rights concerns, and to begin to show some of the inter-linkages that exist between them. While some of these issues – such as rescue of migrants at sea – have received significant attention and are supported by IMO guidelines, amendments to SOLAS the SAR Conventions – others, such as human slavery at sea is relatively new to international awareness and is still lacking an internationally accepted and supported regulatory framework.

Assisting in this effort of greater awareness, is the Human Rights at Sea Initiative [26], which has stated the following goals and objectives as its vision:

- Increased global awareness of the explicit requirement for protection of, respect for and provision of remedies in relation to human rights at sea.

- Continued international development of effective, enforceable and accountable remedies for human rights abuses at sea.

- Independent and effective state, business and individual lobbying in support of the concept of human rights at sea.

- Global awareness of the UN Guiding Principles on Business and Human Rights in the maritime environment and throughout the maritime industry based upon the Human Rights at Sea (HRAS) initiative [27]

The goals include the development of a maritime interpretation of the 2011 UN Guiding Principles on Business and Human Rights and the creation of voluntarily applied Corporate Social Responsibility (CSR) documentation [28]. This will involve not only participation and agreement of governments around the world, but significant contribution and expertise from the international shipping community and maritime experts in academia, the public and the private sectors.

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On a Lookout Beyond STCW: Seeking Standards and Context for the Authentic Assessment of Seafarers

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The Standards of Training, Certification and Watchkeeping Convention (STCW) amendments in 1995 intended to improve the knowledge-based training mandate established in STCW'78 by making it outcome-based. This required seafarer students undertake competence assessment (or outcome of training received) to demonstrate their capacity to perform tasks listed in the STCW Code. This necessitates that students direct their learning efforts to the attainment of clearly stated expectations that, typically, are represented by learning outcomes based on the STCW competencies. Maritime Education and Training (MET) providers working under the directives of the National Maritime Regulators interpret the STCW requirements to develop the seafarer training curriculum and the resulting learning outcomes, to assure that students attain the minimum standards of competence established by the STCW. This paper will review and argue that different ideas as to 'outcomes' has been confusing the interpretation of STCW and, therefore, how seafarer students are being assessed. Critically, a review of specific excerpts from the STCW Code will be used to show that the Code largely fails to provide a 'standard' that can assure assessment of seafarers to one of the most critical outcomes: the performance expected at a level of work in the industry. A short review of the inherent characteristics of authentic assessment is provided in justification of its use as an alternate and optimal solution to improve current assessment practices and respond to stakeholder needs. The paper will point to an evidence-based way forward where future research will empirically investigate how authentic assessment can improve the STCW and the resulting training outcomes.

Keywords: STCW, Outcomes, Criteria, Standards, Context, Authentic Assessment

1. Introduction

The International Maritime Organization (IMO) established the Standards of Training, Certification and Watchkeeping (STCW) Convention in 1978 (referred to as STCW'78) to provide global, minimum standards of competence for seafarers. Prior to STCW'78, individual countries established their own standards. However, STCW'78 did not prove to be as effective as expected due to criticisms from stakeholders that complained of vague and unclear standards left to the individual interpretations by maritime nations [16], which posed the risk of variation in the standards of competence development amongst international seafarers. To address these concerns and improve upon the training mandate, the STCW Code was revised with significant amendments in 1995 (referred to as STCW'95). Through the 1995 amendments, IMO intended to fundamentally improve the training mandate by making it outcome-based. This would require seafarers to demonstrate their competence in the tasks outlined in the STCW Code rather than just show they had acquired knowledge (as in STCW'78). Over the years STCW has been updated with various amendments (1997, 1998, 2004, 2006, Manila amendments 2010) to provide training and assessment guidelines to Maritime Education and Training (MET) providers and other stakeholders with an interest in developing the competence seafarers require at the workplace.

The STCW Convention developed the STCW Code which provides guidelines on what the seafarer student should know and demonstrate before being awarded with the Certificate of Competence (CoC). The CoC opens job opportunities and based on competence, becomes the basis for their recruitment, reward and promotions. The Code promotes specific assessment methods to collate evidence of demonstrated competence for the tasks listed in it. However, both competence demonstration and student assessments require explicitly stated 'intended outcomes' be achieved. The intention being to allow students to direct their learning efforts towards 'outcome' attainment and to guide assessors on what they are supposed to measure via assessments. The Code provides guidelines for MET providers working under the directives of the National Maritime Regulators to interpret the STCW Code requirements and develop the seafarer training curriculum (with the intended outcomes) to assure that students can demonstrate the attainment of the minimum standards of competence established by the STCW Code.

This paper argues that the STCW Code fails to provide explicit guidelines and instead lays down vague statements which can encourage individual interpretations as to what benchmarks should guide competence assessment. If the benchmark falls short in the measure of essential, minimum, and required competence, graduating seafarers may lack the required competence to perform in a consistent manner in the workplace. This can be dangerous for the shipping industry where any regional weakness in assessment against the STCW Code has profound ramifications as it is an international industry where employees are sourced globally. The perceived oversight of the STCW Code continues into the lack of essential 'criteria and gradations for the quality of performance', and 'context', which can describe the student performance and contextualise the evidence of competence produced. Sub-standard evidence diminishes the value of the resulting CoC creating dissatisfaction among the concerned stakeholders, such as the employers [5, 6, 21, 23]. Supported by specific examples from the Code, basis will be laid to highlight the need for a review and improvement to the STCW Code as a standard with unambiguous, assessable outcomes. Additionally, a review of literature in the area of authentic assessment will be used to provide theoretical arguments in support of its use to address the inherent flaws in the STCW Code and improve upon the resulting training outcome.

2. Structure of the STCW Code for 'standards' for competence assessment

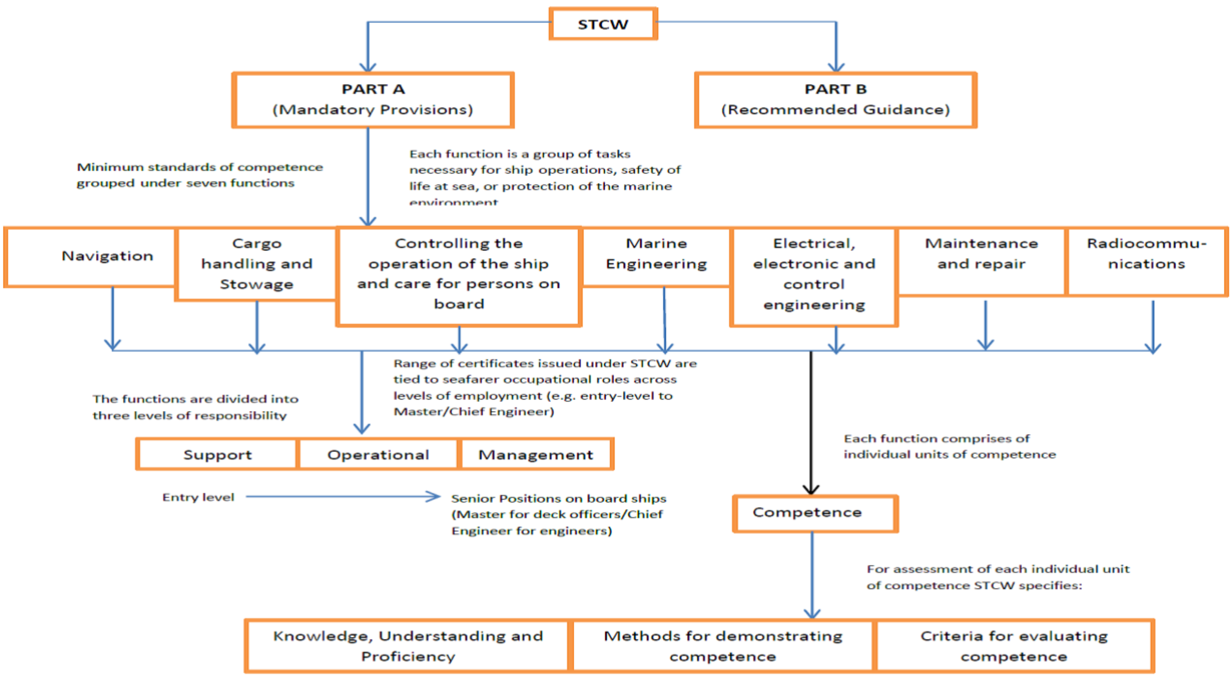


Figure 1: Standards of Competence and Assessment as laid out in the STCW Code

Figure 1 provides a snapshot of how the STCW Code is currently structured in providing 'standards' for competence assessment. As can be seen in the figure, the 'standards' are grouped under seven functions for the three levels of responsibility. Table 1 shows that under these seven functions, the competence for every individual task (or unit of competence), the Code specifies the minimum knowledge, understanding, and proficiency. The evidence of having achieved the required standard of competence is provided with the methods for demonstrating competence and the criteria for evaluating competence.

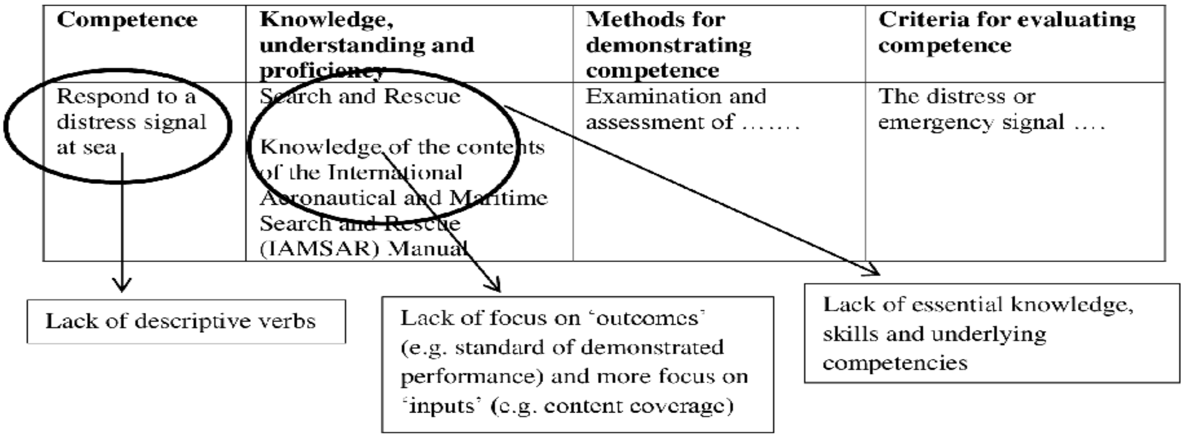
Competence	Knowledge, understanding and proficiency	Methods for demonstrating competence	Criteria for evaluating competence
Carriage of dangerous goods	International regulations, standards, codes and recommendations on the carriage of dangerous cargoes, including the International Maritime Dangerous Goods (IMDG) Code and the International Maritime Solid Bulk Cargoes (IMSBC) Code Carriage of dangerous, hazardous and harmful cargoes; precautions during loading and unloading and care during the voyage	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved simulator training, where appropriate .3 approved specialist training	Planned distribution of cargo is based on reliable information and is in accordance with established guidelines and legislative requirements Information on dangers, hazards and special requirements is recorded in a format suitable for easy reference in the event of an incident

Table 1: Example within the STCW Code stipulating the minimum standards of competence for assessment [24]

3. STCW lacks explicit guidelines for 'outcome' development

Assessment is a significant component of education along with learning and teaching as it provides feedback about a student's progress and achievements, the effectiveness of the teaching and instruction methods, and the course outcomes [25] while supporting the overall goal of improving student learning [20]. One of the functions of assessment is also to gauge whether the student has achieved the desired outcomes that the learning tasks and teaching processes intended. These outcomes or more correctly 'learning outcomes', define what the students should be able to do at the end of a learning period [8]. The learning outcomes thus guide the teaching and instruction towards the assessable outcome. Hence, outcome statements should always precede assessments [29]. The outcomes should be explicitly stated to ensure that the appropriate assessment methods are adopted to produce the required evidence of outcomes achievement. For example, if the intended outcome is to develop a student's professional competence to fight fires, then the evidence of such competence will be more credible and valid via practical demonstration and not just rely on written examinations. On the reverse side, if the outcome to be achieved was a students' ability to recall the theory behind the cause of fires, written and oral examinations may be more appropriate than practical drills and exercises.

Although, the STCW Code is not a curricula or a source of learning outcomes, the 'standards' provided in its Code guide the MET providers (working under the regulatory bodies) to develop curricula with learning outcomes. However, Table 2 provides an example of how at times the 'standard' in the STCW Code can only be a 'standard' of what the students should know in terms of content with some suggested indicators of competence instead of providing 'standards' of demonstrated performance. This makes the STCW an input-based [4] standard, which is in direct contradiction to the 'outcome-based' objective of the STCW'95.



Competence	Knowledge, understanding and proficiency	Methods for demonstrating competence	Criteria for evaluating competence
Respond to a distress signal at sea	Search and Rescue Knowledge of the contents of the International Aeronautical and Maritime Search and Rescue (IAMSAR) Manual	Examination and assessment of …….	The distress or emergency signal ….

Table 2: Extract from the STCW Code for the function of navigation at the operational level [24]

The word 'respond' represents an action word that provides some indication of what the students should be able to do but does not provide the reader with a 'standard' of how well they must do it. The task should be described with a verb that provides qualitative and/or quantitative descriptions of specific 'performance standards' expected from the students. Descriptive verbs can accurately describe the 'action' outcome expected during student assessments and ensure that the teaching and instruction process for students follow accordingly allowing them to learn and practice the required skills.

The 'standard' for demonstrated performance in the STCW Code should ideally also identify some of the essential knowledge, skills, and behavioural attributes required to perform the task at a professional level. It is because developing the professional competence to perform the task necessitates both cognitive ability to recall information (knowledge) and apply it (skills) based on analytical and critical thinking [19]. Underlying it are the principles, values, and attitudes (behavioural attributes) that are non-cognitive skills developed by the profession through historical experience that promote reflection and shape thought and prompt responses across a range of contexts [18]. However, Table 2 reveals that the STCW Code fails to identify such essential elements.

Lack of descriptive verbs that provide specific and measurable performance standards as well as a lack of essential knowledge, skills and behavioural attributes leave it to the discretion of the National Maritime Regulators and MET providers to develop them. This creates a risk of individual interpretation which in some cases may lead to subversion by low standards and expectations [29]. If MET providers set low expectations for their students that do not reflect workplace standards, the seafarer may hold a CoC but lack the required level of competence. This can prove dangerous for employers that trust such seafarers with ships worth millions of dollars putting the lives of other seafarers and passengers sailing on these ships and the marine environment at risk.

4. STCW lacks explicit 'Criteria' and 'Standards for Criteria'

Driscoll and Wood [8] describe criteria as the essential qualities expected from a student's performance that allows them to demonstrate and provide evidence of the achievement of learning outcomes. For example, in Table 3, the 'criteria' column identifies that an essential criteria for the 'prevention, control and fighting of fires' is the identification of the type and scale of the emergency.

Competence	Knowledge, understanding and proficiency	Methods for demonstrating competence	Criteria for evaluating competence
Prevent, control and fight fires on board	Fire prevention and fire-fighting appliances Ability to organize fire drills Knowledge of classes and chemistry of fire……	Assessment of evidence obtained from approved fire-fighting training and experience……	The type and scale of the problem is promptly identified….. Evacuation, emergency shutdown and isolation procedures are appropriate to the nature of the emergency…..

All the essential criteria for this task not identified and outlined

How soon is 'promptly'?

What does 'appropriate' mean and how can we measure it?

Table 3: Extract from the STCW Code for the function of controlling the operation of the ship and care for persons on board at the operational level (Master and deck department) [24]

However, Table 3 can also be used as an example to show that the STCW Code may overlook some of the other essential and necessary criteria required for performing the tasks listed. For example, the essential and mandatory criteria for donning and operating personal protective equipment for fighting fires are essentially missing from the 'criteria' column. Additionally, the column may also lack in providing a definitional glossary defining key words that shape assessment for the essential criteria. For example, the use of the words 'promptly' and 'appropriate' do not explain how 'quickly' or 'accurately' the task is to be performed. What is the measure that indicates competence as per workplace standards? Lack of measures may lead to vagueness for students and assessors on what is to be expected from the performance. The criteria should describe such words in measurable terms across a range of cultural and performance contexts, e.g. timeframes.

This would not mean that students who are unable to perform the task in the stated timeframe will be deemed incompetent. The criteria should be explained by a range of performance levels that provide a gradation of the quality of performance [1] or an accurate description of the current competence of the student in performing the task. For example, to perform the task identified as an essential criteria in Table 3 ('type and scale of the problem is promptly identified…') the gradation of the quality of performance could be written as,

Criteria	Standard 1 (Deemed insufficient to be declared competent at any level)	Standard 2 (Minimum required to be deemed competent at support level)	Standard 3 (Minimum required to be deemed competent at operational level)	Standard 4 (Minimum required to be deemed competent at management level)
Identify the type and scale of the problem	Type and scale of the problem identified in less than ….. minutes of observation or when made aware of	Type and scale of the problem identified in less than ….. minutes of observation or when made aware of	Type and scale of the problem identified in less than ….. minutes of observation or when made aware of	Type and scale of the problem identified in less than ….. minutes of observation or when made aware of

Table 4: Example of how the STCW Code could define the gradations for the quality of student performance

Explicit 'criteria' and 'gradations of the quality of performance' expected from students are essentially missing from most of the tasks described in the STCW Code.

5. STCW lacks explicit ‘Contexts’

Forneris and Peden-McAlpine [9] define context as the foundation upon which a learner’s knowledge is constructed in an environment that includes culture, underlying assumptions, previous knowledge, facts, rules and principles. Statement about students’ performance made in the specific context in which the assessment was carried out, may inform stakeholders whether competence developed can be directly transferable to workplace or not. For example, the competence to plot a ship’s position on a hydrographic chart using GPS data in a classroom may be directly transferable to the workplace (termed as transferable skills), whereas the competence to manoeuvre a vessel which was developed in a simulator may not (termed as non-transferable skills).

Table 5 shows that the STCW Code provides the ‘methods for demonstrating competence’ but does not explain the contexts in which such demonstration should be carried out. For example, in the case of ‘approved in-service experience’, should the evidence of competence be collated when the vessel is at sea, at anchor or alongside a port? Should the watchkeeping be done alone or under observation of an onboard assessor? Similarly, the Code does not explain what kind of simulations the simulator should create to obtain reliable evidence of competence. Should the simulated scenarios comprise of other ships to assess the students’ competence to apply the relevant theoretical knowledge?

Lack of context in suggested assessment methods

Competence	Knowledge, understanding and proficiency	Methods for demonstrating competence	Criteria for evaluating competence
Establish watchkeeping arrangements and procedures	Thorough knowledge of content, application and intent of the International Regulations for Preventing Collisions at Sea……..	Examination and assessment of evidence obtained from one or more of the following: .1 approved in-service experience .2 approved simulator training, where appropriate	Watchkeeping arrangements and procedures are established and maintained in compliance with international regulations…..

Table 5: Extract from the STCW Code for the function of navigation at the management level [24]

In an ideal world, educational institutes would exactly replicate workplace situations as the skills developed could then be directly transferred to the professional world. However, due to the complex nature of the ship as a workplace, it may be difficult for MET providers to recreate exact workplace settings. In such cases, assessments should be designed to contextually resemble situations likely to be faced by students in the real world, thus making it apparently ‘real’ rather than apparently artificial [7]. For example, to demonstrate their ability to manoeuvre ships, seafarer students may find simulators more ‘real’ than a decontextualized environment of a classroom. However, the context in which the assessment is carried out should be clearly defined. Although, the evidence produced from such assessments will not be an accurate reflection of professional competence, it will provide a contextual evidence of competence. Such evidence informs the concerned stakeholders (e.g. employers) about the gaps in the knowledge and skills between those that have been covered and assessed through learning outcomes and transferred to the workplace, and those that can only be truly acquired in the employers’ context.

Certainty as to expectations and the actual standard of performance for a graduating student is essential. The STCW Code should explicitly describe the contexts, under which the students’ ability to perform the tasks should be assessed. A lack of descriptive contexts may lead to assessors using their individual interpretation in creating contexts for assessments. Different contextual scenarios and varied contextual evidence will complicate matters for the employers and training providers intending to fill the gap. Individual training needs would have to be determined for the employees, which in some cases, may lead to extra training costs and loss of time. Costs of additional training are often borne by the employer [13]. Although employers have training obligations for preparing their employees for specific types of vessels, costs borne for aimless training should be avoided as it can cause a significant impact on the employers' budgets and timelines.

6. Why the STCW needs 'Authentic Assessment'

Although it is imperative that the attention of the IMO is drawn to the inherent flaws of the STCW Code to enable its revision, such processes cannot be expedited. The IMO provides a critical 'safety net' and has a well-established process whereby revisions occur due to the global nature of seafaring. Nevertheless, revisions are required. However, the current focus should be on addressing the issue of the STCW Code failing to provide explicit guidelines to the MET providers and the regulatory bodies for developing learning outcomes that is standardized globally. Interpretation of vague guidelines left to the discretion of the individual parties may cause teaching, learning, and assessment process to vary widely on a global scale leading to inconsistencies in the development of competence level of seafarers. One solution that can be explored to address this problem is the use of authentic assessment methods.

The examples of excerpts from the STCW Code provided in this paper suggest that the Code lacks guidelines for the development of outcomes that can enable students to develop the necessary skills to perform to workplace standards. Authentic assessment tasks are uniquely characterised by tasks contextual to the workplace situations [14] that will replicate the complexities and challenges students will confront in the real world [10]. Performing tasks with strong figurative contexts and fidelity to ship-based scenarios will develop the necessary transferable skills to a higher level of reliability and validity than completely decontextualized scenarios, which may be currently permitted by the STCW Code. Due to the complexity in exactly recreating a ship-based environment, authentic assessment tasks used in seafarer education may only have contextual resemblance to workplace scenarios. Hence, some of the skills developed may not be directly transferable to the real world. However, authentic assessments provide opportunities for students to frequently reflect [15] on their work to recognize gaps in their knowledge and grasp cues for enhancing transfer of context free transferable skills and domain specific non-transferable skills [28].

Students cannot develop workplace skills by a one-off performance in authentic assessments. To perform to workplace expectations and develop the skills, students should be provided with prior opportunity to practice the skills under guided instruction and teaching. Authentic assessments have been characterised to not only guide the assessment process but also be designed to be a continuous process integral with the learning and teaching, which will allow students to practice skills till they reach the required level of competence [2]. Gulikers, Bastiaens, and Kirschner [11, 12] suggested a five-dimensional framework (the assessment task, the physical context, the social context, the assessment result or form, and the assessment criteria) for designing authentic assessment with pertinent questions being framed to consider different dimensions. The framework requires the 'task' that represents professional practices be explicitly defined. It compels assessors to think about the outcome and the required evidence that has to 'result' from or 'form' the basis for the assessments. Such a framework for authentic assessment that requires explicit description of the task to be performed by the student, and the evidence that reflects the level to which it was performed, may provide the contextual evidence that is not currently promoted by the STCW Code.

The framework also requires description of contexts (physical and social) under which the task is to be performed. Explicit descriptions of contexts under which student assessments should take place are essentially missing from the STCW Code. Physical and social context description for authentic tasks should ideally reflect how closely the assessment resembles the professional world [11]. For example, students should not only have access to resources normally available to them on ships during tasks but the resources should be applied to reflect the way knowledge, skills, and underlying competencies will be used in the real world. Students' are then assessed on their ability to integrate different competencies that may develop their critical thinking and higher order cognitive skills [26]. Such assessments are a move away from examinations that only require memorized responses to questions. Ability to memorize is a lower level cognition which is not sufficient for performing in workplaces such as ships, where a higher level of cognition is required to assimilate, analyse, and structure [27] information for decision making and problem solving. Seafarers who are trained to rely on memory and not to assimilate and analyse the available information to deal with routine or novel situations in the context of the work environment, may suffer from memory failure leading to human errors [22].

Finally, the framework designed by Gulikers et al. [11] focuses on designing the assessment criteria. 'Criteria' in this case refers to the basis on which the evidence of student work produced from the assessments, is judged. Setting the assessment criteria may also guide the learning process as the seafarer students will have a clear understanding of what is expected during the learning process and during their assessments. In authentic assessments, students have access to the performance criterion (reflecting workplace requirements) beforehand [17] for them to aim for the desired level of performance, ensuring that they possess at least the minimum competence level essential for the workplace at a particular level of responsibility. Designing the assessment criteria will require identification and outlining of essential qualities (or underlying competencies) expected from a student during the task performance. Additionally, it will also require describing levels that can define the different gradations of quality of performance. Such requirements are currently lacking and not promoted by the STCW Code.

7. Conclusion and the Way Forward

The STCW Convention led to the development of the STCW Code to provide global, minimum standards of competence for seafarers. The 'standards' were expected to act as guidelines for regulatory bodies and MET providers worldwide to develop consistent and uniform training outcomes. However, the paper argues that the STCW Code is too vague and this may lead to individual interpretation in adopting learning and assessment processes towards competence development, which creates the risk of seafarers graduating with CoCs but lacking the required competence for workplace operations. The seafaring industry sources its employees globally and cannot afford to operate under such risks. Based on the review of the selected excerpts, the STCW Code gives the impression of being an input-based education system and not an outcome-based as it was originally intended to be. An input-based system may prove to be regressive for the seafaring industry due to its focus on curriculum and content coverage and not on the appropriateness, learning and assessment, or the attainment of the desired competence outcomes by the student. Graduates may be assessed as competent but lack the necessary attributes making it a point of risk for employers and governments relying on MET providers to deliver seafarers that meet the required standard.

Based on a brief review of some of the past literature on authentic assessment, this paper suggests it as one of the possible solutions to address the discussed weaknesses of the STCW Code. Although the review is not comprehensive of all the literature, the paper discusses the ideas of major authors on authentic assessments, such as Wiggins [28], Gulikers, Bastiaens and Kirschner [11, 12] and Herrington, Reeves and Oliver [15]. Based on their ideas, it is suggested that assessment tasks that contextually resemble real world situations may not only engage students in learning but also assist in the development of skills which may be directly transferred from MET environment to workplace settings. For non-transferable skills, it is suggested that authentic assessment may allow assessors to contextualise the competencies of the seafarers. This would allow stakeholders to identify the gaps, if any, between competence developed in educational settings and those required at the workplace, to be filled with additional training. In the absence of such contextual evidence, any additional training provided to employees is a 'risk accepting' behaviour that is more about 'hope' than assurance that a standard of performance has been obtained. However, further investigations requiring collection of empirical data is needed to substantiate theoretical claims stating that authentic assessment may improve the STCW training outcomes and the resulting training mandate.

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Session 2A

Navigation, Simulation and Deck Training

Innovative Manoeuvring Support - From Today's Shipboard Organisational Structures to Shore-Controlled Autonomous Ships

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On ships with high safety level and a high portion of manoeuvring activities within ships operation the shipboard tasks and procedures have been changed to high back-up procedures as in air planes. For port manoeuvres e.g. the system of pilot/co-pilot was introduced on ferries in a sense that one officer is operating and the other is monitoring and checking the safe performance. In cruise-liner operation there are even new structures replacing the traditional rank-based system with a flexible system based on job functions. The main purpose for this change is to create a safety net around the person conning the vessel, in order to detect and manage any human errors before they lead to negative consequences. Each operation is cross checked before execution by one or two persons depending on circumstances. The consequence is higher costs for double personnel on the one hand and the need for a technology to guarantee that the checking officer is able to monitor what the conning officer is doing on the other hand. This is hard to do if one officer is working out in the wing and the other one is inside the bridge. This opens up chances for the application of the new "Fast-Time Manoeuvring Simulation Technology" (FTS) developed at the Institute for Innovative Ship Simulation and Maritime Systems (ISSIMS). It calculates within one second of computing time up to 1000 seconds of manoeuvring time by a very complex ship-dynamic simulation model for rudder, engine and thruster manoeuvres. This enables the online prediction of all manoeuvres carried out by the conning officer for the observing officer, too. So it is easy for both officers to see whether the manoeuvring actions have at least the correct tendency and even more the effectiveness of the manoeuvres can be improved. This new type of support is called Simulation-Augmented Manoeuvring Design and Monitoring (SAMMON) – it allows not only overlooking the next manoeuvring segment ahead but also for the following or even for series of manoeuvring segments.

Currently, this technology is used within two new research projects:
The Project COSINUS (Co-operative Ship Operation in Integrated Maritime Traffic Systems) sets out for implementing the FTS technology into integrated ship bridges and to also communicate the manoeuvre plans and display it to VTS centres and
Within the European project MUNIN (Maritime Unmanned Navigation through Intelligence in Networks) this technology will be used to investigate if it is possible to steer autonomous ships where the information for manoeuvring the ship will be delayed due to the communication links.
For practical application and testing, the new technology was interfaced to the ship-handling simulator (SHS) at Maritime Simulation Centre Warnemuende (MSCW). During the research activities it became obvious that the new FTS technology has also great potential for teaching and learning in the maritime education both for lecturing and simulator training in briefing and debriefing sessions of exercises.

KEYWORDS

- Simulation-augmented manoeuvring
- Fast-time simulation, FTS
- Dynamic prediction methods
- Manoeuvre planning
- Simulation Augmented Manoeuvring Design and Monitoring, SAMMON
- Institute for Innovative Ship Simulation and Maritime Systems, ISSIMS

1. INTRODUCTION

During the previous INSLC 17 conference in 2012 [7] a fast-time simulation tool box was introduced to simulate the ships motion with complex dynamic models and to display the ships track immediately for the intended or actual rudder or engine manoeuvre in the ECDIS. These "Simulation-Augmented Manoeuvring Design and Monitoring" - SAMMON tool box will allow for a new type of design of a manoeuvring plan as enhancement exceeding the common pure way-point planning – and it will play an important role in future education and training in simulators for ship handling.
Also during this INSLC 17 conference new concepts were presented for innovative organisational structures specifically for bridge management [8].

This paper presents the potential of the new method specifically for the support of manoeuvring of ships both for the new manning concept and even for shore-based support or moreover for autonomous ships. Manoeuvring of ships is and will be a human-centred process despite of expected further technological developments. Most important elements of this process are the human itself and the technical equipment to support its task. However, most of the work is to be done manually because even today nearly no automation support is available for complex manoeuvres. Up to now there was nearly no electronic tool to demonstrate manoeuvring characteristics efficiently or moreover to design a manoeuvring plan effectively.
However, due to the new demands there is a need to prepare harbour approaches with complete berth plans specifically in companies with high safety standards like cruise liners. These plans are necessary to agree on a concept within the bridge team and also for the discussion and briefing with the pilot.
For increasing the safety and efficiency for manoeuvring real ships, the method of Fast-Time Simulation will be used in future – even with standard computers it can be achieved to simulate in 1 second computing time a manoeuvre lasting about to 20 minutes using innovative simulation methods. These Fast-Time Simulation tools were initiated in research activities at the Maritime Simulation Centre Warnemuende (MSCW) which is part of the Department of Maritime Studies of Hochschule Wismar, University of Applied Sciences - Technology, Business and Design in Germany. They have been further developed by the start-up company Innovative Ship Simulation and Maritime Systems (ISSIMS GmbH [6]).

A brief overview is given for the modules of the FTS tools and its potential application:

- SAMMON is the brand name of the innovative system for "Simulation Augmented Manoeuvring Design & Monitoring". 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 ship-handling simulators (SHS) environment 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 SAMMON contains the following modules:
    - Manoeuvring Design & Planning Module to design ships-manoeuvring concepts as "manoeuvring plan" for harbour approach and berthing manoeuvres (steered by virtual handles on screen by the mariner)
    - Manoeuvring Monitoring & Multiple Dynamic-Prediction Module: monitoring of ships manoeuvres during simulator exercises or manoeuvres on a real ship using bridges handles, display of manoeuvring plan and predicted manoeuvres in parallel. It calculates various prediction tracks for full ships-dynamic simulation and simplified curved-headline presentation as look ahead for future ships motion.
    - Manoeuvring Simulation Trial & Training Module: ship handling simulation on laptop display to check and train the manoeuvring concept (providing the same functions as monitoring tool; steered by virtual handles on screen)
- 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 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.

The SIMOPT and SIMDAT modules were described in earlier papers ([1] for tuning of simulator-ship model parameters and also the modules for Multiple Dynamic Prediction & Control [2] for the on board use as steering assistance tool. In this paper, the focus will be laid on the potential of the SAMMON software supporting ship operations aboard and ashore.

2. FUNCTION-BASED BRIDGE ORGANISATION

The concept of Function-Based Bridge Organisation was introduced by Hans Hederstrom at the INSLC Conference in 2012 [8]. Acknowledging that all humans may make errors, the function-based bridge organization introduces organizational countermeasures to detect and manage human error before it leads to any negative consequence. It can help to remove hierarchical barriers and enhance teamwork and communication, if a traditional rank-based system has been replaced by a function-based bridge organization.

The function-based bridge organization does not diminish the authority of the Master. The Master assigns officers to the particular functions based on watch-keeper competence and experience with the upcoming operation, making it a very adaptable system.

The system builds on the airline concept by introducing Navigator and Co-Navigator functions. The Navigator who is conning the ship is required to communicate intentions and orders to the Co-Navigator. This means that no course changes or engine orders will be carried out without a confirmation from the Co-Navigator. These new protocols also require a double watch-keeping system with a minimum of two bridge officers on watch at all times the ship is at sea.

For ships with a single watch-keeping officer and a lookout on watch, the system may be somewhat more difficult to introduce. However, with trained and engaged lookouts there are definitely advantages to gain. When the Captain joins the bridge team, there is no problem to use the function based system. The best way to apply the system in this situation would be if the Captain takes on the function as Co-Navigator, leaving the watch officer to continue conning the ship. The following definitions were given.

2.1 FUNCTIONAL POSITIONS

The following assigned tasks are included in these procedures (only extracted items specifically for manoeuvring aspects):

Operations Director

- Overview of the entire bridge operation, ensuring that it is, at all times, carried out in accordance with these procedures.
- Provides guidance and suggestions to other members of the bridge team as necessary or appropriate.
- Direct monitoring of both the Navigator and Co-Navigator, ensuring that safe passage is maintained and that no internal or external influences are permitted to distract them from their primary tasks.
- If the Operations Director has the charge, s/he can assume any of the other functions at any time.
- Monitors workload and transfers tasks between functions as circumstances dictate.
- Unless directed otherwise by the officer with the charge, will conduct the Pilot exchange briefing.
- Responsible for checklist completion in Yellow and Red manning.
- If the Operations Director takes the conn, then the position of Operations Director must be re-established as soon as possible.

Navigator

- Responsible for conning, navigating the ship following the approved passage plan and collision avoidance.
- Ensure that the bridge team (including the Pilot) is aware of planned actions and intentions by “Thinking Aloud”.
- If a pilot has the conn, the Navigator should ensure the Pilot’s intentions and planned actions are understood in advance by all bridge team members and agreed upon by the Navigator.
- If s/he has the charge, the Navigator is responsible for taking back the conn from the Pilot whenever s/he determines that doing so is necessary or appropriate for the safe navigation of the vessel.
- The Navigator should always foster a climate that encourages other members of the bridge team to challenge the Navigator if warranted.

Co-Navigator

- Monitors and cross checks the actions of the Navigator.
- Supports, challenges, and recommends actions to the Navigator.
- Notifies the Master or Second in Command whenever s/he has reason to believe that the Navigator has taken or plans to take any action that violates the Master’s orders or is inconsistent with the safe navigation of the vessel.
- Monitors and cross checks the ship's position against the passage plan using real time navigation methods.

- Monitors traffic and collision avoidance.
- Unless directed otherwise by the officer with the charge, is responsible for external VHF (may be delegated to the Pilot) and liaison with the ECR.

Administrator

- Responsible for fixing the ship's position when paper charts are in use.
- Responsible for alarm management and actions. Alarms to be identified as either urgent or non-urgent alarm.
- Responsible for internal communications as directed.
- Responsible for logbook entries, checklist management and status board.
- Ancillary tasks as assigned.

Lookout

- Maintains all around lookout by sight and by hearing, reporting all sightings and/or sound signals to the Navigator, unless otherwise directed.
- Maintains awareness of planned intentions and reports any necessary clearances before an alteration of course.
- Must be able to give full attention to the keeping of a proper lookout, and no other duties shall be undertaken or assigned which could interfere with the task.
- Be available to interchange duties with the Helmsman. The duties of the Lookout and the Helmsman are separate. The Helmsman shall not be considered the Lookout while steering.

Helmsman

- Acknowledge and execute steering orders given by the person with the conn.
- Advise the person with the conn of any steering concerns.

2.2 THE CAPTAIN AS A LEADER INSTEAD OF AN OPERATOR

It is up to the Captain to decide who should fulfil any of the four functions. A Risk Factors Table and a Risk Analysis and Bridge Manning Level Table have been developed to assist the Captain in deciding what manning level to set. Those manning levels are to be seen in Fig. 1. The philosophy behind the system encourages the Captain to assume the role of Operations Director, acting as a leader while the team undertakes the operation.
By delegating the operational tasks, he demonstrates trust in his team. This has many positive effects, such as:

- enhanced learning;
- readiness to actively participate in problem solving;
- enthusiasm and motivation to work; and
- an engaged team directly leading to increased safety and efficiency.

As officers are allowed to conduct the vessel, they will be better prepared for their promotion when time comes. This will normally also increase job satisfaction, which facilitates officers" retention rate.

Within this paper some elements are presented on how the communication with in the bridge team can be supported by the Fast Time Simulation Modules of the SAMMON System.

Required Functions at Each Bridge Manning Level

Bridge Manning Level		Bridge Functions					
		Navigator	Co-Navigator	Administrator	Operations Director	Lookout	Helmsman
	Green	Yes	Yes		No	Yes	As required
	Yellow	Yes	Yes		Yes	Yes	Yes
	Red	Yes	Yes	Yes	Yes	Yes	Yes

Green Manning: Minimum bridge manning required underway.

Bridge Manning Level		Bridge Functions					
		Navigator	Co-Navigator	Administrator	Operations Director	Lookout	Helmsman
	Green	Yes	Yes		No	Yes	As required

In Green Manning there is one officer assigned two functions (Co-Navigator and Administrator). His/her title is Co-Navigator.

Yellow Manning: Used in situations where indicated by the Risk Analysis and Bridge Manning Level Table.

Bridge Manning Level		Bridge Functions					
		Navigator	Co-Navigator	Administrator	Operations Director	Lookout	Helmsman
	Yellow	Yes	Yes		Yes	Yes	Yes

In Yellow Manning one officer is assigned two functions, Co-Navigator and Administrator. His/her title is Co-Navigator. Compared to Green Manning, the bridge team is strengthened by the Operations Director and another AB ready to assume function of helmsman at any time if required.

Red Manning: Always used for arrivals and departures and for all situations indicated by the Risk Analysis and Bridge Manning Level Table, or as deemed necessary by the Master.

Bridge Manning Level		Bridge Functions					
		Navigator	Co-Navigator	Administrator	Operations Director	Lookout	Helmsman
	Red	Yes	Yes	Yes	Yes	Yes	Yes

The Master must be on the bridge, assume one of the functions and take the charge. In Red Manning the bridge must be in closed condition.

Fig. 1: Required Functions and Manning Concept for Functional Approach for Bridge Operation

3. SIMULATION-AUGMENTED SUPPORT FOR SHIPMANOEUVRING PROCEDURES

3.1 PRE-PLANNING WITH "MANOEUVRE PLANNING & DESIGN MODULE"

As an example for creating a berth plan and briefing the navigational officer, a berthing scenario is chosen for a harbour area - the starting situation and the environmental conditions within this area on a sea chart is to be seen in Fig. 2. The objective is to berth the ship with port side alongside Grasbrook Berth at Hamburg Port.

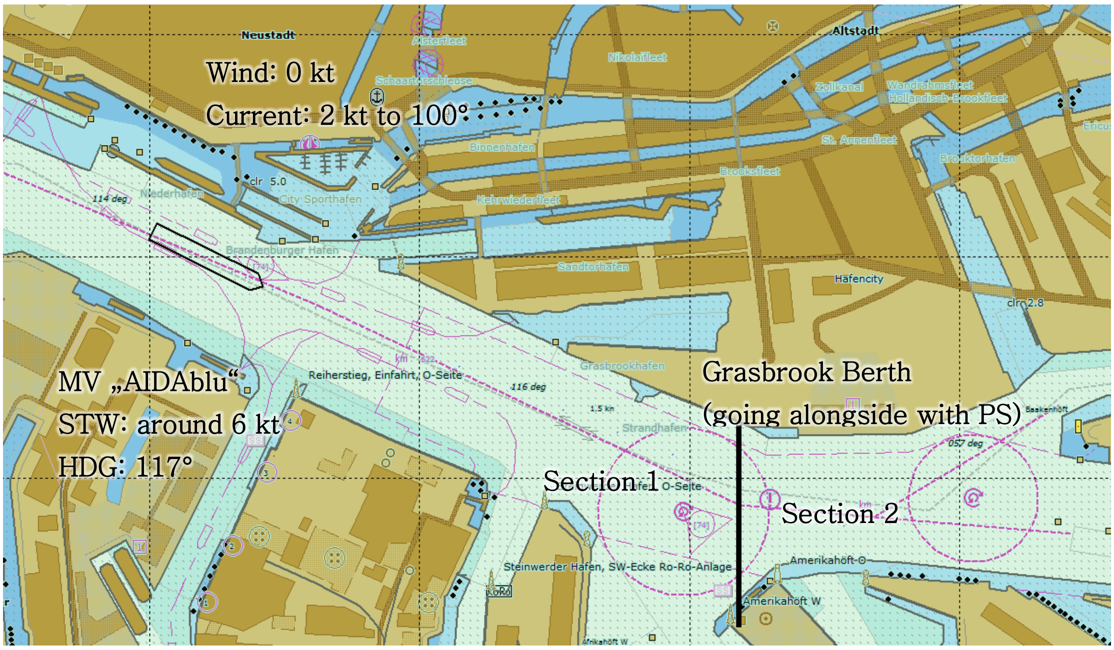


Fig. 2: Exercise area and environmental conditions in Port of Hamburg for berthing scenario, divided into two sections for planning the manoeuvres

The respective harbour area is being divided into two manoeuvring sections following a specific aim:

1. Section 1: At the end of this section the speed over ground (SOG) should be around 3 kn and the heading slightly towards southeast as preparation for section 2.
2. Section 2: A state should be reached, where the ship can be held in the current at a position with constant heading and no speed. Then, the ship can then crab towards the berthing place mainly by means of thrusters. The current can be used as an additional supporting aid to go alongside.

In a conventional briefing only these rough indications of the manoeuvring status can be used to develop a potential strategy for berthing the ship. The manoeuvres and setting of engines, rudders and thrusters cannot be discussed in detail because no specific manoeuvring characteristics are available for the specific situations.

With the new fast-time simulation there is the chance for designing a manoeuvre plan as a detailed strategy with the specific settings at distinguished positions called the Manoeuvring Points (MP). In the following, the course of actions is described in a series of figures to make a full manoeuvring plan by means of the control actions at the manoeuvring points, MP. In Fig. 3 the initial position is to be seen where the instructor has set the ship in the centre of the fairway. The prediction already shows that the ship would drift slightly to port side due to the set handle positions. It can be learned that therefore the rudders have to be put slightly to starboard at the very beginning in order to follow the straight track until the next MP 1. At MP 2 the rudders are set amidships again and both propulsion units are used to slow down and to steer the ship: the starboard engine is kept at 34 %, resp. 43 rpm to allow for a certain rudder effectiveness for steering control, whilst at MP 3 the portside engine is set backwards in order to achieve about 3 kn SOG at the end of section 1.

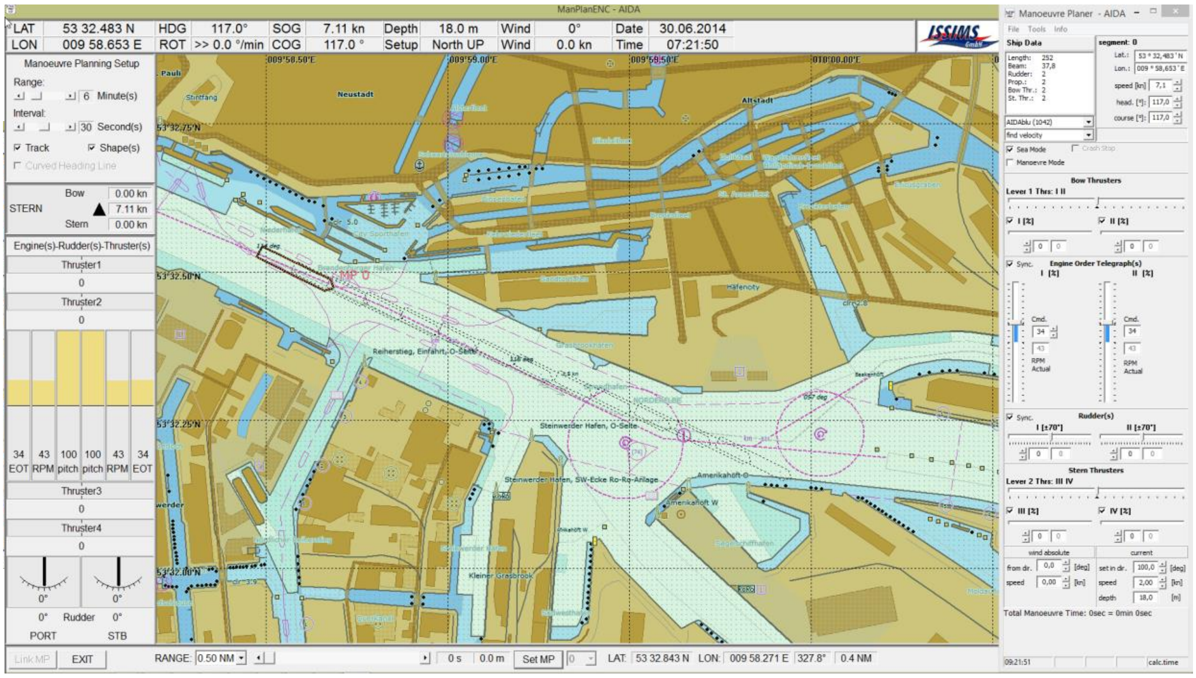
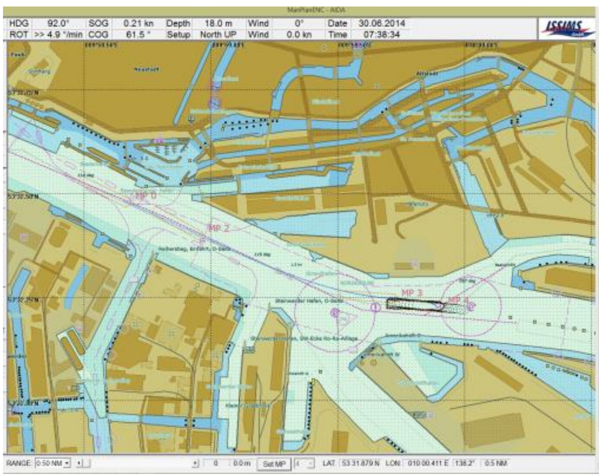


Fig. 3: MP0: Initial position: The prediction already shows that the ship would drift slightly to portside due to the set handle positions.



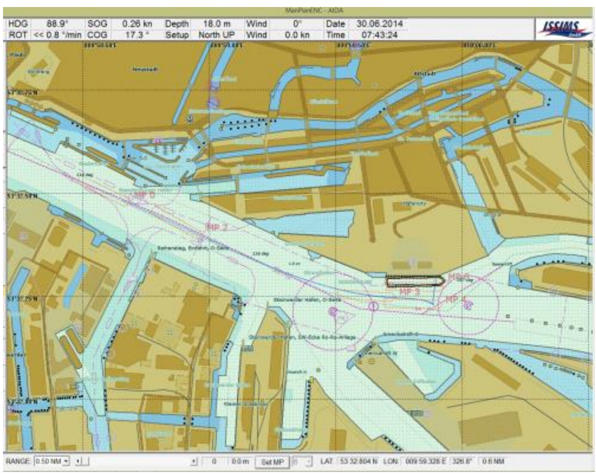


Fig. 4: Final part of the manoeuvring plan: Left MP4 - The vessel is stopped and the heading is chosen in that way, that all handles can be set in zero position. Right: MP5 / MP6: the ship is already brought to the berth

In
Fig. 4 left side, the ship is stopped at MP4: The vessel's heading is chosen in that way, that all handles can be set in zero position, holding the ship with a minimum speed almost at the same position. At this moment, bow and stern thrusters can be applied to bring the ship safely to its berth. In the right figure the ship is already brought to the berth. The crabbing by means of bow and stern thrusters needs a further MP in order to reduce the transversal speed shortly before berthing.

The complete manoeuvring plan can be saved to be used for the training or to be loaded again for editing the plan for an optimisation to achieve a better performance e.g. to do the whole manoeuvre in less time. For an in-depth discussion at the separate manoeuvring points and sections, there is the possibility to save the specific conditions as situation files. These situation files can be useful for discussing strategies during the planning at different places where new challenges will come up as well as for the debriefing sessions. In
Fig. 4 at the right corner at the bottom the time is to be seen for the complete series of segments: the total manoeuvre time is about 17,5 minutes for this version of the plan.

4. SIMULATION AUGMENTED SUPPORT FOR EXECUTION OF MANOEUVRE

4.1 BERTHING EXERCISE WITH CONVENTIONAL PREPARATION AND USE OF SHIP-HANDLING SIMULATOR

For comparing the effectiveness of the simulation-augmented support tools a simulator test was made with trainees who have no support and trainees who have the full support. The result of this attempt by an experienced trainee who has no specific preparation for the exercise is seen for the ships track in Fig. 5. The ship is set at the starting position and the task is to manoeuvre it to the berth with no Fast Time Simulation (FTS) aid at all.

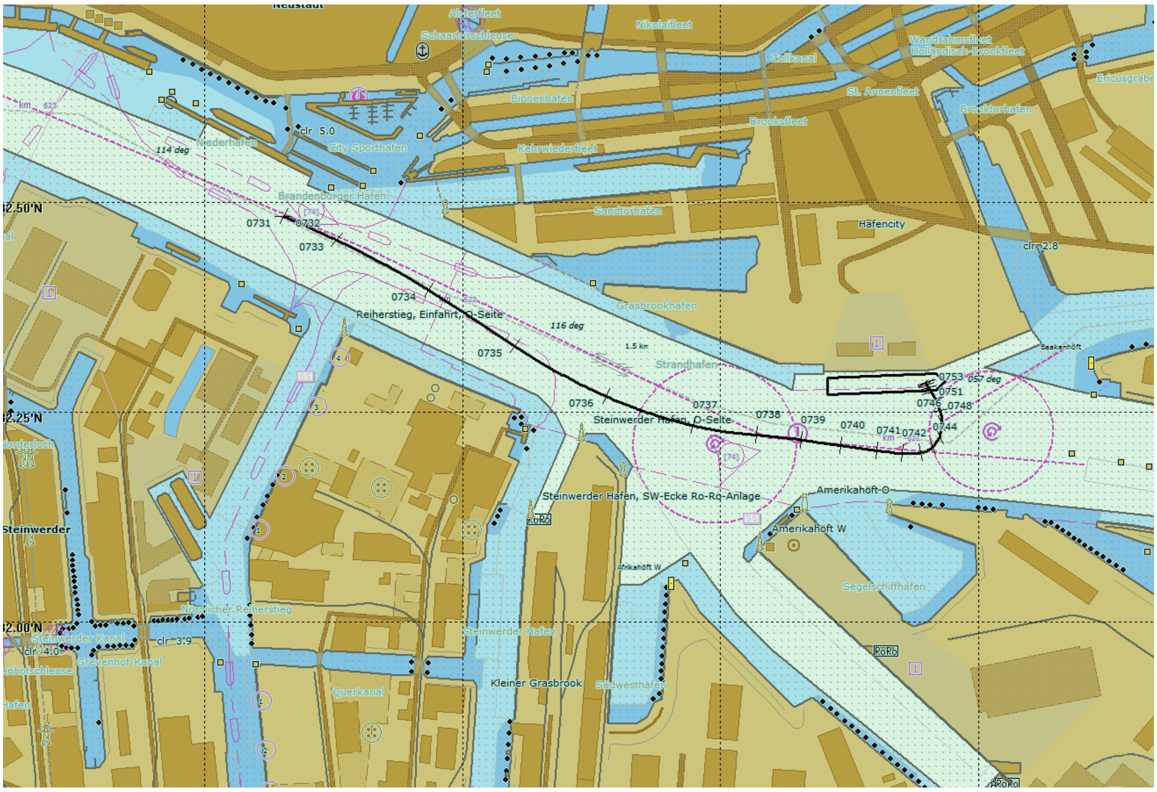


Fig. 5: result of manoeuvring training in ship handling simulator for a trainee with conventional preparation and no support by fast time simulation (Total Manoeuvring Time about 20 min)

4.2 BERTHING MAKING USE OF SIMULATION-AUGMENTED SUPPORT IN SHS AND WITH SAMMON MONITORING AND TRAINING TOOL

During the exercise it is possible to take advantage from the multiple predictions for the manoeuvres. In Fig. 6 the setup is to be seen where a students can bring his own laptop onto the simulator bridge (where he has already developed the manoeuvring plan), the prediction is controlled via the bridge handles. The same laptop with the monitoring tool can also be placed at the instructor station. Alternatively the execution of an exercise can also be trained using the trail & training tool which is available on the same laptop for pre training. The ships motion is then controlled via the same virtual handle panel on the screen as in the planning tool.

Fig. 6: Portable setup for prediction display on ECDIS in Monitoring Tool on students laptop on bridge 1 of ship-handling simulator of MSCW – the prediction is controlled by the bridge handles. The dynamic prediction shows the future manoeuvring track whereas on the radar screen the static path prediction shows still a straight line according to the initial conditions of the ship-handling simulator of MSCW.

In Fig. 7 a comparison is made between the two simulator results of the trainees with different level of preparation and the manoeuvring plan of the second trainee. The achievements of the better prepared trainee are obvious – the planned manoeuvre is very close to the executed track and the actions of the controls has been done also nearly in accordance with the planned procedures. It is obvious that there is not just a reduction of manoeuvring time when applying the Fast-Time Simulation tool in briefing and training; the thruster diagrams show also that a well prepared manoeuvre can minimize the use of propulsion units and therefore be more efficient.

The benefit of using the FTS is to be seen for several purposes:

- The multiple dynamic predictions are always a great help for the Navigator steering the ship: They have a better overview on the current situation and the chances for the potential success of an action can immediately be seen; also for the Co-Navigator there is the chance to see both the manoeuvres and the success – this is a great situation because they can both share a better situation overview.
- Multiple dynamic prediction may be used to see both the current state of motion by the static path prediction and the future development of the ship motion caused by the current handle settings – it is expected that the static prediction changes into the dynamically predicted track, in this case the prediction is correct. If not then the handle settings can be slightly adjusted to

correct for the tendency of the potential impact of environmental effect which might not have been considered by the dynamic prediction, e.g. a non-detected current.

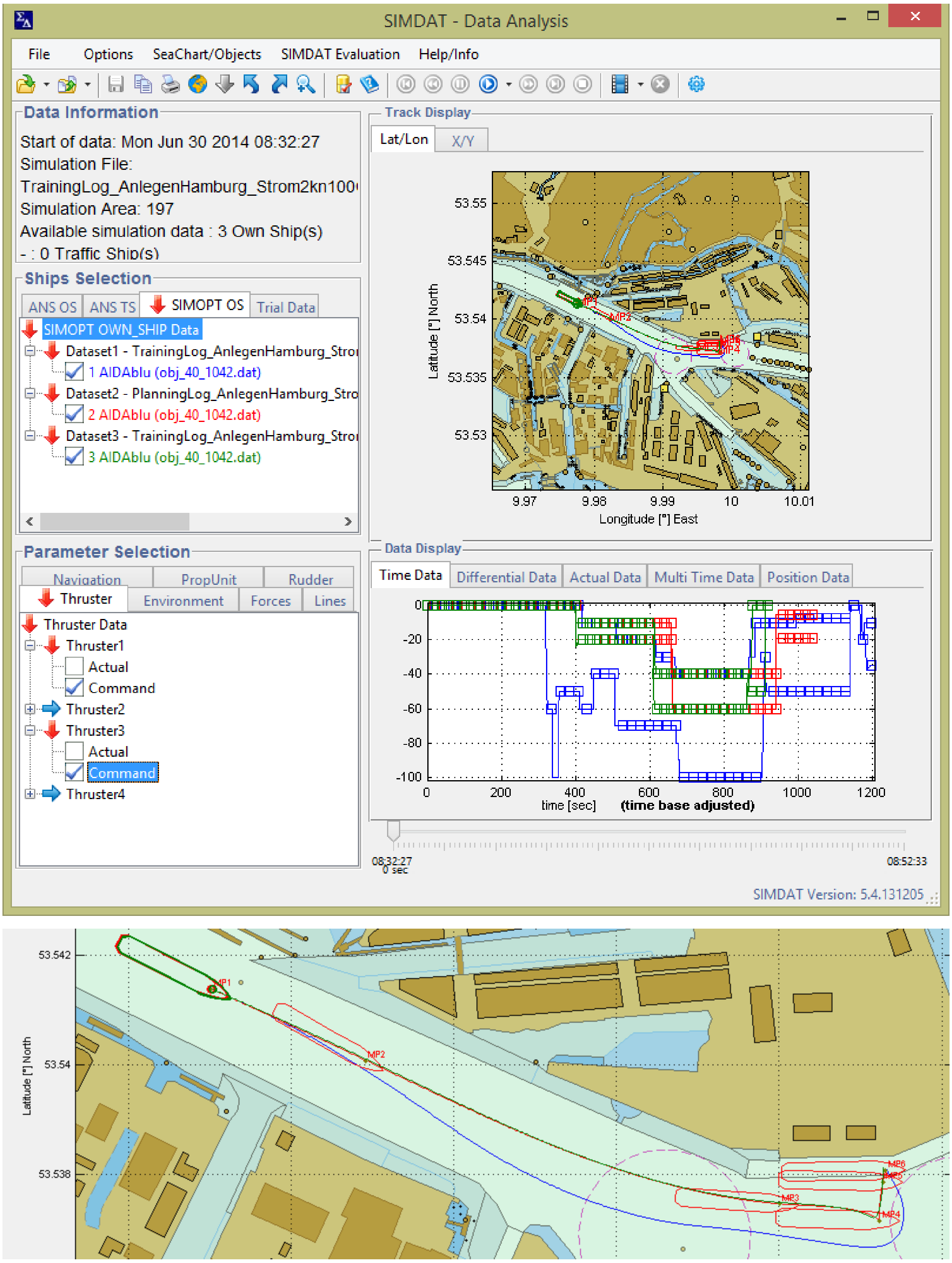


Fig. 7: Results from two manoeuvring exercises in SIMDAT interface with "Track Display" and "Data Display" for time history of thruster activities.

Blue: run of the trainee without support by Fast-Time Simulation

Green: run of the trainee with full support by pre-planning with Design and Planning Module

Red: comparison to the prepared manoeuvring plan with manoeuvring points

5. RESEARCH PROJECT COSINUS - SIMULATION AUGMENTED MANOEUVRING FOR BRIDGE OPERATION AND FOR VTS

The goal of the project COSINUS (“cooperative operation of ships for nautical safety through integration of traffic safety systems) is to achieve the integration of maritime traffic safety systems on board and on shore. Therefore, novel concepts are investigated regarding the presentation of enhanced data to the operator and operation of new tools and services as well as decentralized data capturing, processing and storage. Processed data of land-based information systems will be visualized in such a way that a complete overview over the traffic and environmental situation is given in order to support the navigational operation of the vessel. This includes e.g. the representation of a shared route and manoeuvring plan, the operational interface to the VTS operator, and the depiction of weather-data along the voyage or at the destination port. The goal is to establish a cooperative picture which offers a dynamically enhanced view for the bridge crew going beyond traditional ship-based sensor information like own ship RADAR or AIS. This will improve the safety particularly in heavy traffic situations. A great deal of work will be carried out concerning the definition and establishment of new standards for the ship based navigation in cooperation with higher level traffic management systems. The main areas of work follow:

- Visualization concept for representation of land-based information on ship bridges
- The proposal and the validation of modules and interfaces for autonomous communication between VTS and INS
- Combination of ECDIS representation of navigational data and VTS data to an integrated navigational and traffic picture
- Concept for cooperative route- and maneuver planning
- Investigation of communication channels and interfaces for exchange between VTS and INS

Specifically for the integration of the Simulation-Augmented Manoeuvring Support by SAMMON the new functions have to be interfaced:

- The results of the manoeuvre planning have to be made available into the Integrated Bridge System and
- also the data transfer from ship data into the Monitoring and Control Module have to be adjusted
- the data transfer from ship to shore into the VTS center has to be established.

The concept for sharing the information between ship and shore is to be seen in Fig. 8.

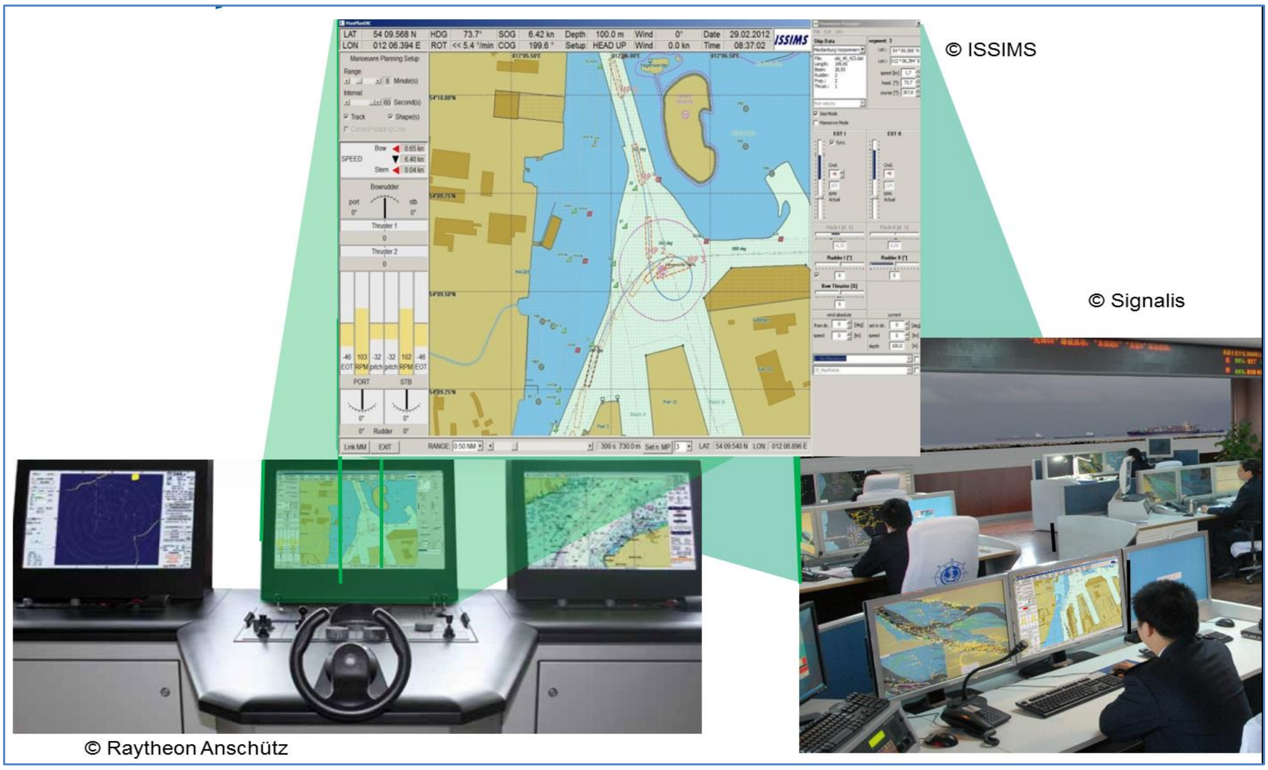


Fig. 8: Project COSINUS – shared information on manoeuvring plans and multiple prediction in ECDIS between bridge and VTS

6. THE MUNIN PROJECT - SIMULATION-AUGMENTED MANOEUVRING SUPPORT FOR AUTONOMOUS SHIPS

6.1 INTRODUCTION & OBJECTIVES

Maritime Unmanned Navigation through Intelligence in Networks (MUNIN) is a collaborative research project of eight partners from five European countries co-founded by the European Commission. MUNIN's aim is the development of an autonomous-ship concept and its simulation-augmented feasibility study.

The main idea behind the MUNIN concept is the autonomous sea passage of an unmanned vessel. Nevertheless, before the ship can be set to autonomous operation it has to put out at sea in the traditional way with a crew on board. For the unmanned voyage part the vessel is monitored by a Shore-Control Centre. When in autonomous mode, the vessel solves appearing problems with regard to weather and traffic situation by autonomous algorithms and follows its pre-defined voyage plan. If necessary, the operator takes over automatic control by commanding the vessels true heading and speed-over-ground. Furthermore, when exact manoeuvring is required, the operator enables a mock-up bridge to manually control the vessels manoeuvring systems like rudder and engine from a situation room within the Shore-Control Centre. Assuming that the connection fails, the vessel has to drift or, if possible, drop the anchor to maintain its position.

The module development within this project is either related to the Shore-Control Centre or to the Autonomous Ship Controller, containing both autonomous bridge and engine-room prototypes.

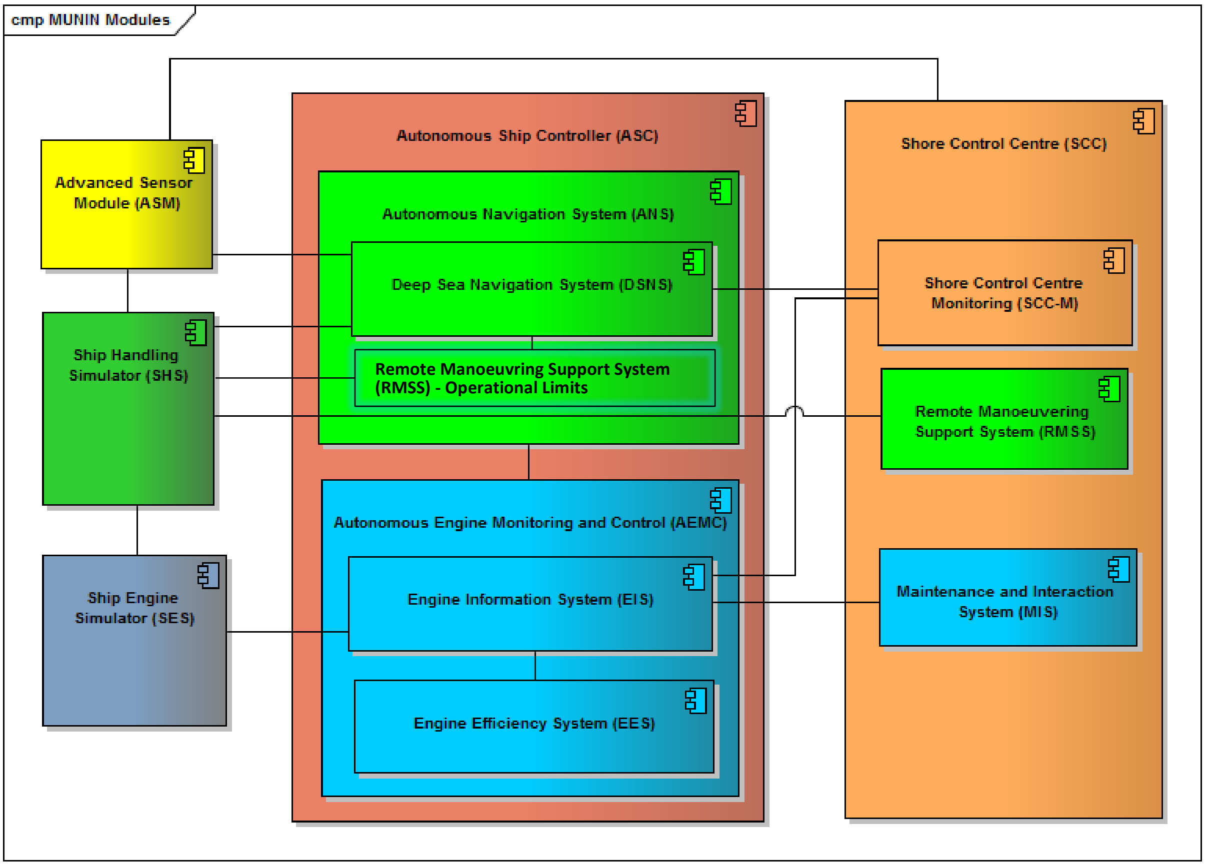


Fig. 9: Overview of MUNIN modules for the proof-of-concept simulation tests (Rødseth, 2014)

6.2 PROJECT PARTNERS

- MUNIN Project coordinator is the Fraunhofer Center for Maritime Logistics and Services (CML) in Hamburg, Germany. CML's scope of work is to identify the nautical tasks that need to be changed to enable unmanned navigation and to define the autonomous functionalities needed while subsequently developing these functionalities. In practise, that addresses the development of the Deep-Sea Navigation System prototype within the Autonomous Bridge System which has to carry out the autonomous weather routing, collision avoidance and stability checks.
- The Marine Technology Research Institute MARINTEK in Trondheim, Norway, develops the Maintenance and Interaction System with new maintenance strategies useful for unmanned vessels and furthermore, develops MUNIN-specific interfaces and contributes this to international standards.
- The Maritime Human Factors group at Chalmers University of Technology in Gothenburg, Sweden, is responsible for the Shore-Control Centre prototype. Its focus is the monitoring of the vessels operational status but also providing direct remote control. Thus, the main challenge is to keep situational awareness of the operator appropriately high despite the physical distance between the vessel and the human.
- Aptomar AS, Trondheim, Norway, focuses on the investigation of sensor capabilities for unmanned vessels and develops an Advanced Sensor Module to allow an unmanned vessel to evaluate current and future vessel-traffic patterns and weather conditions. This Advanced Sensor Module enables the unmanned vessel's navigation system to plan and act accordingly to ensure safe and efficient voyage.

- MarineSoft Entwicklungs- und Logistik-gesellschaft mbH in Rostock-Warnemünde, Germany, develops the process-management module called Engine Information System which provides the Autonomous Engine Monitoring and Control System with relevant data. The Autonomous Engine Monitoring and Control System prototype detects errors before the alarm rises and makes counter measurements to avoid or reduce malfunctions in the unmanned engine room.
- Marorka ehf from Reykjavik, Iceland, investigates current and upcoming regulations regarding emissions and ballast water treatment to ensure that the unmanned engine room is designed to meet future challenges of environmental performance. These results and Marorka's product "Marorka Power" will be incorporated and adapted to the MUNIN project in order to optimize how electricity is produced on board.
- The Faculty of Law at University College Cork, Ireland, analyses legal and liability challenges due to autonomous systems on board and remote-controlled operation from ashore.
- The Department of Maritime Studies at Hochschule Wismar (HSW), University of Technology, Business and Design in Rostock-Warnemünde, Germany, is involved in both parts of ship operation the navigational and technical systems.
    - The ship-engineering department at HSW is responsible for the analysis and conceptual redesign of current engine-related tasks as well as for repair and maintenance optimisation for unmanned operation during the sea passage.
    - The Institute for Innovative Ship Simulation and Maritime Systems (ISSIMS) at HSW develops a simulation augmented manoeuvring support systems for remote-controlled navigation in near coastal waters.
    - The Maritime Training Centre Warnemünde at HSW serves with its simulation environment and partner’s prototype integration for the feasibility study within the proof of concept.

6.3 REMOTE MANOEUVRING SUPPORT SYSTEM – SIMULATION AUGMENTED SUPPORT AND PREDICTION OF OPERATIONAL LIMITS

The Remote Manoeuvring Support System envisages the improvement of the mental model of experienced ship officers on board sea-going vessels to a Shore-Control Centre. Since for the shore-based operators the feeling of the ship’s motion is missing, a way must be found to transmit the impression and feeling of the ship’s actual and future motion to the operators. The problem is: there is no scope for the conventional “trial and error corrections” or “touch and feel experiences” for vessels fully controlled by shore-side operators.

The remote manoeuvring support system’s aim is to allow safe and efficient remote-controlled navigation in near-coastal waters. The innovative value of the Fast-Time Simulation technology is the look-ahead function of ship’s motion by dynamic-prediction methods, so that a ship’s officer or shore-side operator can foresee the vessels future path.

The Remote Manoeuvring Support System prototype contains three different modules - all based on Fast-Time Simulation und dynamic-prediction methods:

- Monitoring tool with visualisation of future ship track by means of dynamic-prediction methods
- Pre-planning tool to design safe and efficient manoeuvre plans for the upcoming manoeuvring
- Prediction of the operational limits visualising the required room to manoeuvre.

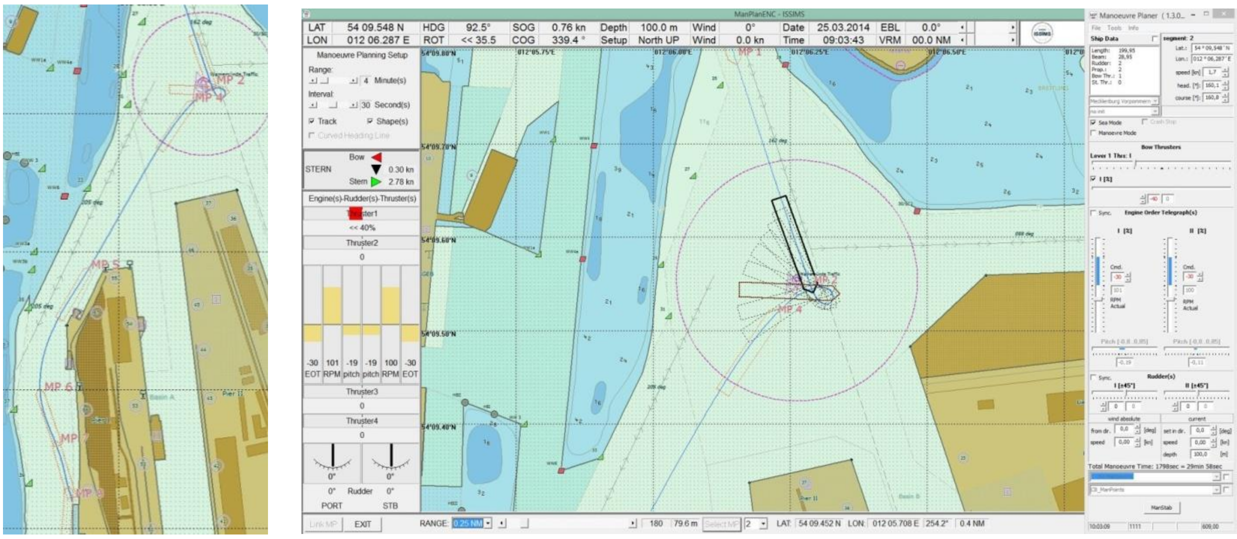


Fig. 10: Example for a pre-planned manoeuvre plan (MP) as manoeuvring basis (left) and Combined stopping/turning manoeuvre with her bow thruster ordered to port side and both engines reversing in Monitoring & Control Interface (right)

Not only for collision avoidance but also for navigation in narrow waters it is from high importance for a shore-side operator to know the operational limits of the vessels under his surveillance. The problem is that the manoeuvrability depends on many hard-to-estimate factors. High speed in shallow water e.g. causes squat effects, and the speed-through-the-water to speed-over-ground ratio increases/decreases rudder effectiveness as well as waves and gales affect the turning and stopping behaviour. The mariner aboard senses this and directly interprets the effect by the above named factors. He can feel and observe a squat effect way easier as an operator sitting in a control centre ashore in front his screens. He has trained his mental model of ship's motion by years of experience at sea.

To support the shore based operator by information on ship's motion dynamics, the Remote Manoeuvring Support System supplies the operator (and the collision avoidance system on board) with vessel data regarding its operational manoeuvring limits. These are in detail:

- Normal prediction of the future track with current handle control settings (grey)
- Hard Rudder Turning circle port side (red)
- Hard Rudder Turning circle starboard side (green)
- Crash Stopping manoeuvre (black)

Fig. 11 shows the monitoring concept with the prediction of the manoeuvring limits. All four manoeuvre predictions will be supplied in a 1 Hz update rate. This figure shows a situation for a collision threat: the own ship is the stand-on vessel and the ship on its port side is expected to do a course change to avoid a collision according to COLREG rule 15. In case the ship as not acting in proper time, the own ship is obliged to do an evasive manoeuvre according to COLREG rule 17. From the figure it is to be seen that a stopping manoeuvre would not help anymore but a turning circle to starboard would help. In Fig. 12 the ship has already ordered full rudder angle to starboard side. In addition to the emergency turning circle, the black shapes indicate a combined turning/stopping manoeuvre with the engine ordered full astern.

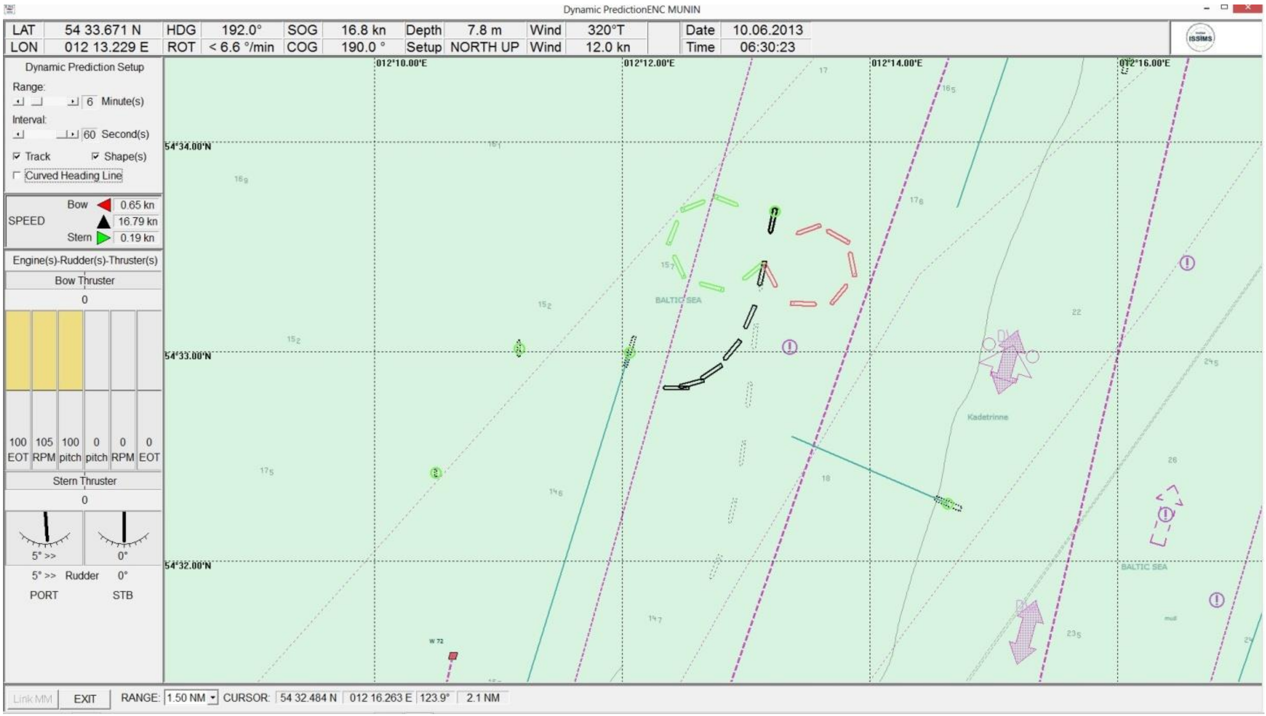


Fig. 11: Sample for presentation of dynamic-manoeuvring prediction of actual manoeuvring track (black-dotted contours) and additional manoeuvring tracks for hard-to-STB (green) and PT (red) as well as for crash stop (black) from actual motion parameters - the ship has applied rudder amidships the contours of actual control are ahead of the ships position.

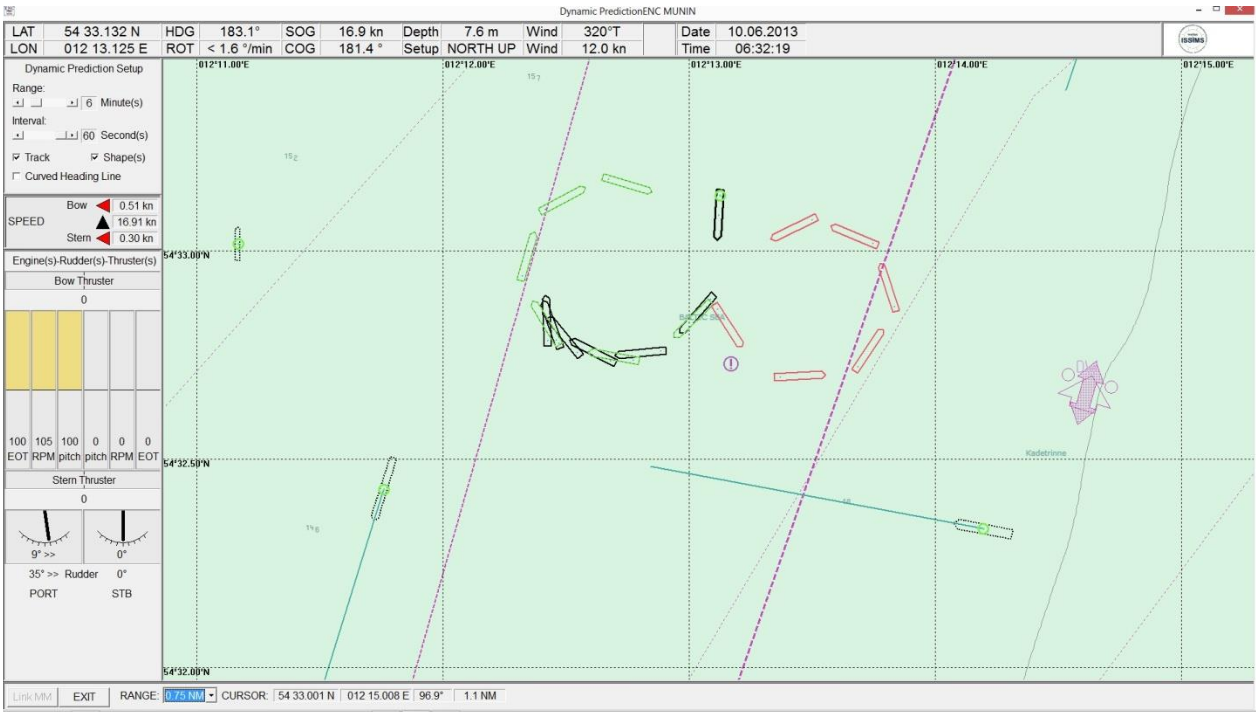


Fig. 12: Sample for presentation of dynamic manoeuvring prediction of actual controls manoeuvring track (black-dotted contours) and additional manoeuvring tracks for hard-to-STB (green) and PT (red) as well as for crash stop (black) from actual motion

parameters – the ship has applied full rudder the contours of actual controls full to STB are identical with the green contours.

The most import support is necessary if there is a time delay in the communication between the autonomous ship and the shore control centre during the remote manoeuvring status: in Fig. 13 a sample is given for explanation of the effect of time delay in ship-shore communication and the advantage of prediction for filtering and remote manoeuvring action by the shore-based controller.

- The message for the measured position was received at 10:00:30 with time delay of 10 sec, i.e. the message was sent 10:00:20.
- This position was filtered (yellow star, as for the previous measured positions before).
- From this filtered position the current position was calculated by prediction on the Predicted track (blue broken line) with control settings from 10:00:20. In the same way the position at 10:00:30 was found which the initial point for the new prediction is.
- From the assumed / predicted position at 10:00:30 the new prediction for new settings from 10:00:30 will take effect after another delay of 10 sec at the position at 10:00:40 – from there the red dotted contours and track are shown for the new predicted track.

It is obvious that it is very difficult to steer the ship if the time delay is increasing. Within the project it is planned to do some investigations into the maximum delay allowed to secure a safe control of the vessel from shore.

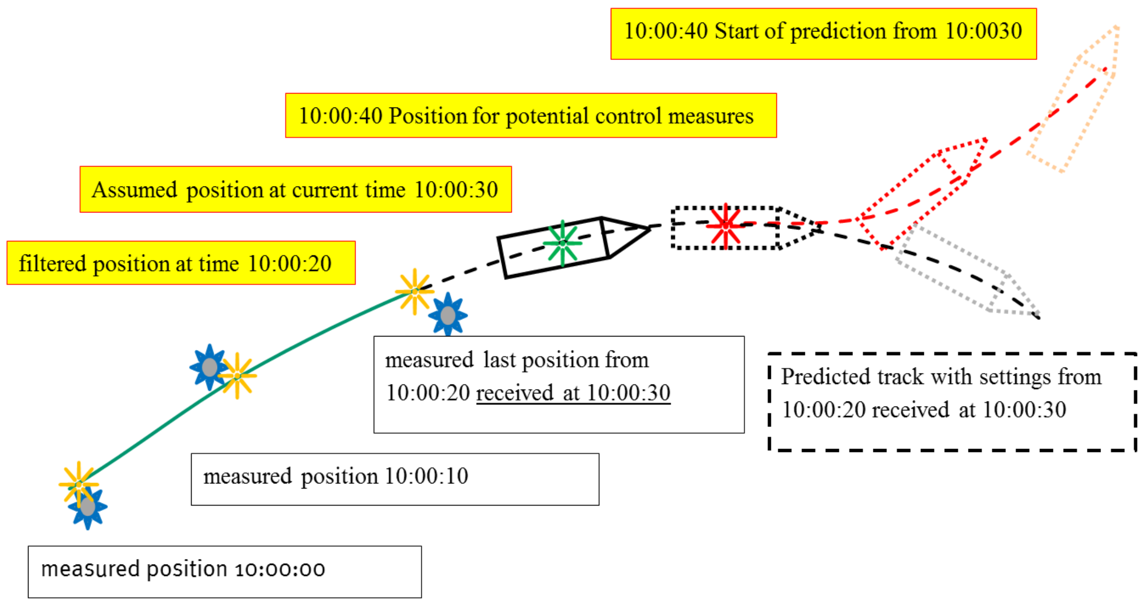


Fig. 13: Sample for explanation of the effect of time delay in ship-shore-communication and the advantage of prediction for filtering and remote manoeuvring at time point 10:00:30

7. ACKNOWLEDGEMENTS

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Enhancement of Non-Technical Skills Training for Deck Officers

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IAMU sponsored study in 2013-14 "Development of taxonomy for deck officers' non-technical skills (NTS) and analysing training needs for human element, leadership and management (HELM) course" concluded that present HELM course is ineffective for many reasons. One being there was no domain specific research conducted by the organisation before the implementation of HELM training course to develop the taxonomy of the deck officers' non-technical skills and behavioural markers to train and assess such skills. Although such research is now available through the above mentioned study but there is lot of room of improvement. The comparison with other safety critical industries shows that more is needed to make non-technical skills training effective such as a change to training structure and shifting training responsibilities from nautical colleges to shipping companies and implementing an aviation style training cycle. To improve the HELM training it would require further research, more resources and more time to train the deck officers. This additional research, resources and time will put further cost to the maritime industry. In this paper author intends to conduct a cost analysis, by using 'Decision Tree' method, of developing a domain specific research to develop the taxonomy of the deck officers' non-technical skills and behavioural markers used to train and assess the non-technical skills and also cost analysis of extended training to explore if there are any benefits of improving safety at sea.

Keywords: Deck officers, non-technical skills, HELM, NTS training, Decision Tree Model, Cost benefit analysis.

1. Introduction

One of the reasons that Human Element Leadership and Management (HELM) course is found to be not effective was due to the fact that IMO did not conduct enough or any research into domain specific non-technical skills, and the manner HELM training courses needs to be delivered and assessed. A thorough research needs to be carried into maritime domain specific human factors to identify deck officers' non-technical skills and behaviour markers system to be developed for the training and assessments of the non-technical skills of the deck officers in a ship bridge simulator.

A workshop was conducted with students who have completed the HELM course as part of the Chief Mate course of study to give feedback on the course. Following are some of the remarks received from students;

- Simulation training is not sufficient; more time needs to be allotted for simulators exercises.
- Instead of having a short course with the duration of five days, the course needs to be incorporated into the entire programme of the study.
- Introducing the case studies on maritime accidents during the HELM training course will help to identify the gap of knowledge in bridge team managements.
- Parts of the course where sessions are interactive such as simulator exercises are very useful.

The question now arises is that how the HELM course or non-technical skills training be improved? First part of the question is which non-technical skills are required to be taught to the deck officers and to answer that taxonomy of the deck officers' non-technical skills are developed (Table 1) as part of International Association of Maritime Universities (IAMU) research project 2013-2. The industries which have researched into non-technical skills have developed the skills taxonomy first then developed the training and assessment models. Anaesthetics non-technical skills research project

(Fletcher *et al.*, 2003) is quite impressive, which developed the taxonomy and the behavioural markers system for the anaesthetics first before implementing the NTS training.

1.1 Methodology

The methodology for this paper is divided into following three steps;

1. A comparison with other safety critical industries' efforts into non-technical skills research and training needs be conducted. Two main industries are looked into are aviation and anaesthetics. The possibility of the adoption of successful methods of aviation and anaesthesia will be explored.
2. A cost benefit analysis will be conducted of all the options explored in step 1. The analysis will be carried out by Decision Tree Model.
3. Based on the cost benefit analysis decision will be made for which option to select.

2.0 Comparison with other Safety Critical Industries' Efforts into Non-Technical Skills Research and Training (Step 1)

Many safety critical industries have conducted a thorough research into domain specific human elements before implementing training course. Anaesthetics, for example, conducted a study which took five years for six full time researchers before implementing a comprehensive and reliable nontechnical skills assessment tool called the Anaesthetists' Non-Technical Skills (ANTS) (Yee *et al.*, 2005). The project was divided into following seven work packages (Fletcher *et al.*, 2003);

1. Review of Human Factors Research in Anaesthesia. Report written by G. Fletcher, R. Flin and P. McGeorge (1999 – 2003).
2. Review of Behavioural Marker Systems in Anaesthesia. Report written by G. Fletcher, R. Flin and P. McGeorge (2000 – 2003).
3. Interview study to Identify Anaesthetists' Non-Technical Skills. Report written by G. Fletcher, R. Flin and P. McGeorge (2001 – 2003).
4. Review of Incident Data - Confidential
5. Development of a Prototype Behavioural Marker System for Anaesthetista' Non-Technical Skills (ANTS). Report written by G. Fletcher, R. Flin, P. McGeorge, R. Glavin, N. Maran and R. Patey (2001 – 2003).
6. Premilinary Evaluation of the Prototype Behavioural Marker System for Anaesthetists' Non-Technical Skills (ANTS). Report written by G. Fletcher, R. Flin and P. McGeorge (2000 – 2003).
7. Experimental Report. Report written by G. Fletcher, R. Flin, P. McGeorge, R. Glavin, N. Maran and R. Patey (2002 – 2003).

In aviation much of the non-technical skills theoretical knowledge is covered in the initial training and it is not repeated when delegates attend Crew Resource Management (CRM) course. Whereas in maritime domain HELM course is a five days course with everything included. And if any institute is delivering course without bridge simulator exercises then there is no practical flavour included in the course.

2.1. Adaption of Anaesthetics' Non-Technical Skills Taxonomy

Based on the proven method used by Anaesthetics, a similar research is performed in the IAMU research project 2013-2 to develop domain specific non-technical skills by developing the following;

1. Review of Human Factors Research in maritime industry.
2. Review of Behavioural Marker Systems in maritime industry.
3. Interview study to Identify Deck Officers' Non-Technical Skills.

4. Review of Incident Data
5. Development of a Prototype Taxonomy and Behavioural Marker System for Deck Officers' Non-Technical Skills.

In the project above areas are covered such as taxonomy of deck officers' non-technical skills (Table 1) and a detailed behavioural markers system for the assessment of deck officers' non-technical skills.

Table 1: Non-technical skills taxonomy of deck officers

Category	Element
1. Teamwork	Team-building and maintaining Considering others Supporting others Communication Information Sharing
2. Leadership and Managerial Skills	Use of Authority and assertiveness Providing and maintaining standards Planning and co-ordination Work load management Prioritisation Task delegation Initial Crisis Management
3. Situation awareness	Awareness of bridge systems Awareness of external environment Awareness of time Situation Assessment
4. Decision Making	Problem definition and diagnosis Option generation Risk assessment and option selection Outcome review

2.2 Developing non-technical skills training model

The non-technical skills taxonomy (Table 1) has been developed in the research conducted by Liverpool John Moores University (LJMU) as part of International Association of Maritime Universities (IAMU) project (2013-2) and it was found that there is a need to develop the training model of training the deck officers' non-technical skills. A workshop needs to be organised where educational and subject experts and psychologists are to be invited. First task will be to find out what would be the best mode of training such skills. Aviation, anaesthetics and other safety critical industry uses simulator based training to train the non-technical skills.

In the present structure of the HELM course students do not have any prior underpinning knowledge of the subject and everything is done in 35 hours of specified course time. An idea may be underpinning knowledge of non-technical skills is integrated into the main course and then extensive simulator training conducted at the end with carefully thought exercises developed to cover each skill and element of the non-technical skills. The present idea of delivering underpinning knowledge within five days of the course may not be very effective as it does not give enough time to students to study the non-technical skills material. If a module is introduce into the main course by teaching 3-4 hours every week over 10-12 weeks will give opportunity to students to absorb the knowledge slowly and then the exam in the end will test their knowledge. Once students have completed the non-technical skills module then they will be introduced to non-technical skills simulator exercises where they will learn the practical aspects of non-technical skills.

2.3 Adapting CRM training Model

To adapt CRM training model it is necessary to draw training objectives based on CRM training (CAA, 2006):

a. To enhance crew and management awareness of human factors which could cause or exacerbate incidents which affect the safe conduct of ship operations.
b. To enhance knowledge of human factors and develop non-technical skills and attitudes which when applied appropriately could extricate a ship operation from incipient accidents and incidents whether perpetrated by technical or human factor failings.
c. To use non-technical skills knowledge, skills and attitudes to conduct and manage ship operation and fully integrate these techniques throughout every facets of the organisation culture, so as to prevent the onset of incidents and potential accidents.
d. To use these skills to integrate commercially efficient ship operations with safety.
e. To improve the working environment for crews and all those associated with ship operations.
f. To enhance the prevention and management of crew error.

In aviation much of the non-technical skills theoretical knowledge is covered in the initial training and it is not repeated when delegates attend CRM course. The theory should concentrate on developing an understanding on the non-technical skills concepts and any reference to the theory of human performance and limitation should be backed up by practical examples in shipping industry.

In maritime industry presently training institutes seem responsible for conducting such training and , in UK, the HELM course is a one off training only. In aviation this responsibility is given to operators. The CRM course is repeated every three years, or when individual changes aircraft or company. When course is repeated it is not religious cycling of the knowledge. It is rather focused on the weak areas within individual or the company (CAA, 2006). In maritime industry the responsibility of delivering HELM course need to be shifted to shipping companies and each individual shipping company will need to design HELM course specific to the company.

Measurement of learning can be divided into following two categories:

1. Those assessing knowledge required
2. Those assessing attitude or attitude change.

In order for HELM training course to have positive effect on behaviour, as opposed to just increasing knowledge of human factors and attitude, following criteria must be met (CAA, 2006);

- *The organisation climate must be conducive to change;*
- *The individuals must have desire to change;*
- *The individuals must know what and how to make change.*

Acquisition of knowledge has limited effect on a person as one can be knowledgeable about a subject but not agree to adopt its principles in practice. Attitude measures are probably more useful as indicators of whether HELM training likely to be effective in particular there are if they are measures of attitude change prior to and after HELM training.

3. Decision Tree calculation (Step 2)

The improvement in the deck officers' non-technical skills will improve a shipping company's performance and hence will improve the profits. The company has to make decision whether to take an action or not to improve the deck officers' performance. The company is uncertain whether the performance of the company's deck officers (ie Deck Officers' Performance or DOP) is high, average or low. The cost of an action is C_1. It is believed by taking an action and enhancing the performance of the deck officers (i.e. with average performance) the reliability of the company's vessels will increase and accordingly the profit and net profit associated with an action will be increased. The profit and net profit can be estimated as B_1 and ($B_1 - C_1$) respectively. Similarly for the deck officers with low performance, the profit and net profit associated with an action can be estimated as B_2 and ($B_2 - C_1$) respectively. An assessment programme (i.e. Audit) will help the company to determine the company's performance (i.e. CP). The cost of an assessment programme (i.e. Audit) is C_2. Based on non-technical skills observations (Table 2) conducted in the IAMU project 2013-2, that 0%, 50% and 50% of the company's deck officers are with high, average and low performance respectively. Based on expert's opinion the relationship between a company's performance and its employee are shown in Table 3.

Table 2: Non-technical skills performance data

		NTS Value
Group 1	Without HELM Training	0.2459 (24.59%)
Group 2	Without HELM Training	0.2724 (27.24%)
Group 3	Without HELM Training	0.3917 (39.17%)
Group 4	Without HELM Training	0.1459 (14.59%)
Group 5	Without HELM Training	0.3487 (34.87%)
Group 6	Without HELM Training	0.5409 (54.09%)
Group 7	With HELM Training	0.4751 (47.51%)
Group 8	With HELM Training	0.1501 (15.01%)
Group 9	With HELM Training	0.2797 (27.97%)
Group 10	With HELM Training	0.3888 (38.88%)
Group 11	With HELM Training	0.4423 (44.23%)
Group 12	With HELM Training	0.2576 (25.76%)

If a group's NTS is less than 0.33, then the performance is Low.
If a group's NTS is between 0.33 and 0.66, then the performance is Average.
If a group's NTS is between 0.66 and 1.0, the performance is High.

Table 3: Conditional probability table

DOP / CP	High (H)	Average (A)	Low (L)
High (H)	0.8	0.1	0.1
Average (A)	0.15	0.8	0.2
Low (L)	0.05	0.1	0.7

Based on Bayes chain rule the following equation can be evaluated;

$$P(CP = H) = P(CP = H|DOP = H) \times P(DOP = H) + P(CP = H|DOP = A) \times (P(DOP = A) + P(CP = H|DOP = L) \times (P(DOP = L)$$

$$P(CP = H) = (0.8 \times 0) + (0.1 \times 0.5) + (0.1 \times 0.5) = 0.1$$

$$P(CP = A) = P(CP = A|DOP = H) \times P(DOP = H) + P(CP = A|DOP = A) \times (P(DOP = A) + P(CP = A|DOP = L) \times (P(DOP = L)$$

$$P(CP = A) = (0.15 \times 0) + (0.8 \times 0.5) + (0.2 \times 0.5) = 0.5$$

$$P(CP = L) = P(CP = L|DOP = H) \times P(DOP = H) + P(CP = L|DOP = A) \times (P(DOP = A) + P(CP = L|DOP = L) \times (P(DOP = L)$$

$$P(CP = L) = (0.05 \times 0.1) + (0.1 \times 0.5) + (0.7 \times 0.5) = 0.4$$

And;

$$P(DOP = H \mid CP = H) = \frac{P(CP = H|DOP = H) \times P(DOP = H)}{P(CP = H)}$$

$$P(DOP = H \mid CP = H) = \frac{0.8 \times 0}{0.1} = 0$$

$$P(DOP = A \mid CP = H) = \frac{P(CP = H|DOP = A) \times P(DOP = A)}{P(CP = H)}$$

$$P(DOP = A \mid CP = H) = \frac{0.1 \times 0.5}{0.1} = 0.5$$

$$P(DOP = L \mid CP = H) = \frac{P(CP = H|DOP = L) \times P(DOP = L)}{P(CP = H)}$$

$$P(DOP = L \mid CP = H) = \frac{0.1 \times 0.5}{0.1} = 0.5$$

$$(DOP = H \mid CP = A) = \frac{P(CP = A|DOP = H) \times P(DOP = H)}{P(CP = A)}$$

$$P(DOP = H \mid CP = A) = \frac{0.15 \times 0}{0.5} = 0$$

$$(DOP = A \mid CP = A) = \frac{P(CP = A|DOP = A) \times P(DOP = A)}{P(CP = A)}$$

$$P(DOP = A \mid CP = A) = \frac{0.8 \times 0.5}{0.5} = 0.8$$

$$(DOP = L \mid CP = A) = \frac{P(CP = A|DOP = L) \times P(DOP = L)}{P(CP = A)}$$

$$P(DOP = L \mid CP = A) = \frac{0.2 \times 0.5}{0.5} = 0.2$$

$$P(DOP = H \mid CP = L) = \frac{P(CP = L|DOP = H) \times P(DOP = H)}{P(CP = L)}$$

$$P(DOP = H \mid CP = L) = \frac{0.05 \times 0}{0.5} = 0$$

$$P(DOP = A \mid CP = L) = \frac{P(CP = L|DOP = A) \times P(DOP = A)}{P(CP = L)}$$

$$P(DOP = A \mid CP = L) = \frac{0.1\ x\ 0.5}{0.4} = 0.125$$

$$P(DOP = L \mid CP = L) = \frac{P(CP = L|DOP = L) \times P(DOP = L)}{P(CP = L)}$$

$$P(DOP = L \mid CP = L) = \frac{0.7 \times 0.5}{0.4} = 0.875 \tag{1}$$

A decision tree is a diagram that represents, in a special organised way, the decisions and the main external or other events that influence uncertainty, as well as possible outcomes of all those decision and events. Figures 1 shows a decision tree representation and solution to this problem. In Figure 1, squares represent decisions and the lines coming out of each square show all available distinct options that can be selected at the decision analysis point. For instance, as shown in Figure 1, to perform an assessment programme (i.e. Audit) or not to perform, two lines coming out of "audit square" show all available distinct options (i.e. Yes or No) that can be selected by the manager. In Figure 1, circles show various circumstances that have uncertain outcomes and the lines that come out of each circle denote a possible outcome of that uncertainty. For instance, as shown in figure 1, the "circle R" shows the result of an assessment programme and the line that come out of "circle R" denote possible outcomes of that uncertainty (i.e. a company's performance is high, average or low). Based on Equation 1 the probability of each outcome is written on each respective line. Based on Figure 1, the manager can calculate the overall desirability of those choices. For instance, if manager makes a decision to perform the audit and based on audit's result the company's performance found to be high, then the desirability for taking an action can be calculated as follows:

$$\begin{aligned} &0 \times (C_1 + C_2) + 0.5 \times [B_1 - (C_1 + C_2)] + 0.5 \times [B_2 - (C_1 + C_2)] \\ &= 0.5 \times B_1 + 0.5 \times B_2 - (C1 + C2) \end{aligned} \tag{2}$$

If the assessment (i.e. evaluated by Equation 5.4) is lesser than "-C", then no action has to be taken. Thus:

$$0.5 \times \mathrm{B}_1 + 0.5 \times \mathrm{B}_2 - (\mathrm{C}_1 + \mathrm{C}_2) < (-\mathrm{C}_2)$$

$$0.5 \times \mathrm{B}_1 + 0.5 \times \mathrm{B}_2 < \mathrm{C}_1 \tag{3}$$

If the company makes a decision to perform the audit, with similar techniques Equations 2 and 3 are evaluated, the desirability for the other choices can be assessed. Thus, the three conditions can be summarised as follows:

1. If a company's performance is high and $C_1 > 0.5\ x\ B_1 + 0.5\ x\ B_2$, then take no action.
2. If a company's performance is average and $C_1 > 0.8\ x\ B_1 + 0.2\ x\ B_2$, then take no action.
3. If a company's performance is low and $C_1 > 0.125\ x\ B_1 + 0.875\ x\ B_2$, then take no action.

As an illustrative example, Italian Cruise liner Costa Cruise Line own 27 ships with revenues of 3.1 billion euros and 2.3 million guest in year 2011 (Costa Cruise website, 2014). One of the Costa Cruise Line ships, Costa Concordia partially sank when it ran aground at Isola del Giglio on 13th January 2012 with loss of 32 lives. The accident mainly caused by human error (Lieto, 2014). After salvage of Costa Concordia the total cost of accident is estimated to be \$800 million (£480 million) (NBC News, 2014).

For the purpose of the following calculations it is assumed that the total loss to the company due to poor performance of the deck officers is £480 million due to the accident.
Assume $B_2 = 2 \text{ x } B_1$. Thus:

$\mathrm{B}_1 + \mathrm{B}_2 = £480\mathrm{m}$
$\mathrm{B}_2 = 2 \times \mathrm{B}_1$
$\mathrm{B}_1 = £160\mathrm{m}$
$\mathrm{B}_2 = £320\mathrm{m}$

The company may decide to improve the non-technical skills of the deck officers by introducing further Human Element training. This needs evaluation based on the proposed methodology in the research, developing non-technical skills training model and implementing CRM style training cycle. The cost of evaluation of non-technical skills taxonomy is estimated as £200,000. For 27 ships a company would have 216 deck officers so training cost of deck officers is £216,000 (i.e 216 x £1000). So the total estimated cost of C_1 is £416,000. The cost of an assessment programme (i.e. C_2) is estimated as £200,000. The assessment programme could be implemented by sending experts onboard ships to assess the performance of the deck officers in the real life such as Line Operations Safety Audit (LOSA) program. During LOSA observation, observer record and code potential threats to safety, how the threats were addressed, and the errors generated, how the errors were managed, and how the observed behaviour could be associated with incidents and accidents (Pedigo *et al.*, 2011).

1. £416,000 > 0.5 x 160m + 0.5 x 320m
   £416,000 > £240m = Condition not satisfied
2. £416,000 > 0.8 x 160m + 0.2 x 320m
   £416,000 > £192m = Condition not satisfied
3. £416,000 > 0.125 x 160m + 0.875 x 320m
   £416,000 > £300m = Condition not satisfied

As a result conditions 1, 2 and 3 are not satisfied. Consequently and based on Figure 1, the expected profit associated with this strategy is calculated as:

$$0.1 \times \{-0 \times (\mathrm{C}_1 + \mathrm{C}_2) + 0.5 \times [\mathrm{B}_1 - (\mathrm{C}_1 + \mathrm{C}_2)] + 0.5 \times [\mathrm{B}_2 - (\mathrm{C}_1 + \mathrm{C}_2)]\} +$$
$$0.5 \times \{-0 \times (\mathrm{C}_1 + \mathrm{C}_2) + 0.8 \times [\mathrm{B}_1 - (\mathrm{C}_1 + \mathrm{C}_2)] + 0.2 \times [\mathrm{B}_2 - (\mathrm{C}_1 + \mathrm{C}_2)]\} +$$
$$0.4\,\{-0 \times (\mathrm{C}_1 + \mathrm{C}_2) + 0.125 \times [\mathrm{B}_1 - (\mathrm{C}_1 + \mathrm{C}_2)] + 0.875 \times [\mathrm{B}_2 - (\mathrm{C}_1 + \mathrm{C}_2)]\} =$$
$$= £239{,}384{,}000 \tag{4}$$

Based on Figure 1, the expected profits associated with taking an action and not performing the assessment programme is calculated as:

$$0\ x\ (-C_1) + 0.5\ (B_1 - C_1) + 0.5\ (B_2 - C_1) =$$
$$0.5\ B_1 + 0.5\ B_2 - C_1 = £239{,}584{,}000 \tag{5}$$

Based on Equations 4 and 5, the optimal strategy is to take an action immediately.

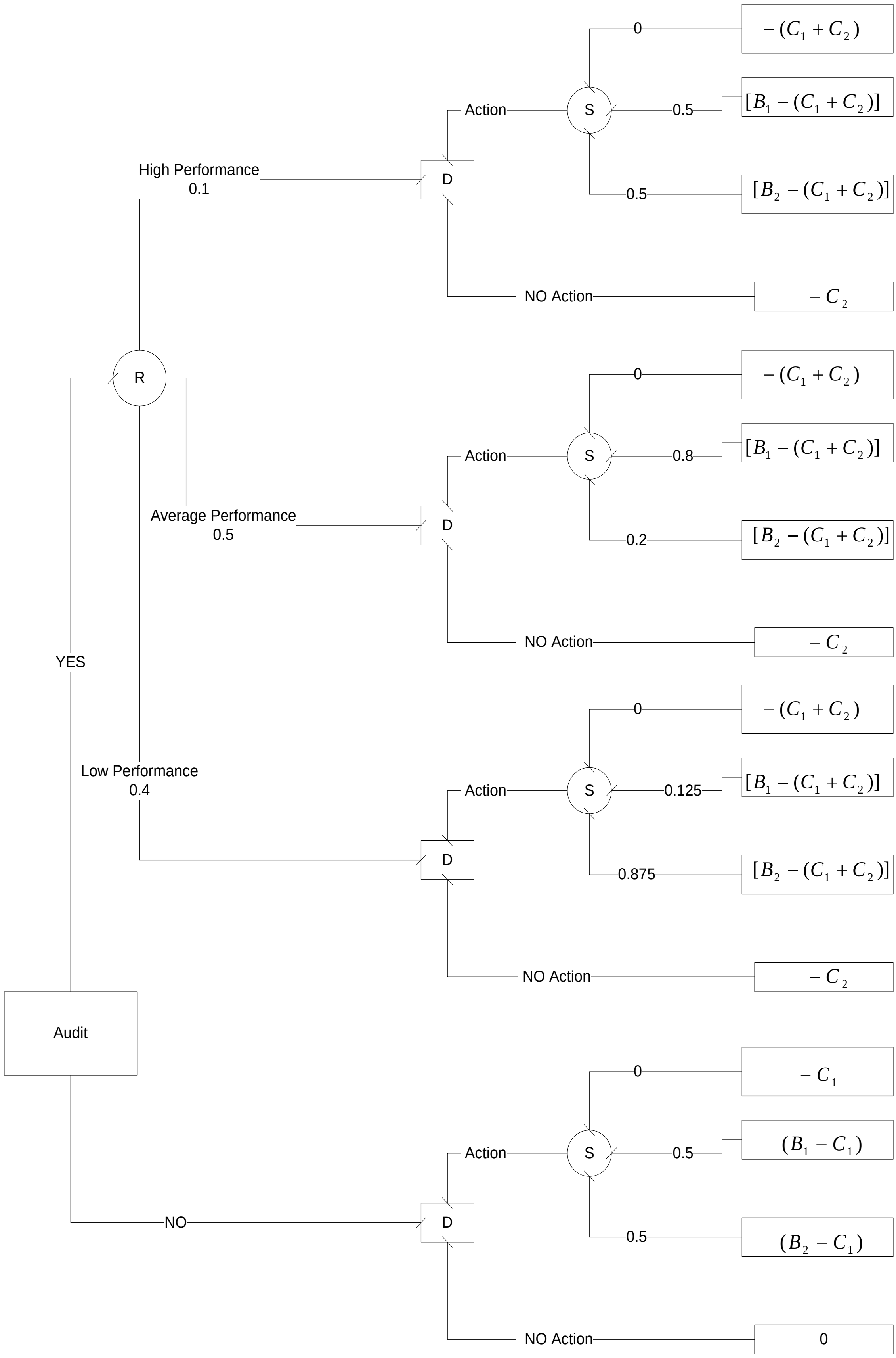

Figure 1: Decision Tree

5.6 Options (step 3)

After conducting decision tree calculations now there are following three options available;

1. Do not take any action and continue with existing HELM course arrangements.
2. Follow the suggestions in section 2 to evaluate deck officers' non-technical skills taxonomy and behavioural markers system, integrate the HELM theory into main course and run HELM simulator training at the end of the main course and implement aviation style training cycle.
3. In addition to following the suggestions in section 2, an assessment programme is implemented.

By choosing option 1 the accidents will continue to happen, innocent seafarers will lose their lives and industry will bear the cost of $541m per year caused by the human error (P&I, 2014). As it is apparent from the decision tree calculations that there is more profit to the company by just carrying out the evaluation of deck officers' non-technical skills taxonomy and behavioural markers system, integrate the HELM theory into main course and run HELM simulator training at the end of the main course and implement aviation style training cycle and do not run the assessment programme.

It can be concluded from the decision tree calculations that option 2 is the most profitable and feasible option to choose at this stage.

5.7 Conclusion

After the study conducted by LJMU as part of IAMU project (2013-2) it was concluded that HELM course is not very effective. It was discussed here reasons why HELM course is not very effective by comparing other safety critical industries practices. It was explored in this paper that what other safety critical industries have done in this area such as Anaesthetics and Aviation and how their proven methods can be adapted for maritime domain. The anaesthetics proven research method can be adopted to develop the deck officers' non-technical skills taxonomy and behavioural markers systems for the training assessment. It was also suggested that a HELM training model need to be developed. Aviation style training implementation will help improving the HELM training in the maritime domain. To improve the HELM training it would require further research, more resources and more time to train the deck officers. The cost of this additional research, resources and time was calculated by choosing an example shipping company. A cost analysis carried out by decision tree method to work out if there are any benefits of applying such methods to improve HELM training to the industry. The results of cost analysis have shown that there is a benefit to the industry by carrying out further research and implementing further training.

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Interim Results of a Longitudinal Study Into the Perceptions of Bridge Team Management (BTM) in Pilotage Waters as Experienced By Deck Officers Studying at the Australian Maritime College.

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Abstract For the last three decades, Bridge Team Management (BTM) has been a process sitting at the periphery of a seafarers skill set, and had been seen as a “nice-to-have” skill, rather than a mandatory requirement. The situation has changed with the Introduction of the STCW2010 Manila amendments (2), which now requires that all bridge officers, during their studies for a Certificate of Competency, undertake Bridge Resource Management training. This project studies seafarer’s perceptions of BTM, how it has been implemented on board their vessels, and will look at how these perceptions change with the introduction of the Manila amendments.

This review of BTM is a longitudinal study based on a questionnaire given to students on the Chief Mate / Master’s course before Bridge Team Management as a concept is discussed in their course of study. The questionnaire uses a Likert scale to determine the subject’s attitudes to various aspects of the implementation of Bridge Teamwork in their experience at sea, and allows for additional comments to be added. This gave the subjects the opportunity to expand or further explain any of their answers, giving further insight into the application and understanding of BTM.

The results indicate that younger officers, working on deep sea vessels, where a harbour pilot is employed, are more used to the processes of BTM, and are more comfortable acting as part of a team than those of more advanced years working on smaller vessels generally without a pilot embarked. There are distinct differences in the perceptions of BTM between officers employed in the offshore industry, and those who work in the blue-water fleet. This marked difference between fleets is also seen in the equipment fit on the bridge, the requirements for pilots and how BTM is implemented.

The results are based on the first three years of the study, and represent a snapshot of perceptions before the introduction of STCW2010. The study will continue, for at least two more years, with the objective of assessing any change to the perceptions once Bridge Resource Management is embedded as a mandatory requirement.

Keywords: Bridge Team Management, STCW2010.

1.Method

The questionnaire was designed to pose a series of questions which gave the subject the opportunity to indicate their experience of accidents and incidents in port operations, as well as indicating their perception of situational awareness, management styles, cultural issues, crisis management, and also looked at the possible effects of increasing complexity of bridge equipment

The Likert scale (1) chosen gave five possibilities, namely “Always”, “Often”, “Sometimes”, “Hardly ever”, and “Never” or “Strongly agree”, “Agree”, “Neutral”, “Disagree”, and “Strongly disagree”. Where thought necessary, space was provided in the questionnaire for the subjects to add additional description, in order to establish the nature of any incident that had occurred in pilotage waters. A final section was provided for the subjects to add any further comments.

Questionnaires were distributed to members of a class studying the Navigation Management unit, part of the Chief Mate/Master course. As part of this unit, the students will discuss the implementation and application of Bridge Team Management systems aboard vessels. Since the chief investigator for the research project was also the lecturer for the unit, another member of staff was used to distribute the questionnaire, in order to remove any bias on the part of the students attempting to answer as might be perceived to be required, or that might be a result of unintended pressure to give the “right” answer. The distribution of questionnaires was also timed to occur before the subject of Bridge Team Management was discussed in class, thus ensuring, as far as possible, that the results were based on what the students had experienced at sea, rather than learned in class.

The students on the Chief Mate/Master course were chosen as the target group for a number of reasons. Firstly, the class consists of students who have entered by a number of different routes, be that limited tonnage, limited area, a traditional unlimited route, and more modern “fast track” cadet training. Thus, the student group collectively had a wide variety of experience not only in different ship types and sizes, but also in their sea-going experience. Secondly, at the time of starting the research, the requirement for Bridge Team Management training was not compulsory. Although seen as best practice, Bridge Team Management was introduced only in this course, as a tool for use by senior officers. The principles of Bridge Team Management (BTM) were discussed with reference to the student’s own experience. Some of the students would have been exposed to the principles, and implementation of the principles was part of the research. Thirdly, implementation of Bridge Team Management principles was not universally applied, and the experience of watch-keeping officers both with and without the implementation was worthy of note.

Classes of students study in four teaching blocks in a year. The course itself extends over three blocks, A, B and C, and with the unit delivered in block B, there would be either one or two deliveries in a calendar year. Classes varied in size from the low 20’s to over 50 students, giving an irregular number of returns from each student cohort. This gives an uneven distribution of subjects against time. The possibility of measuring a specific rate of change in perception with time has been disregarded as unworkable due to this unevenness. However, since this paper looks at the interim results of the study, it is possible to establish the pre Manilla amendment perceptions. Each possible answer in the Likert scale used in the questionnaire has been numbered 1 to 5, and the average and standard deviation for each question established. This establishes the level of perception as a quantitative value for the subjects so far.

The study will continue, with the expectation that subsequent student groups will have been exposed to BTM during their earlier studies, and these new subjects' perceptions of BTM will be assessed to note changes.

2. Results

The interim results review the responses from three cohorts of students, who all attended the college in 2011 and 2012. Not all students chose to complete the questionnaire, a choice required by the ethics approval for this research project. The result was a total of 66 voluntary returns. Although this is a fairly low number, it does represent a cross section of the shipping industry, including as it does Australian seafarers employed on the Australian coast and internationally, as well as overseas students employed in a variety of trading patterns. (See Table 1)

Last Vessel	Offshore 19	Bluewater 44	Undeclared 3			Total 66
Nature of trade	Foreign 38	Interstate 24	Undeclared 4			Total 66
Last rank served	Cadet 13	3rd Mate 11	2nd Mate 35	Chief Mate 4	Master 1	Total 66
Years' experience	0 – 5 52	5 – 10 6	10 – 15 4	15 + 4		Total 66
Age	<20 1	20 – 30 31	30 – 40 23	40 – 50 10	50 + 1	Total 66

Table 1 – subjects taking part in the project

From Table 1 it can be seen that the subjects are biased towards younger, less experienced subjects who have generally served in junior officer capacity at sea. This is unsurprising given that the subjects are drawn from student groups studying for their chief mate certificate of competency. They will therefore have some experience as Watchkeeping officer: the outlying individual is a subject who had sailed as master with a restricted tonnage certificate of competency, and was studying to remove the restrictions on his certificate. Likewise, the 4 subjects who had sailed as chief mate were also studying to remove the tonnage restrictions on their certificates of competency. This does then mean that the results are biased towards the experience and perceptions of junior officers. However, the experiences on which the questionnaire is based refer to BTM evolutions which will have included other officers of differing ages and experiences. So, although we are reviewing the experiences of junior officers, the experiences will be determined by leaders with more experience, who are less likely to have been exposed to the tenets of BTM.

Since all these students have attended college before the mandatory introduction of training in Bridge Team Management as required by the 2010 amendments (Manilla Amendments) to the Seafarers' Training, Certification and Watchkeeping (STCW) Code, they will form the basis on which will be determined any changes to perception of BTM. Students attending the Chief Mate/Master course after this date will probably have studied BTM as part of their Officer of the Watch qualification, though this will only be true for students who return to their studies after gaining the minimum required sea service or who are part of the "fast track" programme[1]. Students who have been at sea for a considerable period of time without advancing their qualifications will still form part of future groups, and this may have to be considered in later results.

[1] The "fast-track" training scheme, is designed for students to complete all the academic part of their training up to Chief Mate/Master, before taking their oral examination as Officer of the Watch. This is the reason why there are a number of subjects whose last job was Cadet in Table 1

The following table (Table 2) lists the xx questions asked of all subjects.

No	Subject area	Question
1	Situation Awareness	During pilotage on your last vessel how often did you feel that your bridge team was unable to integrate all the information that made up the operational environment (ie. objects, events, people, systems and environmental factors) so as to perceive what was happening?
2	Situation Awareness	During pilotage on your last vessel, do you believe that your bridge team was able to sufficiently comprehend what was occurring in the operational environment so as to recognise its impact on the goals and objectives of the team?
3	Situation Awareness	On your last vessel how often did you feel that your bridge team had the ability to project their perception and comprehension of the operational environment forward in time so as to determine what might happen next?
4	Attitudes and Management skills	During pilotage in the past two years, how often have you felt like volunteering your assistance when it appeared that the pilot had not been using all of the available human resources on the bridge?
5	Cultural awareness	During pilotage in the last two years how often did you feel that the pilot/captain's actions made the bridge team feel as though their presence or contributions were not considered equal in the safety of the vessel?
6	Communication and briefing	On average, how well do you think your bridge team is integrated into the pilot's passage plan and briefings, prior to entering a port?
7	Challenge and response	On your last vessel, how often did bridge team members speak up and challenge situations when they believed the limits of safety had been exceeded during pilotage?
8	Short term strategy	On your last vessel how confident were you that if a problem arose that had not been addressed in the passage plan, your bridge team would be able to identify the problem, build a plan, check the plan, perform a briefing and monitor the situation?
9	Authority and assertiveness	During pilotage on your last vessel, how often was your master able to coordinate the bridge's activity so as to bring about an appropriate balance between the pilot's authority and the bridge team's assertiveness?
10	Management Styles	Depending on the situation, do you find that your captain uses a balance of performance and people orientated management styles to get the best out of the bridge team?
11	Workload	During pilotage on your last vessel, how often was delegation used effectively to correct the high workloads of bridge team members that deviate towards doing everything themselves?
12	State of ship (NOTE)	On average in your current role as a watchkeeper, which of these terms best describes the general state of the bridge team during pilotage?
13	Human involvement in error	Human errors should not be expected during pilotage operations and culprits must be singled out and blamed for their actions?

14	Judgement and decision making	Hidden factors such as personality conflicts, time constraints, uncertainty, stress and lack of knowledge plays a large part in weakening the strength of my bridge team.
15	Leadership in emergencies	Do you feel confident that in an emergency situation such as a steering failure during pilotage, your bridge team would be able to manage the situation to the best of their abilities through the techniques of leadership and delegation?
16	Crisis and crowd management	In a crisis scenario during pilotage, do you believe that your bridge team would be able to manage the vessel if the pilot/captain became incapacitated
17	Automation awareness	A bridge that is highly automated with technologies such as ECDIS (Electronic Chart Display and Information Systems) decreases workloads, reduces errors and optimises situational awareness.

Table 2 – Questionnaire questions

With the exception of question 12, the 5 part Likert scale allowed for a number between 1 and 5 to be assigned to the answer, and the average answer for sample to be determined for each question. The numbering conformed to a value using 1 as the positive, agreement, most likely end of the scale, 3 as the neutral value and 5 as the negative, disagreeable, least favourable option. The questionnaire answers having been assessed in this fashion the average for the sample was determined, and the standard deviation calculated to give a measure of whether the average was significant or not. These results are given in Table 3.

Question	Area	Average	Standard Deviation
1	Situation Awareness	3.648	1.148
2	Situation Awareness	1.677	0.670
3	Situation Awareness	1.888	0.754
4	Attitudes and Management skills	3.000	1.123
5	Cultural awareness	3.785	1.091
6	Communication and briefing	2.246	0.961
7	Challenge and response	2.461	1.144
8	Short term strategy	1.953	0.734
9	Authority and assertiveness	2.063	0.936
10	Management Styles	2.281	0.928
11	Workload	2.219	0.950
13	Human involvement in error	2.246	0.898

14	Judgement and decision making	2.270	1.199
15	Leadership in emergencies	1.923	0.775
16	Crisis and crowd management	1.938	0.920
17	Automation awareness	2.661	1.177

Table 3 Average responses and Standard Deviation for questions

Question 12 allowed the options “Inattentive”, “Bored”, “Optimum”, “Concerned”, and “Alarmed”. It was not considered in the same way as the other questions since the scale was not the same. However over half (35 from 66 returned questionnaires) described the general state of the bridge team as Optimum, while a sixth (11 from 66) described the team as bored. Of more concern, were the four subjects who described their bridge team as inattentive, the 9 who described their team as concerned, and, perhaps of most concern, the 4 who described their team as alarmed.

Conclusions

The volunteers who undertook to complete the questionnaire, do not represent a fair cross section of the man-power employed as bridge Watchkeeping officers at sea. Junior officers with short experience as watchkeepers are over-represented, and there are very few returns from senior more experience personnel. Although this does give a biased result, the study is a longitudinal one, observing, in part, the effect of the introduction of the mandatory training. Therefore the effectiveness of the training can be assessed by looking at the perceptions of similar groups observed before and after the introduction of the training. It is the change that is being measured, not the specifics of the sample groups, provided the sample groups are similar before and after. By choosing the student groups that we have, it is likely that similar age, experience and job title profiles will be experienced in future groups.

These interim results of this longitudinal study have established the perceptions of Bridge Team Management for subjects who have not been required to study Bridge Resource Management as a mandatory part of their qualifications. This questionnaire results from this pre-Manilla amendment group, will provide the basis for comparison to the results from future cohorts of students. It is hypothesised that the future groups will perceive that the bridge teams in which they work will implement bridge team management in a more effective fashion, supporting the IMO in its mission to promote safe, secure, environmentally sound, efficient and sustainable shipping through cooperation.

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Simulator Programs (2-D and 3-D): Influence on Learning Process of BSMT and BSMAR-E Students at Maritime University Philippines

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

Keywords: *2-D simulator program, 3-D simulator program, influence, learning process, skills development, learning aids, and competent skill* .

1. INTRODUCTION

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

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

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

2. STATEMENT OF THE PROBLEM

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

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

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

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

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

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

3. THEORETICAL FRAMEWORK

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

4. CONCEPTUAL FRAMEWORK

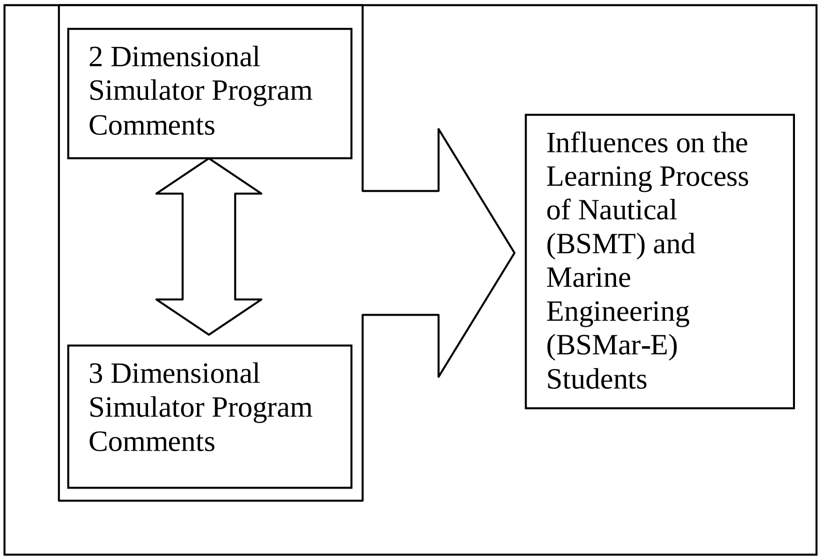

Figure 1 2D and 3D simulator programs and their influences on the learning process of nautical and marine engineering students

5. METHOD

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

6. PARTICIPANTS

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

7. PROCEDURE

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

8. RESULTS AND DISCUSSION

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

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

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

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

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

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

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

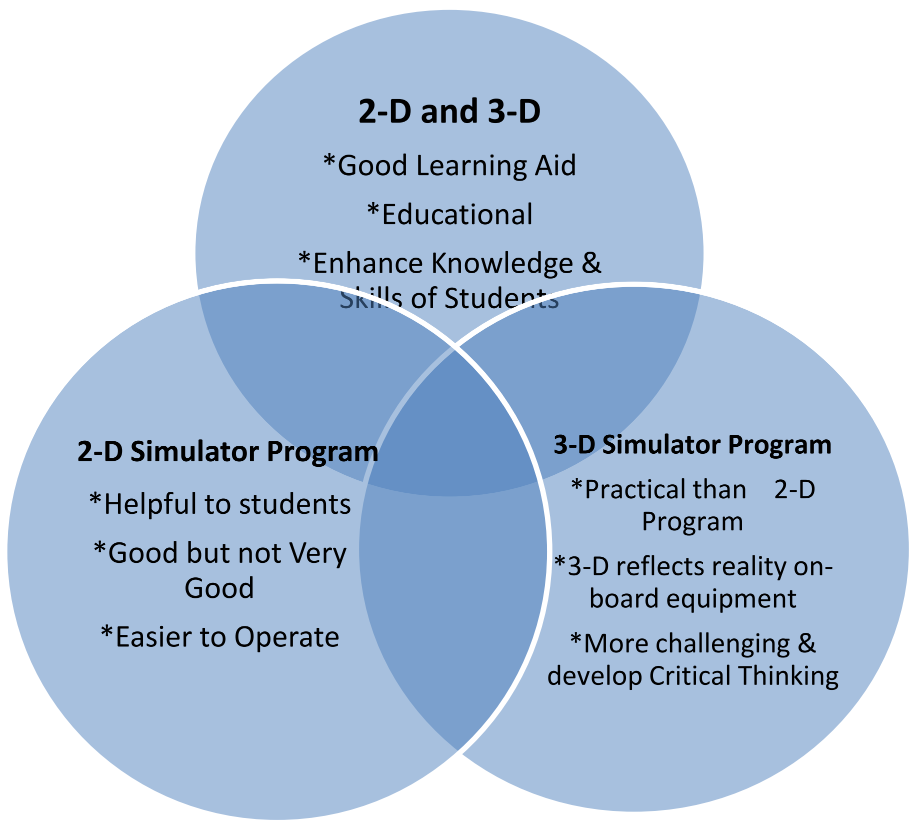

Figure 2 Summary of the views/insights of the nautical (BSMT) and marine engineering (BSMar-E) students towards 3D and 2D simulator programs

9. CONCLUSIONS AND RECOMMENDATIONS

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

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

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

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

In this regard, the following are recommended:

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

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

10. ACKNOWLEDGEMENTS

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The Development of a Shiphandling Assessment Tool (SAT): A Methodology and an Integrated Approach to Assess Manoeuvring Expertise in a Full Mission Bridge Simulator

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While adopted in the maritime industry computer based assessment (CBA) has mainly been deployed to support multiple choice questionnaires (MCQ) or very basic desktop simulations.CBA is principally used for basic screenings at initial stages of personnel selection processes or for Certificate of Competency issuing purposes. The rudimentary efforts to use CBA, even when coupled with oral examinations remain insufficient to assess shiphandling competence due to the complexity of the tasks and responsibilities involved. Nor has a commonly accepted, validated and standardised tool been developed to assess shiphandling. This paper describes the development of a methodology able to obtain the assessment of shiphandlers' outcomes while performing manoeuvres in a Full Mission Bridge Simulator. Variables and parameters used for the assessment are introduced and described even though, due to the limited space available for this paper, no results could be provided and discussed. It is believed that the approach herein presented, could pave the way for an assessment tool in the maritime transport which covers performance, physiological and cognitive measurements. The main aim of the research was to show how it was possible to collect objective measures able to discriminate among different levels of performance in a group of participants as an averaged result. Those results are thought to be valuable in terms of port operations risk assessments, new ports and infrastructure developments, and shiphandlers assessment and training.

Keywords: shiphandling, assessment, expertise, behavioural variables, simulator, heart rate variability, Nasa TLX, Shiphandling Assessment Tool, seafarers, marine pilots.

Introduction

The contemporary maritime industry, compared to any other sector, can be considered perhaps the most globalised labour market in the world [1], with labour force drawn from an unrivalled number of different countries. Even though the maritime industry has established a set of internationally recognised and accepted standards for seafarer training and certification (STCW) [2],many differences can be found in the modalities through which such certifications are issued, endorsed and renewed worldwide. In addition, regardless of the type of approach adopted by each single Nation, a considerable variation in assessing standards [3] within each Country has been noticed, making it very difficult for employers to rely upon seafarer licences as an indication of seafarer competence, skill, or knowledge [4]. Several challenges remain to seafarer education and training [5] [6]. One of those challenges is that there is still the need to identify a commonly accepted and standardized way to assess shiphandling competency and performance. One of the increasingly important options is computer based assessments (CBA). Today, CBA, as adopted by the maritime industry seems to mainly rely on multiple choice questionnaires or simple desktop simulations. Those tools are mainly used to provide an unsophisticated screening during the initial stages of personnel selections or for Certificate of Competency issuing purposes [7]. Assessing shiphandling competency through oral examinations or multiple choices tests, when merchant vessels can reach displacements of hundreds of thousands of tons and when a simple accident can lead to disastrous consequences, is inadequate and high risk. This is increasingly appreciated, for example, by Marine Pilot Companies that have to make considerable investments before the necessary assessment and training period for a newly recruited trainee pilot can be considered completed and satisfactory. Nevertheless, simulators offer a potential solution. Simulators have significantly improved in the last few years. They are at a point where they

have proven their value in different fields of application within the transport industry, for example to simulate logistic dynamics and volumes before a port is even built [8], to improve training for airline pilots [9] as well as for train drivers [10].
The aim of this paper is to introduce an assessment methodology that, when taking into account several objectively measurable variables, can assesses participants' levels of "Shiphandling Expertise" [11]. This methodology will be tested using a Full Mission Bridge Simulator that directly replicates applied practice in a real world environment. Data collected and processed include Simulator data [12], but also Electrocardiogram signals (ECG) [13], eye movement and fixations [14] [15], manoeuvring plans [16] [17], interviews, briefings, debriefings and Nasa TLX form completion [18]. The methodology attempts to better depict the complexity underlying shiphandling in a port environment [19] [20], considering the human element with regards to the safety, accuracy and efficacy of ship conduction, evaluating correlations between physiological variables [21], behavioural markers and performance outcomes. More specifically, the Shiphandling Assessment Tool (SAT) collects and processes variables capable to show how effectively shiphandlers perform, while dealing with Bridge applications and equipment, such as an Electronic Chart Display and Information System (ECDIS), Integrated Navigation Systems (INS), radars, navigation aids, different natural and weather conditions, static and dynamic characteristics of vessel manoeuvrability [22], environmental and infrastructural constraints [23].

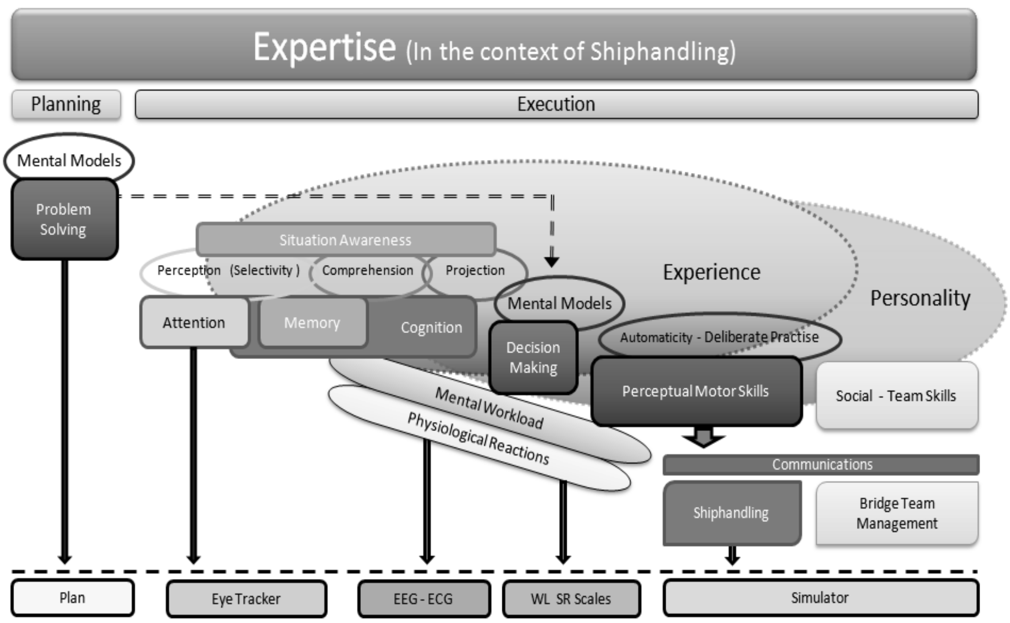

Figure 1 – Model of Shiphandling Expertise adopted in SAT

The figure above illustrates how Shiphandling Expertise can be related to different and consolidated theoretical constructs. Experts involved in planning activities are profitably capable to forecast future developments [24], evaluating initial conditions and structuring them into more accurate and realistic mental models. Mental models have been succinctly defined as "mechanisms whereby humans are able to generate descriptions of system purpose and form, explanations of system functioning and observed system states, and predictions of future states" [25]. In our case, mental models will derive from the capability of the shiphandler to understand the terms and the specificities of each proposed manoeuvre, predicting the implications and providing with a suitable plan. Mental Models are exploited to explain, interact and direct problem solving, working as a guide [26] or as a map [27]. Shiphandler's attention is then directed, guided by the mental model adopted, performing a slim and efficient filtering of available stimuli. Such filtering activity, despite carrying the risk of omitting relevant data, is nevertheless necessary whenever large amount of information is available. Perceived elements are so integrated in a meaningful ensemble and confronted with pertinent contents retained in memory structures. Elements gathered from reality will confirm or not if the mental model adopted is correct. "Testing against reality" is a clear reference to a continuously maintained state of situational awareness [28] through the exploitation of the underlying cognitive processes of perception, comprehension and projection. Based on the outcome derived from the comparison between the maintained situation awareness and the adopted mental model, shiphandlers will take their decisions regarding actions deemed to be required. In the context of this assessment methodology, decision making specifically refers to the naturalistic paradigm where expertise is evaluated in its naturalistic context [29] [30] [31] [32] [33] [34]. The execution is the practical translation of shiphandlers' decisions into competent behaviours, identified by specific motor and communication skills relevant to the context of shiphandling. Perceiving, understanding, recalling and comparing with previous experiences, analysing, projecting, then acting with precision and effectiveness and then reassessing the outcome, put a certain "burden" on the shoulders of shiphandlers involved. This "burden" is what has been referred as mental workload (with its correlated physiological reactions). Despite the interest in the topic for the last few decades [35], there is still no universally accepted definition of mental workload [36]. Mental workload is a multidisciplinary concept and has long been recognized as an important element of human performance in complex systems [37]. The optimization of mental workload has shown to reduce human error, improve system safety, increase productivity and increase operator satisfaction [38]. Csikszentmihalyi, for example, identifies the "Flow" [39] as a state that is reached when a highly skilled individual is fully involved in a in a highly challenging activity. Mental workload could be seen as an indirect measure strictly related to such involvement. Mental workload arises due to a combination of the task demands and the resources that a particular individual has available [40]. The mental workload of a task can be seen as the level of attentional resources required to meet both objective and subjective performance criteria, which may be mediated by task demands, external support and past experience [41]. Subjective mental workload has been defined as the subject's direct estimate or comparative judgment of the mental or cognitive workload experienced at a given moment [42]. Since workload cannot be directly observed, overt measurements of psychological and physiological variables are gathered and used for inference [43]. At the bottom of the figure are reported, for each previously mentioned psychological construct, relevant variables that are collected in this assessment methodology and that will be extensively described in the next paragraphs. Personality traits as well as social skills and bridge team interactions could not be investigated due to the lack of a bridge team in the experimental setting. Experience is considered homogeneous for this particular study, after having evaluated interviews conducted with participants coming from the same group of Pilots. Results so obtained through the use of SAT are thought to be able to address immediate Industry's selection and training needs. Such results can also be used to identify areas of improvement for human machine interfaces [44], communications and operational procedures, influencing Industry's practises at a technical, operational, and regulatory level [45] [2].

Methodology

The assessment is divided into two phases. During the first phase (Phase 1), participants are required to complete the planning of the manoeuvres that will be conducted, later on, in the in the Simulator. The second phase (Phase 2) consists in the observation and the whole data collection and processing during and after the execution in a Full Mission Bridge Simulator of the previously planned manoeuvres.

Phase 1 –Planning

For the trial research study, conducted to test the assessment methodology, the first phase included the planning of four different manoeuvres. Each manoeuvre included the whole process necessary to transfer the ship from a defined initial position to the berth, within constrained port waters, with the use of own and/or external means of propulsion (tugs, when allowed). Even if all the shiphandlers were required to start each manoeuvre in the same position, they were able to choose their initial speed. These manoeuvres were chosen to test one of the aims of the research; to investigate the notion that "shiphandlers expertise "is bounded", or in other words, related to shiphandlers local knowledge of the port where they normally operate. So, for those four manoeuvres, two were the ports chosen as scenario. The first port was the shiphandlers' home port, while the second port was a virtual port (only present in the Simulator database), not representing any real existing port, so as to avoid any possibility of previous manoeuvring experience the subjects may possess. For each port or scenario two levels of difficulty for the manoeuvres were presented: one easier and one more difficult. The level of difficulty was based on differences between the two manoeuvres in terms of spatial constraints, environmental conditions, vessel's manoeuvrability characteristics, number of tugs available, traffic present and communications required. It has to be noted that the manoeuvres were also coupled across the scenarios: i.e. the easy manoeuvres (as well as the difficult manoeuvres) were as much as possible comparable for several characteristics, such as: vessel hydrodynamic characteristics and limitations in manoeuvrability; distances to be covered from the starting position till the berth; spatial constraints due to infrastructures, natural conformation, presence of other vessels moored or at anchor, available depth of water; environmental forces acting on the vessel (wind, current, etc); Availability of Tugs; interactions with other ships' traffic; or radio communications with a local Port Authority – VTS. The manoeuvres where specifically chosen to represent a condition very similar to an ordinary job, regularly carried out in their daily activities, by the Pilots involved in the trial study (e.g. easy manoeuvre in Port of Brisbane). The other manoeuvres where designed as departures from this initial "normal" condition along two dimensions: the difficulty and the port. Difficulty was enhanced introducing / increasing parameters such as forces involved (wind and current, tug use), dimensions, weather conditions, and such like, and setting them up just above the operational maximum limits adopted in the Port of Brisbane. The use of a different port—even if the manoeuvres were designed to have extremely similar spatial constraints—was introduced to investigate the effect loss of familiarity had on a Pilot's outcomes. Despite of the specific manoeuvres chosen for the trial study and herein described, it can be understood how other type of manoeuvres can be chosen and standardized, in order to be profitably adopted for more focussed assessing purposes.

Navigational Charts and the Detailed Manoeuvre Plan

Phase 1 requires participants provide an extensive explanation regarding how they would perform the manoeuvre in the Simulator. In order to create and to obtain the record of such explanation in a numerical form a Detailed Manoeuvre Plan (DMP) table is compiled by each participant for each manoeuvre prior to performing this manoeuvre on the Simulator. This table can be seen as a more detailed version of the routine passage plan that normally is discussed between Pilots and Ship Masters before a ships enters into a port to be moored at a specific berth [16].The compilation of the mentioned table is obtained through a face to face exchange between the shiphandler and the instructor. The initial material provided by the instructor to the shiphandlers includes also a facsimile of port navigational charts at the appropriate scale for each manoeuvre. On these charts the initial and the final positions of the ship are indicated, specifying which side of the ship is required to be alongside at the end of the manoeuvre. At the beginning of the face to face exchange between the instructor and the shiphandler, only the chart and a brief explanation about the manoeuvre are provided (initial position, position of the berth, side to go alongside to). Shiphandlers are invited to ask all the questions they deem necessary to complete the planning. All the questions are collected in order to evaluate the elements considered by the shiphandlers. There are no limitation whatsoever to the amount, specificity or topic of the questions. All the shiphandlers then receive only the list of the answers relative to their questions. Shiphandlers are allowed to require additional information at any time during Phase 1 until, in their opinion, the information is enough to allow them to proficiently complete the planning task.

For this planning task the shiphandlers are required to sketch ship's movements using the previously mentioned charts, identifying any associated elements of interest with some precision. More specifically shiphandlers are asked to complete their intended Detailed Manoeuvre Plan showing, for example: the sequential positions of the vessel (using waypoints), the speed profile, the use of ship's propulsion (main propulsion, thrusters), and external forces (tugs). Shiphandlers have also to describe how they would better exploit ship's sensors (radar and ECDIS information, gyro and magnetic compass, logs..) and account for environmental and hydrodynamic forces acting on the vessels (wind, current, tide, bottom and bank effects..). All the plans are collected before all the manoeuvres can take place in the simulator. As prepared prior to the simulation these plans form a comparative basis for assessing outcomes measures generated from the completed simulation experience. Such measures include the execution of each manoeuvre. In fact a Full Mission Bridge Simulator can record in real time and with a high degree of accuracy at several samples per second, all the previous mentioned parameters being studied.

Phase 2 – Execution

For the purpose of the initial trial study, the Maritime Safety Queensland, Full Mission Bridge Simulator in Brisbane was used (Smartship® Simulator www.smartshipaustralia.com.au). This Simulator included advanced features such as a 16m diameter screen with 360 degree field of view (FOV). In addition, the Bridge was fully equipped with original bridge consoles featuring real navigation equipment and, in particular, NACOS 65-5 (a command and control, Integrated Navigational System) by SAM Electronics. Simulator software and hardware are provided by FORCE Technology® (www.forcetechnology.com), Denmark. A Full Mission Bridges, classified as Class A (NAV) according to the standards issued by DNV [46], should be adopted to carry out the here proposed methodology. Those standards require that such Simulator should be capable of simulating a total shipboard bridge operation situation, including the capability for advanced manoeuvring in restricted waterways.

At the Simulator - Execution of the Manoeuvres

Before starting the manoeuvres previously planned, shiphandlers are fitted with the equipment necessary to record their physiological variables. Once the electrocardiogram and eye tracker equipment is tested, shiphandlers are required to perform a very simple mooring manoeuvre with a vessel different from those used in the experimental runs. This first manoeuvre is used as a familiarization run in order to have the shiphandlers acquainted with the bridge environment and the navigation equipment available. After this familiarization run, the remaining manoeuvres that were previously planned in Phase 1, are used as “hot runs”, so all the data of interest is recorded. Before each manoeuvre, the relevant Detailed Manoeuvring Plan (compiled in Phase 1) is reviewed with the instructor in order to evaluate any possible doubt or additional question. A video recording, where the shiphandler goes through the plan with the instructor, is finally captured. Before the simulation is started an initial physiological baseline recording is carried out. After few minutes of baseline recording the simulation is started, allowing the shiphandler to execute the manoeuvre. During the manoeuvre there are no interruptions or suggestions by the instructor who is generally acting as the ship’s Master or, when required by the specific context, as the member of the bridge team more suitable to interact with the shiphandler at that time. Immediately on completion of the manoeuvre once the simulation is stopped, another physiological baseline is recorded. At the end of the final baseline recording a NASA TLX Questionnaire is completed by the shiphandler. For each run or manoeuvre a debriefing is carried out and video recorded, in order to take note of any comment or consideration formulated by the shiphandler with reference to the just completed exercise. Each manoeuvre requires to complete a mooring using the side of the ship opposite to the position of the berth at the beginning of the manoeuvre (i.e. if the berth is on the starboard side of the ship at the beginning of the manoeuvre, then the manoeuvre would require to go alongside with the port side of the ship). This implies that for each manoeuvre the ship has to swing (rotate 180 degrees) before she can be moored. For this reason, it is possible for each manoeuvre to identify 3 main sections: the “approach” (from the initial position until the start of the swing), the “swing” (from the start of the operations necessary to induce the swing until the rotation is completed and stabilized), the “closing” (from the end of the swing, as previously defined, until a defined certain distance from the berth).

Recording and Processing of Physiological Parameters:

One of the tools used by the assessment methodology is a continuous recording of physiological variables in the least obtrusive possible way. For the entire duration of each manoeuvre and for an initial and subsequent baseline period of at least 5 minutes a continuous recording of the physiological variables is conducted. Those measurements are thought to provide an insight of the shiphandlers level of involvement or difficulty subjectively experienced, helping to better understand end evaluate correlations with following performance outcomes. Only portable, wireless and sufficiently comfortable recording devices are chosen.

For the recording of the Electrocardiogram, a Smartex® Wearable Wellness System® was used (www.smartex.it). This system, among other variables, is able to collect a full electrocardiogram (sampling frequency of 250 samples per second).From the raw ECG signals, the Heart Rate Variability (HRV) is then analysed. HRV is known as a non invasive technique to measure cardiovascular autonomic regulation [47]. It expresses the balance of the regulation of the sympathetic and parasympathetic nervous systems. HRV has been extensively exploited to study the association between psychological processes and physiological reactions [48]. The LF/HF ratio is an important parameter derived from the study of the power spectral density (PSD) of the inter beat intervals signal (IBI) in the Low Frequencies (LF – from 0.04 to 0.15 Hertz) and in the High Frequencies (HF – from 0.15 to 0.40 Hertz) [49]. LF power component is connected with the nervous system sympathetic activity while the HF power component is more connected with the parasympathetic system [50]. Elevated values in the LF are associated with high work stress [51], resulting in higher scores in the LF/HF ratio. The strong correlation between Heart Rate Variability and Stress has been extensively documented in the literature [52]. For the purposes of this paper, we define "stress" as the transition from a calm state into an excited state, through the activation of the sympathetic system [53], considering as "stressors", excessive intellectual, emotional and perceptual stimuli [54]. The measurements of LF/HF ratio and the Heart Rate are specifically chosen for the assessment methodology described in this article, due to their sensitivity to work related stressors [51, 55].
To test eye movements, ASL® Mobile Eye XG® (www.asleyetracking.com) eye tracking goggles are used. The Eye Tracker goggles have a front HD camera that records what is in front of the subject, a second infra red camera is pointed towards the subject right eye and records the pupil movement. This system is then able merge the two channels, providing the gaze position through a red cross overlaid on the video recorded by the front camera. Audio is also recorded. The video and audio recordings obtained from the Eye tracker are reviewed and categorized using INTERACT® software (www.mangold-international.com). The video coding is conducted using a set of labels, hierarchically organized, to identify specific elements that the shiphandler observes in the simulated environment. For example, these labels identify elements that could be observed in the port environment such as beacons or leads, or elements that could be observed on the Bridge such as instruments, indicators and equipment. Due to the long time necessary to complete the manual coding for the whole duration of the manoeuvres, a sampling strategy is applied in order to obtain the video coding from specific parts of the manoeuvre. A total duration of 20 minutes of video coding is obtained for each manoeuvre, considering 4 different sections of 5 continuous minutes. The section's location in each manoeuvre is dictated by the following criteria:

Approach			**Swing**			**Closing**		
Video Coding	GAP	Video Coding	GAP	Video Coding	GAP	GAP	Video Coding	GAP

Table 1 – Locations of video coded sections in each manoeuvre

Each coded section has always a minimum duration of five minutes (unless the whole duration of that specific manoeuvring phase is less). In the swing and in the closing section the video coding is always placed in the middle of the identified window, while for the Approach section, it is placed at the very beginning and at the end, finishing with the limit of the swing section. Gaps, of course, have to vary accordingly, depending on the duration of the different manoeuvre sections. Video Coding provides statistics regarding shiphandlers gaze distribution, in terms of frequency and duration, on different elements, for each section of the manoeuvre. From such data, it is possible then to infer what sources of information are preferred by shiphandlers, in order to maintain and develop (or not) their situational awareness [56].
Those statistics can be profitably compared with performance outcomes (as described in the following paragraph) in order to provide correlations between shiphandlers screening behaviours and performance results obtained [57]. Exploiting the same software application (INTERACT®) it is also possible to code the audio tracks, this time for the entire duration of each manoeuvre. Labels used for coding, identify different type of communications adopted on the Bridge. To provide an example,

these communications could be strictly "orders" originated by the shiphandlers to execute specific adjustments on ship's propulsion settings or rudder, or radio communications with other vessels present in the exercises. The aim of the audio coding is to quantify the volume and quality of communications. Thinking aloud reports (Walker 2004) in the form of situation and intentions sharing with the rest of the Bridge (acted by the instructor), are also considered and quantified. While the actual measurement will be described in the next paragraph, audio coding can also provide insight into the mental workload experienced by the shiphandler through the use of ordinal ratings on a self assessment scale.

Recording and Processing of Self Reported Mental Workload

Measurement of mental workload reflects the enumeration of mental processes which occur during performing a task [58]. One of the methods used in research to assess subjective mental workload is the adoption of self assessment techniques. Self assessment scales present some disadvantages: they can tend to be situation specific and may fail to take into account the individual's learning, experience, natural ability and changes in emotional state, they also might reveal little in terms of the brain mechanism involved in task performance [58]. Nevertheless, self assessment scales are relatively easy to administer and interpret and they do not require extensive training or equipment [42]. In light of all those considerations, for the purpose of this Assessment Methodology, two Mental Workload measurements are adopted.

One of them is the National Aeronautics and Space Administration-Task Load Index (NASA-TLX). NASA-TLX [18] is a multidimensional scale for which the overall mental workload is a function of 6 subscales: 1. Mental Demand (MI), 2. Physical Demand (PD), 3. Temporal Demand (TD), 4. Own Performance (OP), 5. Effort (EF), 6. Frustration Level (FR). At the end of each manoeuvre a NASA TLX form, in a Microsoft® Excel® electronic format, was completed by the shiphandlers.

The second self assessment Workload measurement is obtained through the audio coding. The audio recording is exploited to obtain the level of involvement or Workload experienced by the shiphandler during the entire execution of the manoeuvre. Before the manoeuvres are started shiphandlers are instructed about the use of a self assessment scale, which they will have to refer to, to verbally report their level of "involvement or workload". The scale provided (and always kept in shiphandlers' sight), reports 7 different levels of "exercise difficulty", meaning the personal level of workload experienced or effort necessary, in order to be able to manage the situation at the time of the question. Level 7 was indicated as the level where the situation was felt so demanding, that was just about to be out of hand; level 6 was a challenging situation that required the complete attention of the shiphandler, working at almost 100% of his capabilities; level 5 was a situation requiring more attention than normal, but not felt as critical as level 6; level 4 wanted to depict a normal level of involvement where the shiphandler could feel perfectly capable to achieve the desired outcome with a necessary but comfortable level of effort (routinely operation); level 3 was an easy condition offering no specific challenge, with required effort below the average; level 2 was a very comfortable, almost effortless situation; level 1 indicated a situation of "complete boredom", with very little or no involvement. The shiphandler, during the execution of the manoeuvre, is briefly reminded (every two minutes circa), with a quick question asked by the instructor (i.e. "How do you feel?"), to simply report a number according to the scale above described. The results so obtained, with reference to the whole manoeuvre using the NASA TLX, and within each manoeuvre using the self reporting scale, can be compared with the physiological measurements, as described in the previous paragraphs.

Recording and Processing of Technical parameters provided by the Simulator

The simulator was principally used to gather data more related to technical aspects. For the purposes of the assessment methodology introduced in this paper, the technical performance results are obtained evaluating the difference between the data initially estimated and provided by the shiphandlers in the DMP and the actual measurements recorded by the simulator during the execution of the manoeuvres. More specifically, it is considered: the distance from the intended track and the effective ship track recorded by the simulator (Cross Track Distance); the difference between the intended speed over the ground and recorded speed; the difference between the intended use of power and the recorded power for main engine, thrusters and tugs. The calculation of the results for any of the above parameters is performed for each participant and for each manoeuvre (within each section). In particular, participants are assessed and ranked, based on their capability to minimize the parameters above mentioned.

Conclusions

This paper describes the development of an assessment methodology to objectively evaluate groups and/ or individuals' shiphandling capabilities in a Full mission Bridge Simulator. Given the complexity and the broadness of the concept defined as "Shiphandling Expertise" in this paper, several different objective measurements are isolated to permit assessors to empirically quantify different levels of a Shiphandler's "expert performance". Those measurements take into account shiphandlers' planning and forecasting capabilities through the compilation of a Detailed Manoeuvre Plan. Such plan can be seen as a more advanced version of the currently used "Pilot Master Exchange Briefing". The obvious difference with the latter is that the proposed DMP provides a more stringent and quantifiable way to report the information required, to allow an objective comparison between planned action and execution.

Another element considered by the methodology, is the amount and type of information that the planner requests in order to forecast the manoeuvre. Such information can be used to support an inference about shiphandling related knowledge and experience. Independent and unobtrusive self reporting and physiological variables are also proposed as subjective and objective measurements of experienced stress / workload. Those measurements are thought to provide an insight of the shiphandlers level of involvement or difficulty subjectively experienced, helping to better understand end evaluate correlations with following performance outcomes. Those variables are triangulated with an overall subjective assessment of the manoeuvre, obtained from the administration of a NASA TLX form. Behavioural variables (obtained from eye trackers audio and video recordings) are considered in order to identify and objectively measure working strategies adopted. The measurement and the quantification of specific overt behaviours and screening strategies can identify those that prove to be more efficient and effective. Several performance variables were proposed as concurring measurements able to objectively evaluate different levels of technical shiphandling capabilities. Those measurements can offer the opportunity to trainers and instructors to better understand and evaluate individual performance, allowing, for example, improvements in training techniques.

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Session 2B

Marine Personnel

Lived Experiences of Maritime Cadets: Their First Encounter Onboard Multicrewing Vessels

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Programs leading to Bachelor of Science in Marine Transportation and Bachelor of Science in Marine Engineering include On-the-Job Training (OJT) as part of the curricular requirement. This requirement according to Cicek [1] is intended to provide practical experience to would-be seafarers and is supported by recent theories of learning, instruction and cognition which advance the idea that "the best learning environment is the workplace where the apprentices engage in authentic, interactive, and meaningful learning where they can create their mental models"[2]. To comply with this requirement, maritime students are required to undergo shipboard training for a period of 12 months to complete their OJT.During this period, thesecadets are exposed to shipboard tasks and real-life situations. Most of them are assigned in multicrewing vessels and since it is their first time to be away from their families and their homeland, their first exposure to actual work on board, and their first encounter to work with other people divided by hierarchy, culture, and language among others, they areexposed to a totally new environment and arevulnerable to various conditions such as accommodation problems, work and crew-related difficulties, problems in communication, and cultural differences among others. These challenges experienced by cadets are validated by Stan &Mitu[3] in their article"Importance of Multinational Crewin Cadets' Practice."John B. Lacson Colleges Foundation-Bacolod, a maritime institution in the Philippines known for its quest for excellence to produce competent and world class seafarers, continues to vigilantly keep track not only of the performance of their cadets as evaluated by their superior officers onboard but also to understand in a deeper sense, the kind of life that they experienced after they were deployed in different multicrewing vessels owned by various shipping companies. What did they learn from the training? Had life been easy for them? In the process of performing their tasks and in working with their fellow crew, did they encounter certain problems and difficulties? What did they do to survive and cope with these difficulties?This study seeks to trace valuable information on the realities of life onboard particularly from the point of view of cadets who were exposed to it. Forty-seven (47) first-class cadets who have returned from their 12-month apprenticeship revealed that working onboard has taught them appropriate work values such as flexibility and adaptability, patience and self-control, humility, resilience, stronger sense of responsibility, discipline and perseverance. They were also able to develop practical skills and abilities such as versatility, proper time management, creating a link between theory and practical application, independence, physical endurance as an important tool for survival, and managing their finances. Vulnerability to difficult situations and homesickness were among the prevailing problems of the cadets. It is recommended that clear measures must be done to address issues on discrimination, abuse by authority, emotional and physical harassment, excessive workloads, and unpaid overtime which have been partially revealed in this study. A feedback mechanism is also suggested for shipping companies to allow returning cadets to reveal the quality of their experiences for the purpose of ensuring a fair and honest management of crew in their fleets and the cadets in particular. The maritime industry as well as maritime institutions worldwide should also consider opportunities for improvement on the cadetship program as well as on areas of loyalty, motivation, and work efficiency among their crew.

Keywords: seafaring industry, lived experiences, qualitative research, thematic analysis, Philippines, Asia

1. Introduction

Transport is considered as one of the cornerstones of globalization. For Kumar & Hoffmann [4], it has become an integrated part of the production and distribution system. While transportation comes in different modes, it is transportation by sea, according to Bocanete & Nistor [5] that has tremendously gained momentum and importance across decades. Along with telecommunication, world seaborne trade, having been much improved through the increased efficiency of port and shipping services, has made it easier to buy and sell merchandise and raw materials and transport them in all parts of the globe.But along with this increased demandfor sea trade come great challenges. Managing this transportation of goods by sea has become as important and as critical as the process of transporting. The safe transport of goods, not mentioning the safety of life on board these vessels of transportation, requires a group of highly trained and competent manpower. Developing countries, mostly coming from Asia, have played a vital role in marine transportation as they have been the steady suppliers of seafarers who have greatly helped in terms of poverty alleviation and economic growth. These countries include China, Indonesia, India, and of course, the Philippines.

The Philippines is reported as the largest global supplier of seafarers. In a global crew surveyconducted by the Seafarers International Research Centre (SIRC) as cited by Amante [6] in 2003, 28% of this supply of manpower was composed of Filipinos. In 2011, reports reveal that out of almost 1, 400,000 seafarers serving onboard international merchant fleets, about 400, 000 are from the Philippines [7]. The maritime industry thrives with this workforce who have contributed significantly to the Philippine's socio-economic growth.It was reported that in 2002, an approximate value of $1.99 billion seafarers' remittances was contributed to the national economy. In 2012, this contribution has grown to US$4.8 billion. As the industry continues tosupply the mechanism and manpower connecting nations for easy transport of cargoes for international commerce and trade, there is also a need to sustain the supply of able and qualified manpower to man seagoing vessels.In support to this idea, Emad& Oxford [8] in their article "*Rethinking Maritime Education and Training*" have expressed a great concern about human factors and mariners' competencies onboard ships.

In keeping with this thrust of developing the expected competencies of future seafarers who will man international sea-going vessels, programs leading to a degree in Marine Transportation and Marine Engineering include On-the-Job Training (OJT) as part of the academic requirement. This requirement according to Cicek [1] is intended to provide practical experience to would-be seafarers and is supported by recent theories of learning, instruction and cognition which advance the idea that the best learning environment is the workplace where the apprentices engage in authentic, interactive, and meaningful learning where they can create their mental models [2]. To comply with this requirement, cadets, usually in their fourth year, are required to go onboard vessels for a period equivalent to 12 months to complete their OJT where they could serve different tasks as required of them on board. These tasks are described and recorded in their Training Record Book (TRB). During this period, they are exposed to actual work and are assigned to handle hands on responsibilities related to the deck and engine department. Since it is their first time onboard an international vessel, it is also their first experience to be separated from their families, their first exposure toactual work on board as they translate the theories they learned from school, and their first encounter to work with other people divided by hierarchy, culture, and language, among others.

John B. Lacson Colleges Foundation-Bacolod is a maritime institution in the Philippines known for its quest for excellence to produce competent and world class seafarers.While the institution continues to vigilantly keep track of the performance of its cadets as evaluated by their superior officers onboard, it also tries to understand the kind of life they have after they are deployed in different international vessels owned by various shipping companies. Had life been easy for them? Were they able to relate what they have learned in school to their actual tasks onboard? In the process of performing their tasks and in working with their fellow crew, did they encounter certain problems and difficulties? This study could provide valuable information on the realities of life onboard particularly from the point of view of cadets who were exposed to it. As the institution continues to provide a link between theoretical knowledge and practical application, it also considers as important that feedback should be gathered from authentic sources to identify problems, constraints, and difficulties so proper intervention can be made to address such concerns. This feedback gathered from returning cadets could provide insights which could serve as bases in improving specific areas of instruction to produce graduates who are holistically educated and trained as competent seafarers.

1.1 Framework

This study builds on Cicek's [1] notion of "*traditional apprenticeship*." Traditional apprenticeship provides for future seafarers to go onboard ships in order to gain practical on-the-job experience. Collins, Brown & Newman [9] further discuss that an on-the-job training is "generally held to be the best part of their training in developing the competencies that they need, to act successfully in their jobs." According to them, apprenticeship through on-the-job training (OJT) promotes learning skills and knowledge in the cadets' social and functional context.When at work however, a person may be faced with factors which could affect the way he performs his job. These factors could be personal or job-related. Examples of personal issues could be problems with relationships as well as emotional or financial problems affecting his life at work. Professional issues are those that relate to one's performance at work in relation to his co-workers. Another factor which could affect people at work is social or racial discrimination. A seafarer who is assigned in a vessel composed of crew who are divided by race and other socio-cultural underpinnings will be more likely to experience unfair treatment and lesser opportunities than those who establish themselves as superior; hence, his chances for professional growth may be hampered. This kind of treatment could lead to poor self-esteem and low morale. Such issue, which iscited by Gregorio [10] as a state of "*demoralizatio*n", is due to perceived double standards of treatment favoring Europian crews who allegedly have better working conditions and regular work shifts. Furthermore, Gregorio cites that seafarers hurdle work-related challenges such as loneliness, boredom, overwork, and injuries due to hazardous working environment just to support their loved ones. These factors are supported by the study of Chirea-Ungureanu & Rosenhave [11] which identified sadness, loneliness, homesickness, idealizing the home culture, sense of isolation, feelings of inadequacy and insecurity, overwhelming and irrational fears, irritability and resentment among others, as manifestations of a serious disequilibrium within the stranger's psyche. These result from the absence of connection between the self and the new cultural onboard environment. In addition to these factors, Feldman [12] explains that problems such as lack of sleep, inadequate salary, difficulty in adjusting with others, the feeling of being insignificant and inadequate knowledge and skills demanded by the job can also be a problem at work.

1.2 Objective of the Study

The aim of the study was to gather a better understanding of the life of Deck and Engine cadets of a group of shipownersand a specific shipping company who had worked on board international sea-going vessels during their On-the-Job Training.Specifically, it was designed to find out what they learned from the experience, the problems and difficulties they had encountered during the training, and how they tried to overcome them.

2. Methodology

2.1 Research Design

This study utilized the phenomenological research design whose central concern is to gather experiential meanings which aim for a fresh, complex, rich description of a phenomenon as it is concretely lived. It involves gathering 'deep' information and perceptions through inductive, qualitative methods such as interviews, discussions and participant observationto discover the meaning of people's lived experiences.

2.2 Respondents

Forty-seven (47)cadets in their fourth year under the program Bachelor of Science in Marine Transportation and Bachelor of Science in Marine Engineering were invited to take part in the study. They were composed of 31cadets of a group of shipowners and 16cadets of a particular shipping company. These cadets had completed their OJT for a total of 12 months onboard international vessels owned by different shipping companies with fleets transiting worldwide. They had been exposed to technical work related to the deck and engine department. These cadets are averagely 18-20 years old, and this period of apprenticeship marks their first year away from their families and outside the country.

2.3 Instruments

Two types of research instruments were employed in gathering the data: a researcher-made survey checklist and an interviewguide that were both presented to a set of experts for face and content validity.The checklist wasused to determine which specific problems and difficulties were experienced by the cadets during their OJT.The interview guide on the other hand, was used in the conduct of small group interviews separately conducted to the respondents. The purpose of the interview was to gather authentic responses and statements specifically on the actual learning the cadets acquired from the OJT experience, their own testimony of the kind of life they had on board as a whole, the problems and difficulties they had encountered, and their coping strategies. The interviews were conducted in a closed door setting with a research assistant who was in charge of audio-recording and note-taking. Guide questions were used to encourage interactive discussion. Probing questions were also given to allow a fuller discussion with the respondents on specific responses which needed further elucidation. Guided by the questions, each cadet narrated and described his experiences. All conversations which transpired during the interview were audio-recorded and were later transcribed for further analysis. The interviewees were instructed to avoid dropping names of their officers and shipping companies to protect the identities of those concerned. Extracts from the cadets' statements expressed in the native tongue were provided English translations.

2.4 Data Analysis

To determine the problems and difficulties encountered by the respondents during their OJT experience, responses in the survey checklist were tallied, and results were shown in frequencies. Answers were encoded, in addition to those indicated in the checklist, and thematic grouping was employed to allow the issues and concerns presented to emerge. Thematic grouping was done by first reading through the data, getting a feel for what is being said, and identifying key themes andissues in each text. This type of analysis was also employed by Gregorio [10] in his study "The Filipino Seafarer's Lived Experiences aboard International Shipping Vessels: A Basis for Health Promotion Intervention."

3. Results and Discussion

3.1 What the Cadets Learned from the OJT Experience

3.1.1 Work Values. Life on board has taught the cadets values which they consider as essential especially during his first time on board international sea-going vessels. Data gathered from the interview fell into the following categories of values which the cadets consider as a must.

Flexibility and Adaptability. According to them, it is important that one should know how to get along with his crewmates. They highlighted the importance of "*pakikisama*", a Filipino trait which means that as part of the workforce onboard, a cadet must be able to share with others and manifest a spirit of camaraderie, unity, and working for a common goal. This value was also emphasized by Muega [13] who claimed that Filipinos cooperate for a common goal through the spirit of "*pagkakaisa*". Flexibility and adaptability enable a person to weather all challenges in life. According to Upton [14] a flexible person is able to change or react with little effort and could readily face new situations with an open mind.To quote a statement from one of the respondents,

> *"I learned how to get along with others. We were a full-Filipino crewing vessel and I had experienced being maltreated at several times. There was a time when I was angrily shoved by…who got the rag I was holding while he shouted at me saying, "This is how you should do it!" He gave me the same treatment for the first three months."*

Patience and Self-Control.Patience is the capacity to endure hardship, difficulty, or inconvenience with calm self-control, and even delight. According to Cheung & Cheung [15],individuals with low self-control tend to be impulsive and lack patience, prefer easy and simple tasks over complex ones that demand persistence, and have a self-centered or insensitive orientation to the interest of others. They also prefer physical activities over cognitive ones that require skills and planning, have a propensity for risk-taking, and lose their tempers easily because of their lower tolerance to frustration. According to the cadets, everyday onboard entails hard work. The first four months is usually the most difficult because it is when they are forced by circumstances to adjust to their new environment. It is important then that a cadet must be able to control his temper, maintain his composure, and endure all forms of strain. How he behaves and how he responds to people and situations during this adjustment period creates an impression and shapes the way he will be treated by his crewmates for the rest of his stay onboard.

Humility. Humility is the willingness to admit mistakes and seek out guidance. A humble person is one who recognizes his own inadequacy, qualities, and abilities, and presses them into service, doing good without attracting attention or expecting the applause of others. The respondents had the following to say during the interview:

> *"We need to lower down our pride and control ourselves because sometimes when we make some mistakes, some crew,especially those who are already experienced, will say words that really make you feel so small.I remembered being called the worst names when I was onboard."*

Resilience.Resilience, according to Arcelo [16] is the ability of an individual to adapt quickly to changes brought about by misfortune, illness or a change of job or social status. A person is said to be resilient when he does not subject himself to long periods of depression or wallow in self-pity in the face of adversity. He is resilient if he can get back on his feet and continue to face life as a wiser and stronger person. The following are some extracts taken from the cadets' testimonies:

> *"There were times when I wanted to give up and go home. But then, after a while, I would be fine again. I just continuously prayed that I will be able to survive each day until the time I disembark."*

Sense of Responsibility.According to the cadets, among the virtues that they learned to develop onboard is becoming more responsible. Members of the crew are expected to perform their respective roles and must assume responsibility over their own actions, and so with the cadets. Sense of responsibility for them is equivalent to accountability and conscientiousness in performing all the tasks assigned to them accurately, so whether they do it right or not, they should be accountable for the consequence. This idea is supported by Rutter [17] who defines resilience as a relative resistance to the adverse effects of risk experiences. According to him, a resilient person is able to positively respond to all manners of stresses and adversities.

Discipline. Bist [18] explains that the presence of a disciplined and organized environment suggests the existence of safety and inspires confidence in the ability of others. According to him, in merchant ships, discipline is tantamount to punctuality, diligence and order in the discharge of duties."The cadets claimed that discipline is a key factor for survival onboard. To them it means departing from one's immature ways and taking control of himself to ensure that he does everything right and correct. On this note, the respondents had the following to say:

> *"In school you can just go home if you feel f**ckd up. There onboard, you cannot. You can only see the sky and the sea…This act of being disciplined is not new to me. I am thankful that I was trained to becomeone during my dormitory days. I am already accustomed to it. It is really very important onboard to be disciplinedin all your ways."*

Perseverance. Wilkinson [19] explains that perseverance can help a person in the workplace. For instance, if one has a low-skilled job where he gets little appreciation for his efforts, having this quality will make him persevere when things go wrong, as he is bound to be the one who gets the blame, even when it is not his fault. According to the cadets, they were able to learn to persevere more as they struggled for survival. Consider the following comments:

> *"I had developed perseverance. Back home, I can be absent from my class for a simple fever. Onboard, I still hadto work even when I was sick…The workload was too heavy. If a cadet does not have a strong will to persevere, he will not last a week there."*

3.1.2 Practical Knowledge, Skills, and Abilities. More than the knowledge and skills that they had learned in school, the cadets claimed that they were able to acquire practical skills onboard. These skills are themed as follows:

Versatility. The cadets had called this term as "'d*iskarte*'—the ability to respond to various situations by making use of whatever resources are available without making a fuss about it. Consider the following comments:

> *"I learned to dismantle and assemble different types of machinery even if, at first, I did not know how. I was able to discover ways to do them under the guidance of my senior officer…I learned to do a lot of work which I did not learn at home because there was always somebody to do chores for me. Onboard I washed by own clothes, cleaned my own cabin, took care of myself when I was sick, and a lot more. There you had to do it all by yourself. You learn to become independent."*

Time Management.A person who values and sees time as gold plans how he or she can spend his or her time well. According to the cadets, time is a serious matter on board especially the issue of punctuality. They explained that punctuality must form part of a seafarer's habit, not something that is imposed by others. It should be self-imposed.

> *"There were those onboard who were fond of malingering. Maybe it was their way of escaping from work so they could rest more. So they got scolded most of the time for not being punctual in reporting to duty…There is no way one can be late in reporting to duty…In school, we were given a 15- minute time to report to class during the first period. On board, you have to be there 15 minutes before time."*

Creating a Link between Theory and Practical Application.For the cadets, there are a lot of theories that you cognitively learn in school while there are those you can only understand better when experienced onboard. During the interview, the cadets shared that there seemed to be a gap between the theories that they learned in school and the actual application of these theories into their work on board.

> *"Being the best in class or getting the highest grade does not really guarantee efficiency on board. Putting what one learns into practice is the real challenge...We were familiar with the theories taught to us in the classroom but it was only on board that we actually learned."*

Independence.Life onboard has taught the cadets to be independent. For them, it was like "you against the world". Everyday was a "battle for survival". They reasoned out that on board, nobody will really stick with you to teach you what to do every step of the way since everyone is also very busy attending to his own duties and responsibilities. On this note, the cadets had the following to say:

> *"They (their senior officers) will teach you the first time but after that, they will leave you to do it by yourself. So you need to learn fast. They easily get irritated if you cannot easily get it…Common sense and initiative is very important. You cannot expect them to be there for you all the time. So once you learn the routine, you are expected to do it regularly then with less or without supervision except for those critical operations where you really need the supervision of a senior officer."*

Physical Endurance as a Necessary Tool for Survival.A cadet needs to be physically fit and should have a high threshold for physical activity. If he is not used to heavy work, then there onboard, he should learn to cope with it. The importance of this attribute is emphasized in the ISM Code 2010, Section 6.2 which says that the company should ensure that each ship is manned by qualified, certified, and medically fit seafarers in accordance with national and international requirements. On this note, one of the comments was:

> *"When the tools are on the deck and you are working down the engine room, you need to walk up and down through the stairs. You need stamina. You need to climb up the deck and run back to the engine room every time you are ordered to do something."*

Financial Planning. When still a cadet, one does not earn yet so he must learn how to manage his monthly allowance very well. The following are some of their comments:

> *"There are a lot of temptations on board so it is also about self-control… It is also about financial management…Money easily drains out if you do not know how to manage it…We have crewmates who borrow money from us. They don't pay what they owe us."*

3.1.3 Stronger Safety Culture.Although awareness and implementation of safety culture has been taught in school, according to the cadets, it was only onboard that they realized why this has been given much emphasis. The following were some of their comments extracted from the interview:

> *"Safety awareness is a company policy especially when dealing with chemicals and heights…One must always wear complete personal protective equipment especially when dealing with heights. One must wear a safety harness…In our ship, there were some incidents of falling…When you see the environment,you will be conscious about safety…In school we listened to our instructors lecturing us on the importance of safety. We used to just take it for granted. Onboard, that was where we really realized the value of safety. On board a chemical tanker, it must be a way of life."*

3.2 The Cadets' Life onboard

The second concern of this paper was to find out from the respondents how they can describe their life onboard during their OJT. Their responses to this question were grouped into the following themes:

Life on board as a continuous learning process.During their OJT, the cadets realized that learning does not stop in school. Even onboard, they were still required by their officers to keep on reading. At specific times, for instance, they were assigned topics to read and then the following day they would be asked about it. These topics were always about the different systems in the deck and engine department and on safety procedures.According to them, their officers were very particular that they should know about the technicalities of the job and that they should augment their shortage of knowledge through reading.

Life onboard as a difficult but honorable job. For the cadets, life onboard was difficult. There were a lot of times when they were deprived of sleep especially during bunkering operation and emergency drills. Some of their crewmates were difficult to deal with. There were also instances when their officers would insult them for making mistakes and then associate these mistakes with the reputation of their school. Sometimes they would be compared with cadets produced by other maritime institutions while pointing at their inadequacies. Yet despite these difficulties and challenges, they felt honored because even just as cadets they had become part of the entire workforce onboard.

Life onboard as preparation for the future.The cadets pointed out that life onboard is also preparing for what is ahead. They are aware that they have to return to the school for another year to complete their Bachelor's degree and to acquire their professional license as officers.

3.3 Problems and Difficulties the Cadets Had Encountered during Their OJT

The fifth concern of this study was to find out the actual problems and difficulties experienced by the cadets during their OJT. Results on this problem are shown in Table 1.

Table 1Problems andDifficulties encountered by the cadets during their OJT

Problems and Difficulties	Group of Shipowners (N = 31)	Specific Company (N = 16)	Total (47)	
	f	f	f	Rank
Homesickness	**17**	**9**	**26**	**1**
Boredom	**15**	**7**	**22**	**2**
Inadequate rest hours	**16**	**5**	**21**	**3**
Verbal/Emotional insult by their senior officers And crewmates	14	4	18	4.5
Voluminous/multiple work tasks	12	6	18	4.5
Irregular work schedules	12	4	16	6.5
Difficulty in adjusting with others	12	4	16	6.5
Unfamiliarity with the use of certain tools/ Equipment	14	2	16	8
Inadequate knowledge/ skills on certain topics Related to the job	12	2	14	9
Language Problems	9	2	11	10

Table 1 reveals that the cadets indeed have experienced different forms of problems and difficulties onboard during their OJT and these are topped by homesickness, boredom, and inadequate rest hours. The rest were experienced by less than 50% of the respondents and they include verbal/emotional insult by senior officers/crewmates, voluminous/multiple work tasks, irregular work schedule, difficulty in adjusting with others, unfamiliarity with the use of certain tools/equipment in the deck and engine department, and inadequate knowledge/ skills on certain topics related to the job. Language barrier is the least among their problems.

3.4 Other Problems and Difficulties Reported by the Cadets

In addition to the factors specified in the survey, the cadets narrated that they were pitted against other schools regarding their performance and compared to previous batches of cadets onboard. There was also the matter of peer pressure on spending their allowance over things which are not expedient. They also recounted that they were sleepy most of the time because they would spend excessive working hours, like working 72 hours per week and sometimes spending the night without any amount of sleep at all. There were also reports of unpaid overtime dues. Moreover, they recalled how their seasickness would worsen when their vessels were transiting across rough seas,causing them to vomit excessively.Some of the respondents also narrated that they were affected by unhygienic practices of their crewmates. Moreover, they expressed their concern on the cost of communication from sea to coast when making calls to their families back home. They also narrated that since they were just cadets, most of the time their opinions and suggestions were ignored and when they would ask for clarifications or assistance, they were answered in a sarcastic and insulting manner.They were also emotionally affectedby family problems reaching them. According to them, this added to their feeling of despair.

In addition to the factors reported above, the engine cadets, in particular, also expressed their difficulty due to their inadequate knowledge and skills on certain topics related to the job, like for instance, starting the purifier, preparing the main engine, and steering gear operations and maintenance.It was more through their familiarization with the actual equipment and machinery in their respective vessels that they were able to really learn how to do things. This predicament is explained in the ISF 2011 which states that “Seafarers who are newly assigned to a ship should take full advantage of every opportunity provided to become familiar with the shipboard equipment, operating procedures and other arrangements needed for the proper performance of their duties. Immediately upon arriving on board for the first time, each seafarer has the responsibility to become acquainted with the ship’s working environment, particularly with respect to new or unfamiliar equipment, procedures or arrangements.Seafarers who do not promptly attain the level of familiarity required for performing their duties have the obligation to bring this fact to the attention of their supervisor or to the attention of the crew member designated (in accordance to the mandatory company responsibilities explained in Section 2 of STCW guide) and to identify any equipment, procedure or arrangement which remains unfamiliar.”

3.5 The Cadets’ Ways of Coping with Problems and Difficulties onboard

On how the cadets had dealt with these problems and difficulties, the following themes evolved from their answers during the interview:

Training their bodies to adapt to the system.This includes adjusting their time so as not to be late, spending time at the gym to be physically fit, and letting their bodies adapt to the strenuous assignments.

Expanding their understanding in dealing with harsh words and insults. Even if the impact of this experience was too great on their emotions, they just tried to make more room for more understanding. They thought that perhaps it was all because of the work stress that heightened and charged the atmosphere with tension onboard. When the attack seemed to be too personal, they would just keep their distance and wait until the coast is clear. This may be similar to what Perry et al. [20] calls as “self-regulated learning”, a highly effective approach that is associated with success in and beyond school. It is the ability to regulate one’s thoughts, feelings, and behaviors in order to reach a goal.This goal might be academic (improving reading comprehension, becoming a better organized writer, learning how to multiply, and asking relevant questions) or they might be socio-emotional, like controlling one’s anger and getting along with peers.

> *“So when my officer gets mad at me and hurt my feeling by throwing at me unkind words, I don’t really take it against him. I understand why he had to be like that or why he is acting that way. It’s mostly all about work and some personal problems each one of us has to carry while we are away from home.”*

Communicating with their families and loved ones back home. The cadets were thankful that electronic communication is now available to let them stay connected. When they felt so down or when they wanted to give up, they communicated with their families and loved ones. According to Bist [18], a ship has always been a place of work from where persons cannot go and be with their families at the end of the day. Everyone appreciates how contact (or loss of it) with family far away can instantly inflate or deflate the morale of the individual.

Socializing with their crewmates. During socializations, they would grabthe microphone and sing with their crewmates as a way of venting out their emotions. They cracked jokes and even cooked food for their officers to diminish their feeling of sadness and to develop camaraderiewith them. When the ship was at port, they would go fishing.Supporting this idea, Bist [18] explains that “good communication between individuals onboard is as important as in any field. When it exists, there is smooth exchange of information which contributes to safe running of the vessel. Interaction among those onboard stimulates communication. A modern vessel with her small crew and work environment where every person has a vital part to play in routine and where operation is an endless chain of watches shared by members of the crew is a place where tension can take root. In this atmosphere grudges may worsen to create conditions that prevent harmony on board.”

Strengthening Their Spirituality. The cadets recalled that listening to gospel music had served as a healing balm to their wounded feelings and enabled them to stay spiritually fit.On this, they made the following comments:

> *"On my seasickness, I prayed. It is in your mind. If you think you will vomit then you will. If you control your mind not to vomit, then it helps. Sometimes after working too hard, I would be allowed some rest. When the ship was rolling so hard, I couldn't sleep. I had to get used to it. If there was an internet connection, I communicated with my loved ones back home. Hearing their voices made me feel better. There were times when I wanted to give up. It's the thought of my family that strengthened me."*

All data that were analyzed and presented above emerged from the survey and small group interviews personally conducted by the researchers with the cadets who have actually undergone on-the-job training onboard international sea-going vessels for 12 months. Responses to the interview that were reported in their native language were translated in English for the sake of global readership. Responses that have touched on confidential and sensitive matters had been selected out of the data. It is but proper to point out then that whatever conclusions were formed in this study were based on the data gathered and may not necessary reflect the experiences of cadets of other maritime institutions who have also undergone their OJT in other vessels. To further validate the findings of this study, more research along this line with other groups of respondents is advised.

4. Conclusions

The cadets' first year onboard requires a great deal of courage and positivism. At a very young age and as they are just starting on their career, they are bombarded with multiple strenuous responsibilities which require a great deal of physical stamina, mental alertness, and emotional stability. They are also exposed to various people and circumstances which could create a serious impact on their psychological and emotional development. Most of their responses during the interview seemed to suggest that they have been academically prepared to possess the required competencies for an engine cadet, but there are still specific skills they have not been sufficiently trained to develop.Italso appeared that some of them have not been thoroughly prepared to face the harsh realities that go with their chosen career. Based on the testimonies gathered, it appears that the quality of experiences they would have onboard is highly dependent on the senior officers who will be assigned to handle them. The luckier they get, the better is the experience. The varied testimonies of the respondents are reflective of the absence of standard norms of action in dealing with the working crew onboard particularly those in relation to cadet apprentices. Findings of this study imply that the contributions of many for the betterment of the cadetship program or on-the-job training program can still be achieved. The reports made by the cadets do not only point to the importance of knowledge and skills acquisition but also on the internalization of the right attitude and values fit for a cadet and a future officer.

5. Recommendations

By looking at the findings and taking the recommendations made in a constructive manner, collaborative efforts can be made to address the issues brought about by this investigation.The school is in the advantage position to spearhead in addressing and looking for strategic ways to better prepare the cadets for the actual test onboard. With its mission to satisfy stakeholders' expectations, the institution could consider the reports made by the cadets and look for solutions to address specific areas so weaknesses and inadequacies could be filled in. Values formation and internalization must be placed on top of its priorities. This issue has become a critical issue in the maritime industry and it is high time that maritime institutions should take it seriously. Moreover, the maritime industry needs to be vigilant in instituting regulations that would prevent discrimination, abuse of authority, emotional and physical harassment, excessive workloads, and unpaid overtime issues which have been partially revealed in this study. A feedback mechanism can also be implemented by all shipping companies to allow returning cadets to reveal the quality of their experiences for the purpose of ensuring a fair and honest management of crew in their fleets and the cadets in particular. The maritime industry as well as maritime institutions worldwide should also consider opportunities for improvement on the cadetship program as well as on areas of loyalty, motivation, and work efficiency and professionalism among their crew.

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Reviewing Human Resources Development Strategies of Merchant Navy Seafarers in South Africa and Australia

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Purpose, orientation and motivation for study

The purpose of this article is to review human resources development strategies for merchant navy seafarers in two southern hemisphere countries: South Africa and Australia. This is done by assessing the labour market and training contexts for seafarers in both these countries. Through its empirical comparative focus, this paper provides HRD insights into current practices in South Africa and compares these findings with evidence from Australia. Through foundation work in South Africa and comparative analysis with Australia this article identifies significant 'common causes' and challenges facing both countries in their efforts to comply with 'outmoded' STCW training requirements and the lack of training berths on compliant vessels servicing these respective countries.

Research Design and Approach

A comparative case study design was used that drew on a mixed method approach. The investigators utilised both primary and secondary quantitative and qualitative data to support their claims. Quantitative data consisted of seafarer labour market statistics and results from maritime stakeholder surveys in South Africa (2013) and Australia (2013). The qualitative data consists of in depth interviews with key HRD stakeholders in both countries. A third point of data collection was a review of extant HRD policies in these countries.

Findings

Indications are a collaborative approach between the nations has merit beyond just sharing research insights. Some of the challenges and opportunities that emerge from the data are summarised below.

- Lack of ship ownership. This has profound consequences for training berth availability for officer and ratings experiential training.
- Lack of alignment between South Africa's national qualifications framework (NQF) and the IMO's STCW requirements for certification. This represents a tension between national and global imperatives on training of seafarers. The NQF advocates for recognition of prior learning (RPL) as a means of obtaining certification of officers. However RPL has no place in STCW requirements. This raises questions about the relevance of STCW training requirements.
- Difficulty recruiting young people into the profession.
- Opportunities may lie in operationalising robust HRD solutions that include recognition of prior learning, dedicated training vessels and increased policy coordination amongst stakeholders.

Keywords: Human Resources Development, seafarers, South Africa, Australia, training berths, authentic assessment

1. Introduction

The first purpose of this study is to assess the seafaring labour markets and training contexts in two southern hemisphere countries: South Africa and Australia. The second purpose is to advance adult learning and policy solutions that can combine to remediate the critical shortage of training berths in these two countries. The trend in the academic and industry literature is to predominantly focus on comparative studies of Western European and Asian seafaring labour markets and training strategies. By providing empirical insights into current practices in South Africa and comparing these findings with evidence from Australia, this paper aims to extend our current understanding. Through foundation work in South Africa and comparative analysis with Australia, we identify common issues facing merchant marine seafarers in these countries. The first part of the paper discusses the labour market for South African and Australian seafarers whilst the latter half of the paper posits potential policy interventions for both countries as a result of comparative findings. Given that some of the industry data presented in this paper indicate a predicted growth in the maritime industry and as a result in the required workforce in both countries, the sustainable growth of attendant labour markets is a matter of national importance for both countries.

2. The South African Context

The labour market for South African seafarers reached its peak in in the 1970s, with an estimated 7000 ratings and officers being employed in the merchant maritime sector. Since the 1970s, there has been a marked decline in the supply of seafarers, especially the number of officers available in the labour market. The current South African Maritime Safety Authority (SAMSA) database indicates that there are currently 1800 South African seafarers employed in the global merchant navy[1]. Of these only 473 are officers of various ranks with the balance of 1327 being ratings. This amount is minuscule when compared to the traditional maritime nations of Europe and Asia. Despite this, the current number of officers and ratings represent a substantive increase from 700 seafarers that were employed in the merchant navy in 2006 [2].

3. Demand

South Africa (SA) enjoys 3.5% of the global sea-trade and the SA state argues that it needs to compete for its share of seafaring jobs commensurate with the percentage of global sea-trade it enjoys [3]. Based on SAMSA calculations, this translates into an aspirational goal of capturing approximately 49,000 seafaring jobs of the 1.4 million seafaring jobs available globally [3,4,5,6,7,8,9]. This total would include both officers and ratings. The South African Department of Transport [10] contends it needs to train between 1000 and 1600 officers a year in order to contribute to building a global supply of seafarers. This is opposed to the 240 officers that are currently trained every year [1]. Maritime academics and professionals [3-5] have been more sceptical about these figures but agree that in order for SA to be considered a global supplier of officers a sufficiently large pool of officers needs to exist. Participants (P1-P5 & P6) also suggested that any human resources development strategy needs to simultaneously ensure that there are sufficient numbers of seafarers to service national and global needs. For example in 2012, 11,049 merchant ships entered South African ports, none of which are flagged in SA or are registered in SA. An estimated 230,000 foreign (i.e. non South African) crew worked on these vessels. Government and domestic policy makers now contend that this is no longer an acceptable practice given South Africa's high national unemployment rate[1-10].

4. Reasons for the decline of South African seafarers

Interviews with key stakeholders in the industry revealed the following themes as reasons for the decline in the number of South African seafarers. The primary theme identified was the lack of available training berths for South African cadets/officers.

4.1 Lack of Training berth availability: A common problem

All interviewees suggested that compounding the human resource crisis centred the reality that of the 240 cadets that graduate annually, many were unable to secure the training berths necessary to complete their final accreditation. Without these placements they couldn't graduate nor be employed in the global labour market. Since 2010, an average of 153 cadets per annum have successfully secured training berths due to interventions by SAMSA[1-7]. In addition to these 153 training berths, Marine Crew SA (a private sector crewing agency based in Cape Town, South Africa) has secured additional training berths for approximately 25-35 cadets per annum. Clearly, lack of training berth availability is hampering the growth of cadet production in South Africa, and any increase in cadet production needs to be met with a concomitant availability of training berths. There is an approximate shortage of 60-70 berths annually.

The lack of training berths is not a uniquely South African problem. It is being experienced by India, Australia, Sweden, Sri Lanka, the Philippines, the United Kingdom and a range of the traditional maritime nations of Western Europe [16].The lack of training berths is part of a larger global issue in the training of seafarers. In spite of the ongoing forecasts confirming globally shortages of officers [11], even the world's largest supplier of seafarers, the Philippines, cannot provide training berths for 1 out of every 5 cadets trained [12]. Reports suggest that of 25,000 cadets only 5,000 will obtain training berths [12]. This represents a profound wastage of human and financial resources if there are no alternate career paths available to these cadets.

4.2 Shortage of and limited capacity of certified institutions to train officers

Compounding the lack of training berth availability in South Africa is the lack of certified training institutions and the severe resource constraints these institutions face (Interviews P1-P10 2013). Only two training institutions are accredited to train merchant navy officers. These are the Durban University of Technology in Durban, KwaZulu-Natal and the Cape Peninsula University of Technology in Cape Town, Western Cape. Both South African institutions are faced with severe human resource constraints in the training of cadets, and produce a combined total of 240 cadets a year [10]. According to the Chief Operating Officer of SAMSA, this is clearly not sufficient to develop a sustained pool of skilled labour for the global labour market (Interview P6). The maritime departments are constrained by factors such as, poor physical infrastructure that they are based in; lack of sufficiently skilled lecturers to teach on maritime programmes; and the expectations of the broader university management for lecturers to publish, conduct extensive administration, and participate in the institutional life of the university (Interviews P1, P5). Since the two maritime departments are part of state universities, the salary scales paid to staff have to be commensurate with South African academic salaries which are relatively low when compared to private sector incomes. One participant suggested that the Maritime departments be moved out of the state university systems and into dedicated state run seafaring training institutions (Interviews P1-P5). This may resolve capacity issues in terms of staff whilst simultaneously being able to increase student graduation levels. In tentative support of this idea, SAMSA is establishing a Maritime Centre of Excellence (MCE) in Durban, but currently this centre will not provide certified training for cadets wanting to work in global commercial fleets. The focus of the MCE will be on port based seafaring work and shore based training (Interview P1-P5, P8).

4.3 Prohibitive fiscal policies for South African ship owners in rebuilding a national merchant navy fleet

Currently, the South African ship registry has no South African flagged merchant ships [3]. This is in stark contrast to the fleet of nationally flagged Safmarine ships that were on the registry up until 1993[3], till they were sold off to AP Moeller /Maersk [16]. The advent of flag of convenience (FOC) shipping, the lure of FOC fiscal policies and a series of mergers and acquisitions by multinational shipping decimated the national South African commercial fleet (Interviews P1-P10). The reduction in national fleet size is not unique to South Africa and is one experienced by many of the European traditional maritime nations. Lack of national fleets is endemic on the African continent, with interview participants citing the lack of indigenous ship ownership on the African continent as a problem requiring urgent policy intervention. The lack of ship ownership is made more acute by the fact that of the BRICS members, South Africa is the only member without a national fleet. Brazil has a fleet of 172 ships, Russia, 1891, India, 534 and China 2044 [3]. The aim is to entice 300 ships to the SA registry over the next few years. Interview participants (P1-P10) argued that a lack of a nationally flagged fleet means that there is a reliance on non-South African vessels to provide training berths for its cadets. Further there is no cabotage system operational in South Africa (as there is in Brazil for example) that compels foreign flagged vessels to employ or provide training berths to South African seafarers. The debate on changing the fiscal requisites of the current ships registry is a long standing one and has been debated in political circles since 2002 [13] with very little movement to actually pass new legislation.

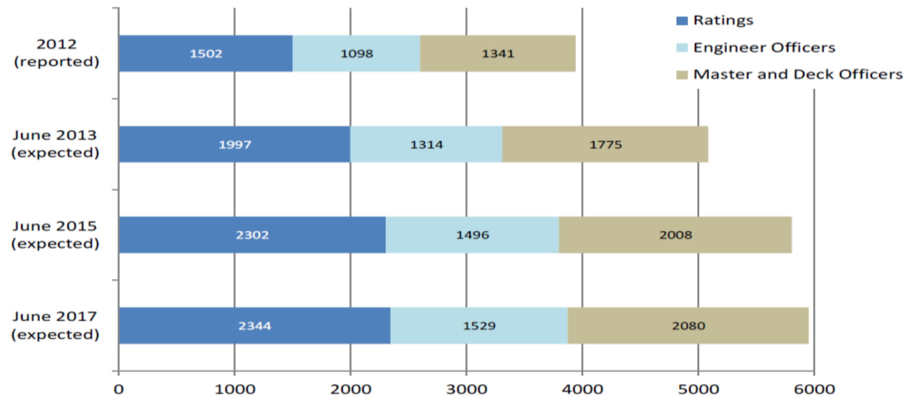
Newly built ships do not make physical provision for extra berths for trainee cadets. Evidence also suggests in a tight labour supply many ship owners and other industries (e.g. off shore oil and gas) prefer to rely on paying more to attract and recruit STCW qualified seafarers rather than working with the 'blue water' shipping companies to invest in resolving the lack of berths [14]. The evidence provides an important caveat to South Africa's intended policy to grow a national fleet. It challenges the belief that a national fleet necessarily can, and the owners will, provide the full complement of training berths required to train the existing pool of South African cadets.

5. The Australian Context in demand of berths

IBISWorld estimates growth in the industry revenue of most of the sectors of the maritime industry in Australia in the next few years. For example, between 2011 and 2017, Australia's LNG export capacity is expected to quadruple to 80 million tonnes [15], and the number of containers crossing the nation's wharves will increase by 150 per cent from 6.2 to 15.4 million (Infrastructure Australia, 2011). Future employment growth in the industry will be patchy. A maritime workforce in Australia includes highly trained seafarers not just at sea as ship operators, but also shore-based positions (e.g. as pilotage, marine surveying, maritime education and training, port operation staff). In the four years to 2016, IBISWorld data shows trends that suggest, in line with overall maritime employment, the demand for STCW certified seafarers will likely shrink in port sector (-8.1%), grow slowly in international sea transport sector (7.3%) but grow more rapidly in offshore, terminal and coastal cargo sectors (11-17%) [15]. This complicates matters for the Australian maritime industry where the struggle to find training berths is not just a problem for international shipping companies. It affects all employers of STCW certified workers. Chartered by the Australian government's Minister for Transport, the Maritime Workforce Development Forum (MWDF) commissioned a national maritime census to determine a future demand profile and impediments to skills supply[17].

Figure 1 below from the MWDF Census confirms not only the need to improve labour supply, but where employers predict the greatest shortfalls will occur. For engineering officers and deck officers alone, the gap was expected to grow respectively by 270% and 67% between 2013 to 2017 [17]. This accentuates not just the shortfall, but the criticality of immediate action.

Figure 1 Number of seafarers expected within the responding organisation's workforce (Maritime Workforce Development Forum (MWDF), 2013)



6. Impediments to skills supply for the maritime workforce in Australia: Other factors in Australia that could inform South African practice

A number of findings from the Australian Maritime census [17], tabled in January 2013, suggested major impediments to future skills supply that will require effective national and enterprise level HR responses.

6.1 Available space

Traditionally, the 'blue water' sector has been the provider of berths for seafarers. But in the case of Australia the national fleet comprises of roughly 22 vessels [18] or less. While the 'blue water' sector may be in decline, for the first time in Australian history, workforce data confirms employment in merchant marine industry occupations in offshore oil and gas sector — offshore oil and gas sector (31per cent), with key supports in towage (17 per cent), dredging (6 per cent), pilotage (4 per cent) and ports (3 per cent) — significantly outstrips employment in the primarily 'blue water' trading sector (22 per cent) [19]. A national workforce survey reported that more than half of the employers responding thought the cost of training entry-level seafarers was a significant issue; particularly if they then left the employer during or immediately after completion of training [20]. For the fear of their skilled employees being poached, employers refrain from investing in high training costs, especially for entry-level seafarers. Table 1 provides an example of average costs involved in such training[21].

Table 1 Indication of cost involved for an employer in training of seafarer employees[1]

Rank	STCW Training Level	Time Taken	Cost*
Deck Officer	Watchkeeper	2 years 9 months	$140,000
Marine Engineer	Watchkeeper	3 years 3 months	$155,000
Integrated Rating	Certificate III	Over 1 year	$75,000
Deck/Engine Watchkeeper	Master/Chief Engineer	5-7 years	$100000 - $150000

6.3 Time (including not able to count sea time towards training)

The offshore oil and gas sector has a lot of ships and employs the majority of seafarers in Australia and while many operators in this sector undertake a significant amount of training, there are constraints on some operators as to how much training they are able to provide because their vessels are not large enough or are not moving, so seatime does not count fully towards certification.

6.4 Shortage of qualified staff to provide practical training

An ageing workforce is another key factor limiting Australian shipping and port companies' ability to increase their labour pool. The seafarer workforce in Australia is aging. With 42% of maritime workers aged over 51 years[17,20] and 20% over 55 years of age [20] the workforce is rapidly facing retirement induced shortfalls.

6.5 Short supply of trainees (nominated by an organisation who had around 20 berths)

The oil and gas sector are increasingly attracting seafarers from the 'blue water' sector with its attractive wages and conditions. However, Cahoon et al [22] suggest this is a debatable issue as some industry critics believe that such shortages are due to the under-performing economy and the numbers will increase with the recovery of the economy. The same paper promotes the use of employee friendly human resource strategies towards recruitment and retention of seafarers. At the same time, Cahoon and Haugstetter [23] maintained the argument that increasingly it is becoming difficult for employers to target Generation Y demographic towards the shipping industry which is infamous for criminalisation of seafarers, piracy threats, long working contracts, etc. Although, their discussion pertains to the global population, the same may hold true for Australian seafarers as well.

6.6 Safety/contract issues (nominated by organisations who together had around 40 berths)

With a high priority on work-life balance [22], Australian seafarers are seeking shorter contracts and being relieved at the end of their contract period. Although, the offshore industry does provide shorter contracts compared to their 'blue-water' counterparts, an employer's inability to relieve its seafarers on time may cause seafarers to feel overworked[22] leading to stress and fatigue causing safety and employee attrition issues.

[1] While these figures are employer costs and do not include the costs of shore staff management of trainees, capital expenditure, maintenance costs of facilities or on-board mentoring and overseeing the trainee

7. The South African context for Australia's impediments to skills supply

Table 2 below shows how impediments to Australia's skill supply compares in the SA context. Table 3 makes a comparison of the training contexts in both countries. Both tables allow for a summarised contextual and comparative view of skills supply and training in both countries.

Table 2 Comparing impediments to Australia's skills supply in the South African context

Identified impediment to skills supply for maritime workforce in Australia	The South African Context
7.1 Available space	• While Australia has less than 25 nationally flagged trading vessels capable of providing training berths, South Africa has none. • The offshore oil and gas sectors are viewed by industry stakeholders as areas of profound growth in South Africa. A total of seven companies hold licences, for which, development or exploration activities exist or are planned (Norwegian Marine Technology Research Institute, 2010). Given that there are no SA flagged ships and hence no berthing space in a SA fleet, a potential consequence of this may be to see a competition between the traditional 'blue water' sector in SA and the oil and gas sectors, as has been experienced in Australia..
7.2 Cost	• In the South African case, cost continues to be prohibitive, since foreign shipping companies have to be paid to offer training berths to cadets. These costs for the moment are borne by the state through various skill development subsidies levied from companies operating in the transport sector. There is therefore a cross subsidisation of the cost of training berths from non-maritime sectors. • South African shipping companies have historically trained for their own needs, even during the peak of South African national ship ownership in the 1970s and 1980s (Bonnin et al 2004). Safmarine for example had a successful in-house training scheme to train cadets to service its own fleet (Ruggunan 2009). It is unlikely that private sector shipping companies will respond to threats compelling them to provide training berths. As the evidence indicates shipping companies respond to incentives more productively than threats.
7.3 Short supply of trainees	• Recruitment of young people to seafaring as a profession continues to remain a challenge in South Africa. Contributing to the challenge is a lack of a 'maritime culture' amongst younger people even in port cities such as Durban and Cape Town. Discussions on how to promote a maritime culture in schools and amongst the public in general are currently being pursued by the National Department of Transport and SAMSA. Apartheid in South Africa excluded the majority of young people from exploring skilled professions at sea and it was only post 1994 that Black South Africans (African, Indian and 'Coloured' South Africans) were allowed to pursue careers as officers. Prior to this they were restricted to careers as ratings and cadet and officer ranks were the preserve of White South Africans.

Table 3 Seafarer training contexts in South Africa and Australia

	South Africa	**Australia**
Andragogic model of achieving sea time	Apprenticeship system	Apprenticeship system.
Availability of training berths.	Limited availability of training berths on foreign ships.	Limited availability of training berths on foreign ships.

Existence and/or size of national fleet.	No national fleet.	Declining national fleet.
Dedicated training vessel	One dedicated training vessel.	No dedicated training vessel
State schemes to train and develop seafarers.	-Subsidises a private sector crewing agency to source training berths. -Runs a simulator training programme to add value to cadet training. -Subsidises training and training berths for cadets up to 100	Partial subsidies from the state but difficult to access.
Recognition of prior learning as a means of accumulating sea time across different vessel types.--	Has a formal recognition of prior learning system that theoretically allows for progression and accumulation of sea time from port and fishing vessels to Deep Ocean going vessels but in tension with global STCW system.	NO
Officer training institutes part of Universities only.	YES	NO

8. Potential Solutions and their implications

8.1 Government shipping reforms and policies

The root cause of the bottleneck in the supply of skilled seafarers is the lack of ships to train people on, something that the Australian Federal Government's proposed tonnage tax and international shipping register, when introduced, should collectively help to solve. Under the proposed reforms, more ships would be under the control of Australian entities and there would therefore be more on-board training berths. The problem associated with this reform is that 'second register' also allows owners to have less regulated crewing requirements which encourages the employment of foreign crew (who work in the country under a Maritime Crew Visa), who not only occupy a training berth but may also be paid lower wages [24]. For example, the AISR requires only the Master and Chief Engineer to be Australian residents [25]. According to the Australian Maritime Industry Census carried out in 2012 by the MWDF, 57 per cent of the staff employed in Australia are working on a visa programme, temporary business visa, maritime crew visa or are from New Zealand [17].

As argued earlier in the paper, South Africa's shipping policy environment has to be overhauled if it is to serve as a driver of seafarer employment. This is currently in process and the consequences if any for seafarer training remains to be seen. The South African state is also considering an African wide cabotage system. There is currently a shift by SAMSA to move towards a compulsory cabotage system as a means of securing training berths for seafarers (Interviews P1-P10). However, as Hutson argues [3] "there is insufficient cargo being moved between South African ports to warrant having such laws in place, so they would be counterproductive". Most cargo in South Africa is moved through road and rail infrastructure, even between coastal cities. Cabotage with a link to training and employment of national seafarers already exists in many South American countries including Brazil and is being proposed as a solution to the lack of training berth availability in Australia [24]. Participants (Interviews P3,P9,P10) also suggested that greater solidarity is needed amongst the various maritime authorities on the African continent to ensure an African wide system of cabotage with links to training berths and employment.

8.2 Cooperation between industry stakeholders

Through joint coordination and cooperation between industry stakeholders (employers, seafarers, maritime education providers, national government, etc.), efforts can be made to seek berths and provide training to seafarers. For example, in Australia, a suggested national Government coordination of the infrastructure and MET activities has been achieved through the three major AMSA (Australian Maritime Safety Authority) approved maritime education and training (MET) providers (AMC, Hunter and Challenger) who have agreed to a cooperative approach under a Memorandum of Understanding [21]. However, such joint ventures need strong legal basis and should not favour any one stakeholder in particular [28].

Similarly in South Africa, a greater coordinated effort needs to be made amongst the 14 MET sector stakeholders. One way of achieving this is through processes of social partnership. It is also the most apt way to describe the strategies of the South African government (through its agencies) in achieving national goals of racial equity in the labour market for seafarers. However, it has been less successful when it came to making significant and rapid inroads into growing the employment opportunities for South African seafarers globally. It has proved to be a parochial and intensely localised approach targeted at national issues of achieving racial equity in occupational ranks of seafarers.

8.3 Simulators and Training ships

In their paper, [29] suggest that training obtained through simulators and training ship experience can be used as a valid substitute for some of the competence acquired through seatime on commercially trading vessels, thus freeing up berths quicker. Since the STCW Code does not specify any mandatory requirements for training provided through simulators or training ships, there is always the possibility of training received to vary as per individual interpretations on a national or global scale. South Africa for example, already makes extensive use of simulator training of cadets (through the South African Maritime Training Authority) but due to no global standard of performance criteria, simulator training is viewed as value adding rather than a replacement of experiential training achieved through training berths. This sits at odds with South Africa's higher education and training policy environment that makes provisions for recognition of prior learning as an alternate access point to obtaining credit for academic qualifications including professional qualifications.

SAMSA and the South African national department of transport recognise that there need to be major investments of financial and human resources into the training and development of officers. To this end, a dedicated training vessel (the SA Agulhas in 2012- a previous South African Antarctica research vessel), has been obtained and refitted to provide training berths for cadets that require their seatime. According to participants interviewed, the Agulhas project (as it has become known) has been very successful despite the obvious logistical constraints of it only being able to accommodate 50 cadets at a time. The success operates at the level of both being able to offer training berths but also contributes to generating public awareness about maritime careers and culture. Proposals for dedicated training vessels have been made by Australian Maritime College to the Australian state [29] as well as by the Nigerian Maritime Authority to the Nigerian state [30] without much success. The cost of this strategy is prohibitive but as the South African case shows that benefits are to obtained if it is part of a wider strategy to train cadets.

8.4 Recognition of Prior Learning

Given industry decline, poaching and lack of incentives to invest in an 'industry solution' evidence from countries such as Australia, the United Kingdom, India and Nigeria suggest the availability of training berths in the private shipping fleet relies heavily upon state sponsored initiatives. One solution proposed in the Australian case is the use of berths on alternate vessels (e.g. naval vessels, 'brown' water vessels, or short voyage vessels) or smaller vessels (e.g. fishing vessels, ferries, tugs and tows) [29]. South Africa has a reasonable sized fleet of brown water and port vessels as well as a modern fleet of navy vessels. An idea proposed by Ghosh & Bowles [29] and Bonnin et al [2]was that a system of recognition of prior learning be applied to training berth certification. Thus, seafarers can cumulatively obtain their sea time on different vessels and engage in a 'tinny to tanker' scheme [29]. This idea has not being successfully applied in Australia or South Africa where recognition of prior learning system formally exists. The main reason for this in South Africa is that a battle tension exists between the rationale of the South African Qualifications Authority (SAQA) and the rationale of the globally mandated STCW qualification, where global regulation has triumphed giving nation states like South Africa very little room to manoeuvre. The global maritime industry needs a better and simpler process of mapping and recognising qualifications and seatime gained on other sectors and trades of the seafaring industry. The assessment regime of seafarers also need to recognize the gaps in their competence to work in different context, and provide further training to allow them to advance their career and learning.

8.5 Authentic Assessment

It is evident that both South Africa and Australia are at a critical point in ensuring a ready supply of seafarers. Crucial to ensuring a pipeline of certified seafarers is the issue of training berth availability. The evidence from the two countries demonstrates that the traditional manner of acquiring training berths as a means to certification is not a viable strategy to grow their seafaring labour markets. Certification is globally regulated and seatime is mandatory to obtain the Standards of Training, Certification and Watchkeeping Convention (STCW) certification. Mandatory seatime that is intended to promote experience but is completed in isolation to assessment of competency or performance in the workplace, has been challenged by many employers as counterintuitive to any vocationally oriented, educational process [17]. The Kenya Maritime Authority [28], in their assessment of the lack of training berths available to Indian and Kenyan cadets, question the pedagogical effectiveness of mandatory seatime as the only way in which cadets can or should be accredited for certification. In recognition of the need for alternative ways to ensure accreditation of the experiential component of the STCW, we propose authentic assessment as a philosophy and strategy of teaching, learning and assessment. However, as we shall see any such approach involves a tension between global regulation and national state imperatives of seafaring as a profession.

Authentic assessment tasks contextually resembling workplace situations and replicating the complexities and challenges in different scenarios will require students to integrate a range of competencies for problem solving and decision making as in the real world [31]. If the students can demonstrate their workplace readiness for a level of responsibility through a range of such tasks, they should ideally be awarded with the STCW certification and allowed to move up the ranks, even if its' before the end of their stipulated seatime. This would essentially free up the training berths at lower levels for prospective trainees and officers. However, current practices do not allow acceleration in certification (either STCW or national qualifications) until the approved duration of seatime is completed.

Authentic assessment will also assist in filling training gaps for seafarers who may have acquired the seatime on a range of vessels by providing frequent opportunities to reflect on their current knowledge. Such reflection by both educators and students allows them to recognise gaps in the knowledge and grasp cues for enhancing the transfer of skills in different contexts [32]. Students can have access to the resources and information that would be available to them in the outside world, making them focus on developing an in-depth understanding by assembling and interpreting information, formulating ideas, critiquing, integrating knowledge and demonstrating the holistic application of skills for higher-order cognition [33]. Such application of competence provides multiple indicators of a students' competence. In their paper Ghosh et al [29] provide evidence based review of literature to suggest that, to a large extent, current assessment methods in seafarer training, as promoted by the STCW, are failing to do so.

9. Conclusion

The main aim of this paper was to assess the labour market and training contexts for South African and Australian seafarers in the merchant navy. A secondary aim is to provide an alternate way of conceptualising the ways in which seafarers can obtain accreditation for the experiential component of their STCW training. In achieving the first aim of the paper we have demonstrated that both Australia and South Africa face similar seafaring labour market challenges. These consist of projected shortages of qualified seafarers to service the growing maritime sector in both countries. Contributing to the shortages are a lack of training berths, declining to non-existent nationally flagged fleets, a failure to recruit young people in sufficient numbers into seafaring professions and a lack of coordination of MET activities. Given the various difficulties in securing training berths for seafarers in both these countries, authentic assessment is proposed as a means by which seafarers can achieve STCW certification. South Africa already has an established simulator training programme, but since there are no global norms or performance criteria for simulator training, its benefit towards certification remains limited. A dedicated training vessel in South Africa is a success but it can only offer capacity to 50 cadets annually. Solutions to the dearth of training berth availability in both countries have to include a championing of authentic assessment at all levels of MET. This requires a coordinated effort between global and local labour market institutions to consider authentic assessment as a viable and quality tool to obtain STCW certification and thus revive ailing national labour markets.

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Successful Recruiting: Potential Lessons from the Canadian Navy

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Historically, recruiting seafarers has been a challenge for the shipping industry, and the same is true today as the demand for seafarers remains high. Increased opportunities onshore, lifestyle concerns, and other factors have been identified as barriers to successful seafarer recruitment. However, the shipping industry is not alone in its quest to recruit suitable candidates for a life at sea. Another maritime entity that faces similar recruitment challenges is the Canadian Navy, and it might be worthwhile for those in the shipping industry to examine one approach to recruitment that has been employed by the Canadian Navy. Since the early 1990s, the Canadian Navy has partnered with the Marine Institute, a Canadian MET institute, to offer training programs through the Naval Technician Training Plan (NTTP), whose graduates fill vacant shipboard positions. This paper examines the approach used by the Canadian Navy to successfully recruit candidates via these programs and compares it to the approach used by shipping companies in their recruitment efforts, with an aim to learn from the Navy's apparent success. To conclude, this paper examines the results of a survey taken by students involved in the NTTP programs who were asked questions modelled after a Shiptalk Life at Sea Seafarer Attraction and Retention Survey. The results indicate that the NTTP programs are an effective recruitment tool, and in particular, an integrated approach to training and recruitment is one of the keys to the Navy's apparent success in recruitment.

Keywords: recruitment of seafarers, MET and industry partnership, integrated recruitment.

1. Introduction

A number of published reports indicate that the shipping industry is about to experience a shortage of seafarers, particularly officers. One publication predicts that the shortfall will reach 27,000 by 2015 [1]. Drewry estimates a current shortfall of 19,000 officers worldwide and predicts that this figure will rise to 21,700 by 2018 [2]. Given that over 90% of the world's goods are shipped via sea [3], if these predictions come to fruition, it could have ramifications on virtually every supply chain in the world as shipments are delayed for longer and longer periods of time due to a lack of qualified seamen. Keeping seafarer numbers up consists of two things – recruitment and retention, or the ability to hire new people and the ability to keep them once they have been hired. While recruitment and retention are often discussed together, they are each significant topics on their own, and because recruitment has specifically been cited as a serious problem in the shipping industry [4], this paper will deal solely with this topic.

A number of factors have been cited as reasons for this staffing shortage. For example, issues such as the criminalisation of seafarers around the world, piracy, tough regulations, good job opportunities on shore, and concern for family may dissuade many from considering a career in shipping [5]. Others point to the poor image of the shipping industry in the eyes of the public as another reason for this staffing shortage, arguing that if the industry were viewed more favourably by the public, then recruiting might be an easier task [6].

The issues facing the shipping industry are not unlike those once faced by the Canadian Navy when it experienced a shortage of skilled technical personnel to fill vacant shipboard positions. The parallels between the Navy and the shipping industry are apparent: they both operate fleets of seagoing vessels, and they both require skilled personnel to fill shipboard positions. Therefore, this paper will investigate one way the Canadian Navy addressed its shortage of skilled technicians by partnering with a Canadian civilian MET institution, namely the Marine Institute in St. John's, Newfoundland.

This paper will provide an overview of the approach employed by the military to successfully recruit new candidates into their technician training programs delivered by the Marine Institute and whose graduates fill vacant shipboard positions. Brief descriptions of the training programs and of the Marine Institute will be followed by an overview of the recruitment process used by the Navy as compared to that traditionally used by the shipping industry. Finally, this paper will conclude by examining the results of a survey given to students enrolled under the Naval Technician Training Plan (NTTP), which consists of both the Naval Combat System Technician Training Plan (NCSTTP) and the Marine Engineering Technician Training Plan (METTP). This survey was structured to ask questions similar to the Seafarer Attraction & Retention Survey Report carried out as part of the Shiptalk Life at Sea Survey 2007/8 [7]. Where appropriate, the responses of the students will be compared to those of the Shiptalk survey to assess how successful the Navy's approach has been in addressing its recruitment efforts and whether there are potential implications for the recruitment of seafarers into the shipping industry.

2. Overview of the NTTP Programs

What is now formally known as the Fisheries and Marine Institute of Memorial University, or simply the Marine Institute for short, was founded in 1964 as the College of Fisheries, Navigation, Marine Engineering and Electronics. In 1992, the Marine Institute became a part of Memorial University, and since that time, it has grown to offer a wide range of educational opportunities to the marine sector, including short industrial response courses, diplomas of technology programs, advanced diploma programs, and bachelor and masters level degree programs. The mission of the Marine Institute is "To foster economic development in strategic marine sectors of the Newfoundland economy, particularly the fishery and offshore development and to enable Newfoundlanders to participate in the marine industry, nationally and internationally" [8].

The current version of the METTP was launched in 1994, and the NCSTTP began in 1992 [9]. The METTP program is currently ongoing, but the NCSTTP program was put on hiatus in 2013.

For both the NCSTTP and METTP, the Marine Institute was the winning bidder in a competitive bidding process for the training contract with the Navy. After selecting the Marine Institute to carry out the training, the Navy worked in partnership with the Marine Institute to develop academic programs that were tailored to the specific staffing requirements of the Navy and which would also incorporate the academic rigour expected at a civilian MET institute. Deazly [10] provides the following summary of the NTTP programs: "Fully subsidized and accredited, both programs provide students with a two-year technician's diploma in one of three fields: marine engineering, electronics engineering and electro-mechanical engineering. Members completing one of the three programs are employed as naval electronics technicians (radar, sonar or communications), naval weapons technicians or marine engineering mechanics." The programs require academic training at the Marine Institute and sea time aboard Navy ships. Students who are trained under the NTTP are enlisted in the Navy during their training program, must attend basic training, and are subject to the same expectations as all members of the Navy, which includes physical fitness and drills even while they are in school. Finally, new recruits must commit to the Navy for six years when enlisting to undertake NTTP training [11].

The Marine Institute does not operate in isolation from the Navy in its delivery of NTTP training as there is regular contact between Navy staff and the staff at the Marine Institute through a detachment of the Canadian Forces Naval Engineering School (CFNES) that is located at the Marine Institute to help oversee NTTP training. This office houses several staff who provide divisional and administrative support for the students and who liaise with senior Marine Institute staff and instructors to coordinate administrative and logistical requirements [12]. Jobe, a former staff member at the CFNES office at the Marine Institute, stated, "The Marine Institute supports the NTTP program in every respect, and ensures that students' needs both academically and outside of class are foremost in their approach. The accessibility of staff and instructors, and a low student-to-staff ratio are the envy of most institutions. Without a doubt, the close co-operation and support between the naval detachment and the Marine Institute continues to be the key to producing naval technicians of the highest calibre" [13].

3. Recruitment Models

Dessler defines recruitment as "the process of searching for and attracting an adequate number of qualified candidates, from whom the organization may select the most appropriate to staff its job requirements" [14]. While this definition may help the academic treatment of recruitment by oversimplifying matters, in that recruitment ends when resumes or job applications have been collected, it has little practical use in the real world of human resource (HR) management. At its core is the assumption that an organization can simply select the best candidate, and that he or she will accept the offer. In many cases, the best candidates may have to be convinced to accept a job offer. A broader definition of recruitment comes from the Merriam-Webster Dictionary, which yields the following for the verb recruit: "to secure the services of <~engineers>" [15]. While this definition is too broad to be useful in an HR setting, the best elements of both definitions may be combined for a more useful view of recruitment: the process of searching for and attracting an adequate number of qualified candidates, from whom the organization may select the most appropriate and attempt to secure their services to staff the organization's job requirements. Therefore, recruitment should be treated not only in terms of soliciting applications from candidates but also in terms of convincing suitable applicants to join the organization once they have been selected.

The first part of this process is letting potential applicants know that an organization is looking to recruit new talent. To this end, there are several methods and approaches that are commonly used such as help wanted ads, postings on internet job sites, soliciting at career fairs, and relying on referrals from those already working within an organization. Partially because there is no military draft in Canada, in this aspect of recruitment, the Navy and civilian businesses, such as those in the shipping industry, take very similar approaches to get the word out that they are recruiting. However, it is whom the Navy targets that differentiates its approach from that of much of the shipping industry.

In the case of the shipping industry, MET institutions often recruit untrained individuals who will become qualified seafarers upon graduation, and then individual shipping companies attempt to recruit these graduates into vacant shipboard positions using various incentives such as pay and benefits. Therefore, the task of initially recruiting people into the world of seafaring is one often carried out by MET institutions.

On the other hand, the Navy oversees its own training programs in partnership with an MET institution. Using this approach, the Navy can recruit from the pool of untrained and unskilled individuals, which is a much larger candidate pool than the pool containing only candidates who have already completed an accredited academic program. This is an important distinction because it allows the employer, the Navy, to recruit directly from high schools and from the entire work force in general. It also means that the Navy acquires talent when it can be had for a smaller cost, when it lacks the training or qualifications to demand high wages and benefits from other competing employers, rather than having to compete against other employers for students graduating with a diploma. The effectiveness of this approach will be discussed shortly.

That is not to say, however, that some in the shipping industry do not already employ aspects of this strategy. For instance, in the UK, the Merchant Navy Training Board (MNTB) offers recruits the chance to enter a sponsorship program whereby a shipping company will sponsor an untrained student and pay for his or her education at one of six UK MET institutions along with a salary during training [16]. The support of the shipping industry in the UK may be partially due to the tonnage tax there, which has also been adopted by other European countries, that requires shipping companies to invest an amount in cadet training based on the number of officers that it employs [17].

Such programs may be becoming more widespread as 44.1% of seafarers surveyed by Shiptalk reported that they had their training costs covered by their employers; 52.8% paid their own way through school, and 3.4% received a loan from their employer [18]. However, it is unclear as to whether the training costs covered by employers for the 44.1% included a salary during training, or if it just covered direct educational expenses such as books and tuition. In any case, this still leaves 56.9% of respondents who had to ultimately pay for their training out of pocket, which means that there is room for expansion of such sponsorship schemes. Please note that the figures presented in this paragraph are as they were presented in the original source where they do not add to 100%.

3.1 Incentives

In the earlier definition of recruitment, the first part involved getting applications from job seekers; after appropriate screening and selection, the next step is getting a candidate to accept the job, and incentives play an important role in this part of the process. According to Levitt and Dubner, "Incentives are the cornerstone of modern life. And understanding them-or, often, ferreting them out-is the key to solving just about any riddle" [19].Therefore, understanding incentives may be one of the keys to solving the shortage of seafarers.

In the case of the Navy Technician Training Plan programs, the incentives may be appealing to many people, especially untrained individuals who have limited career opportunities. Here is a summary of the incentives offered to entrants into either of the NTTP programs: [20]

- Annual salary (as of Oct, 2006): 1st year (in school) – $29,600CDN, 2nd year (in school) – $38,500CDN, upon graduation (after two-year program) – $51,000 CDN;

- Promotion to acting leading seaman upon graduation;

- Subsidized, fully furnished off-base accommodation close to the Marine Institute (e.g. two-bedroom apartment for $82 per month);

- 20 paid days of vacation per year (starting);

- Full medical and dental benefits;

- Six-year contract, with offer for extension;

- Education 100% subsidized, including books and tuition;

- An accredited diploma from a civilian MET institution;

- Guaranteed employment after graduation.

Although it is an option for some, most prospective seafarers do not have the option of a fully funded education with a salary during the training period. However, for those whose education is funded, such as UK students sponsored by a shipping company, they are given perks that are similar to those outlined above for the Navy students, such as a fully funded education with a salary during training [21]. Often, however, incentives advertised by shipping companies often target those who have recently completed training programs or may already be working in the industry. These incentives may also serve to help retain current employees. Common incentives include excellent wages, stand by pay, pension plans, and performance, re-joining, and seniority bonuses [22].

Overall, the incentives offered by the Navy and members of the shipping industry are similar. However, the fact that the Navy offers these incentives to unskilled labour with the offer to train them rather than trying to offer incentives to trained personnel after they graduate may be a better strategy as it allows the Navy to draw from a larger pool of prospective candidates. The fact that some entities in the shipping industry are following a similar path indicates that this may be an advantageous strategy worthy of wider consideration in the shipping industry.

4. Results of Survey Taken by Navy Students

In order to ascertain how effective the NTTP programs are as recruitment tools, a survey was administered to a total of eighty students who were enrolled in the NTTP programs at the time they completed the survey. In the NCSTTP program, roughly two-thirds were enrolled in their fourth academic semester with the other one-third studying in their second semester. In the METTP program, roughly half the students were enrolled in their second academic term, and the other half were enrolled in their fourth academic term. Overall, this means that some respondents were in the early stages their program, while others were close to completing it. The idea behind the survey was to mimic questions in the recruitment section of the Shiptalk Life at Sea Survey 2007/8 to compare if the students' reasons for joining the Navy were similar to the reasons given by seafarers for their career choice. Additionally, the author added several extra questions specifically related to the NTTP programs. The discussion of the results of the survey of Navy students will be limited only to those results which are the most important to the discussion at hand. Also, rather than cite each individual statistic from the Shiptalk survey, they are collectively cited [23].

When comparing the results of "Why did you join the Navy?" to "Reasons for choosing a job at sea," the same percentage of respondents, roughly 16%, answered for the money. 23.8% of Navy respondents joined because they wanted a career in the military as compared to 22.4% of seafarers who said that they wanted a career at sea, and 16.1% of Navy students cited better wages as compared to 15.8% of seafarers. The similarities in these responses demonstrate that recruits join the Navy for similar reasons that seafarers go to sea, with money or wages playing a noteworthy role in both cases. One large discrepancy, however, is apparent; only 4.8% of seafarers cited that they chose a job at sea for the better career prospects, whereas 19.6% of Navy students chose "Better career prospects in the Navy" as their reason for enlisting. Whether there actually are better career prospects in the Canadian Navy or whether there are limited career prospects for those at sea is not necessarily the point. Rather, the point is that these are the perceptions held by potential recruits to each career path, and if these perceptions are incorrect, it is up to the industry in question to help to change that perception if it is having a negative impact on recruitment.

Next, when asked about how they learned about their training program, Navy students cited a military recruitment office in 53.2% of responses. The shipping industry has no obvious counterpart to the military recruitment office, but given the results for the Navy, it may be something for the shipping industry to ponder, although it is not readily apparent to the author as to how the shipping industry could implement something as effective as the network of nationwide military recruitment offices. 20.8% of Navy respondents said they learned about their program from friends and family compared to 42% of seafarers who learned about employment opportunities at sea through friends and family. This seems like a large number for the shipping industry, and it may indicate that the industry has some work to do in publicizing its job and career opportunities. 9.1% of Navy respondents listed the internet as how they learned about their training program, and 8.5% of seafarers cited the internet in helping them learn about employment opportunities at sea. Given the low number of respondents in each case regarding the internet, improving their internet presence may be a future area for growth for both the Navy and the shipping industry, especially considering the target demographic of young adults.

In response to the question "Do you consider your career in the Navy a job for life," 63.9% of Navy students said that they thought of themselves progressing through the ranks and retiring with a pension after a full life career in the military, which is somewhat higher than the 45% of seafarers who gave a similar response in the Shiptalk survey. Only 13.9% of Navy respondents said that they just wanted to stay in the Navy long enough to obtain some qualifications and experience and then look for a civilian job, but 30.6% of seafarers said they would look for a job onshore after obtaining some qualifications and experience. These results indicate that retention seems to be more of an issue in the shipping industry than in the Navy. Finally, 22.2% of Navy students intend to leave the Navy someday when they have family responsibilities as compared to only 7.4% of seafarers who intend to leave their career at sea for family responsibilities.

In addition to the questions that were modelled after those in the Shiptalk survey, the Navy students were asked additional questions that might shed some light on the mind set of recruits of the Navy's training programs. For instance, when asked which incentive was most important in their decision to enter their training program, 25.4% chose an accredited diploma from a civilian learning institution, and 16.9% cited good career prospects in the civilian world that would be available after they left the military. Therefore, Navy recruits seem willing to join the navy partially because it may eventually lead to a better civilian life if or when they leave the Navy. The parallel that can be drawn with the shipping industry is that in trying to recruit people to go to sea, it may help if the prospective recruits thought that their training and career at sea could eventually lead to a good career on land.

On the other hand, these were not the only responses given when the Navy students were asked about recruitment incentives. 23.7% of Navy respondents, the second highest response, cited a full salary during training as the most influential incentive, and 18.6% chose an immediate promotion upon graduation, which comes with a pay raise. The implication for the shipping industry is that while money is not the only important incentive, it is a very important consideration – especially if a salary is provided during the training period. Free tuition and books was chosen only by 5.1% of respondents, which may indicate that the steady pay cheque during training is considered more of a monetary incentive than the payment of education expenses.

As well, prior to entering a Navy training program, only 6.6% of respondents were already in the Navy. This means that 93.4% of trainees came into the program from outside the Navy. This is important because it demonstrates that this program does indeed bring new recruits into the Navy and that the training programs do not simply serve to train those who have already enlisted. Also noteworthy is that 18.4% of respondents came into their program from high school, which was the second highest response, but the vast majority of Navy trainees, 53.9%, had been working as civilians prior to entering their program. One might speculate that many of these in the 53.9% may have been dissatisfied with their civilian jobs, or it is unlikely that they would have been considering joining the Navy. The implication for the shipping industry is that high school students can be recruited if offered the right incentives, but perhaps the biggest potential source of seafarers is those who are currently working but are dissatisfied with their careers.

One of the most telling statistics became apparent when those students who had come into the program from outside the Navy were asked what impact their training program had had on their decision to join the Navy. 66.7% of respondents, or two out of every three, said they joined the Navy specifically to undertake their training program, and they otherwise probably would not have joined. This demonstrates that the NTTP programs are a powerful and effective recruiting tool for the Navy. The implication for the shipping industry is obvious – subsidized training programs, along with other incentives, help to recruit new talent.

Finally, Navy students were asked if they had not joined their training program, how seriously would they have considered a life as a professional at sea? 52% of the students responded either not at all or that they would only have given it minimal consideration while 24.7% stated that they would have ended up at sea in any case or that they would have seriously considered it, with the rest, 23.3%, falling somewhere in the middle. The 52% figure is very important for the shipping industry in that it demonstrates that people with no real desire or ambition to go to sea may be enticed to do so when the right incentives are offered, such as those provided by the Navy through the NTTP programs.

5. Conclusions

As the shortage of skilled seafarers is predicted to worsen, the shipping industry must investigate new and better ways to recruit new seafarers. The Canadian Navy may serve as an example to the shipping industry in this regard; in particular, the Naval Technician Training Plan programs offered by the Canadian Navy in partnership with the Marine Institute have turned out to be an effective means of recruiting skilled technicians into vacant positions on board Navy ships. The Navy's approach of recruiting unskilled individuals and having them trained at the Marine Institute, with whom the Navy works closely, appears to be working as the vast majority of recruits who had come from outside the Navy reported that they had joined the Navy specifically to undertake their training program. Furthermore, many students seemed to indicate that their training program was important in preparing them for a better life as an eventual civilian on land, and many indicated that money was an important factor in their decision to enrol. The majority of these students also indicated that they would not have likely considered a career at sea if it was not for their Navy training program.

There are several implications for the shipping industry. First, even though steps have already been taken by some in this direction, it might help if the industry were more willing to recruit unskilled talent and pay for their training, including a salary during training. Next, more prospective seafarers might be convinced to join the profession if they saw their career at sea eventually leading to a good career on land. As well, money is an important consideration, and excellent remuneration is more than an expectation for possible seafarers, it is a requirement. Finally, it is possible, with the right incentives, to attract people to the seafaring profession who otherwise may never have considered it.

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A Case Analysis of Philippine Transmarine Carriers

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Shipping firms contract with Philippine Transmarine Carriers (PTC) to have crew members available to man ships where, and when, they are needed. PTC handles all human resource functions for client shipping firms (training, compensation, benefits, housing, and travel). Employee turnover is a major challenge at PTC. Ships are generally staffed with contract employees. Life onboard can be dull and repetitive. Hence, the employee turnover rate for commercial shipping is relatively high. Crew quality declines when turnover is high. Moreover, a significant cost is incurred to replace employees. The challenge at PTC is two-fold: First, to get crew members to stay with PTC for longer periods of time. And second, to get crew members to take the training and work initiative needed to advance in rank.

In presenting potential management solutions for the challenges faced at PTC, students must incorporate important theoretical concepts from Human Resource Management (HRM) and Organizational Behavior (OB) disciplines. The case is specifically tailored to expand student knowledge of concepts relating to commitment, motivation, and satisfaction. The case is mainly useful for supplementing OB and HRM courses of study. However, the international context in which PTC operates introduces students to the global influences that can affect HRM and OB disciplines.

Keywords: Case Analysis, Organizational Behavior, Human Resource Management, International Shipping, Commitment, Motivation, Satisfaction

Introduction

In June of 2014, Dito Borromeo, Vice-Chairman and CEO of Philippine Transmarine Carriers Inc. (PTC), and Karen Avelino, Executive Director of PTC were considering their options for the future growth of the company. Effective planning had placed PTC in a position to exploit unfolding trends in the maritime industry.

The maritime industry had seen a recent rise in ship owners' use of outsourcing firms to handle the general maintenance and staffing of commercial vessels like container ships and cruise ships. Shipping firms contract with outsourcing firms like PTC to provide qualified and capable crew members available to man ships at the time and place that they are needed. All a ship owner has to do is call PTC and let them know their crew member needs, and where, and when the crew is needed. PTC then takes responsibility for all human resource management (HRM) functions (training, compensation, benefits, housing, travel, etc.). Shipping firms outsource HRM operations to firms like PTC because these firms have specialized skills and economies of scale that allow them to execute HRM functions more effectively and cheaply than shipping firms could often manage on their own.

PTC handles HRM for both the recreational cruise ship industry and for cargo shipping firms. The cargo shipping industry contracts with PTC to provide ship navigation, engineering, and maintenance professionals. The cruise ship industry contracts with PTC to provide all of these types of mariners. In addition, PTC also provides the cruise ship industry with customer service professionals who are responsible for servicing passenger needs including laundry, food, and maid service, among others.

Cargo ships are overwhelmingly crewed by men (over 99%), while around 30% of crew members on cruise ships are women.

Due to their effective positioning in a growth segment of the maritime industry, PTC has been expanding rapidly. They now handle many types of cargo vessels including container ships, car carriers, chemical and oil tankers, and advanced liquefied natural gas and liquefied petroleum gas carriers, among others. PTC has also expanded into a variety of ancillary industries, including general ship management and maintenance, and offshore processing which includes transporting important supplies and personnel to ships while they are at sea. They have even expanded from supplying customer service professionals to the cruise ship industry, to supplying international hotels with similarly skilled personnel.

Starting from their corporate headquarters based in Manila in the Philippines, PTC has also recently entered Indonesia. The Indonesian branch is known as PTC Centina. Mr. Borromeo and Ms. Avelino hope that PTC Centina will one day mirror Philippine operations, but PTC is beginning their entry into Indonesia with the development of cruise ship staffing services.

Their Philippines and Indonesia locations give PTC access to two of the largest and best sources of qualified mariners in the world. The Philippines is one of the primary sources of maritime professionals used in the global shipping industry. About 280,000 Filipinos graduate each year from the more than 80 universities in the Philippines that offer maritime degree programs [1]. The past couple of decades have also seen rapid growth in the Filipino maritime industry. In 1996, there were approximately 250,000 sailors of Filipino origin [2]. By 2013, that number had nearly doubled to a total of over 460,000 Filipino sailors [3]. Indonesia is an island nation situated in the middle of some of the busiest seaways in the world. There are currently over 12,600 Indonesian-flagged ships on the world's oceans [4]. In 2013, the Indonesian shipping industry was projected to grow at an impressive 20%rate [4], but that growth has slowed somewhat with the global economic downturn. More current projections forecast a still respectable 6-7% growth rate for the Indonesian shipping industry [5].

Employee turnover

Employee turnover is a major HRM cost in the maritime industry. For crew members, life on a ship can often be lonely and repetitive. Filipino and Indonesian crew members are also generally contract employees, meaning that they are temporary employees who work for the length of their contract and then must find another contract employer. To avoid the turnover problem, Mr. Borromeo and Ms. Avelino have considered keeping full-time salaried crews employed year-round at PTC. However, the cost of keeping full-time salaried employees to man ships is high. There is often too much uncertainty in the availability of work, and competitors could underbid PTC by saving payroll expense through the use of short-term contract employees.

Due to the nature of life aboard ship and the prevalence of contract employment, the employee turnover rate for commercial shipping crews is relatively high compared to other industries. Considerable resources are needed to scrutinize new applicants and to train and integrate them into shipboard operations. When a seasoned employee leaves PTC for another contract position, PTC incurs a significant cost to replace that individual.

Employee turnover also affects the quality of crews that PTC is able to provide its client shipping firms. Being a commercial mariner is a demanding, highly skilled position. PTC strives to provide crews that have distinct types of expertise demanded by individual client shipping firms. Hence, crew members are never shared among client shipping firms. Crews are assigned to a specific shipping firm throughout their tenure at PTC. Many of the skills required to be successful can only be learned through years of experience. Crew members who are new to the industry are not able to provide the same quality of service as experienced crew members can provide. A lack of experienced crew members can hinder PTC's ability to attract and retain the best shipping firms as long-term clients.

Employee advancement

Another problem that PTC faces is trying to get mariners to gain the education and experience necessary to advance in rank. Many Filipino and Indonesian mariners see work in the maritime industry as a short-term job which they use to save up money before starting a family and taking a shore job where they can be closer to home. Hence, many do not invest the time and education needed to advance in rank to a more highly paid master mariner position.

Each crew that mans a vessel is made up of about 18-20 members, 2-3 of which must be master mariners. Because of the limited availability of qualified Filipino and Indonesian officers, master mariners are often of Japanese or European origin. These crew members are more costly to hire than Indonesian or Filipino sailors. Moreover, when lower ranking Filipino or Indonesian crew members have a concern that they want to voice to their superiors, they often find communication difficult due to the cultural divide that occurs when higher ranking officers are mainly of a different nationality. This problem is exacerbated by the long chain of command that is often characteristic of commercial shipping crews. Mr. Borromeo and Ms. Avelino suspect that this may contribute to the turnover problem.

Retaining mariners and encouraging advancement

Due to the costs associated with employee turnover, PTC has a strategy designed to retain qualified mariners for as long as possible and to encourage them to advance in rank. PTC partners with a local university to manage a maritime education program that prepares crew members for the demands of the maritime industry, assures that they have the proper qualifications, and provides educational opportunities needed for career development.

Discounted home loans are also available for PTC employees. PTC has contracted with a local housing development company to build "seafarer communities" with a total of over 900 units. PTC also contracts with a local bank to provide employees with easy access to loans. Often the wives of seafarers (who are generally men) are the target of these loans which are used to finance small entrepreneurial ventures. These small businesses provide an additional source of income to households when they are between maritime contract jobs. They also to help keep family members occupied at home during long sea voyages.

PTC strives to make life onboard ship more comfortable by helping employee to keep in contact with loved ones using PTC Connect. PTC Connect is a shipboard communications system that allows easy and constant contact with home in the form of text messages that can be sent and received using a computer or mobile phone. PTC is also in the process of executing an agreement with a maritime communication firm (SMART Communications) to provide shipboard voice communication, allowing crew members to talk live with family and friends throughout their voyage. PTC facilitates holiday parties, barbeques, and birthday celebrations for its crew members to try to break up the monotony that can often characterize life onboard ship. Ships are also normally equipped with a swimming pool, gymnasium, a collection of DVDs, internet access, and a supply of magazines.

Despite the efforts of PTC to retain employees, the average employee still only lasts only a few years before permanently leaving the firm. Mr. Borromeo and Ms. Avelino are convinced that PTC can do better at encouraging employee retention and career advancement.

Case Analysis Questions

1. Describe some HRM functions at PTC that encourage commitment. Explain whether each of these encourages affective, continuance, or normative types commitment and explain how you know that it does so. Also discuss the role of perceived organizational support. Remember that some HRM functions may encourage multiple types of commitment. (10pts)

2. Describe some challenges at PTC that discourage commitment. Explain whether each challenge discourages affective, continuance, or normative commitment and explain how you know that it does so. Remember that some challenges may discourage multiple types of commitment. (10pts)

3. Use expectancy theory to help explain why mariners at PTC are not highly motivated to advance in rank. What part(s) of expectancy theory is/are missing (expectancy, instrumentality, and/or valence) and explain how you know. (10pts)

4. Imagine that you are working as a HRM consultant for PTC. Describe at least two ideas you have for how PTC may encourage employees to stay, encourage them to advance in rank, or both. Explain which course concepts are most strongly related to your suggestions (look for relevant materials relating to commitment, motivation, satisfaction, etc.). Be sure to use course concepts to explain why you think your suggestions are likely to work (e.g., select a type of commitment that appears to be missing and explain how your approach will increase that specific type of commitment). (20pts)

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Session 2C
Seafarer Training

Discovering the Unexploited Skills of Dual Ship Officers

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By studying the ships officers program as a Dual officer, the students from SIMAC end up with skills that enable them to act on the bridge as well as in the engine room.

A holistic approach to the entire vessel operation is one of the beneficial skills which dual officers get from their studies. However the majority of dual officers are not employed as dual officers, but instead they are working as single officer Marine Engineers or Master Mariners.

The dual officers are not making use of their dual skills

Having this in mind, two lecturers at SIMAC sent out a questionnaire to approximately 400 former dual officer students, all in all 158 responded to the questionnaire.

The main purpose of the questionnaire was to study if the Dual officers have unexploited skills or possibly a lack of skills.

The questionnaire revealed that 47% of the158 respondents find that they have unexploited skills and that 21 % of the respondents are experience a lack of management and practical skills [2].

Difference in tasks and skills

To operate a ship with dual officers the vessel must reorganize its organization. This task has been shown to be more difficult than expected because reorganization takes time and demands innovation in the daily routines on board the vessels and in the shipping companies.

When recruiting new employees to man the vessels, it seems that the shipping companies only ask for single officer applicants. The reason for this could be that there is a general lack of knowledge of what the dual officer program consists of and which skills the dual officers have after completing their education.

However the dual officers are often used in the land organisation of the shipping companies because of their dual skills and their wide knowledge about shipboard organisations. This is indicated in the extract below from the questionnaire:

"I almost have to answer that, but in reality the dual education, in my perspective, has not existed long enough to make a mark in traditional shipping organizations. I often see that primarily you have either nautical or technical areas of responsibility, not often both at the same time. Nevertheless if you are employed in a shore based shipping company it makes sense to have the dual training, as it is a great advantage having the complex ship knowledge among especially senior single trained colleagues where you often get the role as the "go-to-guy" in different situations. The essence being that the dual skills are informally implemented, but at least exploited [1].

Conclusion

Our analysis shows that every fifth dual officer has experienced inadequate skills that can be split up into management and practical skills.

Almost every second dual officer feels they are not fully using their skills. These skills could be used for restructuring shipboard organization.

Because a lot of companies are not aware of how they can use the dual officers there is a need for better information on which skills the dual officers have.

Keywords:

Dual officers

Skills

Qualification

Organizational restructure

Tasks

Innovation /future jobs

Upgrade

References

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Introduction

The dual officers are trained both to act on the bridge and in the engine room.

Not many would doubt the fact that the dual ship's officers have broad capabilities, but how many of the dual-educated officers have skills that they do not use in their daily work on board ships? This is question we have chosen to examine. The purpose of the study is to find out how these potentially unexploited skills can be activated via revised job functions in the maritime land organizations.

In contrast with the potentially unexploited skills that dual officers hold, we have chosen to investigate whether there are areas where they have a lack of experience. The aim of this is to have a look if there could be any advantages from making some adjustments to the dual ship officer program.

Furthermore, we will investigate which training activities that can increase their skills are the most preferred.

Finally, we have chosen to investigate whether dual officers believe that networking meetings, which of course is an activity that has had much success in recent years, can help to enhance one's skills. To identify the dual officers' potential competencies, a questionnaire was developed that was distributed to approx. 400 former graduates.

To look at the matter from the maritime industry's point of view, we have further decided to investigate the industry's attitude and experience of dual officers. For this study, we have also prepared and distributed a questionnaire to 16 maritime leaders who have to do with dual officers.

The reason for the dual ship's officer training

In 1995 the Danish parliament set up a committee aimed to come up with suggestions on how Denmark could continue to maintain its position as a leading maritime nation still using Danish seamen on board the ships. This was based on the development in Danish shipping, where fewer and fewer Danish seamen are being hired in favour of foreign ones.

One of the Commission's proposals was to reorganize the officer training program to make Danish officers more competitive than the cheaper foreign labour. In addition to a thorough modernization of officer training, it was also a proposal from the Committee to change the titles of the head officers of the ships from the Shipmaster, Chief Engineer and Chief Officer for Ship Manager, Maintenance Manager and Navigation Manager. The radical change in education meant firstly that the admission requirement for education was increased. In addition, the basic types of education of the officers were merged to a combined course where first they had to choose a main direction of the education after having acquired the rights to take the duty on the bridge and in the engine room. In addition, the Committee proposed that the training should be designed with a mix of experience at sea and theory in educational institutions. This included the stipulation that the industry is obliged to ensure that no one who completed basic training would be unable to complete the full training due to lack of service at sea as a unit officer.

Ship's officer training at SIMAC

The training of dual ship's officer at SIMAC consists of two parts: a junior program and a senior program.

The junior program lasts 4 years, after which one obtains a title of Bachelor of Maritime Transport and Ship Management. The junior program issues a certificate of competency as a deck officer and engineer, equal to (STCW) A-II / 1 and A-III / 1.

Completion of the Junior Officer program gives access to the Senior Officer program.

At the senior program you choose to specialize as Master (A-II / 1, A-III / 1 and A-II / 2), Chief Engineer (A-II / 1, A-III / 1 and A-III / 2) or Ship Manager (A-II / 1, A-III / 1, A-II / 2 and A-III / 2).

The senior program takes between 6, 12 or 18 months depends on what you choose to specialize in. [1]

Analysis of empirical data

Dual officers' experience with use of their skills

As mentioned earlier, we have sent out a questionnaire to approx. 400 former graduates of SIMAC, of these, 158 responded, giving an overall response rate of 38%

The respondents can be dived into the three different fields of education as follows

Chief Engineer	18 %
Master	45 %
Ship Manager	37 %

Of the total number of respondents 58% (92 persons) are working at sea.

The questionnaire consisted of a mix of quantitative and qualitative questions, but the recurring theme in the questionnaire is whether graduates have experienced lack of skills after graduation, or whether they feel that they have unexploited skills that they have not used in their work [2].

The maritime industries' experience with the dual officers

To clarify the industry's experience and attitude to the dual officers, we sent out a questionnaire by mail to 16 maritime leaders in Danish companies and out of these 9 answered. The questionnaire consisted of six questions, starting with two quantitative descriptive questions and four qualitative open-ended questions to clarify attitudes and opinions about the dual officers skills and if the dual officers could be used in a different way than today. [3]

Unexploited potential of competences

The examination of the dual officers shows that 47% of the respondents believe that they hold skills that are not being fully exploited in their daily work. [2].

Many respondents expressed the opinion that dual officers involved in single positions such as engineers or navigators have some unexploited skills. Despite that, there are respondents who believe that the dual skills held together by one person provide some good opportunities and a versatility that are in demand in many areas of the maritime sector. However, we see that there are several respondents who say that one can make use of the dual training, although not directly when employed as a dual officer. This means that the dual skills are to some extent being used, even if they are not used in the way they were actually intended.

The most obvious trend in the responses from the dual officers is that companies should be more focused on using dual ship officers in their fleet. When the dual officers are employed in single positions, either as an engineer or mate, the companies are forcing the dual officers to make a choice of career, and this, of course, naturally creates potentially unexploited competencies. In order to use the dual officers properly you would have to think differently and change the culture, and this is something that takes time and resources.

The study of maritime leaders shows that four out of nine believe that the dual officers could be used in a different way than today. Several of the managers indicate that they certainly can be applied more flexibly than today when they gain some more experience. This attitude also shows that it takes some time before it leaves traces in the organization. As one of the leaders points out, it eventually could be an advantage if the system was made so flexible that the dual officer can spend extra time in the department where they need extra experience. Several dual officers point out that the unused skills are useful in land-based positions. This is also indicated in the below extract from the questionnaire:

> *"I almost have to answer that, but in reality the dual education, in my perspective, has not existed long enough to make a mark in traditional shipping organizations. I often see that primarily you have either nautical or technical areas of responsibility, not often both at the same time. Nevertheless if you are employed in a shore based shipping company it makes sense to have the dual training, as it is a great advantage having the complex ship knowledge among especially senior single trained colleagues where you often get the role as the "go-to-guy" in different situations. The essence being that the dual skills are informally implemented, but at least exploited"* [2].

The opinion about that dual officers are use full in land-based organisation is shared by the maritime leaders, who believe that the effect of the dual officer's broad understanding of ship operation will be ideal in land-based positions, some good examples could be superintendent or surveyor.

One of the dual officers believes that the focus should be more on the general understanding of ship operations which the dual officers have accumulated by working in both departments. Likewise, he points out the potential advantages of the company having only one contact on the ship (single point of contact), which could facilitate decision making and create a shorter path from decision to action. This also demands of course a lot from the land organization.

Tasks at sea

Many companies have tried to use dual officers in their shipboard organizations but have since stopped using dual and instead engaged them in single posts. The fact that some companies have not been able to use dual officers on-board their ships could be related to the fact that the dual officers have just taken over the positions held by single officers, therefore they naturally come into the roles and procedures already running on the ships. This idea about the dual officers being linked in periods to either the engine room or the bridge is also not in line with the way they are taught during the senior part of the ship's officer training program, in which cadets are taught each semester either as master or chief engineer and therefore in practice are trained to work in one or the other department.

Thus the holistic mind-set that was actually the idea of the dual training is being lost. As several of the dual officer respondents say it requires a rethinking of ship organization and a break with the traditional division of labour, as well as a rethinking of the structure of the dual training program leading to an independent program and not a merger of two programs [2]. This division may be a contributing factor to fact that they find it difficult to engage and influence their job functions on board the ships.

Some dual officers suggest that the industry consider them to be less competent because they are both in the engine room and on the bridge, and thus have not kept the focus in one area [2]. But this may be due to a misinterpretation of the profession of dual officer ship. Being a dual officer is not a matter of being a specialist in two existing fields but one who is able to consider the ship as one unit. The cause to this misinterpretation could be due to insufficient knowledge about the background, purpose and awareness of the dual training program.

Educational competence gaps

In a former chronicle we describe the finding that lack of skills is something that 21% of the responding dual officers have experienced at one or more points in their careers, . When we take a closer look at which areas the respondents most often experience lack of skills, economy, project- and personnel management is often mentioned [4].

On the practical level, troubleshooting on electrical installations and machinery comes up as one of the areas where skills are lacking. Looking at what the maritime executives believe about the dual officers' lack of skills, they are also of the opinion that they lack practical experience [2]. Several of the dual officers point out that during their time as a ship officer they hardly dealt with practical troubleshooting. This may be due to the past, where the focus was on a knowledge of components rather than the understanding of technical systems in which the components are used.

> *One of the respondents answered the following to the question: Have you in your career experienced times when you have experienced lack of skills / qualifications because of your dual training* [2]
>
> > ***"At the theoretical level, it would have been great with more focus on management and economics in the dual education. Especially when you consider how many of the former class members have now stopped sailing but are employed in leadership positions in the Blue Denmark."***

Why the dual officers are not made use of?

When the Funder Committee was set up in 1995 it was thought that the Danish shipping needed broad competencies for the Danish officers. The reason was a growing decline in the number of Danish seafarers, a trend the Danish government wanted to turn around.

It was thought that by increasing the skills and making the officers' skills broader, it could make them more attractive at sea compared to foreign seafarers, and thereby increase employment of Danish seafarers [5]. The shipping companies gave as a reason at the time to keep a certain number of Danish seafarers on board Danish ships, a long-term strategy concerning ship management, manning the company offices, etc.

How does it look today, almost 20 years later? The prediction that the Funder Committee made about the need for the seafarers to have broad skills in ships proved not quite fitting. There is a growing demand for specialists, especially in the tanker, supply and offshore market, which means that the industry does not demand the broader type of education at sea. Especially in the tanker market, the companies say that they cannot use the dual officers because they do not earn enough sailing time in each position, which becomes a problem in the oil companies Vetting Regime [4]. The Oil companies' SIRE program has since 1995 taken a greater and greater effect, and the oil companies control the officer crewing arrangements by officer matrices. They do not recognize, in this context, dual officers who therefore must be mustered in single posts. Generally the greater picture shows that specialists are the ones in demand at sea. So the intention of changing the ship organization and bringing in seafarers with broad competencies has not been shown to hold.

One can now see that there is a great migration of skills from the ships to the shipping companies and other maritime industries, which are important for the maintenance of the competencies in the Blue Denmark [6]. So you could say that part of the Committee's reason for amending the education has proved to be true. If you look at the number of Danish seafarers since 1995, the number of Danish officers has increased to over 2,000 in 2000, compared to 1,723 in 1995 [5].. From 2000 to 2011 we will gradually reduce the number of Danish officers to approx. 1,750 (graph is shown in Figure 1). So we cannot conclude that the transformation of education as a result of the Funder report has resulted in a greater number of Danish seafarers.

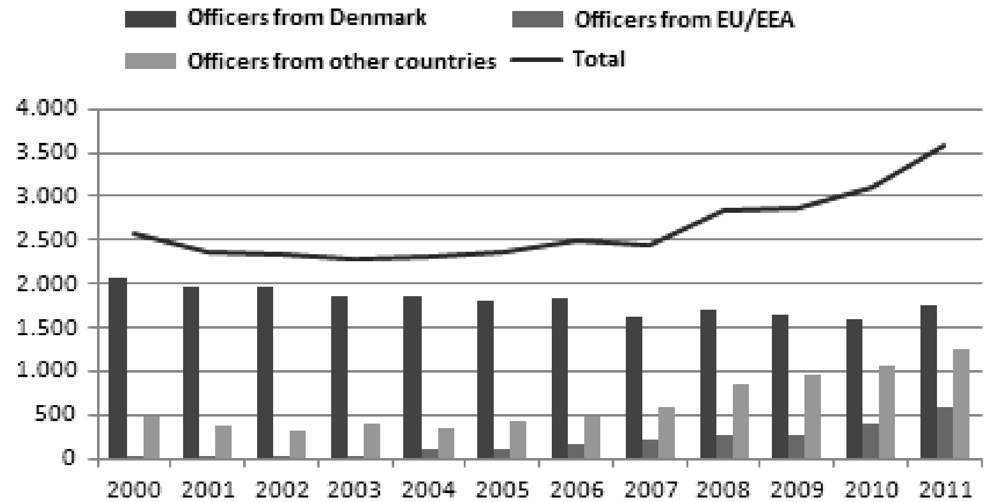

Figure 1 Number of officers employed on Danish ships from 2000 to 2011 [7]

As described earlier, there is a migration of skills from the ships to the shipping companies' organizations, as well as to the other maritime industries [6]. This is what some of the dual officers also point out: a dual officer with practical experience is ideally suited for a job as a superintendent surveyor. The reason why the dual officer is suitable for these positions is their broad knowledge of the technical operation combined with experience at sea [2]. As pointed out in Landlubbers and Seadogs, there are some industries outside the maritime sector where the at sea experience is a major advantage [8]

Changing shipboard culture

In order to be able to use the dual ship officers on board ships it is important to look at the culture on board. It can be difficult to change the culture on the ships. As described in CEFUs analysis of ship's officer students, there is a tendency that sometimes it can be lonely to be the watch keeping officer [9].

Looking at how the ship's officer students perceive the culture in the engine department, it seems as if there is a larger community because of the many common tasks to be solved. When the dual officer is alternating between two very different departments, it is difficult to find your own identity as an officer. Instead they do their best to fit in to the different departments. Some of the dual students point out in that therefore they feel that the responsibility to convince the single officers on board that the dual officer program is a good idea, lies on their shoulders. [9].

As described in Human Factors in the Maritime Domain there is a very strong professional culture in the maritime trade and this culture could well be one of the major reasons why it is so difficult and why it takes time to implement the dual concept [10].

We find that the shipping companies must adjust the organizational structure on board the ships in order to ensure success for the dual officers and ensure that there will be a visible difference when using dual officers in a dual position.

Our questionnaire points out that for the dual graduates the maritime industry's knowledge of the dual training is not sufficient, and therefore the dual officers are not recognized as a potential recruit to the maritime organizations. [2]

Evaluation of the dual training program

Looking at the composition of the dual training, the students expresse a lack of coherence between the individual subjects during the education, which is necessary in order to produce the interdisciplinary skills which the industry has requested [9]. This trend is also seen in some of the respondents to the questionnaire, where it is pointed out that focus should be more on the dual officer as one education instead of a merger of the two programs (engine and navigation) [2].

It is important that the objective is well communicated. What is a dual officer, what are the competencies and what are the benefits for the maritime industry from using dual officers. It is not just an officer who can navigate and maintain the engine, but a generalist who has an overall view of the ship.

As also highlighted in our questionnaire, troubleshooting is one of the most frequent lack of skills that the dual officers experience after they have graduated, especially troubleshooting on electrical and hydraulic systems [2].

Furthermore there has been too little focus on providing information on-board on how to implement the dual training. No one is probably in doubt about how to act in their respective departments. But again then we just return to a merger of two departments. If you want the dual officers to set new standards in ship operation, then focus must lie on shipping operations as a whole and not as two separate departments put together. [2].

Developing the dual officers competences

To find out if any of the dual graduates have made an effort to rectify a lack of competency, we asked them what type of training activity they have participated in.

Furthermore, we examined the graduates' opinion on whether the network meetings can contribute to improving skills.

Upgrading of qualifications

The aim of the Danish government's growth plan is to ensure a strong Danish competitiveness through an ambitious education agenda designed to provide a distinctive competence level of the Danish workforce. In that contest it is problematic that just under half (47%) of the dual ship's officers in the Blue Denmark believe they have an unexploited potential [4].

Furthermore it is also interesting to look at how training is divided between the private and the public sector. As seen in the Figure 2 below, it is primarily in the private sector that dual-officers have completed a Diploma / Masters course.

So to accommodate the growth plan, focus should be maintained on the unused potential competence, as well as for a skilled workforce in the private sector.

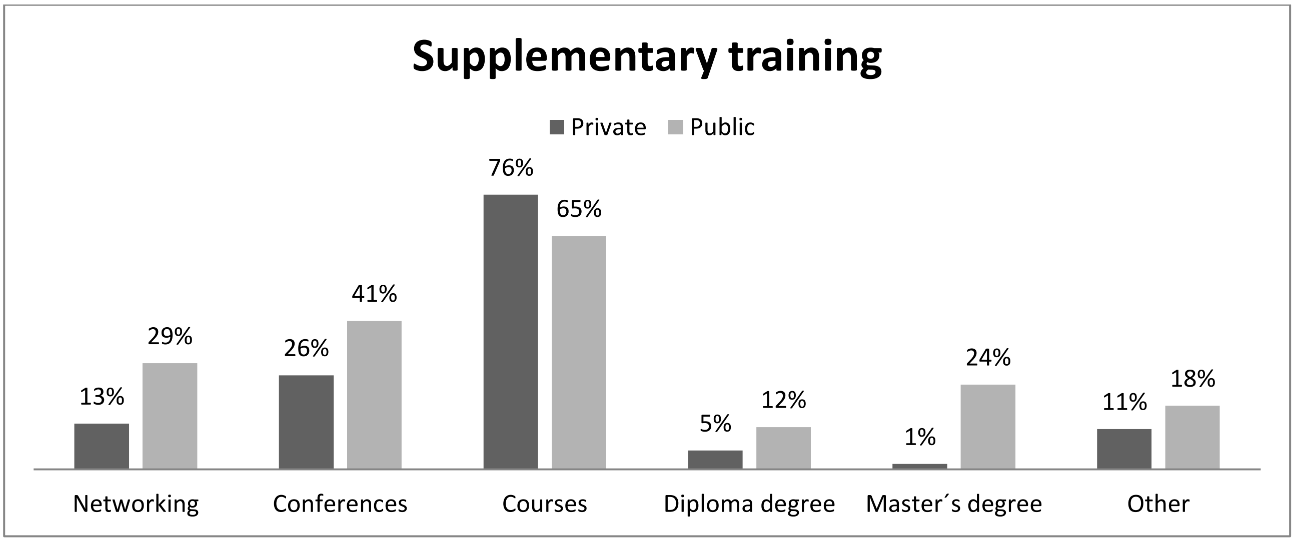

Figure 2 Percentage of supplementary training by public/private employed dual officers [4]

Network meetings

A large number of respondents believe that networking meetings are good for sharing knowledge, both in industry and in general, in order to get a glimpse of what goes on in the maritime sector. It is also suggested that it can be used to identify which skills you lack and what direction to go [2].
However, there are some who do not believe that networking meetings can be used to develop skills of seafarers in the maritime industry. Instead they find that it can certainly be used in land-based positions. This matter of opinion could be related to the fact that as a sailing officer you are often bound by a fixed ship organization.

Conclusion

Our analysis shows that one in five dual officers has experienced a shortage of skills, mainly in the management field and in practical skills.
Furthermore, we can conclude that every other dual ship's officer believes that they do not use their skills fully. These unused skills could possibly be used to restructure the shipping organizations. The most significant reasons for the dual officers not being used is because there is a lack of understanding of what it means to be a dual officer, and the attempt to implement the dual officers in the traditional ship organization, forcing them to choose between departments.
Moreover, it seems as though the educational institutions have too little focus on the interdisciplinary character of being dual trained.
Despite the fact that the dual officers has untapped skills, there are still many who have participated in training activities to improve skills in specific areas, however a clear trend is that a greater proportion of employees in the private sector has acquired a diploma-/ master’s degree.

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Could Introducing Simulation Into Mandatory STCW Short Course Programs Be an Innovative Approach to Assessing Competence?

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This paper presents an argument that while the International Maritime Organisation, (IMO) has identified a number of critical factors, including human failures, which continue to cause disruption to worldwide shipping operations. The paper further accepts that there is supporting evidence that IMO amendments to conventions such as Safety of Life at Sea, (SOLAS) in 2002 have gone some way to improving ship-board conditions and operations, and the 2010 amendments to the mandatory training components of the Standards of Training and Certification for Watchkeepers Convention, (STCW) are likely continue this record of improved performance. The paper also identifies and argues that there is a risk for maritime training and education institutions, (MTE) that unless they are prepared to apply a higher level of assessment when determining an advanced seafarer's level of competence to deal with significant on-board emergencies, this emerging trend of declining emergency response incidents may well be reversed. Supporting this argument is a 2013 review, produced in collaboration between Allianz and Cardiff University acknowledging that while there is evidence of reduction in occurrence of fire emergency on-board, the subject still remains a high risk factor when compared to the likelihood of other disruptive events occurring. The paper presents an argument that in order to prevent a return to past events a MTE will need to become innovative in their approach to training and assessment, achieved through the introduction of simulation into the STCW mandatory short course programs, specifically those that deal with emergency situations.

Keywords: **:** mandatory, STCW short course, advanced seafarer operations, development, skills and knowledge, innovation, realistic assessment.

1. Introduction

Since the late 1950's the world maritime industry, through IMO, has come to realise shipboard safety is heavily reliant on a competent and well trained crew. In 1969 it was agreed that in order to consistently achieve this on as large a scale as possible an international standard for training and certification should be developed. This resulted in the development of a draft STCW Convention coming into existence in 1978.Unfortuently the 1978 STCW Convention was lacking in terms of providing a standardised approach to training of seafarers, and with so much of the detail and subsequent requirements being open to interpretation by the signatories to the Convention. The IMO identified with the United States that a review was in order, and this decision coinciding with the 1992 grounding of the MV AGEAN SEA, was to be the turning point and IMO decided a larger scale review was in order and it needed to take into account the role human failure played in maritime casualties. Attention needed to shift from standards of construction and equipment and start to focus on training, people, and operations.

This paper is not intended to question any STCW review or Casualty investigation, but uses events of the past as a means of identifying the emerging conclusion that human factor failures are significant contributors to casualties within the world maritime fleet. This conclusion forms the basis of an argument that even though the STCW has been reviewed over many years it is only recently, within the last 8 years, that the IMO has come to identify that the level of standardisation is still open to interpretation, and the development of training and education differs between member states. It is evident that the IMO realises there is an immediate need to raise the quality and effectiveness of the combined training and education of seafarers [1] in order to meet the demands of our moderns fleet and attempts to do this through the introduction and entering into force the amended STCW 2010. The paper identifies with a few simple emergency incidents on board that outline possible causes, and with

this, introduces a concept that may address some of the many short falls in the ongoing development of the modern advanced seafarers.
In order to identify and support this concept this paper seeks to analyse current reviews and amendments to the STCW convention and code and seek to define through interpretation what is meant by the acronym STCW. It is through this interpretation that MTE’s will better understand the complexities that have been created, but not addressed, even though at subsequent meetings of IMO and relevant committees it has been highlighted the convention and code needs to account for and reflect the modern shipping fleet and the changing operating environment a ship’s crew find themselves working within [1]. By having a better understanding of key terms such as Standard, Training and Certification it is proposed MTE’s will become better informed and able to adapt and ensure the required managerial and operational level of learning is applied into the program of learning and teaching to support and prepare the shipboard officer of today, and tomorrow.
In Australia the regulatory authority for maritime certification, training endorsement and approval is the Australian Maritime Safety Authority, (AMSA) and they have responsibility for ensuring the STCW requirements are implemented as required and they undertake audit, inspection, detention, and legislative control to ensure this is the case. AMSA recognise the Maritime Training Package as meeting the requirements of the STCW for certification purposes for all short duration safety related training programs. From this point forward within the paper Vocational Education and Training; (VET) is described as being the means to provide the curriculum and syllabus used to direct the training and education requirements of the STCW. So when competency is discussed or assessment it is taken from the Australian VET context.

2. Recent Casualty History

Allianz and Cardiff University’s 2012 report [2] discussing maritime trade over a 100 year history came to realise that while a significant reduction in ship casualties had been experienced, largely due to changes in the conventions and codes covering training, ship build and fit-out, there was still an inherent risk of slipping back to our past, where industry would once again start to observe a more regular pattern of on board emergencies. Examples of this have appeared already, 2008 off the coast of Newcastle Australia a3rd engineer while carrying out what should have been reasonably routine maintanace work received significant burns. To compound this incident, the initial injury treatment was not sufficient. The investigation concluded that a failure to understand the true hazards of undertaking this work, and failure to follow accepted medical practises were factors to this incident [3]. Another example in 2012 occurred in Port Headland Australia where inadequate risk assessment and failure to complete and follow hot work permit procedures, human factor failures led to a significant cargo hold fire [4]. Another incident involving suspected dangerous goods on a large container ship saw a contrast where a wide variety of critical safety actions, considerations and decisions were made in a short space of time. The prolonged nature of this casualty event necessitated the ship board emergency response structure changing many times, but still remaining effective in dealing with a complex and long duration shipboard emergency at sea [5]. So why did these incidents occur. They took place on ships that had competent crews, shipboard work procedures complied with international maritime conventions and codes and companies operated within the constraints placed upon them in this varied and diverse maritime world. The maritime industry has codes and conventions covering training and drill requirements that are followed in line with the required standards. Shipboards crew are trained to the required level, yet we still have casualties. Could it be the education provided, could it be the demonstration of competence required in order to undertake the function required on board, or could it be simply a failure of not exposing the crew to relevant predictable work place situations or emergencies.

To consider this statement it is necessary to analyse the current approach to education and training and identify with the key terms, and come to an understanding as to their place in the structure of ship officer development that supports on-board operations. An early consideration at this point is to provide a definition to key terms such as emergency response, advanced seafarer and what exposure to on-board emergency situations has been provided. Another consideration is to define terms such as mandatory, short course, realistic assessment and skill and knowledge as these are key terms used to determine competence, which is another consideration. What does it mean to be competent when considering emergency response management and what are the implications of not providing a suitable level of education and appropriate assessment during the seafarer's career path? The paper will look to describe each of these terms and by doing so, identify where innovation may be applied to align with, and support the delivery of short duration and mandatory short course programs.

3. Emergency Response

This paper considered the term emergency response and applying a broad definition considered it to be an event that would cause a ship's normal operations to cease even for a brief moment. The emergency may be general in nature, cargo shifting in deteriorating weather conditions; medical where a crew member may be injured while making repairs to damaged ship structure as a result of cargo shift; fire resulting from cargo spillage and mixing with other cargo material, or survival arising from the previously escalating events that become beyond the crews ability to deal with them. It is this definition that formed the foundation to consider how well we are able to prepare the advanced seafarer with insight to deal with these possible ship board situations.

4. Advanced Seafarer

When considering the advanced seafarer, the paper describes a student that has undergone pre-sea components covering deck or engine departments, attained the required level of sea time (workplace experience in their intended role) and return to the MTE area for continued development to attain the watch-keeper endorsement. At the Australian Maritime College this student is in year two of a potential three year program and is returning for the next phase covering short course subjects in shipboard safety [6]. The student should be well experienced in ship operations by this stage, especially concerning deck or engine-room emergencies and the on-board procedures set in place to contend with these extraordinary situations. To be at this stage of career development the student would meet the prerequisite requirements outlined in the STCW.

5. Short course

When the term short course is quoted in this paper it is to be thought of as a course that run less than a typical semester or durations; under 13 weeks. In the area of mandatory teaching learning and training for STCW endorsement a short course can be 4 days, so short course yes, and short duration definitely. Short course mixed with short duration are a challenge for any MTE today. This all adds to there being an inconsistent approach and interpretation of the requirements of the STCW Convention and code which is largely based around skill and knowledge development with an assessment process to determine competency.

6. Mandatory

Mandatory has to be taken into context in order to understand its intent. In simple terms the word describes a compulsory or necessary component [7]. Applying it to the discussion so far we have the parts of a seafarer education that simply has to be in order to progress or achieve the desired outcome. In an advanced course it is the elements of the program that all providers need to ensure are covered. It is possibly this word alone that causes so many of the issues based around what needs to be covered in the delivery of emergency response training and education.

7. Standard, Training and Certification

When considering Standard it is possible to apply a variety of meanings depending on the intended use of the word. Alternative words that could be used in its place; mean, orthodox, typical, customary, conventional or established [7]. Here lies the first issue the word means many things depending its application. In the broadest sense and to an educational institution it could be applied describe goals or end destinations the student should arrive at by undertaking the study.
Training, another word defined by its intended use. From a STCW context it could be taken to mean teaching or educating [7]. The final word worth defining is Certification, which can be interpreted to mean accreditation, endorsement, official recognition for undertaking the program.

If we pull these together it is possible to suggest the term STCW when considered from the IMO point of view could be defined as the conventional education and official recognition received. For the MTE institution it may describe the education program and instruction that is required to satisfy and meet course requirements. It would also suggest that what is undertaken at one RTO should be similar in nature to another RTO allowing the student to transfer their awards of similar study units between RTO's. For the student it may well be defined as the typical education requirements to attain a regulator endorsement or qualification that allows them to serve on-board. The units studied should be transferable and recognised between providers. But this is not the case and a shipping review in 2013 [8] by the International Chamber of Shipping, (ICS) identified where poor interpretation of what is considered to be mandatory education and training as outlined in the 2010 amendments to the STCW convention and code has largely allowed RTO's to determine and develop revised education and training requirements. The ICS highlighted an example of interpretation where it could be possible for white list STCW flag states to disadvantage their own seafarer's through inconsistent application of the STCW 2010 Manila amendments. The issue as identified was based around the application of training for Electronic Chart Display Identification Systems, (ECDIS). It was found that through poor interpretation a large amount of the world seafarers could be left without suitably endorsed training all because a RTO insisted all deck officers undergoing ECDIS training when the amended requirements of the STCW Convention state otherwise.

8. Skill and Knowledge

Another area that requires interpretation is skill and knowledge because depending on what stage a student is at it can and where the particular statement is applied. In Australia as an example so much of the maritime training, while based around the STCW convention and code is applied in the VET space. When terms such as skill and knowledge are applied within the context of training package material, they can come to mean skill and knowledge the student already has or skill and knowledge they will acquire as a result of taking part in the education program on offer. This is interesting because when considering assessment the student will need to demonstrate skill and knowledge, and this may be along their pathway of completing their program. When dealing with VET, like any other form of assessment it needs to meet criteria and what is applied in a higher education, (HE) stream is just as applicable in VET, other than HE may require a more prescribed demonstration of performance [9]. The key though, is for all education training assessment and application of learning to be demonstrated in a realistic environment applicable to the industry training package material.

9. Realistic assessment

9.1 Assessment

The evidence that is collected by assessors is used to determine whether an individual has reached the required level of competence. This assessment is based on a confirmation, through demonstration and application, of an individual's ability to perform in accordance with expected industry or workplace standards, or the competencies as prescribed in endorsed training packages and for the advanced seafarer the applicable tables outlined in the STCW convention and code [10]. The process of assessment involves the gathering of layers of evidence that provide an understanding of the individual's knowledge and skill and their ability to apply the same in workplace environments. Consideration at this point would be given to ask is a four day period is sufficient time to gather enough evidence that is valid, sufficient, current and authentic. It is not possible to move past this argument without a closer look to the assessment requirements as per typical standards [9] The first criteria is that assessment must be valid by providing a process of evidence gathering that relates to the performance standards the assessment is being conducted against and reflects the dimensions of competency [11]. The assessment process must provide sufficient evidence to meet all facets of the unit of competence or the standard being assessed against. This is to allow the assessor to make a judgement about competency. Another criterion to consider is that no matter what process is used to collect the evidence it must be current and applicable to the operating area the student will go into. The final criteria are based around authenticity. This is where the assessment process must be such to ensure all evidence gathered is the work of the person being assessed. Once these criteria are introduced and satisfied the focus can shift to levels of assessment. Typically assessment within VET is staged along the students' journey until an end point where a final stage of assessment may be conducted to determine whether a suitable level of competence has been reach. To achieve this, the following is an analysis of ways assessment needs can be applied

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9.2 Types of Assessment

Formative assessment is conducted at various points throughout the learning program. This may involve questioning, undertaking written quizzes, or assessors watching a student undertake a task. Formative assessment is a critical part of the learning and teaching process, it produces evidence that enables the assessor to provide feedback to the individual about how they are going or to highlight strategies that the learner may employ to address any identified improvements. Formative assessment also allows those delivering to ensure the teaching methodology used is allowing the learning to occur. Summative assessment tends to occur at the completion of a course of unit, it should determine that all specified learning requirements have been met to enable an assessor to confirm competency [12]. If a method of assessment used is reliable, valid, authentic, current and applicable then the use of summative assessment should allow for any assessor no matter what organisation they are employed from to arrive at the same assessment outcome decision.

If the STCW is truly a global standard, a reliable assessment tool should allow the same outcome from one approved RTO to another allowing recognition of training undertaken in other flag states. After all the International Maritime Organisation's (IMOs) Maritime Safety Committee (MSC), scrutinise and approve Flag Sate Authorities documentation for the meeting of this standard. As discussed previously and identified in [8] this is not the case and currently flag state interpret the requirements based largely on what they consider to be valid and in the case of Australia endorse training package material that does not necessarily allow assessment to reflect the industry required operating level of the advanced seafarer.

10. Competency

10.1 Definition

Competency is defined as the ability to do something well or efficiently [6]. The Standards of Training & Certification for Watchkeeping (STCW) Code at Part A identifies methods for demonstrating competency and the minimum standard to be achieved by the seafarer [10].

A number of the mandatory STCW courses are undertaken across the globe in a short course format. Currently at the completion of these courses students will have been assessed and deemed either competent or not yet competent. What does competence mean and how do now know when an individual has achieved the required level of competence? As a definition the word suggests a consistent application of knowledge and skill to a standard of performance that would be required in the workplace [12]. An individual having been deemed competent suggests they have the knowledge and skills to meet the performance standards required in the workplace or industry, in routine and non-routine situations. In the case of advanced seafarers competency needs to more than the ability to apply knowledge and skills to meet workplace standards, there should be an expectation that such individuals are able to operate with a higher level of knowledge and skills. This enables them to meet challenges presented, through analysis, problem solving, innovation, conflict resolution and decision making. When determining competence the assessor must consider all dimensions of competency and not simply be satisfied with the observation of individuals performing a giving task or answering questions. The previous comments regarding a differential between VET and HE apply in this context. HE assessment would have a clearly described and prescribed performance criterion that the student would need to have satisfied prior to a determination being applied [9].

10.2 Dimensions of Competency

There are four dimensions of competency that assessors should consider during the collection of evidence to make a judgment of competency these include: “task skills, task management skills, contingency management skills and job role/environment skills [11] Across all four of the dimensions a fifth, transfer skills is embedded.
The following is an analysis of the four dimensions of competency starting with Task skills. The assessor would consider how well small outcomes have been captured along the way. As an example the assessor may look to consider the students ability to perform each section of a task in a correct, efficient and safe manner in addition to the completed task which may be the required outcome overall. When Task Management is considered it is the capturing of the students ability to manage a series of tasks leading to the completion of a required activity, such as; prioritising a sequence of interconnected tasks, meeting deadlines to allow for progression, communicate efficiently with team members, and delegation etc. The third dimension is Contingency Management which is the ability of the student to react to problems when undertaking a task or whole workplace activity, these may include: equipment failures, a necessity to modify routine, unforeseen occurrences, difficulties with persons on board and/or clients etc. Finally Job role/environment is the ability to meet the requirements of the working environment whilst performing typical work activities. In cases of emergency response it can require demonstration of ability to working with other crew members while complying with the safety management system, policies and procedures. The other embedded dimension is that of transfer skills. This is the ability to transfer their knowledge & skills and apply it to other situations.

10.3 What Does a Competent Individual Look Like?

In a broad sense a competent individual is one who has demonstrated their ability through application of knowledge and skill in both theory and practical environments. The person should be able to come back at any point in time and reaffirm they have retained that competence level, basically demonstrate competence over a range of activities and time line. The assessment process usually concludes that they are able to apply “specified skills, knowledge and attitudes to effectively take part or perform tasks expected in the workplace. This application is considered to be consistently applied over a reasonable time period [11]. Upon completion of a mandated short course, can the individual be assessed as competent, or have they merely been through a process of attending and participating in a course promoted as meeting the requirements of the STCW, and approved by the maritime authority of the flag state. In Australia this would be AMSA. The IMO recognised in 2014 that it had to ensure model courses reflected a uniform and consistent approach to competency that would allow approved RTO’s the ability to deliver the required level of training. It recognised the STCW even with the 2010 amendments could still be applied in such a manner that one RTO required a higher level of demonstrated performance especially around short course programs [8]. Unfortunately in Australia the IMO Model course is not used as a basis of measuring the training package material as meeting or exceeding the standard level of education and training required. AMSA did have for a period of time approved model short courses that mirrored the IMO model course. It is worth noting at this point that the IMO model courses concerning shipboard emergency response training are outdated in that they do not reflect conventional and contemporary shipboard response practises, and currently a number of these are being reviewed or re-written.

11. Innovation

11.1 What is Innovation

In the modern era, innovation and training is widely acknowledged to improve business productivity and reduce the cost of conducting business. It is a management tool that usually includes staff training which aims to change behaviours, lead cultural change and work practices or to increase productivity within an enterprise. This model is best described as training for innovation.

Innovation like so many of the terms described before is open to interpretation but could come to be excepted as meaning introduction or implementation of a new or significantly improved good or service, operational process, organisational managerial process or marketing method. For something to be an innovation, it needs to be new to the organisation. It can either be developed by the firm or be introduced to the firm. Innovation does not need to be something completely new in design or application.

11.2 Innovation in Training

Using the definition above, it can be interpreted that introducing innovative training into the classroom and workplace could conceivably improve learning outcomes in regards to operational processes. New processes of training, new ways to deliver learning opportunities and maximising the potential for learning should be the key goal for any learning strategy. The classroom is suggested as the place to try innovative approaches to knowledge learning and skill application as a seafarer's time on board being correctly mentored is decreasing, due largely to decreasing crew numbers as a more modern complex fleet is introduced. These ships are designed to do more, carry more travel further all with less crew and with the advancement of more complex systems of automation and computer there simply is no time available to effectively train a deck officer in real place and real time situations.

11.3 Acknowledging learning styles

But for an innovative training program utilising simulation to be successful it must be able to recognise one of the most difficult aspects of teaching short duration programs, and that is the inability to cater to all the various learning styles a student may poses. Fleming [13] discusses ways to understand and utilise different learning styles, referring to them through the term VARK or Visual, Auditory, Reading, Writing and Kinaesthetic, or put another way watching, hearing, researching and recording along with practical application. This concept is not new with much of our current teaching centred on classroom theory followed by practical application. In today's classroom it is the mix of theory and practical that at times does not balance out well with the required demonstration of competence. It could even be suggested that in order to attract and retain students, programs have come to concentrate on the classroom teaching so much that the critical element of student learning through practical demonstration, has been pushed further back. Grey [14] even considers this in his observation that today's ship's officer is spending more time in a classroom or simulator environment developing their knowledge and skill of ship's operations, that actual on the job mentoring is fast being lost. It is recognised that many reasons exist for this change; crew number reductions, a result of the ultra-modern vessel; insufficient numbers of mentors on-board, and shorter sailings between ports means less time to spend developing up the junior officer even if mentors were available.

It could be argued that Crowch [15] discussed this change in another way where he argued that due to the complex nature of today's international trading vessel man is not keeping pace with machine, and computer had stepped in to fill the gap and is capable if not making decisions well in advance of the human operator; hence error steps in misunderstood or misread warning signs. This then leads to a consideration to what role innovation can play in the whole development process of the advanced seafarer student. It is known that while innovation in training has the potential to create both major benefits, it is also possible to create deficiencies. It is therefore important to question the need for changing training practices. There is no question that innovation can play an important part in maximising the value of training but then the costs do need to be balanced against the needs of the enterprise.

12. Simulation

12.1 What is Simulation?

Simulation can be described as the replication of a real world situation. In terms of Maritime training and assessment the IMO Intersessional Working Group (ISWG) describes simulation as 'a realistic imitation, in real time, of any ship handling, radar and navigation, propulsion, cargo/ballast or other ship-system incorporating an interface suitable for interactive use by the trainee or candidate either within or outside of the operating environment, and complying with the performance standards prescribed in the relevant parts of this section of the STCW Code.' [16]
Simulation in maritime training is currently used by many Maritime Training and Education institutions to replicate real on board environments and training scenarios such as ship handling pilotage, oil spill management, propulsion plant, electrical power plant, radar and navigation, dynamic positioning and crane handling. As emerging technologies are being developed, simulation is being used to train and assess seafarers within other aspects of a maritime situation such as launching, recovery and handling of lifeboats and rescue boats, firefighting and cargo handling. In certain circumstances simulator training is mandatory under the STCW convention. Electronic Chart Display and Information Systems, (EDCIS) enables the trainee to be placed in a realistic navigational environment that requires the student to analyse the situation, and make decisions based upon the situation. The complexity and intensity of the situation is easily adjusted to suit the requirements of the training.

12.2 Why Simulate?

Using simulation in training and assessment is useful for a variety of reasons. Training activities can be commenced relatively quickly and repetition of an exercise is simple. There are logistical constraints of training Deck Officers on board real vessels, manoeuvring in the vicinity of others within a port not being feasible from a time or cost constraint perspective. In this scenario, simulation in Ship handling using a full mission bridge simulator is invaluable and now assessment method of choice for many MTE's. The other very important benefit of using simulation is that it also enables emergency incidents to be trained for, without imposing any risk to personal safety, equipment or the environment. Crowch [15] discusses a dynamic operating environment as opposed to more stable surroundings. He suggests that aims are different in this dynamic environment due largely to the shipboard officer needing to maintain control over a variety of conditions in a short time frame as opposed to the stable environment which affords time to seek a long term solution. A critical factor here is the ability to make timely decisions based on knowledge, one of the key tools expected of any emergency response officer whether they are land based or ship-board; understand the situation, evaluate options and respond.

12.3 Levels of Simulation

There are different levels of simulation that vary in the degree of complexity and technology. Full mission simulators that look and respond like the real operating environment and interact with other operating stations are the highest and most realistic of simulators. More basic levels of simulation include small operator stations with less realism and at the most basic level a single computer or laptop that gives limited realism, however, is useful for decision making skills for the trainee and conducting theoretical assessment.

In terms of training seafarers in STCW short courses involving emergency response, many of the competencies the student needs to be proficient in are practical skills that require the trainee to physically use equipment and demonstrate practical competencies as stipulated in Chapter VI of the STCW Code[10] Examples include training in personal survival and fire prevention where the trainee must demonstrate activities such as jumping from height into the water, righting an upturned life-raft, using portable fire extinguishers, fighting fire in smoke-filled spaces wearing self-contained breathing apparatus. These skills are important to physically practice as learning is achieved by the body's muscle memory learning the process through doing rather than watching a video or listening to a lecture. The latter does not give the student a feel for the real equipment, such as operating firefighting extinguishers or donning heavy breathing apparatus, feeling the weight and experiencing the possible claustrophobia associated when using this equipment in a smoke filled compartment. There can be no doubt that practically carrying out certain activities using real equipment is the best form of training, however, once these skills have been acquired it prove useful to advance to higher levels of training through the use of simulation. This level of training would focus on the human elements including stress tolerance and human resource management. It has been discussed in recent times that when people are faced with an overwhelming situation such as a major incident they often will not react appropriately and may actually physically and mentally freeze due not being prepared or not having considered what they would do in an emergency situation [17]. Even though ship's officers undertake education and training to deal with on-board emergencies they like so many of their land based counterparts are not tested under extreme operating conditions to understand their actions or inactions. They don't have the opportunity to have this critiqued for improvement and preparedness as people who will be responsible for managing and controlling an on-board event.

12.4 What would simulation of advanced seafarers look like?

Recognising that behavioural inaction may occur at any stage it is important to understand how a potential deck officer will react and identify what corrective actions can be introduced, and monitor whether they improve performance. This would be achieved through the implementation of a suitable enhanced training programme that could use standalone or current computer based simulation programs. Through innovative thinking and the adaption of military approaches that use simulation a range of operating conditions could be presented that would require the student or students on the bridge to identify and deal with an evolving emergency while still maintaining effective control and operations of the ship. As previously discussed military training of bridge officers is conducted in a very similar way. The biggest difference is a merchant vessel does not have missiles or torpedoes being directed at while still trying to refuel or resupply another vessel in less than ideal sea conditions. It is acknowledged a military vessel would have a much larger, and depending on the threat, specialist bridge personnel, but taking this into consideration the setting of priorities, the execution of a plan the channelling of information all remains a common event. The student could be immersed into a simulated cargo shift that then results into a leak which in turn catches on fire. It would be possible to monitor and even measure the student's reactions to the events as they unfold. The scenario could be staged up to introduce other traffic, loss of steerage and a communication failure between engine room and the bridge.

The scenario could require the student to make decisions based against the information before them, it could be voice recorded and videoed for play back during a critique and debrief of the scenario. The event could be reloaded and with amendments run again looking for uptake of corrective actions. It would be envisaged to start with a relatively simple scenario and build complexity as the student developed confidence to the point of a likely scenario is presented. The detail and list of considerations could be as basic or complex as required and this is where maximum value in this type of simulation training would lie. Ability to draw back on past experiences and use them as learning tools is also a reason to apply a build-up level of bridge simulations based around developing emergency response. Reason [18] discusses the need to learn from any past error and it would be possible to load up a series of events that have been investigated and evaluated in terms of what went wrong and why. In today's highly complex operating environment, that forms a ships bridge, it would be possible to measure the human response to the unfolding event, looking for psychological and

physiological reactions and have these evaluated to see how well prepared the student is from classroom based training.
To summarise the ideas brought forward a reflective interpretation of Alainati, AlShawi and Karaghouli,2009 [20] where they discuss the effects of education and training on the development of competency. The operating environment of their paper is different but the key concepts of providing education and training to determine competence is the same. Their conclusion that competency is integral to the success of an organisation, and with constant change in technology the employees of the organisation have to know how to make the right decisions in order to effectively react to any change of circumstance no matter when this may occur supports our maritime training and education environment as discussed and argued in this paper.

13. Conclusion

In considering the assessment process for the advanced seafarer it is evident from the material discussed so far that there is a need to apply a more holistic approach to the assessment process, whereby learning activities and assessment tasks are integrated throughout the course subjects. It is further evident that to meet the operating and management criteria outlined in STCW short courses covering emergency response there is a need to ensure realistic and as close to real time incident scenarios are matched up to general ship board operation. It is further evident that if this is to a recognised approach and become learning and teaching practice, it can only be achieved by use of simulation. If simulation was introduced early in the career path of the deck or engine department worker it would quickly set the scene as to what the role is all about. This may allow formative assessment to be applied across multiple higher or vocational education subjects or through pre-course work over an extended period, with the attendance at the short course culminating with summative assessment to determine competence. Unlike other competency based assessments decisions are usually arrived at the conclusion of the learning and teaching, when a decision is made based upon the demonstration by the seafarer of acquired skill and knowledge. Usually the decision is a simple competent or not yet competent, but in the case of the advanced seafarer the decision making is somewhat more complicated, because while the time line is similar to the other short course subjects the level of operation is management and the expected performance outcomes do not necessarily match the students role or function within the staff structure on-board the ship.
By way of concluding the paper the question around innovation and whether it can be applied to short duration programs needs to be considered in terms of what it could do to benefit what is already in place. Recent anecdotal discussion around why the merchant bridge operation differs from the navies bridge operations lead to an enjoyable debate around why the training methods utilised by navy would not fit the operations of a Very Large Crude Carrier, (VLCC). The consensus appeared to be around bridge human resource numbers. In military style operations the number on a bridge could be upwards of 20 staff, all with varying role and responsibility all of which direct towards ensuring the ship in question remains an active part of the fleet it is sailing with. In other words it needed to continue on with its assigned job no matter what the circumstances. When considering the merchant VLCC, while bridge numbers would be reduced the importance of ensuring the ship continues along its chosen route with little to no delay is the same focus; continue to fulfil your role no matter what.

This paper considers the above comments in the context of applying a more realistic and consistent approach to the bridge training on offer. Realistic and consistent in terms of what is being applied and assessed is actually part of their everyday work routine, and part of something that is likely to occur; not some hypothetical approach that has no to very little chance of eventuating. The application of innovation becomes a systematic approach conducted in the first instance in the simulator room and is applied as the student comes to terms with dealing with ship operations under normal conditions a build-up of changing conditions is introduced over a time period that allows the students reactions to be monitored and measured, the outcome of which would allow for critical reflection and critique.

Over a defined time period the students reactions will be plotted against a base line that will show either a changing approach to their reactiveness of the situation to the point where a degree of competence can be seen and measured through to no change at all and a complete misreading of the situation; will the employee adopt better work practices, is there a benefit to compliance, is productivity increased, or decreased in cases of injury or reduced risk associated with high risk activities. In emergency response there is no doubt practical application plays a key role in ensuring our advanced seafarers have capability to deal with the unfolding scenario. But it could be so much better if they have already been exposed to a range of innovative simulated problems along their career pathway. In terms of being put under pressure and understanding how you will react is no different in merchant navy requirements than it is in military bridge operations. The concept of decision making is the same just slightly different contexts; naval war machine versus merchant super cargo carrier.

Both require the human being to read a given circumstance and react with a set of priorities depending on the requirements of the job. We put our officers of tomorrow on the bridge and give them a range of circumstances that would be commonly dealt with when at sea. We may create a cargo issue juts to give them some complexity. But at no point do we escalate, monitor and measure the decision making and response capability of the student in charge. We don't de-brief after reach incident to see what portion of accountability they are willing to accept for the way the scenario played out. Conversely if this was done as part of the students pathway development; factored into their deck or engine training the current practical demonstration events would take a structured direction where the student is applying true skill and knowledge learnt and could be deemed competent after a more realistic application of skill over time. So the argument of this paper is that a place for innovation, especially around short duration programs does exist, it is a matter of determining what level of complexity could be measured, where and how that would fit in with a program that is competitive and consistent with other RTO's nationally and internationally so as to ensure compliance with IMO requirements.

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Constanta Maritime University's Role in Training Future Romanian Officers

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CMU considers education along with scientific research to be the most important factors of economical growth, and human resources are seen as the main condition for permanent development and innovation. That is why every higher education institution should target first towards identifying, training and developing students' innovation, creativity and originality. On these lines, traditional teaching and evaluation practices are considered to be out of date on the background of nowadays economical, social and cultural conditions. The development of maritime transportation and its connected activities imposed the necessity of having more trained people involved in operation, able to act in very various situations based on a considerable volume of knowledge. CMU, through all members of the academic community, promotes the concept of innovative university, with a specific interest towards practices allowing educational activities' to focus on student's needs. The suggested education system is an open and flexible one, able to easily adapt to all requests coming from world maritime industry and connected legislation. CMU considers that providing quality into educational performance is a fundamental option today in order to adapt to continuously changing needs of the maritime and engineering environment, acknowledging the fact that national and international competitive universities have developed and are permanently improving their evaluation and quality promotion internal mechanisms. In this paper we are trying to point out the main characteristics of the training programme inside the university and how it influences the young officers in their future career.

Keywords: maritime university, officer, training

1. Introduction

Maritime Education and Training is quite an expensive system since it requires high investments. Training on board ships is a difficult target to achieve for all the maritime universities. The main question is if this training on board should continue or could there be another solution for training students within the university. Maritime Education and Training became expensive in Romania since costly equipment, such as simulators and training ships, were considered by the Romanian Naval Authority to be a necessary prerequisite for offering a high-level education. This situation, which suggests the compulsory need for these resources, worth several million euro and incurring considerable running costs, is acerbated by the reduced number of students at many MET institutions. It also leads to the fact that not all institutions can offer high-quality MET (particularly not those which cannot afford expensive equipment) and that maritime education is more expensive than it needs to be. These arguments make it necessary to have a closer look at costs and financing of MET and to investigate the constraints in the present economic conditions.

Rapid evolution of technologies, increased globalization, communication, and economy factors will govern any attempt at finding the best costs' reducing solutions. Therefore, it is compulsory for the maritime universities to catch up with the technologic advancements and to improve the quality standards in order to remain viable and competitive, to design the education of the next generation and to compete with other universities. Constanta Maritime University is a good example of a maritime institution that had to reduce expenses by suspending students' training on board its own ship, “Neptun”, in 2004. Therefore, our university uses a protocol with the most influent shipping companies in Romania, for training our students on board their ships.

2. Maritime Education in the Present Economic Conditions

Over the generations, the education of professional officers has undergone many evolutions. Today’s maritime universities, academies and faculties using advanced methods of teaching, modern simulators and other sophisticated equipment have not to forget that practical training plays an invaluable role in officers education. Training ships and on board practice gives students and cadets an important and unique opportunity to achieve proper skills for performing their future job requirements under the control of experienced teachers and seafarers.

Practical on board training of maritime students became a very important component of the maritime education process since the International Maritime Organization (IMO) imposed seagoing practice as an integrated educational part for future seafarers. Therefore, the optimum solution could be the training of the future officers performed by combining the simulator hours (Radar Training, Ship Handling Training, GMDSS Training) inside the maritime universities with the training on board training ships or on board merchant ships.

2.1 Training on board

On board training record book is an important component of the training process as it includes sea training tasks for cadets. During this training, the cadets gain the professional skills and experience necessary during the work process as a watch keeping officer. On board training skills achieved according to the program included in the Training Record Book fulfil the minimum requirements for certification as an officer in charge of a navigational watch.

During the sea training period the cadets have the opportunity to combine the theoretical knowledge obtained during the classes taken at the maritime university and the practical knowledge achieved first on the simulators in the university and now improved when being onboard a real ship. It allows the future watchkeeping officer to learn everything about his job on board modern and automated seagoing ships.

However, training on board training ships involves spending a large amount of money by the maritime university that owns the training ship (costs for maintaining and repairing the ship, costs for the crew, costs for operating the ship – fuel, spare parts, taxes for crossing the channels, taxes for calling a port, for berthing, flag costs and so on), a sum of money that could be redirected to investing in a better material base inside the university in this present economic crisis (last generation simulators, teaching aids and materials for students and teachers). Training ships belonging to the maritime universities also imply the need for teachers with a particular on board experience to be present on board the training ship during the training period and these teachers also have to be extra paid.

2.2 Training in a multicultural crew

Another important issue to be taken into account is the multicultural crew that will not be on board a training ship under the national flag of the university. Nowadays, the shipping industry is a multinational one and future maritime officers should be prepared for working in a multinational crew. All activities in this industry are based on interaction and collaboration between people from different countries and cultures. This is why Constanta Maritime University introduced specific classes in the curricula such as “Culture and Multiculturalism”. But these aspects become more complex when we refer to onboard ship activities.

For this reason, it is necessary to observe and study the kind of compatibilities or non-compatibilities that exist between seafarers from different countries in order to create a proper working environment on board the ship. These problems are worse when we think for example about a cadet at his first experience on board a ship and especially in a multinational and multicultural crew. This category includes cadets and young officers who performed their practice stages on board merchant ships under international flags.

Facing a multicultural working environment, many seafarers have accommodation problems, difficulties in the working relationships onboard and the worst problem has been created by the use of a foreign language, mostly maritime English, in the daily duties communication. The multicultural problems are hard to be managed at the first contact and here we refer to young maritime cadets and officers, people who can be very affected by the difficult relation especially in communicating with those of a different nationality.

A solution could be the involvement of the training institutions in preparing the young cadets for a multicultural work environment. Before their first experience onboard ships, a special training about multicultural concepts and social activities in a multicultural crew would be useful in order to provide the necessary knowledge about and how to deal with problems raised by cultural differences.

According to Popescu and Varsami [5], maritime English represents another problem for students. It is a fact that the language barrier on board the ship can be overtaken only if the students really master the maritime English, so it could be important for them to work in a multinational crew right from the very beginning in order to get used to speaking in a different language other than their mother tongue. Therefore the teaching curriculum of our university provides maritime English classes for all the four years of study.

In order to reduce the expenses caused by the training of young deck cadets on board a university's own training ship, it would be much cheaper to sign a collaboration protocol with the shipping companies. [3] This way, students have the opportunity to work in a multicultural environment and to get used to it, having the opportunity of improving their Maritime English and the opportunity of learning from experienced seamen. Also, another advantage of these protocols is in favour of the shipping companies having the possibility to train their future officers as per the company's policy and on their own type of ships.

Constanta Maritime University is a good example of a maritime institution that uses a protocol with the most influent shipping companies in Romania. In 2004, the University suspended the students' training on board the training ship "Neptun". Since then, the solution found for training the deck and engineer cadets was to send them in international voyages with different shipping companies, local or international and for this action the local crewing agencies or ship owners' offices have been contacted.

This was the accomplished first step, when over half of our students covered their requested onboard training on ships belonging to different owners, most of them, international shipping companies with a great name on the world shipping market, as NYK Ship Management from Japan, Peter Dohle from Germany, Maersk from Denmark, CMA-CGM from France and many others, in total 22 shipping companies being part of the partnership.

Therefore, Constanta Maritime University is a good example of how not using a training ship can work. Money that should have been invested in a new training ship were spent for training the teachers, for acquiring last generation simulators, for investing in a high standard material base, for improving the library with the latest editions of the required bibliography and so on.

2.3 Training onboard merchant ships through ERASMUS programme

ERASMUS is part of the communitarian education programme SOCRATES and includes actions meant to encourage European cooperation in the superior teaching system. ERASMUS supports the development of the European dimension of university and post university studies, and it covers all study subjects and domains.

The programme pursues to continue, into a revised and extended form, the action project of the European Community for students' mobility (European community Actions for the Mobility of University Students), having as objectives the quality development and consolidation of the European dimension in the superior education; promoting trans-national cooperation between universities on all educational levels (university diploma, post-university studies, doctorate), encouraging students' and teachers' mobility, improving transparency and academic acknowledgement of studies and qualifications obtained in any of the European Union countries, harmonization of university studies curricula, providing them with European value in order to become compatible with well known university's curricula in EU, development and extension of the Transferable Credits European System, meant to facilitate the academic acknowledgement of diplomas and qualifications obtained in partners universities.

ERASMUS programme is developed in Constanta Maritime University during the onboard training periods performed by students who were onboard ships in international voyages. In this view, our university has signed protocols with the largest shipping, crewing and manning agencies in the United Kingdom (Dohle Manning Agency, Zodiac Maritime Agencies Ltd. and Carisbrooke Shipping Ltd.), in Denmark (Maersk Marine Services Ltd) and Germany (Oskar Wehr KG Gmbh & Co, International Tanker Management Gmbh) which provided students' recruitment for the cadet position, their training and monitoring during the onboard training period. We should also mention the fact that, besides the monthly scholarship offered by these companies for our students, they also benefit from the best onboard learning conditions, as well as the possibility to have access to the newest technologies and equipments, compulsory instruments for the navigation activity.

Shipping and ship management companies and maritime training institutions must work together to tackle the raft of concerns that dissuade school leavers and college graduates from embarking on a sea-going career. From this point of view and taking into account the latest experiences one can honestly conclude that much more can be learned on board merchant ships especially about the safety and watchkeeping tasks.

The costs for training the students on board training ships could be totally reduced and redirected to other more important investments and the training on board could be solved by the shipping companies that need to train their future officers. It is also a good deal for the shipping companies as they train the students as per their own purposes and they make sure that they will have well trained officers on board their fleet ships.

3. Cooperation between Constanta Maritime University and the Local Maritime Industry

On board maritime students' training became a very important component of the maritime education process since the International Maritime Organization (IMO) introduced seagoing as an integrated educational part for future seafarers.

Over the generations, the education of professional officers has undergone many evolutions. [1] Today's maritime universities, academies and faculties using advanced methods of teaching, modern simulators and other sophisticated equipment have not to forget that practical training on board a ship plays an invaluable role in officers' education. On board practice gives students and apprentices an opportunity to practice their skills under the control of experienced seafarers.

This means that shipping companies need to have a certain standard for employing when commencing collaboration with crewing agencies all over the world and those young future officers should pass several tests before being accepted on board merchant ships. Simultaneously, the company should provide the best training programme for these apprentices as it is in their interest to have well trained officers.

In this paper we are trying to point out the fact that a proper training programme of future officers means combining simulator hours (Radar Training, Ship Handling Training, and Global Maritime Distress Safety System – GMDSS Training) provided by the Maritime University (in this particular case Constanta Maritime University) with the experience acquired on board merchant ships inside a multinational crew.

3.1. Solution for Compulsory Training on Board

In our opinion, in order to obtain the best training for young cadets on board, it is much better for the maritime university to sign a collaboration protocol with the shipping companies. Also, the shipping companies can form their future officers as per their company policy and on their type of ships. [4] It is in their interest to train the apprentices the best they can in order to have on board well trained officers after the students ended their 12 months period of training on board.

On board merchant ships, there are usually one, two or maximum three cadets, so the entire attention of the officers focuses on training fewer people than on board a training ship where there are more cadets (some training ships can accommodate up to 30 students) and so it is rather difficult to properly train each one of them and to make sure that they fully understand their responsibilities. But there is also the reverse side of the coin for the shipping companies – the students they take on board could have a poor theoretical background or they might not adapt to the sea life, so the Master could be forced to disembark them and so the company could lose the money invested for bringing them onboard.

As previously mentioned, Constanta Maritime University is a good example of a maritime institution that uses a protocol with the most influent shipping companies in Romania. Recruitment for onboard practice of cadets is done by the Crewing agencies in consultation with the school lists of students (by agents) and the test imposed to the cadet who goes into effect (specialized English tests, interview with a manager or crew manager on general maritime knowledge, logic, test insight and psychological profile). The main objective of the onboard training is to achieve or exceed the standards of competence specified in the STCW Code.

Therefore, Constanta Maritime University is a good example of how not using a training ship can work and this way the money that should have been invested in a new training ship were actually spent for training the teachers, for acquiring last generation simulators, for investing in a high standard material base, for improving the library with the latest editions of the required bibliography and most important for developing training on board programmes that actually help the future maritime officers.

Constanta Maritime University's main objectives concerning the on board training programmes are:

- increasing students' training level in order to integrate them in the European environment and provide compatibility and comparability with European diplomas regarding quality and competencies in Constanta Maritime University study domains;
- implementing a monitoring system of graduates' hiring capacity;
- identification of the maritime and technical – economical environments' requirements and real expectations regarding each specialization graduates' competencies and correlating them with the university's experience and international (European) practice;

- continuous tracking of students', graduates' and employers' feedback, regarding educational performance structure and quality, and improving it accordingly;
- improvement of students' practical training by increasing the number of practice jobs on board operating ships belonging to national and international companies;
- University's academic integration accomplished by promoting partnerships' development with public and private organizations aiming for supporting students' integration process in the social economical life.

Constanta Maritime University disposes of a "*Scholarship* REGULATION" and other forms of material support for students, where types of scholarships and conditions for getting them are presented. Scholarships are given from the state budget allocations and from own resources. The best example when it comes to the on board training programmes is the Japanese Ship Management Company NYK which awards monthly scholarships during the whole period of school to students that take and pass the selection exam of the company. Besides this scholarship, that actually represents a support for school expenses, students get a wage for the period they are embarked as Deck/Engine Cadets on board the company's ships.

The students training on board merchant ships combining with the theoretical base acquired from the University's classes obtain general competencies and abilities like:

- Usage of electronic charts and complex calculi of navigation problems based on the knowledge accomplished by: Electronic Navigation, Radar Navigation, Seamanship, Theory, Construction and Vitality of Ship, Bridge Team Management, Commercial Operation of Ship, Voyage Planning and Execution, Astronomy and Celestial Navigation, Ship Handling, Navigation in Special Conditions.
- Conducting and coordinating experiments, measurements, analysis and interpretation of obtained data and usage of techniques, special instruments and modern practices in the engineering activity based on the knowledge accomplished by: Electric Aids to Navigation, Thermo-techniques, Heat Engines, Electronic Transducers and Measurements, Mechanics, Electronic Devices and Circuits.
- Solving of managerial, communication, professional ethics, specific legislation and environment protection problems based on the knowledge accomplished by: Bridge Team Management, Maritime English, International Maritime Law, Global Maritime Distress and Safety System, International Maritime Organisations.

4. Implementation of the 1995 STCW Convention in Constanta Maritime University

Today, Constanta Maritime University is the principal maritime training institution in Romania. This position has been acquired through a continuous effort to offer to future deck and engineer officers the best training and knowledge in the interest field. In this way, we have made a number of changes, starting with revaluation of curricula, bringing it more closely to the present requirements of STCW Convention and shipping industry requirements, continuing with improvements of teaching methods, usage of high technology and newest simulators in this process. The development of the maritime transportation and its connected activities imposed the necessity of having more trained people involved in operation, able to act in very various situations based on a considerable volume of knowledge.

To achieve these standards, the training process, especially for operation, safety and security activities, must be highly professional and in concordance with the international requirements in the field. This professional training involves the use of the latest developed techniques, as simulators and dedicated computerized programs. These new techniques and working procedures in scope of a better skills development has represented, in the beginning, a challenge for the traditional maritime academic training field, some of them still being a challenge due their continuous improvement and updates.

Once the shipping industry develops and the work force market requests more professionals and specialized persons, the training system, at all levels, but special at academic level, have to accept the challenge of necessary technology in order to respond and provide the required personnel. In all cases where it was necessary to change the traditional way of teaching and practice to the new one, the first step was represented by the mentality changes of the trainers involved and, in the same time, by the rethinking of the theoretical base, including the technical aspects now. This was not an easy process, the beginning and first stages were complicated, partially due to the reduced knowledge about the new technologies and the better approach way to perform the best training in order to reach the proposed results.

4.1. The development of the training process in Constanta Maritime University according with the STCW Convention and shipping industry requirements

The improvement of the training process is compulsory in the present is due to the new position of the Maritime Education and Training institutions, as providers of services for maritime industry and correspondent activities. For this they must never lose sight of the following underlying factors: *programmes and courses must meet industry standards and regulatory requirements, programmes and courses must be relevant to and meet clients and industry needs, training level of graduates must be accordingly with STCW and national authorities requirements, teachers and trainers involves in the training process to have a high level of knowledge and understanding of the system and his requirements under present in force regulations.*[2]

According with these major objectives, Constanta Maritime University has developed its study programmes under requirements of the Convention and applying the curricula recommended by this through the IMO Model Courses for each of the main specialisations, Navigation and Marine Engineering.

Not only the programmes and curricula have developed and updated according with these requirements, also the study cycles have been structured in operational and managerial levels. For achievement of these objectives, Constanta Maritime University performed a process of training of the trainers, to improve or to reline their knowledge and teaching skills to the present conditions and evolutions, based on:

- ✓ Increasing lecturers competencies through promotion of knowledge and technologies in the academic maritime field;
- ✓ Creation of a development, update and on-line management framework for initial and continuous training of the human resources;
- ✓ Initiating studies and analysis to define formative programs and an optimum correlation of these with maritime industry necessities;
- ✓ Increasing access and participation of lecturers to formative programs and to obtain a double qualification;
- ✓ Verifying the process and teaching activities through initial and continuous formative programs in order to improve TIC using level.

All these are based on the premise that continuous learning is the main condition for restructuring and development of educational and formative systems, for assuring decisive competencies and to realize the coherency between persons involved in the maritime academic system. Also, it is necessary to involve maritime lecturers in the international maritime transport framework, to put them in direct contact with the end users of their work, the companies from maritime industries and to know exactly their needs. The international maritime companies are the necessary source of information regarding worldwide requests for employing maritime personnel.

Collaboration with partners from the maritime field, as project objective, will be found on communication and information changes to identify and implement of adequate modalities to increase the number of work places and to optimize these. According with the revised STCW Convention, the simulators must be used more effective in the training process of the future seamen and officers. The high technology has to be used in order to increase the level of training and to reach higher standards of knowledge and skills. The use of simulators and technology, especially electronic devices in the training process offer the possibility to create models close to reality, students are more implicated in the events and also more receptive to the training objectives.

5. Conclusions

In the present, Constanta Maritime University, as a maritime training institution, complies with and applies the complete requirements of the STCW Convention and national legislation regarding levels of training and content of the training process according with the final specialisation, deck or engineer officer.
Study programmes are structured according with the requirements of the present regulations and with the shipping industry needs, at the end of their studies, the graduates having knowledge and skills necessary to perform their on board duties in respect of safety and secure procedures and standards.

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Investigate the Possible Impacts of Differential Seafarers' Career Progression on Seafarer Competence in China

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With the rapid development of advanced science and technology, the frequency of marine accidents caused by external factors, such as haphazard breakdown of engines or disastrous weather, is declining; while internal factors related to the human element remain the dominant contributor to such incidents. In order to minimise mishaps associated with the human element, seafarers must keep pace with the fast development of modern ships. The safety and security of ships and those on board and the preservation of the marine environment depend very much on the professionalism and competence of seafarers. This has been well embodied in the recent international conventions as well as some national regulations. In addition to the Maritime Labour Convention 2006, the Manila Amendments 2010 are of supreme relevance to the improvement of seafarer competence. China has introduced some new regulations and amended some existing ones to improve the competency of Chinese seafarers and to ensure the overall effective implementation of the Manila Amendments 2010. The Regulations on Competence Examination and Certification for Seafarers in China, 2004 were amended in December, 2011. China has developed a relatively comprehensive system related to seafarers and maritime education and training institutes have undergone great changes accordingly. One of the major ones is the introduction of the regulations on differential seafarers' career progression. Since the regulations are relatively new, little research has been done to evaluate possible impacts on Chinese seafarer education. The purposes of this paper are to: a) compare the different pathways now available in China for seafarer career progression; and b) examine the possible impacts of the new regulations on the quality control of maritime education and training and the seafarer competence in China.

***Keywords*:** Maritime education and training; Chinese seafarers; career progression; seafarer competence; STCW; Manila Amendments

1. Introduction

In order to ensure that necessary global standards will be in place to train and certify seafarers to operate technologically advanced ships in the near future, the "Manila Amendments" were adopted at a Diplomatic Conference in Manila, the Philippines, held in June 2010 and entered into force on 1 January 2012, with a five-year transitional period until 1 January 2017 under the tacit acceptance procedure. The Amendments are of great significance in shaping the short and medium-term education and training of seafarers and their respective careers at sea. The role of seafarers in shipping is becoming increasingly salient these years. Efforts are being made to recognise the importance of the human element where seafarers and their roles in world shipping are concerned [1]. Various technologies have been introduced to relieve human operators from repetitive tasks. However, technology itself is subject to failures, and the Man Machine Interface (MMI) may bring more complications [2].

Research reveals that seventy to ninety per cent of recent major marine incidents are related to the human element [3] and research and investigation need to focus on people who have to cooperate with each other on board [4]. The safety and security of ships and those on board, and the preservation of the marine environment depend very much on the professionalism and competence of seafarers. In order to acquire this professionalism and competence, seafarers must undergo sufficient and high quality maritime education and training (MET) beforehand. This has been well embodied in the Manila Amendments 2010 and recognised by China as a member state of the International Maritime Organization (IMO).

In order to promote the competency of Chinese seafarers and to ensure the overall effective implementation of the Manila Amendments 2010, a series of ancillary regulations has been introduced or amended in recent years in China. The educational and training process in maritime education and training institutes is to a great extent influenced by the IMO legislative activity [5]. For example, the Regulation on Competence Examination and Certification for Seafarers in the People's Republic of China 2004 (Regulation 2004) [6] was amended and adopted by the Ministry of Transport of the People's Republic of China (MoT) as a new regulation in 2011 (Regulation 2011) [7] against the background of the Manila Amendments 2010. As a result, Chinese MET institutes have undergone great changes, one of which is the introduction of the differential seafarers' career progression with an aim to control and improve the quality and competence of seafarers in different professional positions. The concept of the differential seafarers' career progression is seen as offering more alternative progression paths for prospective seafarers with different academic qualifications. In order to make these alternative progression paths practicable, MET institutes must develop well-balanced curricula to guarantee well-designed and internationally recognised programs leading to higher qualifications and certifications for seafarers as they advance their careers [5]. This paper aims to a) compare the different pathways now available in China for seafarer career progression; and b) examine the possible impacts of the new regulations on the quality control of maritime education and training and the seafarer competence in China.

2. Seagoing Service Requirements under Related Regulations

The IMO strongly emphasises the quality and competence of seafarers who must adapt themselves to the increasing complexity of technology and management on board ships. Since 2001, IMO has started to place human element considerations at the centre of its work to reduce shipping-related accidents and to lessen related consequences. The International Safety Management (ISM) Code and the 1995 Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) are the most important instruments, both of which are concerned primarily with people rather than technology. The ISM Code deals with corporate management and sets out how shipping companies must establish effective structures and procedures that create and promote a safety culture, while the STCW deals with seafarers and the standards to which they must be educated, trained and certified [8].

Some countries have put in place processes for progression to encourage ratings to become senior officers. In China, Regulation 2011 lays out a path for ratings to move through the ranks to senior officer positions in order to make the occupation more attractive to young persons. The new policy emphasises seafarers' practical sea experience rather than stringent academic qualification for career progression. This means seafarers with lower academic qualifications can progress to the captain or chief engineer position by undergoing required training and prolonged seagoing service. The onshore training, ranging from 3 months to 24 months, must be carried out in MoT-recognised training institutes. For a Chinese seafarer with a bachelor degree who wants to progress to the master or chief engineer level, the requirement of total seagoing service (including on board training) by Regulation 2011 is 12 months shorter than that required by Regulation 2004. Low academic qualifications may be supplemented or made up by prolonging seagoing service [7].The requirements of seagoing service for different positions are detailed in Table 1.

Ranks	Regulation 2004 [6]		Regulation 2011 [7]	
	Bachelor degree	High school	Bachelor degree	High school
Master/chief engineer	18m	N/A	18m	18m
Chief Mate/chief engineer	12m	N/A	12m	12m
Second officer/third engineer	12m	N/A	12m	18m
Third officer/fourth engineer/ETO	12m	N/A	N/A	30m
Able seafarers	Nil	N/A	Nil	18m
Ratings	Nil	6m	Nil	6m

Table 1 Comparison between Regulation 2004 and Regulation 2011 relating to seagoing service requirements

3. Seafarers' career progression paths

In China, the 9-year compulsory education includes 6-year primary and 3-year junior high schooling. After this, students can choose 3-year senior high school or vocational school education [9]. After the national higher education entrance examination, the majority of senior high school graduates will go onto higher education comprising 4-year universities or 3-year vocational colleges [10]. Generally, students with higher examination scores go to universities while those with lower scores go to vocational colleges.

The new seafarer career progression approach primarily aims to improve the attractiveness of a seafaring career while meeting international and domestic standards. In China, a major quandary in the industry is that those who are deemed academically suitable for career progression are often unwilling to spend their working life at sea while those with a lower education level are more inclined to remain at sea for longer. The new regulations are designed more preferable for the latter group: an enticement to stay on as active seafarers and to advance to the top of the profession.

According to Regulation 2004 [6], lower education qualification, for example, high school education or below, was a barrier for seafarers to progress to an officer position in China. This barrier was removed in the new regulation system for seafarers in China in recent years. Nowadays, it is possible for seafarers to progress to the top position with only high school qualification, although the master of a passenger ship serving on a voyage of 50 nautical miles or more between two ports must hold a tertiary degree or above according to Clause 8 of Implementation Rules of Regulation 2011 in China [7].

Data from the Ministry of Transport of the People's Republic of China [11] showed that, in 2014, there were 1.97 million seafarers and 155 seafarer education and training institutes, including 18 four-year universities, 32 three-year vocational colleges, 42 two-year vocational colleges and 63 training centres. With a total output of 9,000–12,000 nautical graduates every year, research finds that 42% per cent of nautical students will work on board ships for 1–5 years while 4% will not choose seafaring at all [12]. This high drop-out rate poses a great challenge for China in maintaining an experienced and skilled workforce to operate its ever expanding merchant fleet.

As far as candidates with different academic backgrounds are concerned, those with a higher education qualification have faster career progression than those with lower education background. Maritime students with tertiary degree or above can become officers serving on international voyages, while maritime students without tertiary degree have to serve as officers on near-coastal voyages before being eligible to work on international routes.

Figure 1 illustrates seafarers' progression paths with different educational qualifications. The time shown in the flowchart is the minimum requirement. As far as the total length of progression is concerned, only the first part of career progression (before progressing to second officer or third engineer) is different across different pathways while the second part of career progression is the same.

For a maritime university graduate, the progression to captain or chief engineer is the fastest one. After passing all examinations and evaluations for a Certificate of Competency (CoC) and complete a 12-month on-board training, the candidate can become a second officer (2/O) or a third engineer (3/O). After that, the candidate can continue to progress to chief officer (C/O) or second engineer (2/E) after 12-month seagoing service, 3-month theoretical preparation training in recognised training institutes and 3-month on-board training. With another 18-month seagoing service, 3-month theoretical preparation training in MoT-recognised training institutes, and 3-month on-board training, the candidate can then progress to captain or chief engineer level provided that the candidate passed all examination requirements. The minimum total length of their career progression for maritime university graduates is therefore 54 months. For a maritime vocational college graduate, the candidate has to become a 3/O or a 4/E or an electro-technical officer (ETO) before progressing to 2/O or 3/E, which requires a minimum of 12 months. The total length for their career progression is 72 months, 18 months longer than their tertiary graduate counterparts. Two-year vocational school graduates have to apply for near-coastal junior officer positions before oceangoing ones requiring additional 12 months in their career progression. The total length of their career progression becomes 84 months. Non-maritime engineering college graduates, due to their lack of maritime training experience, need 18-month maritime training before becoming eligible candidates as 3/O or 4/E or ETO serving on oceangoing ships. The total length of career progression for them is 90 months, 18 months longer than their counterparts from 3-year maritime-related vocational college. The longest pathway exists for students with only high school education qualifications, totalling 130 months, because they must start as ratings and it takes at least 88 months for them to become a 2/O or 3/E as compared with 12 months for graduates from 4-year maritime-related universities. The differences in the length of progression of different pathways reflect the importance and benefits of maritime-related academic qualifications while at the same time acknowledge the possibility of people of non-maritime and lower academic qualifications progressing to senior positions.

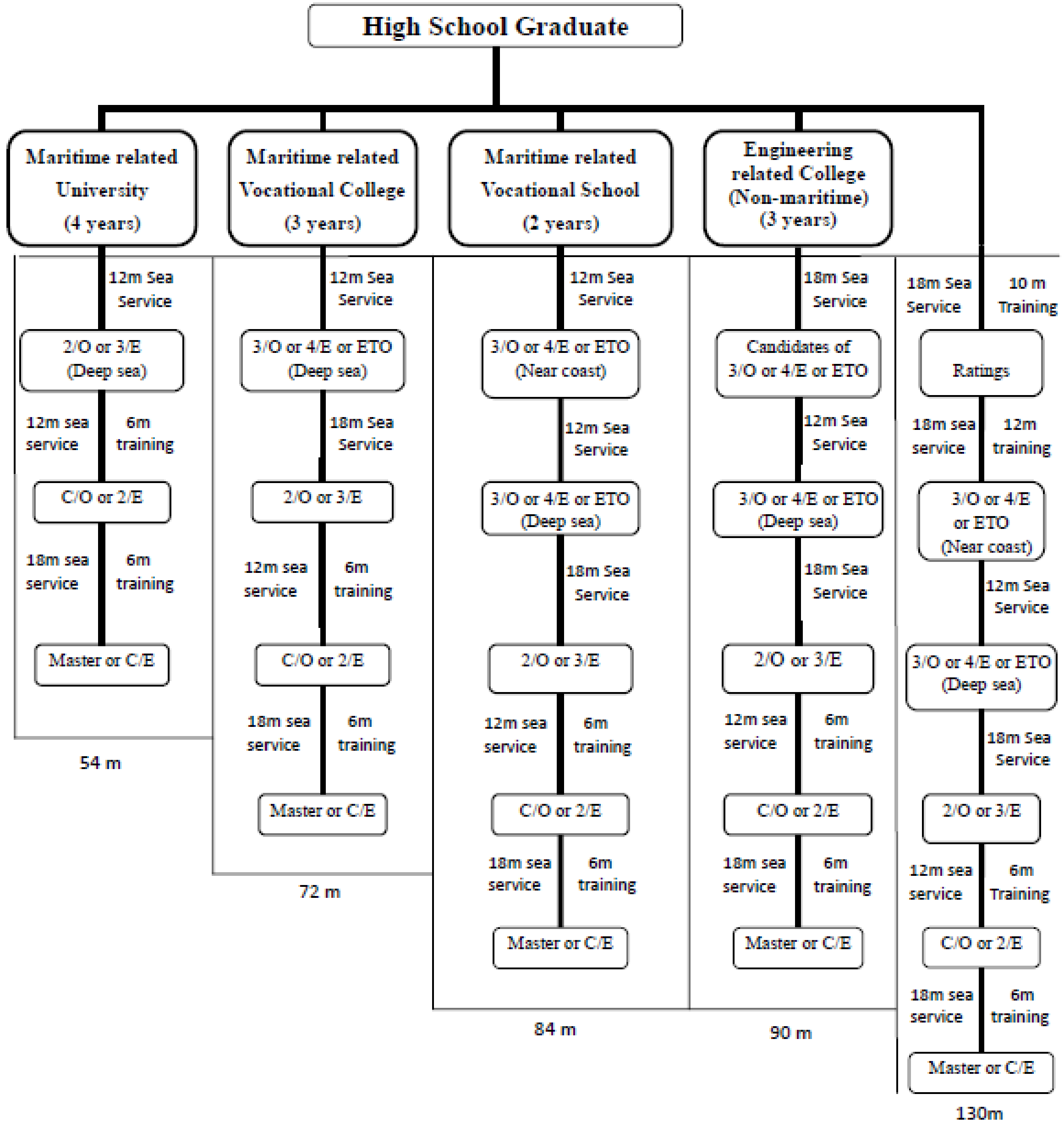

Figure 1 The Minimum length of career progression via different pathways (m: month)

4. Discussions

4.1 The effects of adjustment of requirements for educational qualification

Due to China's economic development, there is little wage difference between ratings at sea and workers onshore. The increasing wage levels of onshore jobs have made seafaring unattractive causing many ratings to drop out in recent years since they could not progress to higher positions under Regulation 2004 due to their lower educational qualifications. In view of the characteristics of seafaring, much emphasis is placed on the practical experience instead of academic qualifications under Regulation 2011. The lowered requirement for academic qualifications can attract more candidates for senior officers on board. It provides a possible channel for ratings of lower education to progress to top positions. Generally, seafarers starting from ratings have more practical experience and get used to the life at sea earlier than those with higher educational qualifications. Research shows that seafarers with a lower educational background are more determined to work at sea and have lower drop-out rate than those with higher educational qualification [13]. It is, therefore, hoped that the new channel will not only allow ratings of outstanding capability to progress to top positions, but also mitigate the shortage of senior officers in China in the long term. Furthermore, although the employment rate of nautical graduates in China remains above 95% [12], data show the drop-out rate of senior officers with bachelor degree is up to 70% to 80% during the span of 5 to 10 years at sea [14]. The reason for this is that there are many shore-based job opportunities for seafarers who have bachelor degrees and some seafaring experience. The rationale behind offering a shortened career path is to keep officers at sea in top positions for longer so that they can fully utilise the knowledge acquired at university.

4.2 The effects of incorporating on-board training into practical teaching

On-board training is included in practical teaching under Regulation 2011 as one part of approved education and training [7], which again highlights the importance of practical knowledge and experience. Without approved on-board training, students cannot apply for the examinations and evaluations for a CoC. The new approach of incorporating on-board training into practical teaching has shifted the responsibility from shipping companies to MET institutes to provide required on-board training opportunities for their students. Due to the very high cost involved, only a small number of institutes can afford the financial burden of owning a training ship. As a result, many institutes have to cooperate with shipping companies to facilitate on-board training. Otherwise, they might be eliminated from the business. The cooperation strategy and elimination process, to some extent, may ultimately contribute to the quality control of maritime education and training in China.

The new approach not only allows students to accumulate sea experience, but also helps them get used to work and life at sea earlier. It may be an effective practice and experience for junior officers of higher educational qualification who find it difficult to get used to the real working and living environment on board [15]. The earlier they experience the real working environment, the better they will be prepared for their future work at sea. The “sandwich” model of learning in institutes, going to sea and coming back to learn in institutes, is considered an organic combination of theory and practice.

4.3 Effects on maritime higher education in China

Regulation 2011 will affect maritime higher education in China since seafarers do not have to formally enrol in maritime colleges or universities any more to obtain their maritime-related academic qualifications in order to progress to top positions. Consequently, maritime colleges and universities might lose market share on student recruitment, creating a new challenge to maritime higher education institutes when prospective seafarers have alternatives to progress to the master or chief engineer level. Generally, there is no salary difference between masters of different academic qualifications. It can be expected that some senior high school graduates may choose to take maritime training rather than higher education to start their seafaring careers due to the significant expenses on tertiary education in China. Maritime higher education providers, thus, need to strengthen their competitive advantages to attract prospective students because fewer people would be willing to pay high tuition fees and spend four years in a university without seeing concrete benefits. In some cases, some shipowners prefer to place and financially support some prospective officers in institutes. In order to reduce their investment costs, shipowners may prefer generic engineering graduates to maritime students who have higher education qualifications. If shipowners have to financially support nautical students for their 4 years of education, then it would be more cost-effective for them to support generic engineering students to take 18 months maritime training to become a 3/O or 4/E. All these factors may affect the scale of student recruitment for maritime higher education in China.

4.4 Challenges for the implementation of Regulation 2011

Notwithstanding the differential career progression for seafarers of different academic qualifications, the standards of examinations and evaluations for CoC apply to all prospective seafarers. It is a great challenge for candidates with lower academic qualifications to pass the national examinations and evaluations for CoC. It is anticipated that, the pass rates of CoC examinations for students of lower academic qualifications are significantly lower compared to those with higher academic qualifications. Meanwhile, it is a known fact that in China the pass rate of maritime English examination is always the lowest, which might discourage some prospective seafarers with lower academic qualifications from pursuing higher positions. Moreover, IMO raises the standard of seafarers' maritime English proficiency in STCW 2010 [16], requiring that companies are at all times responsible for effective oral communication onboard their ships, which may become a challenge for some candidates of lower educational qualifications.

5. Summary and Conclusion

Regulation 2011 introduced two new career progression pathways. A lack of higher education qualifications can be supplemented by prolonging seagoing service, which allows seafarers of lower academic qualifications who are keen to pursue a seafaring career to fulfil their dreams. The fact that students of generic engineering majors can now choose a seafaring career after 18 months of maritime training has greatly enlarged the recruitment pool for prospective ship officers. The Regulation will encourage more new entrants to pursue their career for longer and consequently contribute to the sustainable development of the Chinese seafarer workforce.

University graduates are encouraged to remain longer at sea by shortening the time needed to progress to the master or chief engineer level. Again, the overall active seafaring career can be prolonged as a result. Substandard training institutes may be eliminated by the heightened standards of practical training under Regulation 2011. All these will have a positive impact on the quality and competence of Chinese seafarers as a whole.

Notwithstanding the additional two progression pathways to the master or chief engineer level, candidates may face challenges in reality. The examinations and evaluations for CoC are always the greatest challenge for them, particularly maritime English examination. The new regulation is still in the early stage of implementation. It will take years to show the full effects of the regulation on seafarers, MET institutions, and the Chinese shipping industry as a whole. Further research is required to examine the effectiveness of the implementation of Regulation 2011 in the future.

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Trends in the Training of Maritime Personnel - Professional vs. Academic Education

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The dynamic socio-economic development has a clear impact on maritime education. The progress of technologies, the growing level of automation, and the globalization of markets are some of the factors that define new requirements for the training and education of maritime personnel. Meanwhile, a standardization process of the maritime education and qualification was completed. Obviously, there is a need to broaden the training programs and increase the educational requirements for maritime specialists.
A parallel tendency towards more in-depth professional expertise of the personnel has emerged. In this context some discrepancies arise. On one hand, technological development requires broader interdisciplinary approaches and strengthening the academic character of education. On the other hand, the process automatization and standardization require more professional training. The question of the balance between the academic and professional education is currently on the agenda of maritime universities.
This paper analyzes the current trends in the maritime education and proposes a possible new approach for managing the discrepancies. The conclusions and the recommendations are based on conducted survey among the „users" of maritime personnel, the academic society and experts from different maritime institutions. Proposed is a general model for multi-level system of maritime education and qualification.

Keywords: simulators, vocational training, academic education, trends in maritime education

1. Introduction

There is high complexity in the perception of highly dynamic and difficult-to-predict area of maritime activities. The longstanding perception of seas and oceans as specific environment for transport, fishing and recently – for extraction and transportation of energy resources – has significantly changed. The globalization processes and the economic growth led to new activities by their nature as well as to a spread of the maritime influence on the „deep" land.

The result was new and partially contradictory tendencies: narrow specialization of the activities and global management of branches; multi-institutional approach for the process management and need for standardization procedures; high economic independence and unified system for process regulation, especially in the maritime safety and security domain and in the area of maritime personnel training. Examples for such regulation are the IMO publications [1].

The abovementioned tendencies are typical not only for maritime activities, but their current dimensions fragmentize the maritime area, and have strong interaction between the components and as a whole – loss of the integrated character of the existing systems in the maritime environment. In such conditions the question about adapting the maritime education to the current tendencies in the maritime profession becomes evident.

2. Current tendencies in the maritime activities and challenges for the maritime education

For the sake of the analysis it is very important to outline the tendencies in the maritime meta-system. In 2012, following the institutional accreditation of the Nikola Vaptsarov Naval Academy a profound research to outline the tendencies in the maritime sphere was initiated. The research included several categories of maritime personnel: the users of maritime personnel (shipping companies, maritime logistics enterprises), civil and public servants and employees (experts in the Maritime Administration Executive Agency and State Enterprise Port Infrastructure), lecturers (professors in universities and training centers) and employees, practicing the maritime profession. Analyzed were the processes in the area of maritime activities and the maritime personnel training. Special interest was put on the "global" dimension of the processes so they could be assumed globally valid. The research focused on the actualization of the national training system for maritime specialists but the described processes and tendencies can be assumed as valid in a more global context.

One of the most common aspects is the growing automatization and the **global tendency for "professionalization" of different activities**. Such combination of specialization and automatization inevitably leads to the following opportunities:

- "Fragmentation" of the personnel and differentiation of narrow carrier fields;
- Setting a management staff, whose current hierarchical development can no longer be completed in traditional manner (For a long period of time managers of maritime companies in Bulgaria have been accustomed to the system of gradual promotion from watchkeeping officer (engineer) to the higher positions. Now this practice is significantly changed and there are experts on managing positions without profound experience in the hierarchical positions order. Moreover – in some cases the experts do not have maritime education.);
- Exporting a bigger part of the activities, especially management and maintenance "onshore";
- Broadening the range of experts, necessary for the functioning of each component of the maritime meta-system;
- Eminent need for equal understanding of the maritime activities problems and unified technological procedures.

The "professionalization" of maritime activities originates from the changes in the maritime meta-system so the next global tendency can be viewed as their result, namely **formation of inter-institutional environment of maritime activities.** In such an environment every function or task is a combination of the interests and the competencies of different components. This tendency means shared responsibilities as well as competition. In both directions arises the need for process regulation, common rules or common value system.

The third global tendency in the area of maritime activities is classically connected to **its broadening in geographical terms**. The broadening characterizes by integration of the maritime systems of different countries as well as interrelation of what was before considered "purely maritime" and "purely onshore" activities. It is to be noted that this tendency contributes to the establishment of narrow carrier fields, establishing a management staff, exporting a large part of the activities onshore and the broadening of the experts range, necessary for the normal functioning of every component of the maritime meta-system. From the research stand-point it is essentially interesting that such processes of re-influencing of traditionally "purely maritime" with "purely onshore" activities will inevitably lead to some kind of a contradictions, on one hand between the ordered onshore relations between the subjects and the sovereigns and on the other between the traditional independence of the maritime thinking with the ex-territoriality of activities.

Obviously there is an important challenge for the integrity of the maritime meta-system. Its most significant area will be the sensitive maritime safety and security domain. **The fourth global tendency** will be defined in this context: **formation of common system for maritime safety and security.** It is not to be understood fragmented as establishment of unified safety procedures and unified manual for the security systems [2]. It is to be transferred to the traditional maritime "transnational" perception of security problems, which results in the understanding that the national engagement in "hot points" like the Gulf of Aden thousands miles away is not only a problem of financial resources but a question of national confidence evolving from the vastness of world maritime society. In other words, the tendency of globalization of the maritime security and safety system is a serious challenge for resolving the contradictions between the maritime “global” thinking and the existing national political framework.

In the context of the maritime transportation system globalization is the **fifth general tendency- the implementation of common standards for training of maritime personnel**. With the adoption of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers [3], a unique global process was initiated. In addition to cultural differences, the variety of the models in a particular area exist and the economic freedom is a paradigm necessary to adhere to very strict and detailed standard for personnel training. It is clear that the process of fragmentation of the standard will continue and its scope will broaden in functional and geographical aspect.

The above analyzed tendencies generate **specific challenges for the maritime educational system**. Within the conducted research the challenges were summarized by phrasing. Those formulations should be synthesized. They are connected with the necessity of:

1. High personalized specialization.
2. Integrating the practice in the educational process.
3. Succession in the training on different educational levels.
4. Educational insurance of the strategic management levels of the companies.
5. Improving the training on maritime safety and security.
6. Adapting the training of the non-maritime experts who work in the maritime domain.
7. Broadening the scope of competencies of the maritime personnel.
8. Implementing common international standards in the maritime education.
9. Unified national regulation of the maritime specialties education.
10. Hetero-archic system [6] for control and regulation of maritime education.

The most serious challenge for the academic society is the necessity to integrate the practice in the educational process. There are several different dimensions of the problem. On one hand, the question of broadening the academic education, where new disciplines have to be implemented. On the other, the question of increased requirements for practicing the profession. Considering also the pressure of the short educational periods, the traditional four years model of education becomes insufficient if one year internship should be completed [3]. Under the pressure of the market the academic part of the education shrinks in order to open opportunity for practice. A paradox appears – in a high technology century the academic training for a profession that is highly computerized turns out limited.

In the conducted research this paradox gets an interesting dimension. The users of maritime personnel unanimously support the necessity of practical training but at the same time the nostalgia for the broad training programs for maritime personnel which influenced their professional way up is still present.

3. Model for overcoming the challenges for maritime education (The Bulgarian Standpoint)

According to the abovementioned challenges for the maritime education an expert team from Nikola Vaptsarov Naval Academy engaged with the task to draft a strategy for development of the maritime education in the Republic of Bulgaria. As far as this strategy is an accumulation of models and specific activities, this part of the paper presents the models and activities in the context of the particular challenge which they address.

The first priority is the necessity for **high specialization of personnel**. Actually the approach for this challenge is based on the national model for developing a high education system, which is realized according to the National Qualification Framework of Republic of Bulgaria [5]. The adoption of

National Qualification Framework of Republic of Bulgaria is pursuant to the Bulgarian responsibilities according to the Recommendation of the European Parliament and the Council for establishment of an European Qualification Framework (EQF) for lifelong learning [4]. EQF is a common European reference framework, aimed to create a common European base (starting point) for comparing the different qualification levels of the national qualification systems. The National Qualification Framework of Republic of Bulgaria includes the whole educational system and all its qualifications. It has the following idea to be implemented: **broader profiled Bachelor education and high specialized training for the Masters degree.** According to this principle there is an opportunity to address the higher specialization of the personnel through variety of master programs. In Nikola Vaptsarov Naval Academy this model is already implemented. The two key majors are "Navigation“ and "Ship Power Plant“, they are the fundamental undergraduate majors, upgraded with profiled postgraduate study programs. Currently, there are postgraduate programs in Navigation that are under preparation or initiated, which prepare specialists for management positions, as well as programs in maritime safety and security, maritime administration, ship brokerage, water transport management, logistics.

In the same fashion, the undergaduate program in "Ship Power Plants“ continues into the postgraduate level of ship power plant (which train for manager positions in maritime engineering), ocean engineering (profiled for positions in the maritime industry), ship building and ship repair, maritime administration.

The same principle is used for the ship electro engineering and radio engineering specialties.

The next step is to address the main challenge for the maritime education – **the integration of practices in personnel training**. There are many activities in that respect. It is very important to **adapt the training programs to the requirements of the *International Conventionon Standards of Training, Certification and Watchkeeping for Seafarers, 1978 as amended in 2010 /3/*.** In 2013 in reply of the Manilla amendments of the *STCW Convention* the training programs were revised. The programs were re-drafted according to the functions of the Convention, and their content was fully completed with tables comparing on one hand the required competencies according to the Convention, and on the other – the topics of the lectures of the disciplines. The requirements of the model courses according to the Convention were integrated in the training programs. Based on that the training and practice model were further developed and currently it looks as follows:

- Four years undergraduate academic education in eight semesters;
- One month basic practice after the first academic year (after the second semester);
- Three months for technological and maritime practice after the second educational year;
- Six months practice at sea after the third educational year;
- Six months practice (cadets practice) after passing the state exams according to the functions of the Convention (after the eight semester), concluding with state practice exam.

The postgraduate training is integrated with the practice as well. In this case a model with an entry level is implemented. For admission it is necessary to have a bachelor degree and to practice. In order to practice the profession, this education is planned as extramural. It is planned to implement an admission requirement for having a particular certificate for professional competence with the appropriate practice time period.

For the sake of integrating the practice in the education it is extremely important **to include the shipping companies in the process of practicing**. Currently this is fulfilled by appointing a board of trustees for the specializations and their engagement with the training programs drafting, and through implementing the *Training Record Book*. Additionally the content and the terms of the practice are coordinated with the companies. The **Career Center for coordinating the company activities and the training system** is responsible for this task.

The challenge with the practice has an additional aspect- **the practice of the lecturer staff**. This aspect is addressed by attracting maritime experts for the teaching staff. Currently the teaching staff according to the functions of the Convention fully consists of practicing maritime specialists.

The next challenge for the maritime education is the need for **continuity in the training on all educational levels.** This is already present with respect to the continuity between the bachelor level of maritime personnel training (for specialists on operational positions) and the master training level (for experts on management positions). It is supported by the Common national requirements for the different professions [7]. According to them it is **absolutely compulsory to have a Bachelor degree before admission to a Master studies.**

Very serious challenge is the continuity between secondary and higer education. To meet this requirement Nikola Vaptsarov Naval Academy signed an **agreement for association of the Maritime Secondary School in Varna to the Academy** in 2014. According to the agreement the training programs of both educational institutions will be harmonized in order to achieve the same logic in the education on different educational levels and categories of maritime expertise.

The Career Center of the Naval Academy will get additional mission. It is the formation of so called **"career paths**". The idea is to give the students the opportunity to choose a profession at the beginning of their studies and to get a package of educational services (secondary school, high school and the appropriate qualification courses), for full training on the chosen profession.

The next challenge is the **educational maintenance of the strategic management levels of companies.** This is possible to combine with the necessity for **adapting the training of non-maritime experts occupied in the maritime economy**. In both cases it can be approached by **new majors** which cover the required competencies. Such new specialties are "Maritime Transport Management“ and "Information technologies in the maritime transport“. The majors are implemented for Bachelor and for Master degree as well. From this year on the Naval Academy initiates new majors on business administration and accounting. The main point is to include some disciplines for concrete competencies which cover specific activities in the maritime economy sector.

The challenge of adapting the training of non-maritime experts to the specifics of the maritime industry has another aspect – the necessity to broaden the range of competencies of the maritime personnel. It can be approached by upgrading of training through the abovementioned Master degrees. Other approaches are to attract experts from different professional domains (management, accounting, business administration, informatics etc.) in cooperation with other universities. The Nikola Vaptsarov Naval Academy uses three forms of such partnership – joint specialties, franchising and establishing of alliances. Some activities should be mentioned. First, the established Alliance with the Varna Free University which allowed the realization of a master program on ship brokerage with maritime experts from the Naval Academy and management experts from Varna Free University. Secondly, the franchising agreements between the Naval Academy and the Cyprus Institute of Marketing. The agreement allows educational exchange of students and professors from both institutions on Shipping Administration.

Not least important is the joint university education. This relates to joint Master program on maritime safety and security between the Naval Academy and the Maritime University in Constanta (The initiative for establishing a joint master program on maritime safety and security between Nikola Vaptsarov Naval Academy and the Maritime University in Constance is funded by the Nippon Foundation through the realization of two research IAMU projects – MAREM и MARSA). The Master program is the best example of cooperation between foreign universities and concerns the challenge on **improving the training on maritime safety and security.**

The development of partnership between the maritime universities has high importance for the next challenge – **implementing common international standards in the maritime education**. In this context private initiatives should be also considered, f.ex. implementing a state regulation for the maritime professions and Unified national requirements for education and practicing.

3. Conclusions

Despite the fact that the described tendencies and challenges in the maritime area are analyzed in national context the suggested models do not represent “a national patent”, but an international tendency. In conclusion, the main point is to overcome the contradictions between the academic and professional education. Choosing the right approach is crucial for developing a common plan of the maritime academic institutions in a more global context and concerns all other challenges for the maritime education.

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Session 2D

Human Factors, Leadership, and Risk Management

Crisis Management Through Behavioural Approach of Personality

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During any activity onboard ship there are different situations which can become rapidly a crisis. These situations are not always dangerous at the beginning, but they will become soon, in many cases, often in a short period of time. Under these circumstances, people react differently depending on each person's personality and also by the level of knowledge in using the equipments onboard. In order to manage a crisis situation it is important to be able to predict expected or unexpected reactions of the persons in charge and his or hers capability to operate correctly the equipments available.
Loss prevention involves dealing also with the human mistakes, and solution can be given by studying human reactions during training and evaluation, studying the use of technology which helps creating crisis situations and offers the chance to observe human reactions and interactions between human element and technology in a crisis condition.
Using simulation techniques, our university developed a study that analyzes different navigational situations with difficulties which has as main target the reaction of students at different levels of training compared with experienced seafarers, in the same scenarios. The methods used closed monitoring of changes in people's behaviour and interaction with different equipments in a potentially dangerous or crisis situation, types of personalities, changes in physiologic parameters due to stressful situations, capabilities to focus on important equipment for safety of ship and the way that all these will interfere with the understanding and management of particular situations. The target is to find the best way of reacting and managing a crisis situation, to understand the risks involved and properly solve them, taking into account reaction ability, behavioural personality and interaction with possible vital equipment.
This paper presents the data obtained in the study, and behavioural changes triggered by dangerous situations along with their impact on the final decision and action. The effect of experience appears to be the decrease of introverted actions with a plus into rationale and perceiving attitudes that is translated into better reactions under the pressure of events, without interfering with sensitivity reactions.

Keywords: crisis, personality, behavioural, management, study, safety of navigation

1. Introduction

Most of high-consequence but low-probability accidents involving complex systems such as ships are caused by human and organizational factors. The fundamental problem in most cases is not hardware but 'human ware'. [1] Most of these accidents could have been prevented even though they involve operating actions that contain fundamentally unpredictable combinations of events, which are unsettling. Many of these accidents consist of rapidly unfolding sequences of events in which the pace of operations is dramatically increased and the normal organization structure rendered ineffective.
We know that the human factor plays a significant part in maritime accidents, and that accident reports frequently highlight deficiencies in non-technical skills, such as communication, team-work and leadership. There appears to be a paucity of formal research within the maritime industry on behavioural markers which could underpin criteria for evaluating competence in non-technical skills, and STCW [5] itself provides only the broadest of measures.
Crisis situations onboard ships are not isolated incidents. Many of the usual activities, especially on the bridge, have the aspect of a crisis situation. These are situations when the seafarers have to take decisions in a short time, and, very probable, with little information.
Today, there are specialised training courses for the management of a crisis situation, where the trainees learn how to identify such a situation, how to analyse it and what decisions to make for a safe

result. But, none of these trainings have included the study of individual personality and how it affects the final decision.
People's personality is difficult to be defined, because it is a characteristic of each individual. For this reason, the definition of reaction in case of emergency or crisis is difficult to be given in a general format. A better understanding of the ways to manage a crisis situation is based on the understanding of involved persons' behavioural personality. Seafarers' behavioural personality must be treated as part of the safety concept onboard ship.
The study conducted by our university intended to analyse the impact of behavioural personality on ship's safety in different crisis situations. The analysis was made using students and experienced seafarers, two groups with completely different approaches to a well defined crisis situation.
The results of the study allow us to have a better image and understanding of how people react in a crisis situation according to their personality and experience.

2. The behavioural approach of personality

The way in which we interpret an event is critically linked to another type of cognition: our core beliefs. A complex blend of factors derived from both "nature" and "nurture" are thought to drive the formation of people's core beliefs. Cognitive theory assumes there are certain inherited dispositions such as temperament (nature), which interact with children's environments (nurture), to influence the ultimate shape of their personality, and their characteristic interpersonal strategies. Moreover, cognitive theory emphasizes the importance of social learning with respect to personality development. Childhood experiences, including childhood trauma and abuse, are seen as important factors that establish these core beliefs about the world. These core beliefs will later colour, and potentially distort, people's perceptions and interpretations of subsequent experiences. [6]
Thus, people appraisal of events is influenced not only by our immediate experience of the situation or event before, but also by preconceived ideas and beliefs formed in the past. When individual core beliefs are faulty, biased, or distorted, they may end up drawing incorrect, irrational conclusions about the meanings of events. Individuals may subsequently behave in ways that cause us unnecessary distress.
Generally speaking, there are two interrelated factors that contribute to the development of people's personality.
These are:
a. biological factors, meaning people's genetic make-up and temperament, and
b. environmental factors, meaning people's life experiences, particularly early childhood experiences.
Although it is simpler to discuss these two factors separately, many experts believe they cannot be understood independently from one another.
Personality refers to a set of distinctive personal characteristics, including motives, emotions, values, interests, attitudes, and competencies. [8]
Trained and certified professionals generally assess personality in three ways:

1. ***Personality inventories*** require the person to answer questions that describe the respondent's personality;
2. ***Projective tests*** require the person to describe what she sees in a picture or relatively ambiguous stimuli, such as an inkblot. A detailed scoring protocol places the person along numerous personality dimensions;
3. ***Simulations, role-playing exercises, and stress interviews*** require the person to behave in specific situations. An observation and scoring protocol categorizes the person along dimensions such as adaptability, assertiveness, or dominance.

In our study, we applied the last procedure to obtain information about how cadets and experienced seafarers react in different conditions.
Also, psychological research has identified many traits and attributes, some measured by the previously mentioned instruments that compose a person's personality. In a special working environment, such as onboard ship, it can be useful to know how these dimensions might influence personnel behaviour. [6]
Describing and analysing a person's personality can suggest some issues that should be considered in managing the personnel.

Related to personality behaviour, in the present, there are different ways of classification. First, people can be classified according to their basic interaction with others. *Introverted* types tend to be shy; they like silence for concentration, dislike interruptions, and work contentedly alone. Having the ability to concentrate intensely and develop ideas, this type tends to be reflective and inwardly directed.

Extroverted types tend to be outgoing and sometimes aggressive. They like variety, enjoy functioning in a social environment, often act quickly without thinking, and may dominate situations or people. This type focuses on people and things.

Secondly, people acquire information by either sense or intuition. *Sensing* types like action and getting things done. They focus on facts, data, and details. Although they tend to be pragmatic, precise, and results-oriented, they can reject innovations. They work steadily and reach a conclusion step-by-step. *Intuitive* types dislike doing the same thing repeatedly and enjoy learning new skills. They may reach conclusions quickly and often follow their inspirations and hunches. They tend to be imaginative, creative, and idealistic, but can be unrealistic or scattered.

Third, people make decisions by thinking or feeling. *Thinking* types excel at putting things in logical order and respond more to people's ideas than to their feelings. Characterized as analytical, rational, logical, and impersonal, they can undervalue feelings or be overly critical. They need to be treated fairly and tend to be firm and tough-minded.

Feeling types like harmony and respond to individuals' values and feelings, as well as to their thoughts. They tend to be persuasive, sympathetic, sensitive, and loyal. They enjoy pleasing people, but can be overly sensitive or moody.

Fourth, people also differ in the way they evaluate information about the world. *Judging* types like to get things finished and work best with a plan. They are organized, settled, and structured, but dislike interrupting their tasks and can be closed-minded and inflexible.

Perceiving types adapt well to changing situations and do not mind last-minute changes. They tend to be open-minded, curious, and flexible. They may begin many projects but have difficulty finishing them, or they may postpone unpleasant tasks. [6]

2.1 Individual values and attitudes

A person's values and attitudes develop over time, beginning in early childhood. Values and attitudes are linked to personality and can influence behaviour. In the onboard ship activities, leaders understand how values and attitudes affect seafarers; they can diagnose the reasons for workplace problems more effectively. Once diagnosed, they can also prescribe ways to solve such problems.

Values refer to the basic principles and tenets that guide a person's beliefs, attitudes, and behaviours. Values tend to be relatively stable characteristics. They become evident in working and non-working settings throughout adulthood. People's values can influence their beliefs about money, social interactions, the importance of work, and other aspects of their professional and non-professional lives. [6]

Core values are more susceptible to change, and *peripheral values* are less susceptible. A research study indicated that organizational influences affect peripheral values, and non-professional influences affect core values. Leaders would have difficulty changing a seafarer's core values through training or other interventions, but a parent, spouse, or friend can alter them. [8]

Diagnosing the impact of core values on working situations helps leaders place seafarers in appropriate situations.

An *attitude* refers to a person's tendency to consistently respond to various aspects related to people, situations, or objects. We infer attitude from a person's statements about their beliefs and feelings. We infer people's attitude from what they say, what they do, and how they react. It is possible, for example, to determine a person's professional satisfaction by inferring it from the general demeanour on the job or by asking for a description of satisfaction. It is also possible to use attitude surveys or other attitude scales to assess seafarers' attitudes towards their activity, co-workers, senior officers, or the shipping company in general. [6]

Diverse workforces include people with varying attitudes. People have an array of beliefs, formed in large part from their socioeconomic and cultural backgrounds and other experiences. These varying beliefs likely result in different attitudes.

Once we understand particular attitudes and their impact on specific work situations, we can prescribe ways of changing either the attitudes or the situation to result in more productive outcomes.
Attitudes have a cognitive, affective, and behavioural component.
Cognitive – Individuals have beliefs about a certain person, object, or situation that they accept as true based on their values and experiences. These learned beliefs, such as "you need to work long time to get ahead in this job", lead to specific attitudes.
Regarding seafarers, although they have many beliefs, only some lead to attitudes that have an impact on their behaviour at the workplace.
Affective – People have feelings that result from their beliefs about a person, object, or situation. A person who believes extra effort deserves praise may feel angry or frustrated when one puts in extra effort but one's manager doesn't acknowledge it. The affective component becomes stronger as a person has more frequent and direct experience with a focal object, person, or situation and as the person expresses one's feelings about that object, person, or situation more frequently.
Behavioural – Behaviour appears as a result of a person's feeling about a focal person, object, or situation. A person may complain, request a transfer, or be less productive because one feels dissatisfied with work.
Attitudes can also result from a person's experiences. How easily a person can call on an attitude, affects its impact. Personal experience with the object and the repeated expression of the attitude increase its accessibility, and the attitude more frequently affects behaviour.
Seafarers may experience *cognitive dissonance*, which describes their attempts to deal with situations in which they have contradictory knowledge, information, attitudes, or beliefs. In this situation, the seafarer tries to reduce the contradictions by redefining the situation. Theorists argue that dissonance is short-lived. People reduce dissonance by changing their attitudes, forgetting about the inconsistency, reaffirming their core values, trivializing the dissonant elements, or misattributing the cause of the dissonant events. [6]

3. Onboard ship crises and crisis management

A crisis is defined as a rapidly developing sequence of events in which the risks associated with the system rapidly increase to a hazardous state. The crisis begins with a surprise warning of some type that the system is moving from a safe to an unsafe state. Crises involve potentially grave life and property threats.
In some of the specialized papers, crises are described as "events that do not play by the rules". [1] These destabilizing breakdowns seem to feed on themselves and overwhelm normal problem solving resources. Crises are characterized by a threat to normal values and goals, pressures to decide quickly, short time to act, unexpected events that shock, confusion, pressures to innovate in solving the crisis, development of limited options, developments in which inaction produces undesirable consequences, incomprehensible developments, information overload, ambiguity and uncertainty, increased numbers of important demands, conflicts, limited resources, problems lumped together, exaggerated deviations, intense scrutiny, and loss of critical functions. Crises are traumatic affairs.
Also, it was observed, that the ability to deal with a crisis situation is largely dependent on the structures developed before chaos arrives. [1] The event can in some ways be considered as an abrupt and brutal audit: at a moment's notice, everything that was left unprepared becomes a complex problem, and every weakness comes rushing to the forefront.
In its simplest terms, a crisis can be divided into three general stages: perception, evaluation, and, action. The first stage requires individuals to perceive and recognize warning signs of the evolving crisis. The second stage involves processing information to identify problems and causes, alternatives that might bring the system back into a safe state, consequences associated with each alternative, evaluation of alternatives, and the choice of alternative or alternatives to be implemented. The third stage involves implementing the alternative, and observing the results. If the observation indicates that the alternative is not working, the process must be repeated selecting a different alternative. If the system cannot be brought back to a safe state, an accident happens. If the system can be brought back to a safe state, then a 'near-miss' or 'incident' occurs.

Applying in maritime transport activities, this characterization of crisis raises issues about strategies that can more frequently bring engineering or navigation systems back to safe states and to understand how to have more 'near-miss' than 'direct hits' (accidents).
Perhaps no stage in a crisis is as important as the first stage: recognition or perception. Because the crisis is just unfolding, if the situation can be quickly and correctly recognized, there will be more opportunities and time to bring it under control.
Humans seem to have a fundamental difficulty accepting the potential danger of a situation under development. In a study of crew reactions to accidents onboard passenger vessels or ferries, it was found that 60% of the people ignored or misjudged the hazards, 30% investigated, and 10% accepted that hazards existed and initiated action. Once the hazard was recognized, something of the order of 10% to 25% panicked or went into shock, so called crisis paralysis, 50% to 75% behaved in confused helpless ways, and 10% to 30% made realistic evaluations and started positive corrective actions. During the study it was observed that people who have generally accepted the risks associated with an activity are not usually motivated to study or practice safety procedures or recognize early warning signs of a developing crisis. [4] They have become 'risk habituated'.
Three classes of cognitive factors seem to govern how well people perceive a crisis:

1. Knowledge – background that can be accessed when solving problems,
2. Attention dynamics – control and management of mental workload, maintenance of situation awareness, and avoidance of fixations,
3. Strategy development – successful trade-off between conflicting goals, dealing with uncertainty and ambiguity, avoidance of organizational double binds, and development of good priorities and decisions. [2]

Developing and maintaining an awareness of potentially hazardous situations involves a constant process of detecting anomalies; things that are not right or don't fit. [1] Reporting this concept to bridge activities means to have all the time a control of developing activities and to be aware about what can go wrong in the present or future activities. Not only on the bridge, this principle can be applied, it can be used in all ship departments. The development and maintenance of awareness of potentially hazardous situations have to be the first concern of all seafarers. This is the first principle in the development of a safety culture onboard.
The usual approach to investigating crises in the interests of improving crisis preventions is to look for maintenance and design failures to equipment. If the human element is considered at all, this is the hands-on operator. A rapidly developing sequence of events onboard ship implies the contribution of more than a single or a few seafarers to the outcome.
In order to reduce risk or improve crisis prevention we need to look at two aspects of sense making, how individuals make sense of things and how groups and organizations make sense of things.
People support strategies including such things as selecting personnel well suited to address crises, and then training them so they possess the required skills and knowledge. Re-training is important to maintain skills and achieve vigilance. The cognitive skills developed for crisis management degrade rapidly if they are not maintained and used.
Crisis management teams should be developed having the requisite variety to manage the crisis and having developed teamwork processes so the necessary awareness, skills, and knowledge would be mobilized when they are needed. Auditing, training and re-training are needed to help maintaining and honing skills, improving knowledge, and maintaining readiness. [3] Crisis management teams need to be trained in problem 'divide and conquer' strategies that preserve situational awareness through organization of strategic and tactical commands and utilization of expert task performance' teams. [7] Crisis management teams need to be provided with practical and adaptable strategies and plans that can serve as useful 'templates' in helping them to manage each unique crisis. These templates help reducing the amount and intensity of cognitive processing that is required to manage the crisis.

4. Study of behavioural personality's impact on ship's safety

As mentioned before, there are no or very few studies about how seafarers' personality affects the safety of ship and personnel. At the same time, the entire maritime industry, including education and training institutions, is focused on increasing safety and reducing accidents or 'near-miss' events which may occur. Maybe, it can be considered that behavioural personality is the 'missing link' in completely understanding accidents' development. Anyway, even if it is not the 'missing link', it is an important aspect to analyse in an accident development.

Aims of the study. In an effort to understand how the individual personality and knowledge can affect the safety of the ship, we decided to realize a study in this field, using as research method, simulation techniques combined with role-playing and interviews, for a clear explanation of decisions. The study was realized using Constanta Maritime University's facilities and with the support of our students and graduates in management positions. It involved a number of twenty students from the third and fourth year of study and five graduates.

For the study of behavioural personality and psychological classification, we received support from medicine faculty lecturers.

One of the purposes of the study was to understand the changes in a person's behaviour and interaction with different equipments in a potentially dangerous or crisis situation, types of personality, changes in physiological parameters due to stressful situations, capabilities to focus on equipments important for the safety of the ship and the way in which all these will interfere with understanding and managing particular situations.

Another target of the study was to find the best reacting way and managing a crisis situation to understand the risks involved and properly solve them, taking into account reaction ability, behavioural personality and interaction with possible vital equipment.

Methods. 20 students of Constanta Maritime University were included in the study after giving written consent about data resulted. The simulation scenarios were created according to situations reported as high generators of dangerous situations, like sailing in bad weather conditions, failure of different equipments, entrance or leaving port manoeuvres, passing through a heavy traffic area or confined waters. In scenarios' preparation there were taken into account indications and advices given by the experienced graduates involved in the study. These advices were given based on their own experiences during years of service at sea.

For a better image of students' reactions and decisions in a crisis situation, we decided to enrol in study both students with cadet practice, and students without it. In this way it was possible to analyse how a little experience, as onboard cadet practice, can influence decisions during uncommon navigation situations. 10 students were presenting no experience on board ships, and 10 were having cadet practice for 6 months and the 5 graduates were having practice for more than 5 years.

Also, during the study, the chosen team was mixed, meaning that in the same team it was possible to have students from both categories and, where we considered necessary, together with an experienced graduate. This kind of team, allowed for the behavioural personality to be observed during subordination relations, in respect with the normal arrangement on the ship bridge.

As a role play, students have taken position as senior officers and helmsmen, graduates have taken, in most of the cases, senior officer positions or Master position. Through this arrangement, it was also intended to study the flow of information during a crisis situation and the effect of stress and pressure on communication and following actions.

Results and discussion. Analysing the behaviour, according to a person's personality classification, described before, the participants were grouped in types of personality, as: introverted, extroverted, sensing, intuitive, thinking, feeling, judging and perceiving.

Analysing the behavioural personality of the students with or without cadet experience, in the considered navigation situations, we got the following results about personality classification (Table 1).

The effect of experience as it's visible in figure 1 appears to be the decrease of introverted actions with a plus into rationale and perceiving attitudes. This is expressed also in time of reaction (decrease into thinking and increase in judgement decision. The sensitive figures were not affected by experience, facing the fact that in both groups the level of sensing and intuitive figures was similar).

Personality type	Students without experience No. = 15	Students with experience No. = 20	p (<0.05)
Introverted	20%	10%	0.28
Extroverted	≈ 5%	10%	0.32
Sensing	10%	10%	NS
Intuitive	20%	20%	NS
Thinking	15%	≈ 5%	0.24
Feeling	10%	10%	NS
Judging	15%	20%	0.73
Perceiving	≈ 5%	15%	0.11

Percentages are evaluating the distribution of personality figures, not defining the personality type as individual.

Table 1. Classification of test students according to personality type figures

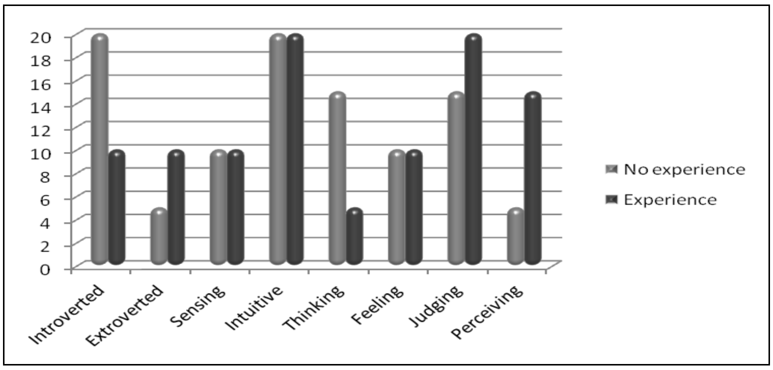

Figure 1. Comparison between cathegories of students as personality type during study

Analysing the way of reaction and interrelation with the team and leaders, it was noticed that most of the students with practice onboard, have better reactions under the pressure of events and in the presence of a superior rank. The students without onboard practice, felt less comfortable in the presence of an experienced seafarer, and reacted slowly or blocked when receiving orders from them.
In relation with equipments, especially those important for the safety of navigation, the study revealed that students with experience on real equipments or with simulators practice react better to different crisis situations generated by the equipment malfunctions.
The report of dangerous situations for ship after a decided manoeuvre was quite equal for both groups, the difference between situations was given by the reaction of the leader in those conditions, or, how the leader could communicate with the team and the clearness of the messages.

Simulation - 2h	Length of reaction (mean +/- SD)	Refractory period (mean +/- SD)	No. errors
No experience	70” (+/- 16.57)	54” (+/-26.32)	>10
Experience	27” (+/-6.48)	22” (+/- 4.21)	< 5

Table 2. Capability of reaction during simulation of crisis situations

At the end of the simulated situations, during the interviews with the participants, the research team tried to explain the decisions for different navigation situations and in this way to understand what role played the persons’ personality in these.
According to the opinion of the specialized interviewers, many of the students tried in the first stage to deny their mistakes or to minimize the impact of their faults. This behaviour is considered to be normal and in accordance with personality expression.
Considering that one of the final interviews’s meaning was to help students to understand their mistakes and how it was correct to react in particular crisis situations, the evaluators advised students

to try to be as much frank as possible in their answers, and in this way, the evaluators to be able to offer the risk conclusion about it.
Analysing all results reached after the study resulted in the fact that it is true that the personality influences the decision making process in crisis situations and the decisions are examples of each decider's personality.
Following the study, the research team intends to initiate a new study about how the psychological behaviours or personal feelings influence decisions in a dangerous or crisis situation. This study can be applied to all seafarers, disregarding the decision level or ship department.

5. Conclusions

As long as safety will be considered the most important part of the maritime activities and humans will be in charge of managing this, there will always develop crisis situations. For this reason it will be important to improve the crisis management procedures for covering new possible situations.
Another important thing is the importance of selecting, training and organising the 'right personnel' for the 'right activity'. This is much more than an activity design; it is selecting those able to perform the tasks within the required performance for that activity. Taking in consideration the future trend in technological improvement of ship activities, it will be necessary to improve the team work concept and group decision also.
The systems must provide adequate support and security for crisis management teams to accomplish their tasks. They must provide adequate warning of approaching danger and important data that do not overload cognitive resources. Most important, the future ship systems must be tolerant of human errors through the incorporation of adequate measures, including behavioural personality of the operators, and stability.
Summarizing the targeted goals of the study, the research team considered that they were fulfilled and the results allowed them to better understand how personality problems can be managed in relation with onboard ship activities.
For the future it is considered as important to consider more seriously the behavioural personality and its impact on ship safety. In this sense, it is recommended for training institutions to generate applications able to reveal each individuals personality and his behaviour during a crisis situation. These applications will allow defining better how to model the individual training for a better performance later at sea.

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Marine Transportation Application of Risk-Based Decision Making

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Decision making frequently involves determining parameters that are imbued with uncertainty. This sometimes involves the use of subjective, qualitative methods, such as a risk ranking matrix, in which consideration is given both to the probability of occurrence and the expected consequences of an event. These are found on the horizontal and vertical axes of the matrix; inside the matrix are blocks denoting the expected severity of the situation, with each block denoting risk levels, such as acceptable, moderate, serious, and critical. The decision maker makes a qualitative determination of both input parameters, and where the two intersect on the matrix determines the severity of the situation, which informs the action to be taken. The inputs (probability of loss and resulting damage) are typically imprecise. Recent research has criticized methods such as the risk ranking matrix as being ineffective and for giving users a false sense of security, which can have serious consequences at sea.

One alternative is the use of Monte Carlo (MC) simulations. MC simulation is a quantitative risk analysis technique where the inputs, such as the probability of a loss event, are modelled as statistical probability density functions (PDFs) rather than given imprecise labels, such as low, medium, or high. Once the inputs have been characterized as PDFs, a MC simulation program can determine the expected outcome thousands of times using random numbers along with the PDFs to determine the actual values of each input parameter for each particular instance the simulation is run. This will result in thousands of outcomes being generated. The aggregation of these outcomes allows the decision maker to determine the outcomes for the worst case scenario, the best case scenario, and the most likely scenario, along with the statistical probability of each scenario. Such a tool is more powerful and informative than a risk ranking matrix.

The paper begins with an overview of risk ranking matrices and associated problems. Next, we provide an overview of Monte Carlo simulation and explain its use in marine risk management situations. We then present a hypothetical case in which a Monte Carlo simulation is used to advise the course of action for a shipping company considering using the Northern Sea Route instead of the Suez Canal for shipping between Rotterdam and Yokohama. We conclude that the use of Monte Carlo simulation is a promising option for risk-based decision making at sea, that significant work is required in the area of characterizing input parameters as PDFs, and that training in the areas of probability and statistics should be an important part of the curriculum at MET institutions.

Keywords: Monte Carlo simulation, risk ranking matrix, marine risk-based decision making, quantitative risk-based analysis, Northern Sea route, Suez Canal.

1. Introduction

When operating a vessel, dealing with uncertainties and risk is a part of everyday life. Decisions will always have to be made in the face of uncertainty, but it is the job of ship operators to be responsible in their decision making processes to ensure that their decisions do not unnecessarily endanger the lives of workers at sea. Decision making is a process that is always made in the face of uncertain events with known outcomes. Therefore, it is imperative that decision making processes involving the ocean are as sound as possible to prevent loss of life and property.

One famous example of marine decision making gone awry is that of Captain Edward Smith and the RMS Titanic. It is generally acknowledged that Captain Smith was warned about the potential for ice in the path of the Titanic, but he chose to proceed at normal speed despite the risk. This is a classic example of an individual having to make a decision in the face of the unknown – to reduce speed and reduce the probability of striking an iceberg or to sail on at normal speed without reducing the risk. While the answer will never be known, it is valid to question if Captain Smith were fully aware of the actually probability of colliding with an iceberg or the magnitude of the potential consequences, might he have made a different decision? This paper will examine risk-based decision making processes at sea, and in particular, the use of Monte Carlo simulation as a means to facilitate risk-based decision making.

A more recent example is that of the British Petroleum (BP) Deepwater Horizon oil spill in the Gulf of Mexico in 2010. In this case, BP admitted that it made the final decision on a crucial negative pressure test that had been misinterpreted as showing that the Macondo oil well had been properly sealed with cement when it had not [1]. This was a mistake that led to catastrophic failure with human casualties and financial losses of approximately $50B as of Nov. 2010 [2]. If the magnitude of the potential loss had been understood in this case, it is likely that BP may have proceeded differently. In essence, BP placed a roughly $50B bet at unknown odds that its interpretation of the negative pressure test results were correct, a situation that could have been avoided through the use of better risk-based decision making models.

2. Risk Ranking Matrix-Based Decision Making

A popular method of assessing risk in marine industries is the risk ranking matrix, such as the one shown in Figure 1, which is from the 2011 annual report of PotashCorp [3]. This matrix is representative of the risk ranking matrices commonly used in ocean industries, although they are commonly tailored to suit the needs of the company or situation in question. When making a risk-based decision, consideration is given both to the likelihood of occurrence of the threat in question along with the expected consequences, and where the two intersect on the matrix determines the severity of the situation. For instance, an event that is considered 'probable' with a severity level of 3 (labelled Acceptable in this case) leads to a risk ranking of B, which as explained below, is considered to be a 'Major' risk that is to be addressed at the next available opportunity. One issue that is apparent with this matrix is that "Severity" and risk ranking are categorized using the same titles. A risk ranking of "Acceptable" can be found under the "Extreme" severity category. This alone could be very confusing when discussing a risk-based situation. For example, when one says the risk is low, does he or she mean that the overall assessed risk ranking is low, or does it mean that the severity is low, in which case, the assessed risk ranking might actually be major?

Furthermore, several researchers have recently pointed out flaws of using risk ranking matrices in industry. For example, Cox, as summarized by Talbot [4], pointed out the following limitations of risk ranking matrices:

1. They can correctly and unambiguously compare only a small fraction of randomly selected pairs of hazards and can assign identical ratings to quantitatively different risks;

2. They can mistakenly assign higher qualitative ratings to quantitatively smaller risks to the point where with risks that have negatively correlated frequencies and severities, they can lead to worse-than-random decisions;

3. They can result in suboptimal resource allocation as effective allocation of resources to risk treatments cannot be based on the categories provided by risk matrices;

PotashCorp Risk Management Ranking Methodology

Risk Ranking Matrix		SEVERITY OF CONSEQUENCE				
		1 Negligible	2 Low	3 Acceptable	4 Major	5 Extreme
LIKELIHOOD OR FREQUENCY	5 **Probable** (0-6 months)	C	B	B	A	A
	4 **High** (6 months-2 years)	D	C	B	B	A
	3 **Medium** (2-10 years)	D	D	C	B	B
	2 **Low** (10-50 years)	E	D	D	C	B
	1 **Remote** (> 50 years)	E	E	D	D	C

A Extreme: Initiate mitigation activities immediately to reduce risk. If such activities cannot sufficiently reduce risk level, consider discontinuation of the applicable business operation to avoid the risk.

B Major: Initiate mitigation activities at next available opportunity to reduce risk. If such activities cannot sufficiently reduce the risk level, board approval is required to confirm acceptance of this level of risk.

C Acceptable: Level of risk is acceptable within tolerances of the risk management policy. Additional risk mitigation activities may be considered if benefits significantly exceed cost.

D Low: Monitor risk according to risk management policy requirements, but no additional activities required.

E Negligible: Consider discontinuing any related mitigation activities so resources can be directed to higher-value activities, provided such discontinuance does not adversely affect any other risk areas.

Figure 1 PotashCorp Risk Management Ranking Methodology [3]

4. Categorizations of severity cannot be made objectively for uncertain consequences. Assessment of likelihood and consequence and resulting risk ratings require subjective interpretation, and different users may obtain opposite ratings of the same quantitative risks.

Point number 2 is particularly troublesome as it indicates that in some circumstances, the decision maker is better off making a random assessment of risk than using the matrix – making the matrix "worse than useless," in the words of Cox [5]. As well, Wall argues that users of risk matrices claim risk scores provide the information needed to rank risks [6]. According to Wall, this is a baseless claim as the theory of decision making and research results describing actual decisions produce models that do not support the risk scoring in risk matrices, leading Wall to question the validity of risk scores obtained from risk ranking matrices. This makes the study of alternatives, such as the use of Monte Carlo simulation for risk-based decision making, that much more important.

3. Monte Carlo Simulation

Monte Carlo (MC) simulation is a method for modelling the output of a system that has varying inputs. In a system that has many varying inputs, it is often impractical to determine the expected outcome using deterministic methods as the inputs themselves cannot be determined with certainty. In such cases, Monte Carlo simulation may provide greater insight into how a system behaves.

MC simulation is a process that works by sampling values for input parameters from probability density functions (PDFs) that represent the input parameters. If the model calculates the output enough times, with input parameters randomly selected from the input PDFs, the model will eventually calculate the outcome for virtually every possible combination of input parameters – thus producing virtually every possible outcome. MC simulations not only theoretically produce all possible outcomes for a simulated problem, but also the probability of any particular outcome occurring can be computed. Essentially, it allows a decision maker to look at many, many 'what-if' situations as the input variables are randomly selected over and over again to produce the entire range of possible outcomes. MC simulation is best explained by example, as in the following section.

3.1 Example of a Monte Carlo Simulation Analysis

Liu and Kronbak [7] presented a case study which examined the economic viability of shipping from Rotterdam to Yokohama via the Northern Sea Route versus the conventional Suez Canal route as shown in Figure 2 [8]. They compared two basic scenarios to determine which was more economically viable – Option A: Buying a regular 4300 TEU vessel and shipping year round through the Suez Canal; Option B: Buying an ice class 4300 TEU to be used in the NSR during the months the NSR is navigable and which would be used for the Suez Canal route the rest of the year. The idea is that due to the significantly shorter distance though the NSR, option B trips will, on average, require significantly less time than the option A trips, thus allowing for more trips annually and generating more annual revenue using option B. Whether it is more profitable is another question.

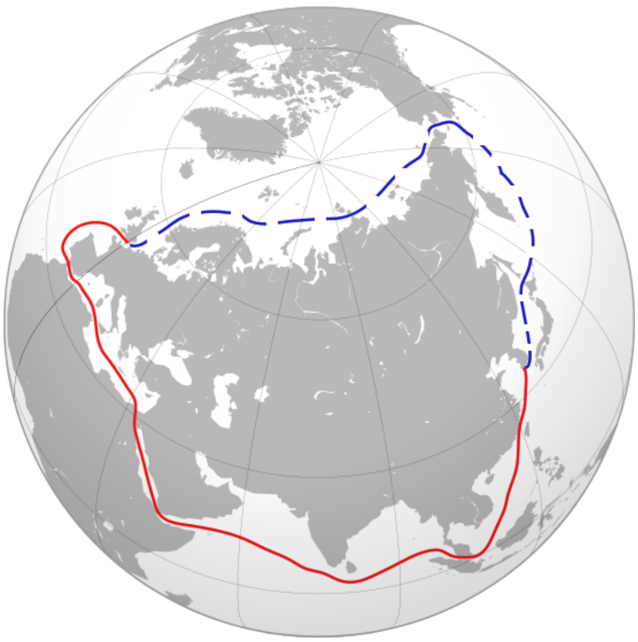

Figure 2 The Northern Sea Route and the Suez Canal Route [8]

In this section of the paper, we will revisit this case study and create a Monte Carlo based analysis of the same question using the information and assumptions used by Liu and Kronbak [7]. As the purpose of this section of the paper is simply to present an illustrative example of using Monte Carlo simulation for marine risk-based decision making, we will refrain from critically examining the information used and assumptions made by Liu and Kronbak. Note that all dollar amounts in the following discussion are US dollars (USD).

3.2 Input Data for Monte Carlo Simulation

In their analysis, Liu and Kronbak [7] examine the economic viability of the using the NSR when it is navigable versus the Suez Canal under differing scenarios: the NSR is navigable for 91, 182, and 274 days in a given year (with differing ice cover scenarios in each case), bunker prices are \$350, \$700, or \$900 per ton, and the icebreaking fee is set at \$4M, \$2M, \$0.6M, and \$0. They take each of these data points and compare them discretely. For example, what is the expected profit if the NSR is open 274 days, bunker costs \$700/ton, and icebreaking fees are \$4M? This produces a 9×9 matrix for the option B, which is then repeated three times for an assumed 50%, 85%, and 100% reduction in ice breaking fees. This produces four tables for option B. With a Monte Carlo analysis, our goal is to reduce this to a more straightforward comparison of the two options by modelling the differing input parameters as probability density functions (PDFs), which are then used to calculate the expected profits under randomly varying input conditions. The analysis of all these outputs taken together can help make an informed decision about which option is more economically sound.

Here are the assumptions made and data used in the Monte Carlo simulation, which have been adapted from Liu and Kronbak [7]:

- Bunker prices per ton follow a triangular distribution (350, 700, 900);
- The number of days in any particular year that the NSR is navigable is represented by a triangular distribution (91, 182, 274);
- The icebreaking fee for the NSR varies uniformly between $0 and $4M;
- Annualized Capital Cost for non-ice class 4300 TEU is $4.4M;
- Annualized Capital Cost for ice-class 4300 TEU is $5.28M;
- Daily operating cost for non-ice 4300 TEU is $8925;
- Daily operating cost for ice-class 4300 TEU is $6100;
- Average ship speed in water containing ice is 10 knots;
- Average ship speed in ice free water is 18 knots;
- Fuel consumption per nm in ice water is 0.5 tons;
- Fuel consumption per nm in ice free water is 0.3 tons;
- Distance via NSR is 7100 nm;
- Distance via Suez Canal route is 11400 nm.

If the NSR is navigable, the amount of ice free water (for which navigation speed is higher than ice infested water) is directly proportional to the number of days that the passage is navigable. It is represented by the following formula:

$$\textit{ice free water (nautical miles)} = 3.3 \times \textit{days navigable} + 6100 \qquad (1)$$

The data regarding ice water/non-ice water distances in Liu and Kronbak's analysis is not exactly linear, but it is close enough that we have used the two outside points ([91, 6400] and [274, 7000]) to characterize all points in between for the purposes of this example [7].

3.3 Modelling the Simulated Trips

For either option A or B, the idea is to model the costs and revenue associated with many individual trips using Microsoft Excel and the @Risk software, which allows for the use of probability distributions that are not native to Excel, such as the triangular distribution. For the simulation, each line on the spreadsheet represents one simulated trip and its associated costs and revenues. Once many trips are simulated for a given option, the expected profit can be annualized by calculating the average number of trips that could be taken in a given year and multiplying that number by the expected profit per trip, which is just the average of the profits of all the trips for a given option.

Option A							
Simulated Trip Number	Bunker Price	Fuel Consumption	Fuel cost	Capital Cost	Operating Costs	Suez Canal fee	Profit for trip
1	480.21	3420	1642311.55	318112.63	160972.22	240800	$637,803.60
2	817.76	3420	2796753.09	318112.63	160972.22	240800	-$516,637.94
3	693.90	3420	2373149.60	318112.63	160972.22	240800	-$93,034.45
4	567.80	3420	1941889.95	318112.63	160972.22	240800	$338,225.19
5	647.51	3420	2214488.02	318112.63	160972.22	240800	$65,627.13
6	807.60	3420	2761979.99	318112.63	160972.22	240800	-$481,864.85

Table 1 Sample Simulated Trips for Option A

Option B							NSR									Suez						
Simulated Trip Number	Random number to determine route	Number days NSR expected to be navigable in given year	Probability of NSR open at a given point in the year	NSR	Suez Canal	Bunker Price	Ice Water (nm)	Non-Ice Water (nm)	Transit time (days)	Fuel consumption (tons)	Fuel Cost	Capital Cost	Operating Costs	Transit Fees	Profit for NSR trip	Fuel Consumption	Fuel cost	Capital Cost	Operating Costs	Suez fee	Profit for Suez Canal trip	Profit for trip
1	0.369280	192.9	0.528	1	0	694.21	365.7	6734.3	17.1	2203.1	1529438.40	247544.88	152728.86	1112973.38	-42685.53	3420	2374184.69	318112.63	235520.83	240800	-168618.16	-42685.53
2	0.417345	143.4	0.393	0	1	693.74	527.9	6572.1	17.4	2235.6	1550916.75	251889.54	155409.41	2092005.61	-1050221.31	3420	2372594.49	318112.63	235520.83	240800	-167027.95	-167027.95
3	0.481659	156.7	0.429	0	1	832.71	484.5	6615.5	17.3	2226.9	1854369.05	250726.19	154691.65	3642941.45	-2902728.35	3420	2847880.52	318112.63	235520.83	240800	-642313.99	-642313.99
4	0.055631	196.1	0.537	1	0	441.62	355.2	6744.8	17.1	2201.0	972010.06	247261.53	152554.04	790535.83	837638.54	3420	1510325.29	318112.63	235520.83	240800	695241.24	837638.54
5	0.584452	121.4	0.333	0	1	728.71	600.0	6500.0	17.5	2250.0	1639593.91	253821.03	156601.08	3360437.24	-2410453.25	3420	2492177.52	318112.63	235520.83	240800	-286610.98	-286610.98
6	0.039121	186.0	0.510	1	0	700.17	388.2	6711.8	17.2	2207.6	1545730.07	248146.54	153100.07	2821759.29	-1768735.96	3420	2394592.46	318112.63	235520.83	240800	-189025.93	-1768735.96

Table 2 Sample Simulated Trips for Option B

The modelling of option A, year round shipping via the Suez Canal, is straightforward as the only parameter that actually varies is the price of fuel. All other parameters are presented as average values (i.e. revenue per trip) in Liu and Kronbak's paper and are treated as constants for the Suez option. Refer to Table 1 for sample simulation results for option A.

The modelling of option B, shipping via the NSR part of the year and Suez Canal for the remainder, is slightly more complex because it involves conditional probability and several input variables that varied. Given that the costing is different depending on which route is taken, the first thing that has to be determined for an individual trip is whether it will be through the NSR or the Suez Canal, and this is dependent on the number of days in a given year that the NSR is navigable. A number of navigable days is generated by @Risk from the triangle distribution for NSR navigable days, and that number is divided by 365 to give the probability that the NSR will be navigable during any particular instance during a given year. Another random number between 0 and 1 is then generated, and if this number is less than the probability that the NSR will be navigable, the trip will be through the NSR. Otherwise the trip will be through the Suez Canal. This is denoted by a 1 or a 0 in the NSR or Suez Canal column for each trip instance. Then the expected profit for each route is calculated and multiplied by its corresponding trip column. For example, if NSR =0, Suez Canal =1, NSR Profit = $400,000, and Suez Canal profit = $500,000 for a particular line, the overall profit for that line will be $500,000 as it indicates that the Suez Canal route was taken in that instance.

As per formula 1, the number of navigable days is also used to determine how much of the NSR trip will be ice free, which will then be used to calculate the trip duration and the fuel consumed on the ice-free and non-ice-free portions of the trip (which each have different speeds and rates of fuel consumption). These figures are then used to calculate the cost of fuel consumed on a given trip. The capital cost for a trip is given by the annual capital cost of the ship in question divided by 365 and then multiplied by the calculated trip duration (in days). Operating costs are simply the length of the trip in days multiplied by the daily operating cost as noted above.

Table 1 shows sample simulations for option A, and Table 2 shows sample simulations for option B.

For illustrative purposes, each option was simulated with 500 trips. For option A, the simulated per trip (except for Annualized Profit) results are as follows:

Average profit	$50,489.45
Standard Deviation	$386,686.43
Minimum Profit	-$764,189.79
Maximum Profit	$1,003,731.28
Annualized Profit	$698,348.83

For option B, the simulated per trip (except for Annualized Profit) results are as follows:

Average profit	-$468,162.25
Standard Deviation	$971,193.42
Minimum Profit	-$3,181,065.23
Maximum Profit	$1,550,458.83
Annualized Profit	-$7,770,219.23

In each case, the annualized profit figure is calculated by determining the average number of trips expected per year for each scenario and multiplying that number by the average profit per trip. While these numbers are somewhat informative for the decision making process in that they convey the average and extreme results for each scenario, they do not convey the entire picture. For instance, how likely is it that a trip will result in a profit greater than $0.5M for either option? Such a question is one that MC simulation can help answer.

Figures 3 and 4 show histograms of the profit distributions for each option which were generated from the MC simulations. For option A, the profit distribution appears to follow a triangular distribution. For option B, where there were multiple variables that had different distributions, the profit distribution is mostly centred around the $0 mark with lower probabilities of values occurring in the extremities of the distribution. From these histograms, one can see not only the extreme and average profit values but every value in between along with the probabilities of their occurrence. This is one of the biggest benefits of MC simulation. For instance, for option A, there is an approximate 16% probability that the profit of any given trip will be between $500K and $750K, which is easily seen with the aid of a histogram.

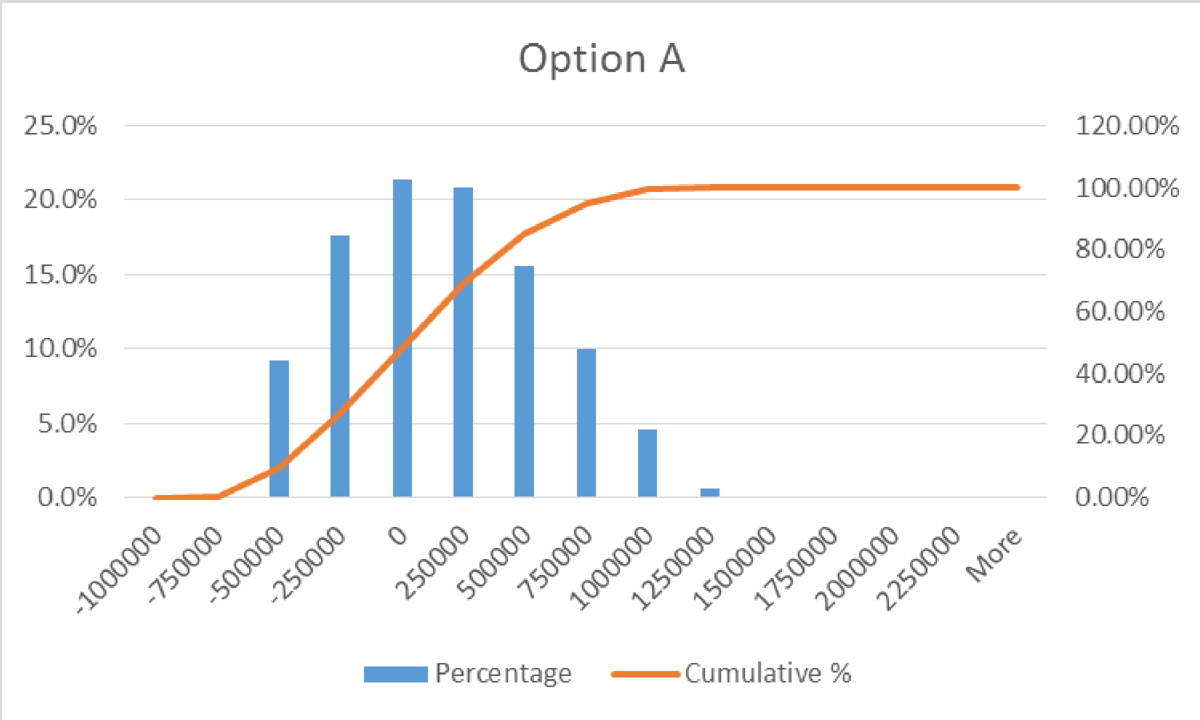

Figure 3 – Illustrative Histogram for Option A

As for the decision to be made in this example, if would depend on the criteria of the shipping company in question. While neither option seems particularly appealing from a profit point of view, option A, with an annualized profit of approximately $700K, seems more preferable than option B with its annualized loss of $7.8M. Ultimately, the outcomes of the analysis can only be as good as the data and assumptions that are used as the basis for the analysis. In this case, while we are confident in the methodology, we do not feel strongly enough about the underlying assumptions and data that we would necessarily make recommendations based on this particular data. The purpose of this example is simply to present an illustrative example of how MC simulation could be used for marine risk-based decision making. If the input data accurately reflect current realities, the results of the analysis would be valid if enough simulated trips for each scenario were carried out. Therefore, ensuring that input data and probability distributions are as accurate as practicable is crucial to any decision making carried out with MC simulation. For instance, in this example, it would be crucial to incorporate the latest information regarding the NSR shipping fees and expected if the results of the simulation were expected to be relied upon. Furthermore, in their original analysis of NSR vs. Suez Canal shipping, Liu and Kronbak [7] made a simplifying assumption regarding cargo availability by assuming an average load factor of 60%. In reality, cargo availability, like other parameters considered in the simulation, is variable in nature. As such, if cargo availability were also properly modelled as a probability density function as part of the simulations, it would also make the outcomes more reliable.

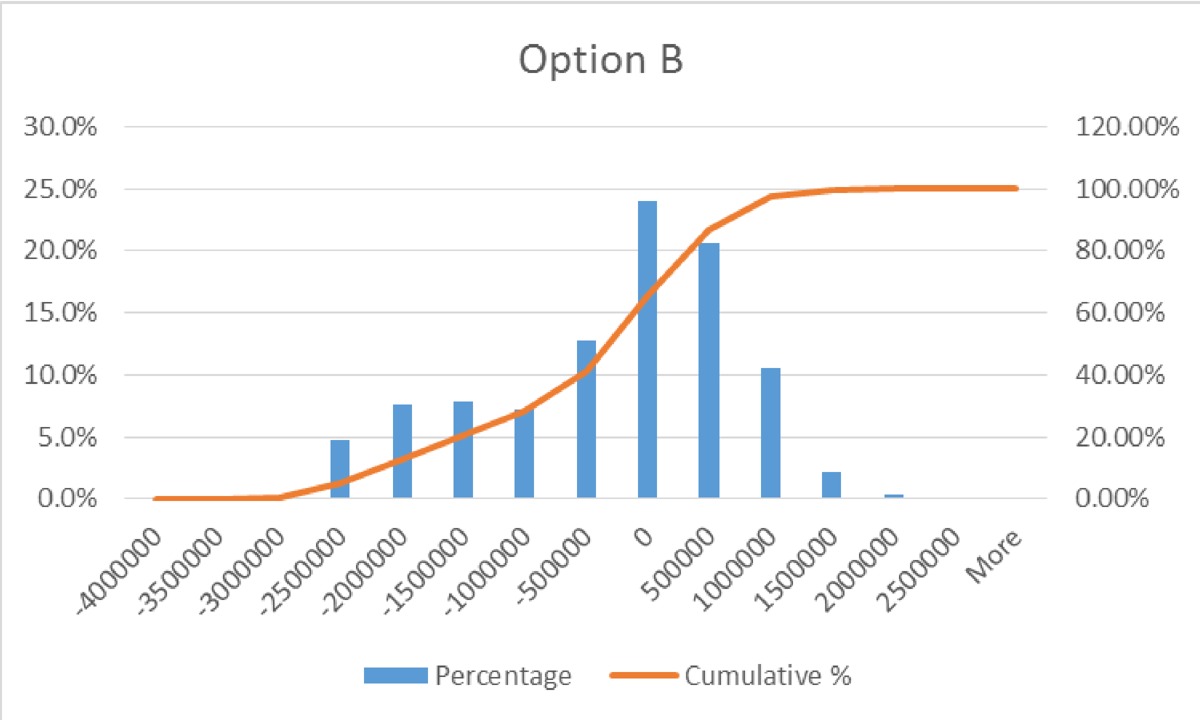

Figure 4 – Illustrative Histogram for Option B

4. Conclusions

Decision making in any industry is often the result of weighing many unknown parameters to determine a best course of action. The risk ranking matrix is one method currently widely used in marine risk-based decision making. Recent research has called into question the efficacy of this tool and the validity of any conclusions drawn from such an analysis.

We have examined an alternative process for marine risk-based decision making, one that uses Monte Carlo simulations to give the decision maker a better understanding of the scenario. Using Monte Carlo simulations, the decision maker can examine many, thousands or more if necessary, what-if scenarios whose outcomes will vary as the inputs change for each instance of a particular simulation. In general, while no one particular outcome is of special significance, if the input parameters reflect reality, the outcomes will be generated in quantities that are proportional to their probabilities of actual occurrence. Therefore, not only does this allow the decision maker to see the range of potential outcomes, but also the likelihood that any particular outcome, or range of outcomes, will occur. This makes MC simulations a powerful tool for marine risk-based decision making. As mentioned earlier, the analysis can only be as strong as the data upon which it is based. Therefore, care must be taken to ensure that input parameters are modelled to reflect reality as closely as possible.

If a Monte Carlo methodology is to be used for marine risk-based decision making, it does have obvious staffing and training implications. Given that it is crucial that input parameters be accurately modelled and classified as appropriate statistical distributions, anyone using MC simulation should have training in probability and statistics. Such training would also be very useful to anyone interpreting the outcomes of a Monte Carlo simulation. Therefore, training in the areas of probability and statistics should be an important part of the curriculum at MET institutions.

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Adapting Maritime Education and Training (MET) Courses to the Digital Brains of the Millennial Generations

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There is mounting evidence that digital technology impacts brain development. As a result, the digital brains of the Millennial generations, which includes current and future generations of MET students, process information in a fundamentally different way. As a result, MET pedagogy and teaching must be adapted in order to accommodate both the preferential and biological differences in the current upcoming cohorts of learners. This paper explores some of the research that highlights the impacts of digital technology on neuroplasticity and examines a few possible teaching and learning techniques and strategies that might be employed in response to these changes.

Keywords: MET, Learning, Student-Centered, Digital, Millennial, Online, Technology

1. Introduction

There is mounting evidence that digital technology impacts brain development. Relatively recent advances in brain scanning technology allow researchers to literally observe the brain in action. One of the most interesting developments is the concept of neuroplasticity, which is the brain's ability to reorganize itself and form new neural connections throughout life. [1] In addition to being able to compensate for damage and disease, the brain also exhibits neuroplasticity to adjust to new situations or new environments. For example, the neuroplasticity between readers who use an alphabet-based language (e.g., English) and those who use an image or character-based language (e.g., Chinese) are profoundly different. Similarly, these scans have revealed that the human brain reengineers it's neuroanatomy in response to the type of medium being used (e.g., writing using pen and paper versus using digital tablets like the iPad). Thus, neuroplasticity [2] helps to explain differences between book- and digital-reading brains. On the one hand, the traditional canonical practice of slow, sustained reading (i.e., deep book reading) imprints customized neural pathways. Alternatively, the continuous, partial attention intrinsic to digital reading cuts an alternative track of neural recalibrations. [3] According to developmental psychologist Maryanne Wolf: "We are not only what we read. We are ***how*** we read." [4] Therefore, it is no exaggeration to suggest that reading *is* biology and, as a result, we must adapt our teaching and learning practices.

2. The Digital Brain

Just as the written word inevitably altered the human brain, through neuroplasticity, the digital brain (i.e., the human brain that predominantly reads and consumes information from digital media and online sources) is fundamentally different than the human brain before the advent of personal computing and digital technologies. The science behind exactly how the digital brain is different remains emergent, but it is important to note the differences observed from early studies.

In some ways the digital brain is advanced through digital technologies, including improved visual literacy, such as iconic representation, spatial orientation, special visualization, as well as multitasking and divided attention skills. [5] Although they are important, and vital in many professions, especially the maritime professions, digital technologies may also be creating gaps in other types of cognitive skill development. The following quote by Patricia Greenfield, a distinguished professor of psychology, highlights the challenge:

> Although the visual capabilities of television, video games, and the Internet may develop impressive visual intelligence, the cost seems to be deep processing: mindful knowledge acquisition, inductive analysis, critical thinking, imagination and

> reflection. It is difficult for schools to teach reflective habits of mind to children whose informal education and cognitive socialization have not prepared them for this kind of learning and thinking. Yet, society needs reflection, analysis, critical thinking, mindfulness, and imagination more than ever. [5, p. 71]

As a result of these recent findings about the digital brain, MET educators need to address whether our teaching and pedagogy effectively meet the needs of students from the Millennial generations, also known as *digital natives*, whose cognitive socialization is fundamentally influenced by digital media/technology.

3. Digital Natives

Cultural generations are cohorts of people who share the same life stage, live through the same economic, social, and political times; and are shaped by the same social markers and events. [6] Often, people are categorized by their generational cohort; while this leads to overgeneralization, it also serves to identify important stereotypical traits and behaviors. *Digital natives* (born after 1980) [7], also known as Generation Y or the Net Generation, grew up immersed in digital technologies (e.g., using personal computers, mobile devices, video games, social media, and the Internet) and are considered technologically adept/interested and digitally literate. [8] On the contrary, people born before 1980 might be considered to as *digital immigrants* or *digital adaptives* [9] since they largely grew up in an analog world and have had to adapt their ways to the growth of these digital technologies which were introduced during their lifetimes. It might even be said that the digital immigrants are DSL (i.e., *digital second language*) while the digital natives possess DFL (i.e., *digital first language* in tandem with their first spoken language).

The defining characteristics of digital natives have been described by many scholars [10], [11], [12], [13], [14]. The following is a summary of some of the key themes that Tappscott uses to define digital natives who are assertive, self-reliant, curious, and enmeshed in an interactive culture:

- *Fierce independence*: Their sense of autonomy derives from their experiences of being an active information seeker and creator of information and knowledge.
- *Emotional and intellectual openness*: The digital natives value the openness of the online environment, like anonymity, and communicate through numerous tools.
- *Inclusion*: They view the world in a global context and move toward greater inclusion of diversity.
- *Free expression and strong views*: With access to knowledge resources at their fingertips, the digital natives are assertive and confident.
- *Innovation*: This group is constantly trying to push the technology to its next level and figure out how to create a better world.
- *Preoccupation with maturity*: Armed with knowledge, they strive to be more mature than their predecessors.
- *Investigations*: Curiosity, discovery, and exploration are key for this generation.
- *Immediacy*: This generation views the world as 24/7 and demands real-time and fast processing.
- *Sensitivity to corporate interest*: Consumer savvy, these customers like customization and want to have options and to try before they buy.
- *Authentication and trust*: Net savvy individuals, they know the need to verify and check resources and authenticate people. [15]

Arguments have also been made that generation alone does not define digital fluency [16] and often gender, education, experience, and breadth of the use of technology play a role in defining if one is a digital native. For the purposes of this paper, since the biggest determinant of digital fluency is the degree of immersion in the digital environment (and that a large portion of the Millennial generations use the Internet and digital technologies as a first point of entry for information, communication, and knowledge – particularly in the developed world), the Millennial generations will be considered digital natives. In cases where the Millennial generations are not digitally fluent, the current MET methods and pedagogies are likely sufficient.

4. Learner-Centered Teaching

Much of the way in which MET has been shaped is based upon the book-reading brain of past generations. Skiba and Barton summarize this traditional type of education as follows:

> The traditional teaching paradigm, prevalent in higher education for many years, focused on the role of instructor as the "sage on the stage" who disseminated knowledge through lectures and PowerPoint slides. Brown [10] refers to it as the authoritarian, lecture-based model of education. This traditional teaching emphasized the acquisition of facts or, as Oblinger [17] noted, content-focused learning. Faculty from previous generations were text-based; focused on logical sequencing of knowledge; emphasized memorization, repetition, and recall; believed "one size fit all"; and saw the teacher as master and commander [18]. [19]

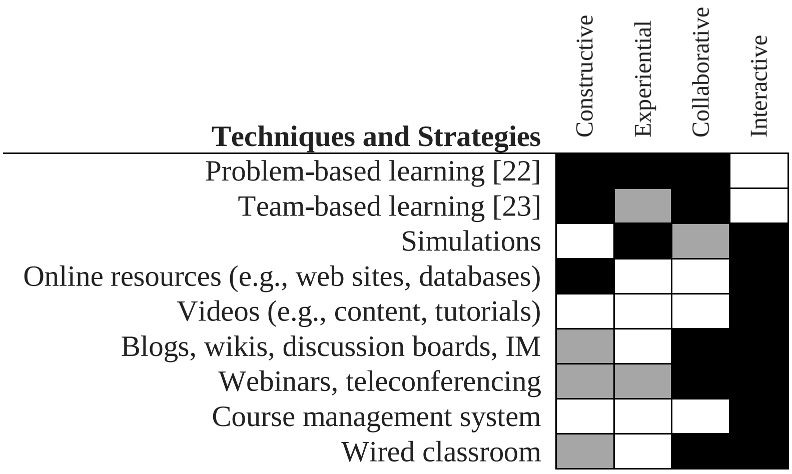
To accommodate the digital brains of digital natives, MET methods and pedagogies need to be adapted. Digitally fluent learners focus on understanding, constructing knowledge using discovery methods, and active engagement and these digital natives want tailored and option rich learning; and view the teacher as expert and mentor. In short, they thrive best in a student-centered learning environment. As Maryellen Weimer, a highly acclaimed authority on effective teaching, has described, there are five key changes to practice to create a student-centered learning environment [20]:

- *Balance of Power* – this represents a shift from the traditional authoritarian view of education to one that is more democratic, egalitarian, and open to a diversity of learning. In short, it moves from a "one size" to an "on demand" form of learning.
- *Function of Content* – rather than the content serving as an *ends* to be memorized and otherwise digested, content is the *means* by which students collectively and individually construct knowledge.
- *Role of the Teacher* – since the goal of teaching is to facilitate learning, teachers no longer serve as the exclusive content expert or as the authoritarian; instead, teachers lecture less and support more as the "guide on the side" as opposed to the "sage on the stage."
- *Responsibility of Learning* – student learning will shift from being extrinsically- to intrinsically-motivated using a developmental process that might include self-determination theory [21].
- *Evaluation* – both formative and summative assessment of learning from the teacher, peers, and self will be used for feedback in continuous improvement and also to measure proficiency.

5. Teaching Digital Natives

Using our understanding of digital natives and the digital brain, we can apply Weimer's concepts of the learner-centered teaching to MET. In general, digital natives seek a constructivist learning paradigm [18] and seek active engagement, experiential learning, interactivity, and collaboration. Many of these are out of alignment with the traditional teaching paradigm. Instead, students become active participants in the construction of knowledge and seek to create that learning collaboratively while being immersed in a digital environment. In general, the following table of techniques and strategies indicates some potential means by which to satisfy Millenial student preferences.

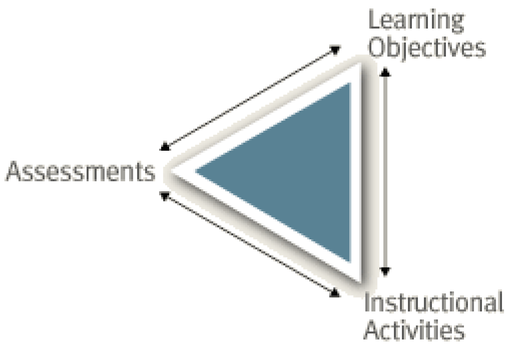
Figure 1: How different learning techniques and strategies
satisfy specific preferences of digital natives



It should be noted that there is no one technique or strategy that satisfies all of the preferences of the digital natives. As a result, this leads us toward a hybrid learning environment where at least a portion of the learning takes place online and involves several of the above learning techniques and strategies.

Therefore, to adapt our MET courses and teaching, we must employ an instructional design frame and evaluate how the identified *learning activities* will help students fulfil the intended *learning outcomes* as measured by appropriate *learning assessment* – all while keeping the digital natives' digital brains in mind.

Figure 2: Relationship between Learning objectives,
learning activities, and learning assessments



[24]

To facilitate how MET courses and teaching must be adapted to the digital brains of the Millennial generations, the following preliminary questions are offered:

- What are your students' preferences for learning?
- For the specified learning outcomes, how might you accommodate those preferences?
- How might you adapt your course in cases where there are multiple preferences?
- Which learning techniques and strategies (including those that involve digital media) are most appropriate for students to achieve the learning outcomes, given the preferences?
- What are the best methods and technologies for engaging your students in learning?
- Given the digital brain, how might you create scaffolding for deep learning?

- How might you strike a balance between the traditional classroom and the digital world?
- How might we assess student learning most effectively?

6. Conclusion

There is no doubt that the digital brains of the Millennial generations demand a fundamentally different approach to teaching and learning. Our challenge will be in which ways we will change to accommodate t demands. At the same time, we cannot abandon our desire to instill deep learning (and the resulting critical thinking, reasoning, and reflection) that often results from the sustained focus and attention required by book-reading even though the digital brain is not effective in this mode. Rather, we must consider ways in which we can capitalize on the assets of the digital brain while finding practical measures to enable the deep learning.

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Teaching Leadership: A Model for Embedding Effective Leadership Practices in the Academic Classroom

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The education and development of maritime leaders is integral to the mission of all maritime universities. With the increasing complexity of ship systems and the modern maritime environment, it is vital that maritime professionals be educated to the highest standards of teamwork and leadership, rather than focusing exclusively on their training as entry-level mates, engineers and shoreside professionals. While all maritime universities have elements of leadership in their student development, few have fully developed leadership programs within their academic coursework. This paper proposes a set of leadership approaches and techniques that can be employed in the classroom environment and argues that many leadership techniques and strategies can easily be embedded in existing major-specific coursework, and not just courses specifically dedicated to leadership. The techniques and approaches addressed were developed in two courses in the Global Studies and Maritime Affairs major. The key unit of analysis was student project teams, specifically, "leaderless" teams. While the expected salutary effects of the techniques and approaches used were not initially realized, they did demonstrate significant remedial benefits. The findings suggest that adequate development of the leadership capacities and skills discussed cannot be achieved in a single course. A multi-stage arc of leadership development, spanning curricular and co-curricular programming is indicated.

Keywords: Leadership development, classroom instruction, classroom pedagogy, teamwork, group projects

1. Introduction

The education and development of maritime leaders is integral to the mission of all maritime universities. With the increasing complexity of ship systems and the modern maritime environment, it is vital that we educate maritime professionals to the highest standards of teamwork and leadership, rather than focusing solely on the training of entry-level mates, engineers and shoreside professionals. While this need for a greater emphasis on teamwork and leadership is stressed in the 2010 STCW Manila Amendments for all licensed seafarers, we argue that students pursuing "shoreside" business and policy careers also need to be educated to high standards of leadership and teamwork as well.

While all maritime universities have elements of leadership in their student development, few have fully developed leadership programs within their academic coursework. Some universities may offer a course in leadership, and some courses contain natural leadership elements (eg., bridge team management), but most universities lack a broad program of leadership tools and methodologies applicable in multiple classroom environments across diverse academic disciplines. This said, few curricula have room to add more leadership coursework, despite the accepted need to educate our cadets for 21st century leadership challenges. This is a problem we have particularly faced at Cal Maritime, given university mandates to lower our degrees to 120 units[1].

[1] Two of our programs – International Business and Logistics, and Global Studies and Maritime Affairs – are currently at 120 units; all other programs carry higher unit requirements with a mandate from the California State University that we make every effort to lower these even further.

Extracurricular models are sometimes suggested as suitable alternatives to academic program design and leadership; we reject this form of silo thinking (i.e., Student Affairs vs. Academic Affairs) as leading cadets to believe that leadership happens "there" (ie, outside the classroom) and classroom learning happens "here" (in an academic – not "real world" context). We believe that a model and philosophy must be developed so that cadets begin to appreciate that leadership, academic learning, practica, etc., are all part of one and the same whole, and must be developed and approached as such. Only when leadership elements are seen throughout the cadet experience, and are appreciated equally, will our cadets be able to view leadership as an inclusive whole, embodied and embedded in everything they do.

It is not the purpose of this paper at this time to present a comprehensive and fully integrated model and plan for cadet leadership development spanning all areas of cadet activity. Rather, we are proposing a set of leadership approaches and techniques that can be employed in the classroom environment beyond traditional leadership courses; this is an area often neglected by leadership programs at many institutions (including, historically, our own). Furthermore, we argue that many leadership techniques and strategies can easily be embedded in existing major-specific coursework, and not just courses specifically dedicated to leadership.

2. Background and Methodology

In Fall 2012, the authors received a research grant to develop techniques to embed assessable leadership elements into existing coursework. The idea for the grant came out of a long series of conversations between the two authors – one, an Assistant Commandant in the Leadership Development Office with extensive background in teaching Leadership and Organization Development at both the undergraduate and master's level; and the other, a professor in the Global Studies and Maritime Affairs major with considerable content expertise in maritime policy and teaching pedagogies.

In our conversations we came to realize that, working together as a team in a series of pilot-courses, our two areas of expertise – leadership process and discipline-specific content – could create an enriched learning environment for our cadets. Not only would they be learning the "information and analysis" necessary to their degrees, they would learn ***how*** to develop and present this information as future maritime professionals. Envisioned as an "arc of development" within each major at Cal Maritime, the cadets would learn and practice increasingly higher levels of leadership competencies in the classroom as they progressed through their degrees.

At nearly the same time (Spring 2013), Cal Maritime began an extensive undertaking to rework its entire leadership development program on campus. A Leadership Development Task Force (LDTF) was established comprised of faculty, cadets, and leadership and student affairs professionals. The LDTF and grant objectives dovetailed nicely, since both focused on a progressive approach to leadership development. Specifically, the mandate to the LDTF was as follows:

- Fourth Class (Freshmen): A year of programming aimed at developing self-discipline and freshman success;
- Third Class (Sophomores): A year of programming aimed at developing accountability for self and one other person;
- Second Class (Juniors): A year of programming aimed at developing diverse-group leadership competencies;

- First Class (Seniors): A year of programming aimed at developing life skills necessary to thrive as a new graduate

The grant was implemented in Spring 2013 with the above general student development goals in mind. We determined that the key unit of analysis would be ***student project teams***, with the leadership element occurring at two levels – 1) support for the individual student within the team, and 2) support for the team as a whole.

2.1 Design of Student Teams

We developed our techniques in two courses in the Global Studies and Maritime Affairs major: 1) *Comparative Maritime Policies*, a sophomore-level course, and 2) *Maritime Security*, an advanced junior-level course. Dr. Nincic agreed to devote one week in each class to leadership and group dynamics, taught by Mr. Berkana-Wycoff; and Mr. Berkana-Wycoff agreed to work with the student project teams and attend classes on the days of student presentations.

Students in each class were formed into teams of four students each with the responsibility of delivering a 60-minute in-depth presentation on a topic relevant to the content of their course, plus a 15-minute question and answer session. For example, students in *Comparative Maritime Policies* might deliver a presentation on different fisheries management regimes within the European Union; students in *Maritime Security* might do their presentation on the role of human error in maritime accidents, or on the global response to maritime piracy. Students were given some latitude by the professor as to the topic selected, within parameters that ensured the topic was integral to the course.

We specifically chose to use student presentation teams as our unit of analysis for two reasons; 1) they present clear leadership opportunities as they are typically formed by three or more individuals, and 2) student group projects occur in multiple courses on campus, across all disciplines. In this manner, any useful findings we would discover would – hopefully – be easily transferrable to students and courses in different majors.

Furthermore, we wanted to work with student presentation teams since we knew from experience that students had a tendency to dislike group work for many of the following reasons:

- Most students in groups feel like they're the only one who does "all the work,"
- It's difficult to impossible to get everyone to meet at the same time
- People aren't reliable, someone always fails to come through
- Someone tries to take over
- Conflict inevitably arises
- It's hard to trust others and their work

These issues, and others, often arise from the method used to form student project groups. Conventionally, either students are allowed to form their own groups (usually their friends) or instructors determine the groups (sometimes randomly, or based on specific criteria such as grade point average, for example). The first method leverages natural affinities but often fails to be fully inclusive of social outliers or to achieve a balance of aptitudes, skills, and points of view. The latter method relies too heavily on chance or instructor omniscience and typically leaves students feeling disempowered from the outset, due to their disenfranchisement from the decision-making process.

To address these legitimate concerns, we "co-designed" the teams *with the cadets* around the following parameters:

- Personal preference of presentation topic (primary delineator)
- Personal interest in topic
- Personal expertise relevant to topic
- Personal learning goals related to topic
- Personal career goals related to topic

and the following design criteria:

- Each topic must have a presentation team
- The teams created must represent the "best possible" teams attainable from the class population.
- No team is officially constituted until all teams are approved.

Based on these criteria, we allowed the students to select their own teams as long as the above conditions were met, or at least optimized, for each of the teams. Once all the students had established themselves into teams based on these criteria, the teams were approved. In both classes, the teams formed quickly and in only one or two cases was instructor intervention necessary to "form" teams (this usually occurred because a student was absent and had to be "placed" in a team still needing additional members).

2.1.1 A note on "leaderless" teams

We especially designed the student teams to be "leaderless" – that is, we did not designate a specific leader for each team, nor did we ask the teams to do so. This was for a number of reasons:

First, it reflects our leadership philosophy at Cal Maritime that all cadets – regardless of class standing – are leaders; this is in contrast to the leadership-followership models in use at many other institutions (and previously used at Cal Maritime). We believe everyone has a leadership role to play in all our interactions, even when we are not formally in charge of a team; we can all be ***a*** leader even if we are not ***the*** leader [1] (we also argue strongly that leadership occurs when we are alone – we refer often to ***leadership of the self*** in how we make decisions and choices when no one else is looking).

Second, despite the explicit leadership and organizational hierarchies that exist on ships and within business organizations, much work in the maritime workforce occurs in environments where there may be no designated leader; or where the gravity of decision consequences or the complexity of decision contexts requires the full contributions of all group members. For example:

- Importance to Safety: Modern "positive safety cultures" expect everyone to share care and concern for hazards; in a similar vein, many maritime accidents occur because the team is not willing to challenge the decisions of the captain, even when they are known to be wrong;
- Environment Complexity: With the modern ship bridge and engine environments containing multiple electronic systems, it is increasingly impossible for one person to have a full grasp of all necessary information in any given moment. In times of acute stress and complexity, often what "saves the day" is a highly competent team member offering up a solution to the "leader." Similarly, in the business and policy environments with financial, logistics, security, trade and political information coming from multiple sources around the world, decisions must increasingly be made by a team of experts, even in a crisis.

2.2 Support for the Individual: Contracting

Once formed, the cadet teams had two process requirements: to create team ***contracts*** and to hold a preparatory meeting with Dr. Nincic and Mr. Berkana-Wycoff prior to their team presentation. The purpose of the team contracts was to create an explicit agreement between team stakeholders about their expectations and plans to work together. The stated objective was to clarify both the working relationship and the expectations of the work. We dedicated one class meeting to instruction and practice for team contracting. Handouts were provided delineating specific components of good contracts, including performance expectations for the team and its members, communication standards, decision-making methods, and corrective action protocols. Our intention was to show the cadets how to be more mindful and proactive in their group interactions in an effort to build capacities at multiple human systems levels: personal, interpersonal, group, and community (whole classroom). The goal was more collectively supported, engaged learning for each cadet.

At the heart of contracting is informed consent, which forms the basis of a legitimate sense of shared ownership in the shared work [2]. It was our assumption that creating clear perceptions of shared ownership would yield more satisfying and effective work from the teams, while supporting the development of each team member's identity as a leader. The contract included shared team expectations about what their goals were for the presentation, how often they would meet to prepare for the presentation, how they would communicate with each other, how work would be apportioned, when and how to intervene when a group member was seen to be falling behind, and when to ask for help from Dr. Nincic and Mr. Berkana-Wycoff.

2.3 Support for the Team: Mandatory Group Presentation Preparation Meetings

Working from prior experience, Dr. Nincic knew that required preparatory meetings with the instructor were necessary, in order to mitigate the tendency of cadets towards delivering last-minute "thrown together" presentations (the painful bane of instructors and students alike who are forced to sit through sub-optimal, ill-rehearsed, and often factually-incorrect deliveries), as well as the pervasive free-rider problem bemoaned by the better students. In the context of our research, these meetings also provided formative assessments of team dynamic and task effectiveness. It was our assumption that, given the explicit contracting each team had previously undertaken, we would observe clear demonstrations in the preparatory meetings of multiple positive behaviors, including: equitable sharing of workload and integration of individual work product into a coherent whole; individual reliability and decreased and better managed team conflict; and, higher quality, more polished draft presentations.

During the course of each preparatory meeting (which was held with the team members, Dr. Nincic and Mr. Berkana-Wycoff), we asked each team to do a walk-through of their presentation. We then addressed with the team members any performance issues the team was having and made preliminary grading assessments, based on the presentations as they currently stood. This feedback constituted expectations for the final presentation; cadets knew that failure to take the feedback into account would result in lower grades. Further, we noted privately whether we held an expectation for high, moderate, or low performance by the team during its actual presentation. This would provide a comparison basis by which to assess whether or not the preparatory meetings made any difference to the final presentation outcome.

3. Relationship to Leadership Theory

We intentionally chose not to present the details of leadership theory to the students in the classes, as they were required maritime policy courses – not leadership courses – in the Global Studies and Maritime Affairs major; as such, the courses needed to be strongly focused on maritime policy. This said, our work with the students was strongly informed by various elements of leadership theory, specifically drawn from:

- The Social Change Model [3]
- The Leadership Identity Development Model [1]
- The CAS Leadership Development Competencies [4]
- The Student Leadership Practices Inventory (SLPI) [5]

As depicted in Table 1, the overarching theory contextualizing our research was the Social Change Model, developed in 1996 by researchers at the University of California, Los Angeles. All four sources of leadership theory share in common an assertion that, fundamentally, leadership is *relational*¸ *non-positional*, *contextual*, *collaborative*, and *values-based*. Also represented in each theory source is an understanding of leadership development as being multi-systemic and multi-staged. The Social Change Model is explicitly organized into three levels of values, Individual, Group, and Community. While we recognized that all three levels would be active in our work, we specifically focused our attention on the Group level; the values associated with this level being Collaboration, Common Purpose, and Controversy with Civility. Team contracting aligns well with these values.

Social Change Model	Individual Group → Community	Collaboration Common Purpose Controversy with Civility
Leadership Identity Development Model	**CAS Leadership Development Competencies**	**Student Leadership Practices Inventory**
Awareness Exploration/Engagement Leader Identified Leadership Differentiated Generativity Integration/Synthesis	Foundations of Leadership Personal Development Interpersonal Development Development of Groups, Organizations and Systems	Model the Way Inspire a Shared Vision Challenge the Process Encourage the Heart Enable Others to Act

Table 1 Leadership development theory set

3.1 Process *is* content

According to Cetron and Davies [6], “fully half of what a student learns as a freshman is obsolete by his senior year.” It is our belief that, while one can’t reasonably predict what all will constitute the *content* of our cadets’ future career work, one can be fairly certain that the *processes* will include work and leadership in teams and groups. Thus, developing in students the (process) skills required to learn and work with others more effectively and with greater satisfaction is a critical set of content that serves student engagement, leadership development, and good citizenship.

4. Our Findings

As previously mentioned, we expected the salutary effects of required team contracting to be manifold. Our expectations were largely disconfirmed during the preparatory meetings. In all the ways we have described that group projects *can* go wrong, they *did* go wrong. Most teams demonstrated a lack of preparedness, of integration, and of broadly shared leadership; presentation drafts were clearly thrown together last-minute, presented in discrete stand-alone pieces of individual work, and shepherded by the cadets in each team who were already known to be leaders. Several of the teams struggled with a team member who was uncooperative and unresponsive.

Noteworthy, however, were the enormous remedial benefits afforded by the team contracts, as well as the process used for team formation. In every case where a team struggled with an individual's poor performance, they managed with minimal instructor support to remedy the problem and achieve desired performance levels. In one case, a team that looked destined to fail in its presentation, due to a member's complete lack of collaboration in the several prior weeks of preparation, used its contract to hold the wayward cadet accountable and went on to deliver a high-quality presentation. The aggrieved cadets were pleasantly surprised at the degree of empowerment they felt to correct a team member's behavior; the offending cadet noted how easy it was to defer to the shared agreements and modify his actions.

The preparatory meetings also proved quite beneficial in mitigating evident problem dynamics and task performance issues. We made our observations explicit when it was clear that one member was monopolizing the briefing or stifling the contributions of other team members. We would refer the team to its own contract expectations of performance when it was clear that they were underperforming. While it was not always clear whether this feedback was effective in the moment, in most cases, the final presentations were markedly better than our predictions. The shared ownership that we strived to imbue in the teams through the formation and contracting processes, in the end, repeatedly saved the day.

Nevertheless, our expectation that the need for such "saves" could be avoided altogether as a result of these processes was not met. Our findings indicate that the cadets were simply not ready to achieve this level of effective self-management. We discovered that greater levels of basic skills and capacities were needed than could be achieved in a single course.

It is worth noting that the syllabi we use in our classrooms are effectively *unilateral contracts* (delineating what we expect of students). These fail, however, to fully capture the learning (one could say, leadership) relationships present in the classroom (e.g., cadet to cadet, cadet to whole class). Teaching cadets to articulate their expectations of themselves and their relationships with the instructor and the class as a whole could go a long ways towards developing shared ownership of learning, particularly if undertaken at the outset of a cadet's tenure at the academy.

Finally, in a summative survey of perceived outcomes and satisfaction, cadet response was mixed. Despite clear evidence of improved performance by presentation teams, roughly 30% of responses from each course indicated a dislike for the added "burden" of work caused by the team formation and contracting processes. This said, however, many cadets in the following semesters went on to ask for similar format and support in their subsequent classes, suggesting that they may not have appreciated the more formal structure of presentation preparation, and perception of extra work in the moment, but appreciated the value to their academic performance with the benefit of time and distance.

5. Conclusion and Suggestions for the Future

It is clear that the modern maritime industry requires more of its workforce than mere technical expertise. Increasingly, *how* we do things (process) matters as much or more than *what* we do and know (content) and represents a necessary new form of "content" expertise. The capacity and skill to bring effective appropriate leadership to all of one's relationships, from personal to whole-system, will be a hallmark of our cadets' future career lives. It is incumbent upon maritime universities and colleges to comprehensively provide this capacity and skill development to their cadets.

It is equally clear from our findings that such development cannot adequately occur within a single course. While our team formation, contracting, and coaching processes proved efficacious, a more longitudinal developmental effort is indicated. An introductory development level appears requisite. Preferably undertaken during the cadet's first year, this should include both training and practice in contracting *and* expectation setting that this skill is critical for academic success and integral to the curriculum. This is a likely place for co-curricular contribution by our Corps of Cadets leadership development program.

Furthermore, in order to convincingly demonstrate to cadets the value accrued from process-oriented competencies, we believe that requiring an after-action team self-assessment, post-presentation, would do much to support improved perceptions of value and better cement the learning achieved.

Lastly, it should be noted that Dr. Nincic and Mr. Berkana-Wycoff worked as a team in these classes, involving a time commitment on the part of both that will not be feasible to replicate in additional courses throughout all majors at Cal Maritime. We therefore need to streamline the process for ease of implementation by professors and instructors not as well versed in leadership-theory and practices. Additionally, we need to demonstrate clearly the value-added for the instructor (improved student performance in group and team work) before it can gain widespread acceptance in additional courses and majors.

Additional research is needed to determine how a complete developmental arc for leadership within an academic program might be constituted, as well as, what cross-functional co-curricular programs might be designed to better enable cadets to be prepared for and supported in their in-class learning. Equally, further research is indicated to demonstrate the particular applicability of the models chosen to the concept of leadership as experienced in the maritime industry.

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Swiss Cheese, Butterflies and Algebra: Looking Ahead at an Innovative Approach for Researching Culture and Safety

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This paper presents fuzzy set qualitative comparative analysis (fsQCA), a configurational comparative method (CCM), as an innovative research method that may be used to conduct research in the area of safety climate. Data obtained from using the method to research safety climate and views of error reporting in a health care study will be used to demonstrate how the method may be useful for future maritime research.

Results suggest the presence of some non-positive safety climate factors may be more consistent at producing a view that an error would always be reported than if positive all safety climate factors are positive. Hence a view that a positive safety climate is a means of improving error reporting may not be accurate. Results also indicate clear differences in relation to between managers and clinicians in relation to safety climate and views of reporting error.

Keywords: methodology, configurational comparative methods, safety climate, error reporting, complexity

1. Introduction

This paper will outline results from a health care study investigating how rural nurses' attitude to safety climate influences their views of reporting and disclosure of a hypothetical medication error. The results consider safety climate and teamwork factors and views of reporting severe and near miss error amongst management and clinicians in rural clinical settings.

The study adopted a Configurational Comparative Methods (CCM) research design [1]. Results of the fuzzy set qualitative comparative analysis (fsQCA) suggest that a positive attitude across all factors is not related to an outcome of a view that an error would "always" be reported. There are also differences between managers and clinicians in this area.

The results of this study have potential implications for other industries. Whilst maritime and health care settings may not be identical enough is known about disasters and their cause(s) for similarities to be considered. Similar research using CCM could be undertaken with a focus within maritime safety.

2. Background

On 16 April 2014 the South Korean vessel *MV Sewol* capsized and sank. In the days following the incident information was inconsistent regarding passenger numbers and potential causes. By 21 May it became clear that 288 lives were lost with 16 still missing, the Captain and several crew members had been arrested and charged and the world looked on wondering how so many regulations could potentially have been breached and a century following the sinking of *Titanic* (and the more recent events relating to *MS Costa Concordia*) that another maritime disaster could have occurred.

On 6 February 2013 the final report of the *Mid-Staffordshire NHS Foundation Trust Public Enquiry* [2] was released. This followed a similar report and enquiry conducted in 2010. The report found a culture of acceptance of poor standards of care that adversely affected patient outcomes. The world also looked on at these events and wondered such things could occur following numerous enquiries into other incidents such as the *Bristol Infirmary* and other major incidents in health care settings.

Whilst some elements have been identified as unique to health care there are many similarities that lead to events such as those mentioned above [3]. How disasters occur has been examined for some time and whilst human factors are attributed to their cause organisational factors are also now considered to contribute.

Three elements have informed the design of this research. “Swiss cheese” refers to error and error management, “butterflies” refers to complexity science, the complexity of organisations and organisational culture and “algebra” relates to the Boolean expressions obtained through the use of a configurational comparative method.

2.1 Swiss cheese

Safety and error are complex areas. The “Swiss Cheese Model” acknowledged that multiple factors could lead to a major accident [4]. This model also acknowledged two forms of error – active and latent error. The latter is often undetected within organisations and is perhaps less well understood. Organisations are complex in terms of how they operate hence understanding what should be done to ensure safety is maintained is difficult to research.

It has been suggested that a shift in focus is needed away from concentrating on what has gone wrong in a few cases (Safety I) to what has gone right in most cases (Safety II) [5]. This notion of resilience requires determining “what should happen” for things to go right.

It is also known that a large amount of error, particularly near miss error, goes unreported. Near miss error is regarded as a learning opportunity whilst failure to report and/or manage error may be regarded a precursor to a major organisational accident [4]. Indeed, in his remarks regarding the Mid-Staffordshire Trust Enquiry, James Reason highlighted the importance of culture and its contribution to the acceptance of a poor standard of care amongst health care staff in that particular organisation [3]. Near miss error occurs where things go wrong but no harm occurs and/or something goes right to prevent a major event. A better understanding of near miss error could perhaps assist in understanding ‘what should happen’ in some cases. However, without an adequate level of reporting that level of understanding cannot be achieved.

This raises questions in relation to both latent error and how near miss error is dealt with if it is not routinely reported. What elements need to be present in an organisation for near miss error to be reported? If it is not routinely reported then how do workers in organisations handle such situations? Are there approaches to near miss error that we are unaware of? How can we better understand how organisations should work for ‘what should happen’ to actually occur?

The culture of an organisation is often cited as an important factor in building resilience and the prevention of major disaster. However, there is still much that is unknown about how complex organisations work.

2.2 Butterflies

Complexity science is emerging as a paradigm for a better understanding of how organisations work in respect to organisational culture and safety. Rather than focussing on macro level approaches, complexity science acknowledges the need for micro level understanding and recognises that different things work in different settings and situations. As organisations adapt to complex environments they move closer to working at the “edge of chaos”. Subsequently small changes can lead to big differences in outcomes, often referred to as ‘the butterfly effect’ [6].

This concept of complexity science has been applied to organisational theory and management and some of the key elements will be outlined here now. Complexity science postulates that organisations are complex and self-organising resulting in the "emergence" of properties that may not reflect the elements from which they form [7]. Lewin [8] outlines as an example how hydrogen and oxygen separately bear little resemblance to water.

These small changes can sometimes lead to big disasters or alternatively help prevent them. These relationships are also non-linear in their progression. Just as water has a 'tipping point' where it can become solid from liquid (at zero degrees Celsius) it has another "tipping point" at which it becomes vapour (one hundred degrees Celsius) [8]. Organisations that operate at the "edge of chaos" have been described as "drifting" towards the "tipping point" that results in a disastrous event [9].

Safety climate is an element of safety culture that has been present in the literature for some time. There is a suggestion in health care research that as safety climate increases the reporting of error also increases [10]. However, other research contradicts this with one study that considered one hospital where various measures were put in place that increased safety climate that whilst one hospital unit achieved increased reporting of mediation error the overall institutional reporting of medication error decreased [11]. These types of conflicting results are examples of the limitations of the dominant focus of cause and effect approaches to research that are present in health care which have been described as inadequate [12]. As a result there have been suggestions that a greater focus on new methods be undertaken [12] and the need to explore how better to understand complexity as a means of reducing harm to patients [13]. This includes the suggestion that CCM be applied to research hospital error [14].

2.3 Algebra

Configurational comparative methods offer an innovative means for the future research of organisational complexity. These methods have their foundations in mathematics and fuzzy set theory. A key concept of CCM is an acceptance of multiple means of causality (or conjectural causality). That is that multiple factors across a number of cases may result in a particular outcome and that these factors may be present or absent in a variety of different configurations. Schneider and Wagemann [15] describe this allowance for '… different, mutually exclusive sufficient conditions or paths for the outcome' as "equifinality". Boolean algebra is applied in the analysis and results are presented as "logical equations" [16].

Two recent publications indicate the growing number of studies where a CCM research design has been applied [17, 18]. Recently the first application of this type was published in a high ranking journal [19]. One of the CCM approaches is fuzzy set Qualitative Comparative Analysis (fsQCA). There is growing consensus that fsQCA is considered the more rigorous approach to use and it is certainly evident that its use is growing.

Charles Ragin [20] recognised as the "founder" of the QCA approach, argues that approaches to research have been variable based and that case based methods offer an alternative. Rather than deciding between quantitative or qualitative approaches, he suggests the choice should be between variable or case based approaches.

He argues that in quantitative research the focus is upon the comparison of different variables and how they interact with each other (whether it be single cause and effect randomised control trials or multi-variable analysis). That is, the primary consideration is upon diversity. Qualitative research by comparison is focussed upon the identification of variables through considering data in terms of thematic or discourse analysis. The primary consideration here is upon considering sameness. With QCA the focus is upon the presence or absence of conditions across cases against the presence or absence of a particular outcome. The primary consideration is upon understanding complexity [16].

3. Research Method

A CCM research design was adopted for PhD research considering how rural nurses' views attitude to safety climate influences their views of reporting and disclosure of a hypothetical medication error. The data obtained for this research has been used for this paper, although only one element of the analysis and results will be presented: configurations of factors of teamwork and safety climate relating to the outcome of views of reporting severe and near miss error.

3.1 Data collection

Following receipt of the appropriate ethics approval data for this study was collected in the form of a survey. The survey consisted of three sections. The first was the Safety Attitudes Questionnaire (SAQ) [21, 22], a highly validated tool used in health care settings [23] that was developed from the Flight Management Attitudes Questionnaire (FMAQ) which is used in the airline industry. The SAQ adopts a 5-point Likert Scale with responses of *agree strongly, agree slightly, neither agree or disagree, disagree slightly and disagree strongly* [21]. The option of *not applicable* was also included.

The second section included an error vignette that contained three different outcome levels of harm: severe, moderate and near miss [24]. Respondents were asked the likelihood that the error would be formally reported in their workplace. Respondents were also asked the likelihood that the patient and/or family would be informed of the error but this element will not be considered for this paper.

The final section of the survey contained demographic questions. The demographic area that is the focus of this paper is that of workplace role where respondents indicated their role as either "Management", "Clinical" or "Other".

The survey was distributed directly to nurses in rural clinical worksites via mailing an invitation to participate and the invitation was also emailed to members of relevant nursing unions. The invitation to participate contained a link to an online survey. The period of data collection was from mid-April until end of May 2012.

3.2 Data analysis

Figure 1 outlines the process of analysis relating to this paper. A total of 116 surveys were returned. Following principal components analysis (PCA) four factors were identified. Missing data resulted in a total of 93 responses being included for the teamwork factor analysis and 104 responses included in the analysis of safety climate factors.

The four factors identified from principal components analysis [25] are listed in Table 1. Also included in this table are the outcome sets and Boolean expression for each. Factor scores were then calculated using Sexton's approach [21] where a score of 75 or higher is deemed as positive for the relevant factor.

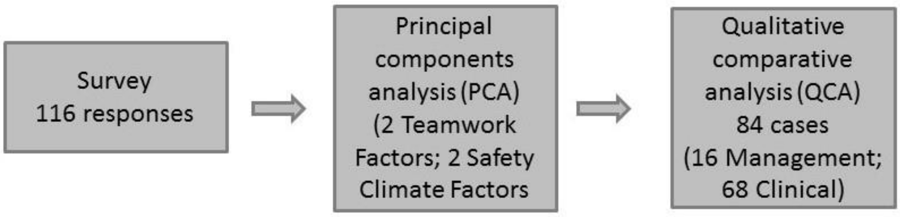

Figure 1: The process of data analysis

In order to undertake QCA research it is necessary to have diversity (heterogeneity) in the cases being studied. The diversity needs to be present across both the conditions and the outcome sets. All the "Management" cases viewed the severe error scenario would be reported so this lack of diversity meant a comparative analysis using QCA was not possible. The view of reporting near miss error amongst the "Management" cases exhibited diversity allowing analysis as did the views of reporting both severe and near miss error amongst the "Clinician" cases. In each case the outcome set was the view that the error would "Always" or "Not always" be reported.

Factor	Description
Teamwork factor 1	Teamwork and patient safety at the bedside
Teamwork factor 2	Workplace relationships and communication
Safety climate factor 1	leadership and management of error
Safety climate factor 2	safety culture in the workplace

Table 1 Teamwork and safety climate factors identified through PCA

The two groups of responses (managers, clinicians) were considered as separate sets of data. Thus a fuzzy set analysis was conducted on the "Management" set (16 cases) and a separate analysis conducted on the "Clinical" set (68 cases). One respondent who indicated their work role as "Other" was not included in the fuzzy set analysis for the purpose of this paper.

Full terminology	Role	Boolean expression
Teamwork factor 1	Condition	tf1
Teamwork factor 2	Condition	tf2
Safety climate factor 1	Condition	scf1
Safety climate factor 2	Condition	scf2
Overall teamwork factor	Condition	tf
Overall safety climate factor	Condition	scf
View of reporting severe error	Outcome	sr
View of reporting near miss error	Outcome	mmr
Negated set (ie not 'in' the set)	Expression	~ (before set expression)
Logical 'OR'	Expression	+
Logical 'AND'	Expression	*

Table 2 Terminology and Boolean expressions

3.3 Set calibration and analysis

In order to conduct fsQCA it is necessary to prepare the data in the form of sets. For each condition and outcome it is necessary to 'calibrate' the data to illustrate whether it is in or out of the particular set of interest [15]. The calibration also considers the degree to which the data is in or out of the set. The calibration results in a figure between 0 and 1 indicating the degree to which the condition or outcome is in or outside of the set. The calibrations applied in this analysis are listed in Table 3 and Table 4.

	Outside the set (factor not positive)			**In the set (factor positive)**	
SAQ factor score	0	0-74.99	74.999	75-100	100
Calibration	0.05 minimum value (fully out)	0.05 - 0.49 Out of the set of positive factor	0.5 point of indifference	0.51-0.95 In the set of positive factor	0.95 maximum value (fully in)

Table 3 Data calibration of the conditions (factors)

The score of 75 is the point at which SAQ scores are viewed as positive so the point of indifference was set so that cases with a score of 75 or higher were included in the set of "positive" factor. The outcome set 'point of indifference' was set so that cases which view the error would "Always" be reported were in the "Always" set and cases with responses of "Usually", "Sometimes", "Rarely" or "Never" were not included (ie they were in the set "Not Always").

	Outside the set (view error not always reported)					**In the set (view error always reported)**
Response	Never	Rarely	Sometimes	Usually		Always
Calibration	0 minimum value (fully out)	0.15 (almost fully out)	0.3	0.45 (almost fully in)	0.5 point of indifference	1.00 maximum value (fully in)

Table 4 Data calibration of the outcome sets

3.4 Use of software

Two software platforms have been used for analysis. *fsQCA 2.5* [26] was used for the analysis. *Kirq* [27] was used for the identification of contradictory rows (although these have not been reported in this paper). Contradictory rows (or configurations) occur when cases displaying a particular combination have examples of both the presence and the absence of the desired outcome [16].

4. Results

Figure 2 illustrates the frequency of each of the teamwork and safety climate factors. Overall each of the factors had more responses that were positive than not positive with *workplace relationships and communication* exhibiting the highest rate of 79.6% (n=74). The factor with the lowest rate of positive scores at 66.3% (n=69) was *leadership and management of error*. The remaining two factors *teamwork and safety at the bedside* and *safety culture in the workplace* had positive scores at rates of 75.3% (n=70) and 73.1% (n=76) respectively.

Those in a clinical role accounted for 80.7% of responses (n=92) with 19.3% (n=22) indicating they worked in a management role. Scores for overall teamwork factor and overall safety climate factor were also calculated. Chi squared analysis indicated that those in a management role were more likely to have a positive overall teamwork score (p=0.016) and positive overall safety climate score (p=0.002) when compared to those in a clinical role.

For the purposes of this paper the responses relating to views of reporting severe and near miss error were subject to the QCA analysis. This was considered sufficient to provide an example of what is possible through the use of this methodological approach. In addition, the views of reporting moderate error contained some contradictory rows that made the analysis more complex.

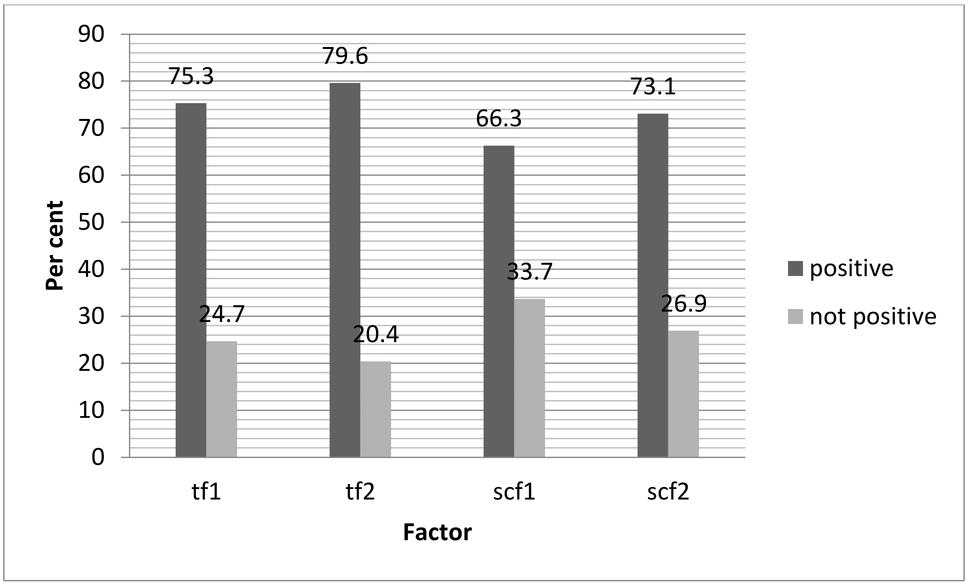

Figure 2 Frequency of teamwork and safety climate factors

Table 5 provides a brief explanation of how to interpret the results tables for QCA. This table should be referred to in conjunction with Table 2 which assists in interpreting the logical equations. When interpreting values the key elements in to take note of are "Consistency" and "Solution consistency" whereby the closer this figure is to "1" the more consistent the equation is in relation to the outcome.

Outcome	**Logical Equations**
Consistency	Expression of percentage of cases' set membership scores in two sets that is in line with the statement that one of the sets is a subset of the other [15]
Raw coverage	Percentage of cases' set membership in outcome covered by a single sufficient path of the equifinal solution term [15]
Unique coverage	Percentage of all cases' set membership in the outcome that is uniquely covered by a single path of an equifinal solution term [15]
Solution consistency	Expression of consistency of the complete solution term
Solution coverage	Percentage of all cases' set membership in the outcome covered by the solution term [15]

Table 5 How to interpret QCA results tables

For this analysis the four factors were considered as conditions for the analysis with the outcome the views of reporting of near miss or severe error. In undertaking QCA there are 2^k possible combinations of conditions [16] thus with four factors there are 2^4 or sixteen possible configurations. The sixteen configurations can be seen in Table 9.

Other terms that are used in CCM relate to different types of solution terms. In considering Table 9 it is evident that there is a row of conditions where no cases were present in amongst clinicians and several rows of conditions where no cases were present amongst management. These are referred to as 'logical remainders' and analysis may be undertaken where they are included or excluded in the analysis [16].

Different terms are used for solution terms depending upon if and how logical remainders are incorporated [16]. Where logical remainders do not aid analysis the solution term is referred to as complex. Where logical remainders are considered in the analysis (although plausibility of the remainder is not considered) the solution terms are referred to as parsimonious. Where the plausibility of the logical remainder is considered the solution term is referred to as intermediate. The latter solution terms have not been listed in this paper as the plausibility of the remainders have not been considered (and thus the intermediate and complex solution terms produced were identical).

Severe Error "Always" Reported (Clinicians)	tf1*tf2*~scf2	+	tf1*tf2*scf1	+	~tf1*~tf2*scf1*scf2
Consistency	0.880992		0.872500		0.872776
Raw coverage	0.280035		0.550087		0.171804
Unique coverage	0.025569		0.280911		0.019440
Solution consistency	0.880996				
Solution coverage	0.595096				

Table 6 Solution terms for factors and views of reporting severe error (clinicians)

Table 6 presents three solution terms that indicate the outcome view amongst clinical nurses that a severe error would always be reported. Positive teamwork factors and a not positive view of workplace safety culture is the most consistent of the three. Positive teamwork factors and a positive view of leadership and management of error (safety climate factor 2) is another configuration which results in the outcome. If both safety climate factors are positive and yet both teamwork factors are not positive then the outcome will also be present. These results suggest that not all factors of safety climate and/or teamwork need to be positive for the outcome to be present.

Near Miss Error "Always" Reported (Clinicians)	~tf1*~tf2*~scf2	+	~tf1*~tf2*scf1	+	tf1*scf1*~scf2
Consistency	0.852405		0.858103		0.848361
Raw coverage	0.246523		0.245084		0.347482
Unique coverage	0.037410		0.035971		0.146523
Solution consistency	0.830934				
Solution coverage	0.429017				

Table 7 Solution terms for factors and views of reporting near miss error (clinicians)

Table 7 reflects different configurations in relation to the outcome of a view amongst clinical nurses that a near miss error would always be reported. Once again there are three solutions terms, although the overall solution consistency and the consistency of each solution term are slightly lower.

If teamwork factors are not positive and the workplace safety culture is also not positive then the outcome is present. If both teamwork factors are not positive yet leadership and management of error is positive then the outcome is also present. If teamwork and patient safety at the bedside a positive, along with a positive score for leadership and management of error yet the safety culture in the workplace is not positive then once again the outcome is likely to be present. Once again, not all factors of safety climate and/or teamwork need to be positive for the outcome to be present.

Near Miss Error "Always" Reported (Management)	Complex solution tf1*~tf2*~scf1*scf2	Parsimonious solution ~tf2*~scf1
Consistency	0.988142	0.988930
Raw coverage	0.204082	0..218776
Unique coverage	0.204082	0.218776
Solution consistency	0.988142	0.988930
Solution coverage	0.204082	0.218776

Table 8 Solution terms for factors and views of reporting near miss (management)

Table 8 displays the solution terms for respondents indicating their role is a management one. As indicated earlier only the views of near miss reporting amongst these respondents could be analysed with fsQCA. The complex and parsimonious terms are also different in this instance (due to the larger number of logical remainders in this group). The complex solution term indicates that if teamwork and patient safety at the bedside along with safety culture in the workplace are both positive and workplace relationships and communication and leadership and management of error are not positive then the outcome of a view that a near miss error would always be reported is present.

The parsimonious solution term is simpler and suggest that the outcome may be present if only the workplace relationships and communication and leadership and management of error are not positive then the outcome will be present.

These solution terms here have a higher consistency than the solution terms from the respondents in clinical roles. However, once again there is an indication that not all factors need to be present for the outcome to be present also.

Teamwork and patient safety at the bedside	**Leadership and management of error**	**Workplace relationships and communication**	**Safety culture in the workplace**	**Cases (Clinicians)**	**Complex and Parsimonious**		**Cases (Management)**	**Complex**	**Parsimonious**
					Severe	**Near Miss**		**Near Miss**	
1	**1**	**1**	**1**	**31**	x		**10**		
0	1	0	0	5			1		
0	1	1	1	4	x		0		
1	1	0	1	4			1		
0	**0**	**0**	**0**	**4**			**0**		x
1	1	0	0	3	x	x	0		
1	1	1	0	3	x		1		
1	0	1	1	3	x		1	x	x
0	1	0	1	3			1		
0	0	1	1	2	x		0		
1	0	1	0	2			0		
0	1	1	0	1			0		
1	0	0	1	1			1		
1	0	0	0	1			0		x
0	0	1	0	1		x	0		
0	0	0	1	0			0		x

Table 9 Solution coverage

Table 9 indicates the configurations covered by the solution terms amongst clinicians in relation to views of reporting severe and near miss error. This table also displays the rows covered by the solution terms amongst both clinicians and managers in relation to views of reporting near miss error. Complex and parsimonious solution terms have been presented.

It is clear when viewing this table that the configuration of all positive factors results in an outcome view that error would always be reported in severe error only amongst clinicians. It is not however, the only configuration that results in that outcome.

If all factors except the second teamwork factor (workplace relationships and teamwork) are positive then amongst management there is a view that a severe error would always be reported, yet clinicians with the same configuration of factors view that a near miss error would always be reported.

Clinicians view that both severe and near miss error is always reported when both teamwork factors are positive and both safety climate factors are not positive. There were no cases in the management set with this configuration. However, the analysis utilising logical remainders indicated that this configuration was not likely in the parsimonious solution.

The parsimonious solution term for the management respondents indicated that if all factors were not positive then there may be a view that near miss error would always be reported. However, with four clinicians indicating this configuration the outcome that the near miss error would always be reported was not present. The other configurations also indicate differences between clinicians and management in relation to the configurations for positive/not positive safety climate and teamwork factors and the outcome of a view that the error (severe or near miss) would always be reported.

5. Discussion

The inferential statistics presented here indicate there are differences between managers and clinicians in relation to safety climate and teamwork. The fsQCA results provide some insight into how the factors safety climate and views of reporting error differ between management and clinicians. How such differences impact upon the management of error in clinical settings cannot be determined but further research may be warranted in this area.

Perhaps one of the most pertinent results from this research is from the analysis that could not be undertaken. The responses from nurses in a management role all indicated that the viewed the severe error would always be reported. This suggests a limited diversity [15] with regards to the outcome (views of reporting severe error) amongst managers.

Closer inspection of Table 9 also shows that there are less configurations of safety climate and teamwork factors amongst managers (7 of the possible sixteen are present) compared to clinicians (15 of sixteen). This suggests there may also be less diversity amongst managers with respect to safety climate and teamwork factors.

There are also less configurations amongst both management and clinical nurses that result in a view that near miss error would always be reported when compared to the number configurations present that lead to a view that severe error would always be reported. However, when considering the parsimonious solution, there are potentially more configurations amongst managers compared to clinicians with respect to the view that a near miss error would always be reported. More research is therefore needed in relation to safety climate and teamwork.

The fsQCA results also suggest that whilst fully positive safety climate and teamwork may result in a view amongst nurses in a clinical role that severe error is always reported, it is not the only configuration of factors that leads to that outcome. Some configurations where teamwork and/or safety climate factors are not positive still result in a view that severe error would always be reported.

The vignette for this study for the severe harm outcome from the hypothetical error referred to a patient who had a severe reaction to a medication, was resuscitated but remained unresponsive twelve months after the event [24]. If clinicians do not feel that severe error is always reported yet those in a management role do then there an indication that those in management may be overly confident of what may be reported in their workplace. Such a difference in views should be concerning for anyone in a management role, regardless of their industry.

If such differences are suggested from data in health care settings then it is also possible that similar results exist in other industries. With the recent events in the maritime sector it is also possible that those in management roles may have very different views of what could be happening at the coalface of their workplaces.

6. Limitations

The fsQCA undertaken for this paper used the "Standard Analysis" in fsQCA software. Contradictory rows were identified using Kirq and were included in the analysis. It is recognised that an analysis using "Specify Analysis" may have yielded different results. However, the purpose of this paper is to explore the use of CCM and hence the more simplified process of analysis has been applied. Further exploration of the cases, making use of demographic data may also provide further insight into the results.

7. Conclusion

The fsQCA results presented here suggest that whilst teamwork and safety climate factors may be positive it does not necessarily result in a view that error would always be reported, regardless of whether it is severe error or a near miss. Indeed, factor scores that are not positive may play a role in such outcomes.

There is also a suggestion that those in clinical and management roles may think differently in relation to safety climate and views of error reporting. This raises a question in relation to how error is managed in clinical settings.

Clearly the relationship between safety climate and views of error reporting is complex. What is potentially gained from the use of CCM and fsQCA is an improved understanding of what this relationship may look like.

In releasing his report, Robert Francis QC [2] reflected on the number of times the term 'benefit of hindsight' had been used in his enquiry. James Reason has since commented in relation to this report that the term 'culture' is perhaps more relevant [3]. Whether further investigations into the *MV Sewol* results in similar dialogue is yet to be determined but it is likely that some will acknowledge known issues that contributed to the disaster.

Using methods that recognise complexity may make it possible to improve understanding of what needs to happen to ensure organisations are enhancing safety outcomes. Similar research could be undertaken in maritime organisations and workplaces. Through combining Swiss cheese, butterflies and algebra it is possible to look ahead at future maritime research aimed at understanding the complexity of organisational culture and safety. Innovative approaches such as CCM should therefore be considered for future research in other industries, including maritime safety.

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Session 2E

Seafarer Training

Distance Learning at the Turkish Maritime Education

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Distance education or distance learning is a field of education that focuses on teaching methods and technology with the aim of delivering teaching, often on an individual basis, to students who are not physically present in a traditional educational setting such as a classroom. It has been described as "a process to create and provide access to learning when the source of information and the learners are separated by time and distance. Some Maritime Collages and Universities have distance-learning courses in the world. These are such as Marine Surveying, Maritime and Logistic Management, Marine Law, Marine Insurance, etc. International Maritime Organization advises Distance Leaning at the Maritime Education. Unfortunately Distance Learning is insufficient at the Maritime Universities and Faculties in the Turkey.

This paper focused to applicability of distance learning at the Turkish Maritime Universities and Faculties. Authors compared distance learning at the Maritime Education both Turkey and World. It is also supposed to get more efficient distance learning at the Turkish Maritime Education.

Key Words: Distance Learning, Maritime Education, Training, E-Learning, Open Education, Distance Education.

1. Introduction

Distance education or distance learning is a field of education that focuses on teaching methods and technology with the aim of delivering teaching, often on an individual basis, to students who are not physically present in a traditional educational setting such as a classroom. It has been described as "a process to create and provide access to learning when time and distance, or both separate the source of information and the learners." Distance education courses that require a physical on-site presence for any reason (including taking examinations) have been referred to as hybrid or blended courses of study.

The field of distance education has changed dramatically in the past ten years. Distance education, structured learning in which the student and instructor are separated by place, and sometimes by time is currently the fastest growing form of domestic and international education [1]. What was once considered a special form of education using nontraditional delivery systems is now becoming an important concept in mainstream education. Concepts such as networked learning, connected learning spaces, flexible learning and hybrid learning systems have enlarged the scope and changed the nature of earlier distance education models. Web-based and web-enhanced courses are appearing in traditional programs that are now racing to join the “anytime, anyplace” educational feeding frenzy [1].

Distance education relies heavily on communications technologies as delivery media. Print materials, broadcast radio, broadcast television, computer conferencing, electronic mail, interactive video, satellite telecommunications and multimedia computer technology are all used to promote student-teacher interaction and provide necessary feedback to the learner at a distance. Distance education has experienced dramatic growth both nationally and internationally since the early 1980s. It has evolved from early correspondence education using primarily print based materials into a worldwide movement using various technologies. The goals of distance education, as an alternative to traditional education, have been to offer degree granting programs, to battle illiteracy in developing countries, to provide training opportunities for economic growth, and to offer curriculum enrichment in non traditional educational settings. A variety of technologies have been used as delivery systems to facilitate this learning at a distance [1].

This paper focused to applicability of distance learning at the Turkish Maritime Universities and Faculties. Authors compared distance learning at the Maritime Education both Turkey and World. Based on this viewpoint, it is also supposed to get more efficient distance learning at the Turkish Maritime Education.

2. History of Distance Education

The earliest distance education courses may date back to the early 18th century in Europe. One of the earliest examples was from a 1728 advertisement in the *Boston Gazette* for "Caleb Phillips, Teacher of the new method of Short Hand," who sought students who wanted to learn through weekly mailed lessons [2].

Distance education traces its origins to mid-19th century Europe and the United States. The pioneers of distance education used the best technology of their day, the postal system, to open educational opportunities to people who wanted to learn but were not able to attend conventional schools. People who most benefited from such correspondence education included those with physical disabilities, women who were not allowed to enroll in educational institutions open only to men, people who had jobs during normal school hours, and those who lived in remote regions where schools did not exist. Distance education increasingly uses combinations of different communications technologies to enhance the abilities of teachers and students to communicate with each other. With the spread of computer-network communications in the 1980s and 1990s, large numbers of people gained access to computers linked to telephone lines, allowing teachers and students to communicate in conferences via computers [3].

Figure 1 Distance learning

Distance education also makes use of computer conferencing on the World Wide Web, where teachers and students present text, pictures, audio, and video. File sharing and communications tools like email, chats, audio and video conferencing are integral to the Internet model.

3. Distance Education in the Turkey

Distance education is one of the newest forms of education that basically depends on these communication and information technologies. As a new and modern approach to deliver instruction, many corporations and organizations for both formal and non-formal educational settings in Turkey and all around the world have increasingly used distance education. A recent study reports that corporations and organizations that have successfully implemented distance-learning systems list a range of benefits for their corporations.

Distance Education has been actually applied in Turkey since 1982. When the past of distance education is examined, though it can go back to 50-60 years ago, it seems it appeared in 1970s, closer to its meaning of today. In 1970s, the methods and components of the distance education were given by a television system established at the Eskisehir Economical and Commercial Sciences Academy (EECSA) and under the structure of EECSA, the close circuit education by a television was realized in an academic environment and level with the assistance of the national and international symposium and conference studies on education technology and distance education. In 1981, reading/writing campaign was started in all around Turkey for purpose of increasing the literate rate in our country, the studies made through television in great extent, these studies became successful and the literate rate was increased. By 1982 a new constitution and new Higher Education Acts were accepted. As a result a Council for Higher Education (HEC), referred to as YOK, was created and given the authority by the Constitution of the Republic to regulate all higher education [4].

After 1998, a videoconference system was established between the universities in the East Anatolian Region and distance education has been carried out by means of television, radio, camera, satellite and other new technologies. In 2000, Bilgi University, a foundation university, started its web-base MBA program and continues it successfully. Since 2000, distance education has been made between Istanbul University and Harran University by means of videoconference and broadcasting. Istanbul Technical University also provides teaching in different campuses by means of videoconference system [4].

Figure 2. Anadolu University Open Education Resources

Technologies used to deliver distance education programs in Turkey are typically one-way and are designed to reach the masses. The two primary forms of distance education are the Open Education Faculty (OEF) at Anadolu University in Eskisehir and the Open High School (OHS) through the Ministry of National Education. The technologies for both programs include specially designed textbooks and other printed materials including newsletters and bulletins, television and radio broadcasts; technologies for the OEF include videotapes and face-to-face lectures at universities throughout the country. Distance education in the OEF and the OHS provides for all three types of education such as learner-content interaction, learner-instructor interaction and learner-learner interaction [4].

4. Distance Education at the Maritime Collages/ Institutes in the World

Many maritime collage/institutes have distance courses. Some of them are for graduate and undergraduate students. Others are short-term maritime courses. There are;

- SUNY Maritime Collage,
- Australian Maritime Collage,
- Lloyd's Maritime Academy Distance Learning (Certificate in chartering course),
- World Maritime University(WMU-Sweden),
- North West Kent Collage (UK),
- Videotel Distance Maritime Training Courses (UK)

SUNY Maritime Collage is a facilitator competent in the field conducts the courses. Reading materials, personal assignments, and discussion questions are provided. The heart of the class is the discussion questions. This is where student will be able to share ideas and get feedback with others in the class. The format is "asynchronous." That means it is not "live" so student can determine what time of day you want to be online. Student will receive the equivalent of 40 hours of regular classroom instruction within a 45 day time period. Classes may run 4 to 8 weeks depending on the subject. Graduate program are offered five core courses and four elective courses online. Undergraduate programme is offer also some distance course, so student can take some course online. Some examples are, Essentials of Macroeconomics, Fundamentals of Marketing, Transportation Management, International Business and Transportation Law, Maritime Port Security, Transportation Risk Management, Economics of International Trade, Financial Management, Logistics within the Supply Chain, Dry and Wet Bulk Vessel Operations, Financial Management, etc. [5].

World Maritime University has been Distance learning program developed to enable students to study marine insurance at the highest educational level, and is delivered by distance learning, making it available to students based anywhere in the world. In cooperation with Lloyd's Maritime Academy, WMU offers two options for Postgraduate Diplomas (PGD). Delivered by distance learning, these programs are available to participants based anywhere in the world. WMU has two postgraduate programmes are Maritime Energy Management and Marine Insurance [6].

Australian Maritime Collage's unique suite of Distance Education options allows you to take your career to another level. The distance delivery system is first class, the qualifications are world renowned and the jobs are worldwide. AMC have Distance Education options**;**

- Maritime and Logistics Management courses
- Graduate Certificate of Applied Science (Marine Environment)

* Graduate Diploma of Applied Science (Marine Environment)
* Master of Philosophy (Masters by Research)
* Doctor of Philosophy (Doctorate by Research) [7].

5. Distance Education for ITU Maritime Faculty

ITU Maritime Faculty doesn't have online-distance learning courses. Some course is only theoretical course, which is suitable for online course, but some course is both theoretical and practices so they are not suitable for distance education. Some courses, which are only theoretical, Physics I (3 hours Theoretical, 1. Semester), Economics (2 hours Theoretical, 2. Semester), Seamanship (2 hours Theoretical, 1. Semester), Dynamics (3 hours Theoretical, 1. Semester), Physics II (3 hours Theoretical, 2. Semester), Statistics (2 hours Theoretical), Electronics (2 hours Theoretical), Linear Algebra (3 hours Theoretical), Electronic Navigation - I (2 hours Theoretical), Maritime Management I (2 hours Theoretical), Differential Equations (4 hours Theoretical),Maritime Law-I (3 hours Theoretical), etc.

But most of graduate course are theoretical which are suitable for distance learning, such as, International Maritime Conventions (3 hours Theoretical), Advance Port Management (3 hours Theoretical), Meteorological Navigation (3 hours Theoretical), Electronic Navigation Systems (3 hours Theoretical), Human Resources Management (3 hours Theoretical), National and International Maritime Law (3 hours Theoretical), Maritime Risk Management (3 hours Theoretical), Engineering Mathematics (3 hours Theoretical), Advanced Ship Management (3 hours Theoretical), Safety and Reliability in Ship Operations (3 hours Theoretical), Analysis of Maritime Insurance Law (3 hours Theoretical), Environmental Management in Marine Operations (3 hours Theoretical), etc.

6. Result and Discussions

All selected courses are theoretical so suitable distance/online courses, other undergraduate courses have lab and simulations hours so there are not suitable for distance/online courses, Undergraduate students also must finish 12 months commercial vessel cadet. Distance courses are suitable some courses for undergraduate. Graduate courses are more suitable for distance/online courses, all courses are theoretical, most of graduate students are working maritime sector, and some of them freeze their programme because of their busy work.

ITU Maritime Faculty has not distance/online learning courses both undergraduate and graduate programs, Distance/online course is only suitable for some undergraduate courses but undergraduate students are wearing uniform and must go to ships for cadet, First year is most convenient for undergraduate students, Distance/online course is most suitable for graduate students because all courses theoretical and they are working maritime sector. This paper is first study for ITU

Maritime Faculty and also maritime school in the Turkey. But it need more and detail study for distance/online study.

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Towards the Creation of a Formal, Auditable Standard for the Delivery of Distance Learning and E-Learning Programs for Mariners

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As a follow up to the paper presented in the IAMU AGA14 entitled *'Setting the Standard' – A Proposed Standard for Delivery of Online Courses"*, this paper describes the efforts of the authors at the Marine Institute in collaboration with the maritime certifying authority, Transport Canada to prepare a formal standard for the delivery of online courses for the progression of mariners in their certification. While developed in Canada, the technologies and delivery strategies involved are global. Thus the model for creating such a standard has international application.
Several tasks were undertaken in an effort to further refine the conceptualized standard elements presented in the AGA 14 paper. These include:

- Consultation with the maritime certifying authority. Transport Canada
- Interviews with relevant technical experts; and
- A review of several existing guidelines for the delivery of online courses

The guidelines reviewed focused heavily on course delivery pedagogy and failed to emphasise the technical elements we were interested in addressing in an auditable standard. An emphasis on technology is critical due to the nature of the course participants and the unique conditions under which they will participate in these courses.
This paper presents the findings of these efforts grouped into the following categories

- Technology Requirements
- Content Delivery Format
- Course Development
- Learning Management System
- Examinations

While this is still a work in progress, a draft standard under consideration by Transport Canada shall be discussed.

Keywords: distance learning; e-learning; audit; standards; Manila amendment; maritime education and training; MET; maritime training institutions; maritime universities

1. Introduction

Courses that are prepared and delivered by maritime training institutions to seafarers which facilitate their progression through levels of national certification are very well regulated. The STCW code gives sufficient guidance to national certifying authorities to have them develop their own certification procedures and standards which are territorially customized to permit flag states to regulate and audit maritime training institutions within their jurisdiction.

The creation of a standard at the international level is a delicate thing. It must balance the implementation of sufficient regulatory detail with an appropriate amount of generality permitting flag state regulatory authorities the opportunity to author national codes and standards that work within the context of the flag states' unique cultural, legal, technological and demographic environment.

Flag states have developed a level of familiarity and comfort with the STCW Code as it applies to the traditional delivery (or classroom delivery) of Maritime Education and Training (MET). National codes and standards for the delivery of MET are in place and systems on both regulatory and training institution 'sides' are well developed and adopted. On the national regulatory side, STCW compliant codes and standards have a long history of successful implementation. On the maritime training institution side programs and courses both have historically been audited and found or made compliant with the national codes and standards via audits by the national regulating authority against their STCW standard.

With these existing standards in place, the authors have adopted a philosophy for the development of this standard which focuses on the delivery methods and technological tools that would permit distance/e-learning to occur and be effective. Fundamental to this is the philosophy that any standard created must be comprehensive, concise and auditable. The authors feel that the above would permit certifying authorities to have confidence in distance/e-learning as the delivery mechanism for MET as well as the certification of mariners trained through this mechanism.

A challenge for maritime national regulatory authorities has arisen with the release of the Manila Amendment to the STCW code in that regulatory authorities are recommended to permit training of seafarers for advancement in certification by distance learning and e-learning. At the same time there is no standard for implementation of these learning technologies and methods.

This paper describes the collaborative efforts of the authors with members of the Canadian maritime regulatory authority, Transport Canada (TC), to develop an auditable standard which they can use to certify Canadian maritime training institutions to deliver MET courses by distance learning and e-learning.

2. The Narrative of the Standard

2.1 First Draft

In a 2011 press release by IMO [1] it was stated that the 2010 Manila Amendments to STCW were created to enhance the STCW code to "ensure that the necessary global standards will be in place to train and certify seafarers to operate technologically-advanced ships for some time to come". One of the key elements outlined in this press briefing was the introduction of distance and web-based learning as methods of delivery for certification advancement.

Section B-I/6 of the STCW Code [2], as amended states that regulating authorities may allow the training of seafarers by distance learning and e-learning so long as it conforms to the original pedagogical standards outlined in the STCW 95 standard as well as a set of six guidelines. The guidelines state that each party (regulating authority and maritime training institution) should ensure that any distance learning and e-learning programme:

1. Is provided by an entity that is approved by the party;

2. Is suitable for the selected objectives and training tasks to meet the competence level for the subject covered;

3. Has clear and unambiguous instructions for the trainees to understand how the programme operates;

4. Provides learning outcomes that meet all the requirements to provide the underpinning knowledge and proficiency of the subject;

5. Is structured in a way that enables the trainee to systematically reflect on what has been learnt through both self-assessment and tutor-marked assignments; and

6. Provides professional tutorial support through telephone, facsimile or e-mail communications.

The necessity of a standard is implied by bullet one above. Approval of a maritime training institution to deliver a program by virtue of distance learning or e-learning methods requires some basis for evaluation. The means of evolution currently employed to evaluate maritime training institutions and certify them to deliver MET using traditional means is by audit.

The introduction of this facility into the IMO guidelines for MET resulted in some preliminary discussions at the Marine Institute (MI) surrounding the implementation of future MET programmes. The MET programmes at the MI are audited and certified by the Canadian maritime regulating authority, Transport Canada (TC). Audits of our programs and evaluations are regularly conducted by TC against a standard they have authored and regularly amend to be compliant with STCW regulations, ensuring that MI's MET programmes are STCW compliant.

The authors have a combined cumulative experience with distance and e-learning programmes that spans over 30 years. In the last four years the authors have been deeply involved with the development of technologies and methods to enhance distance and e-learning methods. One of the challenges the authors envisioned in the creation of future STCW compliant MET programmes was the development of a standard which TC could use to regulate the delivery of MET programmes at certified training institutions.

In their paper entitled 'Distance Teaching Standard' presented at the IAMU AGA14 [3] it was stated that pedagogical standards for the creation and regulation of MET programmes are well established and require only minor modifications to result in STCW compliance facilitating distance learning and e-learning. The significant challenge in the authoring of a standard for the creation and regulation of such programmes is the technological requirement and describing how distance learning and e-learning technologies are to be used. In their 2013 paper the authors describe 5 broad categories which can be used as the beginning of an STCW compliant national distance learning and e-learning standard. These categories include:

1. Delivery Infrastructure;
2. Receiving Technology;
3. Content Format;
4. Learner Management System (LMS); and
5. Instructor Standards

In anticipation of TC creating and implementing a distance learning and e-learning standard as well as the interest at the MI for creating and using standards in adherence to our quality system, the authors endeavoured to draft a standard for the delivery of distance learning and e-learning programmes that would be completely STCW compliant and conform to the categories of concern listed above.

2.2 Transport Canada Consultation

Senior Inspectors of Marine Safety from Transport Canada visited the MI to conduct a regularly scheduled audit of one of our traditional delivery MET programmes in December of 2013. During their multi-day visit the authors had an opportunity to meet with the TC representatives and discuss the 2010 Manila Amendment as it pertains to distance learning and e-learning and how this would influence development of such programmes within our institution.

An interesting finding from this discussion was that the TC representatives we were meeting with had already been asked to begin work on authoring a standard to facilitate implementation of distance learning and e-learning delivery of maritime certification programmes. To be specific, this standard was focusing on the technology and not the pedagogy of MET delivery. This task was considered a challenge as it was a deviation from their fields of expertise. Consequently, they were pleased to discover a possible source of information they could review in the creation of such a standard.

The authors presented the preliminary draft standard based on MI distance learning procedures. This draft was created to be one that encompassed the spectrum of categories presented in section 2.1 while being as open and non-excluding as possible. The result was a very loose standard containing many general descriptors in its categories that would have been quite easy to satisfy and comply with.

TC took this standard and considered it carefully. They provided feedback on our work with the intention that we might develop our standard into a document that they might work with and evolve into a national standard for Canada.

TC's initial feedback on our standard indicated that they felt the standard should be a balance between being rigorous and attainable while also being auditable. The standard must be rigorous in that it would be used to ensure that MET programmes are delivered using a high quality of delivery using a means that ensures confidence and integrity to the learners and the certifying authority. The standard must be attainable in that established maritime training institutions should have the capability of meeting this standard and attaining certification to delivery distance learning and e-learning programmes.

The standard must also be auditable in that it has to be able to be structured in a checklist format with unambiguous headings. TC also wished to see more technical detail and specifications. This would empower a regulating authority to audit potential maritime training institutions and certify them as deliverers of distance learning and e-learning maritime programmes without the auditors requiring in-depth technical knowledge of computer and software systems or distance/e-learning educational methods.

2.3 Consultations with Technical Experts

Response to this feedback entailed a multi-faceted approach. At the Marine Institute which is a part of Memorial University of Newfoundland, The authors have been successfully creating and offering online courses in a variety of programs up to and including the graduate student level. It was the author's intention to obtain a snapshot of our existing hardware, software and procedures and use this specific snapshot to create a template which would form the standard.

The authors are faculty who have been leading the way at MI and MUN with regards to course content and evaluation software packages as well as the development of course implementation and delivery methods [4]. How these software packages are used was taken into consideration, but further consultation had to occur with computer systems managers and technical support at the MI to determine information such as technical support procedures and schedules dealing with learner issues, software update and maintenance scheduling policies as well as data backup and security policies.

The Learner Management System (LMS) is the online software environment in which our distance learning and e-learning programmes reside. The particular LMS in use at MUN is one called Desire To Learn (D2L) and is maintained by the umbrella group within MUN responsible for university-wide applications and computer systems called Distance Education, Learning and Teaching Support (DELTS). DELTS is a much larger organization within MUN and is responsible for MUN's LMS as well as other systems that cross the borders of individual faculties, as well as providing technical support for these systems.

An interview/meeting was conducted with DELTS which was similar in format to the one conducted with technical support at the MI. In this meeting, information on relevant hardware, software, networks, technical support, maintenance and data security relevant to the authoring of our draft standard was obtained.

2.4 A Review of Existing Standards for Distance Learning/E-Learning Course Delivery

The standards already in place with TC as well as the various certified maritime training institutions deal primarily with course content and pedagogy. These standards, originally crafted by TC to comply with STCW guidelines, have evolved over time and the certifying authority has developed a degree of confidence and understanding of their standards, well-equipping TC to administer the standard to the maritime training institutions. Conversely, the maritime training institutions to which these standards have historically been applied have evolved the content and documentation for their MET programmes to satisfy the evolving content of the TC standard.

While the content was in place, what was lacking were the elements necessary to regulate an institution's ability to deliver programmes using distance learning or e-learning methods. The focus of the review of existing standards is to identify the specific elements as well as the structure of appropriate standards that could be used to regulate the delivery of distance learning and e-learning maritime certification programmes using the categories identified in section 2.1 as an initial guideline,

A review of numerous existing standards for the development and delivery of distance learning and e-learning programmes including the Campus Alberta Quality Council, "Additional Quality Assessment Standards for Programs Delivered in Blended, Distributed or Distance Modes", [5], Southeastern Louisiana University Standards for Quality Distance Education, "Distance Education: Policy" [6] and the International Test Commission's International Guidelines on Computer-Based and Internet Delivered Testing [7] has shown that many provide very ambiguous descriptions of the various standard elements. These are most often focused on the pedagogy of distance learning/e-learning programmes as opposed to technological capability or specific delivery methods and tools as is the case with the Accrediting Commission for community and Junior Colleges 'Guide to Evaluating Distance Education and Correspondence Education' [8].

Another great portion of the available standards focuses on very specific, non-technical and non-infrastructure elements of the training institutions ability to deliver distance learning/e-learning courses. As an example of this, the Campus Alberta Quality Council [6] states under their *Technical Support* criteria that:

> *Academic staff are provided with an orientation to, and sufficient ongoing training/technical support for any hardware and software resources required in the program, and are also updated in a timely manner about any impending or actual changes that could affect their access to or involvement in their online programs.*

The authors are not in disagreement with this as an element in an academic delivery standard, but this is a description of a criteria that deals with one small part of the communication of technical support details to the academic staff and does not describe any details of the type, format or availability of technical support.

Of the standards reviewed only one partially aligned with the philosophy of the standards document we are creating. This one is the Ministry of Training, Colleges and Universities Policy Directive #9 [9]. This standard is designed specifically for private career colleges whose primary mode of programme delivery is distance education. It contains a standard in tabular format, assisting in making it auditable and able to be used for self-evaluation and containing some level of technical and teaching method detail modestly overlapping the suite of categories presented in section 2.1.

In general, it was concluded that no single standard encompassed the philosophy or scope of the standard that the authors are crafting. Some standards did give enriching ideas that can or have been included in the draft standard in its current state. The challenge remains to 'strike the balance' in creating a standard to be employed to regulate the technology, infrastructure and methods employed in the delivery distance learning and e-learning maritime certification programs, and have a standard that can easily be blended with existing content and pedagogical standards.

2.5 Standard – Latest Version

Following additional consultations with TC and the review of the original draft document by TC approved external reviewers, the categories of the standard have been expanded to include:

1. Instructor Evaluation and Approval;
2. Delivery Infrastructure;
3. Delivery Format;
4. Receiving Technology;
5. Content Delivery Format;
6. Standard Course Information (Presented in LMS);
7. Course Development;
8. Learning Management System (LMS); and
9. Examinations

The standard document consists of a narrative detailing each of the above categories in the appropriate government paragraph format. As an example, a portion of the narrative describing the standard on delivery infrastructure is:

X.X Delivery Infrastructure

(1) At the core of most distance delivery systems is some form of electronic communications and in almost all cases this communication system is the internet. This is expected to remain as the primary method of delivery of distance education for the foreseeable future. However based on historic performance it is anticipated that the ability to transmit and receive data communications will improve.

(2) Consequently, any distance delivery of course material should take advantage of existing communication infrastructure. At the minimum this infrastructure shall consist of internet connectivity and telephone access.

(3) The connectivity of the institution delivering the course material must be sufficient to ensure unrestricted access to material. In this case unrestricted is taken to mean at least 1 Mbps (1 mega bit per second).

In an effort to provide clarity for the exercise of auditing as well as guidance to maritime training institutions in their efforts to be certified in accordance with this standard, a tabular checklist of all content items in the narrative portion of the standards document is also provided as:

Delivery Infrastructure	
Able to host the course on dedicated web servers	✔
Able to provide telephone access to course providers	✔
Able to provide at least 1 Mbps connectivity to course materials	✔

This is a sample from the latest draft standards document and is presented to give an idea of the intended format of the final standard.

standards, but in the case of distance learning and e-learning standards, there will be an challenge in that effort and time will always be required to match the teaching and learning standard the technology of the day.

Technology will continue to evolve and change at an ever increasing rate, and if standards related to it are not judiciously and rigorously maintained then standards effective and state of the art today can quickly and quietly become outdated and irrelevant.

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Flexible 'On Country' Training for Indigenous Seafarers

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This paper presents the concept, challenges and results of Certificate II Coxswain and Certificate II Marine Engine Driver (MED3) training that was tailored for a specific cohort of indigenous candidates within a unique set of training parameters. The challenge presented to the Vocational Education and Training (VET) area of the Australian Maritime College (AMC) was to integrate with an existing maritime training program in the Torres Strait region of Far North Queensland and then take the program forward with student pathways into higher level vocational maritime qualifications. With relatively short notice, assessments were completely redesigned to minimise written components and to maximise workplace demonstrations of competence, learning material was re-written to be language-neutral, and presentations and diagrams were converted to functioning physical training aids.

The training commenced with a pilot course in November 2013. It was shown that the benefits of this training were that the students remained 'on country' (that is, in their traditional geographic region) and that on board the training vessel they were not just trained and assessed; they lived the lives of Coxswains and Marine Engine Drivers for a full four weeks. The feedback from students on completion of the course was overwhelmingly positive, and there was very high course completion rate. The governing partner agencies, AMSA and the TSRA, were entirely satisfied with the innovative and tailored training that delivered nationally recognised qualification outcomes to each of the participants. The innovative approach to maritime training and the successful results to date have caught the interest of the Great Barrier Reef Marine Park Authority, and a similar approach will be used to tailor maritime training for that authority's indigenous marine rangers in remote communities on Cape York. AMC's flexibility and innovation has also set the precedent for this style of delivery across all remote indigenous areas of northern Australia.

1. Introduction

Despite the technology and techniques available to the 21st century educator, the style of classroom delivery aimed at well-educated students doesn't work for every cohort. Indigenous Australians, some with low Language-Literacy-Numeracy (LLN) levels, and with English as a second or third language, are even more challenged by the traditional educational model which includes theory lectures and written assessment instruments. VET is specifically designed for delivering practical hands-on skills for direct transfer to a particular vocation, and this method lends itself to a more flexible delivery of training and assessment by practical demonstration.

This paper presents the concept, challenges and results of Certificate II courses (Coxswain Grade 1 Near Coastal, and Marine Engine Driver Grade 3 Near Coastal (MED3)) delivered to students in the Torres Strait region of Far North Queensland. The training was tailored for a specific cohort of indigenous candidates within a unique set of training parameters. With a very short lead time, staff from the Australian Maritime College's (AMC's) VET area developed and delivered an innovative program of training and assessment, based on the existing programs, which produced highly satisfactory outcomes for the funding organisation and the individual students.

2. Background

2.1 Torres Strait Islanders and their Communities

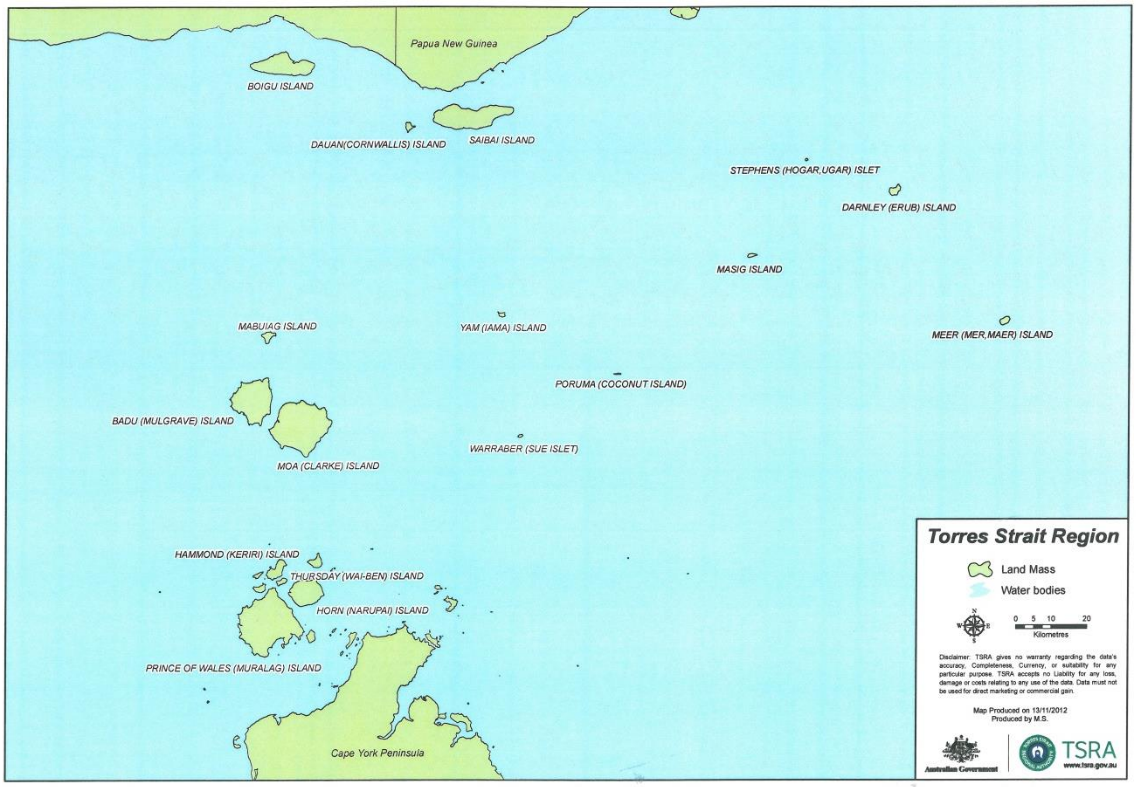

Figure 1 Map of the Torres Strait region [1]

As seen in Figure 1, the Torres Strait comprises the relatively small sea area that lies between the northern tip of Australia's Cape York, and the southern extremities of Papua New Guinea and adjoining part of Indonesia. The Torres Strait Islander (TSI) people live in twenty distinct communities spread across eighteen island and two Northern Peninsula Area communities, in a geographic area of 48,000 square kilometres. Throughout the TSI communities there are two main languages with a number of sub dialects [2].

Evidence of human settlement has been found in the Torres Strait dating back 2,500 years [3]. Life in the TSI communities has by necessity involved close interaction with the maritime environment. The TSI people have travelled on the sea and harvested marine resources throughout their history, and as a result they have very strong and highly robust traditional seafaring skills.

2.2 Government Funding for Greater Maritime Safety

For several years an Australian Commonwealth and Queensland State government initiative has been in place with the aim of increasing the safety and survival of people operating small boats in the Torres Strait. The Torres Strait Marine Safety Program (TSMSP) is a joint initiative of organisations including the Australian Maritime Safety Authority (AMSA), Maritime Safety Queensland (MSQ), the Torres Strait Regional Authority (TSRA), Queensland Police Service and National Maritime Safety Authority Papua New Guinea. The program was put in place to help address the unique geographical challenges facing residents of the Torres Strait, primarily the reliance by many of these people on seaborne transport over long distances across open ocean in small open boats. Through consultation and strong community relationships, the program has delivered increased boating safety education

3. Future Steps

The authors and other faculty at the Marine Institute currently deliver distance/e-learning courses as part of the degree programs offered at their university as well as preparatory courses for mariners to write challenge examinations at the national certifying authority. Participants in these courses come from all over the world and frequently move across boarders while participating in the course.

Many of the challenges inherent in offering learning opportunities of this nature have been encountered by the authors. Although the demographic from which the courses have been offered as well as the particular national certifying authority have been restricted to Canada, the authors have developed a roadmap for the creation of an international or multi-national standard that could be used by maritime regulating authorities around the world to certify maritime training institutions for the delivery of online/e-learning MET.

In describing the efforts of several Asian universities to develop a quality assurance program for distance education and learning, Jun et. al [10] emphasize the importance of benchmarking one's training institution against others. Benchmarking provides a relative comparison of performance indicators which can be used to develop a realistic set of cross-national standards that may then be used to track and ensure quality of MET training.

To this end a significant first step in the creation of an international standard to be applied to distance and e-learning MET is that of benchmarking a representative set of institutions to determine a realistic and reasonable set of performance indicators. The performance indicators and the benchmark results could then be analysed and considered by an international committee of IAMU who can then structure this set of performance indicators into a quality assurance standard for consideration and submission to external bodies.

4. Conclusion

The unique circumstances surrounding maritime education and training require that great care and consideration be given to not only the course content and pedagogy of maritime certification programmes delivered by distance learning and e-learning, but also to the technologies employed and the methods in which they are employed. The fact remains that if a mariner is to be able to take a course by distance using electronic means, then it should be assumed that they would have reasonable access at any time from almost any location.

The standard as discussed in this paper and presented to Transport Canada members for consideration is detailed and customized for the Canadian cultural, legal, technological and demographic environment. It is a work in progress and one that will be continue to be revised iteratively following consultations with stakeholders as we proceed down this path of this effort.

It is worthy to note that standards of this type are necessary for regulated environments such as the maritime or aviation industry where stakes are high and a high degree of regulation of training is a necessity to ensure the safety and well-being of all persons involved.

Although this is the case, it can also be noted that credit for most programmes delivered at higher learning institutions is exclusively granted by the institution. In the case of MET, at least a portion of the credit is granted by the external certifying authority, resulting in the assumption of a goodly portion of the responsibility for the quality of the programmes and their delivery. With the responsibility shared between the maritime training institution as well as the national certifying authority (in our case, Transport Canada), there will always be a necessity for teaching and learning across the region, an integrated safety campaign and various boating safety sub-projects [4]. The sub-projects have included the production and distribution of loan ‘grab bags’ of safety equipment, and the development of training and commercial licencing regulations for the outboard powered dinghies used as everyday transport between communities.

The Torres Strait Marine Pathway Program (TSMPP) has evolved from the TSMSP, and aims to provide islanders with maritime and maritime-related vocational career pathways. These pathways lead into careers through diverse and higher level qualifications, and literal pathways into maritime employment beyond the Torres Strait. Both AMSA and MSQ provide operational support and additional funding to the TSMPP, and AMSA’s Thursday Island community liaison officer acts as a project manager for the program.

2.3 AMC’s Engagement by the TSMPP

The challenge presented to the VET organisation at AMC was to integrate with the existing maritime training initiatives in the Torres Strait and then take the program forward with student pathways into the next level of vocational qualifications. The criterion set for the training project by AMSA and the TSRA was, in essence, to train and assess fifteen indigenous TSI students using as little language-specific material as practicable whilst underway in a chartered training vessel in the Torres Strait seaway. Whilst this was in many ways a simple continuance of AMC’s core business, the specific needs and unique context of the project required renewed perspective on the college’s training and assessment methods and resources.

3. Tailoring the Delivery of Training and Assessment

3.1 Culture and Language

Through a range of circumstances, the lead time given to AMC to tailor our Coxswain and MED3 course, and prepare to deliver it was approximately two weeks. This required our staff to rapidly gain an understanding of the TSI culture, research the geography of the proposed training area and obtain specific details of the training vessel.

The TRSA Cultural Protocols Guide [5] was the primary source of information regarding the cultural requirements of teaching TSI students and was used as a reference against which to benchmark AMC’s standard course delivery and resources. There were many cultural differences to take into account within the training environment, such as the way in which to initiate discussions and conversation, and the manner in which to conduct a discussion with an individual without raising concerns or offending other group members. Very importantly the trainers needed to appreciate the traditional land and sea rights the students hold over the Torres Strait islands and waters, and the long campaign undertaken to obtain these rights. Whereas navigation or vessel handling training in Tasmania simply takes place in the local river or coastal areas, the Torres Strait is considered to be the ‘country’ of the TSI people. This required the respect of the academic staff but it also gave much greater meaning and applicability to the skills obtained from the course; the course outcomes relate directly to the lives of the students and how they live and work on their country.

A significant consideration in relation to the training development was that English is the second or third language for many TSI people [6]. The TSRA recommend using basic English and not complicated jargon that may cause confusion [7]. However in a discipline such as navigation the exclusion of jargon could in many ways be considered to be counterproductive. Technical terms and descriptions also form an integral part of the MED3 training material and are important to ensure that the training and qualifications are transportable. With these challenges in mind the review of training and assessment material was undertaken to eliminate unnecessarily complicated language and jargon, and to ensure as much language neutrality as possible with technical terms and descriptions. During the process there was thought given to providing simple translations within the training material to accompany the English terms, however the range of languages and dialects spoken within the student cohort would render such a process unmanageable.

A support mechanism provided by the TSMPP partners was the employment of an indigenous mentor onboard the training vessel. The mentor was an employee of AMSA and had a level of experience in the subject matter being delivered. This innovative measure proved very effective, from basic translation functions through to providing moral support to students and cultural advice to the academic staff. As the training progressed and students gained the desired knowledge and levels of familiarity, the language difficulties gradually reduced, and the licencing requirement to communicate in English was ensured via the final summative assessments.

3.2 Training and Assessment Materials

In a heavily paper-based society, where legislation, regulations, codes of practice and training packages are available in either printed or electronic form, the natural format for training material and assessment instruments a written format. Notwithstanding the practical elements such as vessel handling, mechanical maintenance, chartwork and simulation, much of the existing Coxswain and MED3 material was printed in learner guides. The assessment of knowledge also tended towards written format. Given the language issues discussed above, such assessments would probably not provide the students with a fair opportunity to demonstrate their competence using their second or third language.

With these considerations in mind, a different style of learner guide was developed for the cohort. Rather than relying on reading a text and committing it to memory, the students were provided work books to complete. The workbooks led the students through the theory but provided simple aids to learning, such as labelling diagrams. The complexity of these tasks increased over the duration of the training and progressed, for example, through the basic steps of simple navigational tasks right through to the planning of a navigational passage through the coral waters of the Torres Strait.

On a very simplistic level, the students were presented with an innovative way to review buoyage symbols and markers on one particular morning. One of the staff went to the effort of sculpting a range of navigation marks and top marks from butter, and arranged these on the counter in preparation for breakfast. Whilst the educational benefits of the exercise may have been marginal, the gesture was taken with great pleasure and aided in increasing the motivation of the group throughout that day.

3.3 Packaging of Qualifications

AMSA's initial request for AMC to deliver the Coxswain training sought to create a pathway from the previous training for commercial dinghy (Traditional Inhabitant Boat) licences to the qualification needed to be master of a vessel up to 12 metres in length. The Coxswain qualification includes the mandated minimum level of engineering skills and knowledge, but is predominantly a deck or navigational qualification. With the release of Australia's new VET Maritime Training package in 2013, AMC's staff saw an efficient way to combine both the training and assessment of the Coxswain qualification with the MED3 course. This was a new approach for AMC, but with minimal impact on either course fees or duration of training this innovative approach has broadened the qualifications and licences of our Torres Strait graduates, and has provided an engineering branch to the seafaring pathways available to them.

4. AMC Staff Set Sail On Country

The training commenced with the four week pilot course in November 2013 (which excluded some course components previously completed by the candidates). AMSA, on behalf of the TSMPP, arranged the charter of a 32m vessel for the duration of the course, and this served as the training platform and the accommodation. The voyage set out from Thursday Island and slowly progressed through the waters of the Torres Strait, passing the islands and communities to which a number of the students belonged. The significance of conducting the training on country became apparent to the trainers very early in the course; the TSI people hold an extremely strong connection to their land and sea country. The students were very much at ease by virtue of being at or near their homes, and the familiarity they had with the waters meant they could tackle their training with an increased foundation of confidence. Clearly these are not advantages that would be realised if the training was conducted even a short distance from the Torres Strait. The negative impacts of isolating indigenous students from their country have been informally observed to some extent in the past when students have travelled from the Torres Strait or Cape York to undertake other courses in Tasmania.

In a determined effort to address some of the language-specific concerns of the course delivery, formative and summative assessments had been changed to a model in which students were immersed in the daily routines on board the vessel. The students spent much of their time putting newly acquired skills into practice in the workplace at sea. They also had the opportunity to do this in small teams alongside the vessel's crew, across subjects such as navigation, deck work and engine room duties. O'Callaghan recognises the benefits of teamwork in reinforcing learning outcomes and providing the opportunity to orally explain concepts [8]. Through this team-orientated approach, the crew, the academic staff, the indigenous mentor, and indeed emerging leaders with the student cohort could all model the behaviours and practices required for shipboard life and course-related duties. Australian indigenous culture typically relies very heavily on the spoken word, so the students responded very well to practical demonstrations of their training and assessment activities. An exemplar watershed moment in one student's training followed a visit to the engineering spaces on board the vessel. After struggling with the theoretical description of the vessel's steering system, the trainer took the student below to trace and examine the physical layout and system operation in situ. This practical approach gave the student a rapid and thorough understanding of the topic, and with a wide smile he exclaimed to his lecturer that, "It all makes sense Bro!"

An interesting comparison was made during the voyage between the modern navigational techniques and practices being taught by the staff, and the traditional navigational skills that had been acquired over time by the students. The visual use of landmarks and natural transits are mainstays of the traditional techniques. As the course progressed through the Torres Strait, various students shared the methods they used to safely navigate from one specific island to another. These resultant routes were plotted on the chart, along with the route determined by modern practice and the use of compasses, radars and GPS. In these instances the students were able to gain a better understanding of the modern techniques and rationale by building on their own experience, rather than learning the concepts without reference to their former practices.

5. Outcomes of the Training Innovation

5.1 Student outcomes

The initial Coxswain/MED3 pilot course demonstrated that the main benefits of this innovative training were that the students remained on country, and that on board the training vessel they were not just trained and assessed but lived the lives of Coxswains and Marine Engine Drivers for a full four weeks. Despite a small number of minor lapses, the motivation and morale of the students remained very high throughout the course. The student feedback received on completion of the course (both formal and informal feedback) was overwhelmingly positive, and as pseudo observers the training vessel's crew cast a very positive light on the activities and the program that was conducted. Unlike general figures for VET completion rates across all disciplines in Australia, this course enjoyed a very high completion rate of 93%. Perhaps even more satisfying for the students is the licensing outcome whereby all students who completed the Coxswain/MED3 course successfully passed the Regulator's oral examinations and now hold the corresponding commercial licences.

The licensing outcomes yielded immediate results in the local communities. After graduating, two of the students took up positions as masters with the local ferry service linking two of the main islands. Two others have procured their own fishing vessels and have commenced operations within the Torres Strait, with the added economic benefit of having hired their crews from the local population. There are also two students showing great interest, and potential, in the next level of qualification (Master Class 5).

5.2 Client Satisfaction and National Recognition

The governing partner agencies, AMSA and the TSRA, were entirely satisfied with the innovative and tailored training that delivered nationally recognised qualification outcomes to each of the participants. The successful pilot course of study has results in the delivery of three further courses by AMC in the Torres Strait and has paved the way for pathways into higher levels of marine qualifications. Through involvement with these Commonwealth Government agencies, the training has gained national attention and is viewed as a preferred model for training in other coastal indigenous communities in the north of Australia. With the support of the TSMPP partner organisations, AMC was recognised for 'Excellence in Industry Promotion' in the Australian Transport and Logistics Industry Skills Council's 2014 awards for excellence.

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Distance Education for Seafarer Students: Survey of Seafaring Community

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Many academic courses offer distance study as an option. However, there are very limited such offerings for seafarer students. This paper presents the results of an investigation of the possibility of offering distance courses for seafaring students (cadets) who undertake their practical training at sea. The data were collected using an online survey of sixty participants representing cadets, junior and senior officers and ship masters mainly from Australia, Sri Lanka and Singapore.

Some respondents were highly appreciative of having an opportunity to study at sea while some others were concerned about availability of technologies and the availability of time for additional study. The study found that 69% of the respondents would like the opportunity to engage in distance education while at sea and consider it is helpful for their future learning. Nearly 80% of the respondents indicated that the available time for additional study for cadets over their normal working hours is between one and three hours. They also indicated (about 80% of respondents) that the perception of the employers for cadets to undertake distance study is supportive. Further the survey found that senior officers were highly supportive (24.4%) or supportive (48.9%) of cadets undertaking distance study while at sea. Respondents from the offshore industry indicated that they do not have enough time to do such study at sea.

Keywords: Distance education, seafarer training, seafarer attitude, and e-learning.

1. Background

"The key issue is identifying the starting line for each student and helping them progress by addressing, if possible, their individual needs. The goal is to "add value" by assisting student progress from their various starting lines"[1].

Distance education has emerged in response to the demand from both employees who intend continuous professional development and those who have limited access to required further studies. According to Beldarrain [2] distance education is developed in order to provide access to those who are distanced and not be able to participate in on campus courses. Distance education opens up many new learning opportunities, and it gives a greater degree of control to the learner, which might have a significant effect on what the institutions offer to teach and how they teach. In distance education mode, the learner's position constitutes the centre of the universe in that teaching responds and supports learning rather than teaching. That means students have to take responsibility for their learning, in such matters as deciding when they will study and how much they want to study and seeking out information and resources. In moving to distance education, the role of the instructor will continue to change, some will have a job of preparing materials without being involved in teaching and some will learn how to use communication technologies and so teaching will become quite different [3].

According to the transactional distance theory of Moore [4], distance education does not mean simply a geographic separation of learners and teachers, but it is a pedagogical concept. It is a relationship that exists when learner and teacher are separated by space and time. Transactional distance varies with many contributing factors such as the strength of the relationship, behaviour of the teachers and learners, and other environmental factors surrounded by them. The transactional distance is reduced when the gap between people who are teachers and learners are reduced.

According to Muirhead [5] education institutions are required to plan for delivery of courses with caution by considering evolving information and communication technology. Good communication has always been a primary criterion for the successful teacher. Students learn in part by communicating their knowledge both orally and writing between teacher and themselves [6]. Communication plays an important role in delivering learning at a distance whether by mail, telephone, fax, satellite, e-mail or the Internet.

Most of the distance education providers have changed their delivery mode today to take the advantage of emerging technologies, so that distance education now offers blended learning opportunities or completely online delivery. Blended learning involves a combination of Internet and digital media with established classroom forms that require the physical co-presence of teacher and students. This was aided by the rapid development of the Internet as a potential course delivery platform and which enabled significant incentive for universities to provide distance delivery programs [7].

Information and communication technology (ICT) provides academics with an opportunity to create rich learning environments for their students, as a consequence many major distance education universities in Australia are now replacing traditional, print-based courses with multimodal types of courses, which involve the use of multimedia and ICT to develop dynamic course resources that appeal to different sensory modes and a variety of learning styles, for example, in both a visual and aural form. This strategy has shown that it leads learners to perceive easier, and to improve attention rates, and thus leads to improved learning performance [8-12].

According to Digital Ship (March 2013), internet facility is available to 68% of seafarers today. But how much this would be useful to learning objectives is not yet clear. Textbook or written class material can be replaced by online documentation, available on disk or downloaded from the Internet. Various types of e-book applications are also available depending on the learners' level of study [13]. Those computer based training (CBT) applications together with internet facility (if available) can look just like the hardcopy document, and the advantage of this system is that they can also include hyperlinks and jumps.

According to Moore [4], education systems need to be responsive to the specific educational needs of different ethnic communities, especially in the context of distance delivery. It is important to address issues related to different cultures to provide better acquisition of knowledge and skills [1, 14]. With regards to seafaring, maritime course delivery is usually undertaken using the English language. However, in other cultural settings the respective mother language may be used (e.g. Germany, Sweden). One of the main issues with the different cultural groups is to identify their understanding and enhance it by addressing their issues, and if possible their individual needs. This process may have an added value to assist student progress and overcome their initial difficulties [1].

Generally the use of emerging technologies and the attitudes of the learner and teacher in education represent assumptions about learning and they are often based on observations of the learner and the teacher without testing the actual learning outcomes related to the technology in use.
One study on attitude [15] towards internet connected devices shows that students have differing views of the benefits of these devices. This research investigated the students' attitudes toward using mobile learning technologies particularly in relation to tablet computers, e-textbooks and learning management systems (LMS) on mobile devices. Findings have shown that students feel there is benefit in blended learning with internet connected devices used during class. While 12% of students said there was "little benefit" or "no benefit at all", 88% said there was "reasonable benefit" or "lot of benefits". When asked about distraction from using mobile devices, 64% indicated there was "distraction" but 36% said "a little or no distraction". When asked whether the iPad motivated them to learn, 54% said "it did not, or sat on the fence", and 46% said it did. Similarly, 48% said the iPad "gave me an advantage in the classroom," while 17% did not think so and the rest were neutral; 44% said the iPad "improved my study habits" while 21% did not think so and the rest were neutral".

In the context of seafarer learning at sea, as the physical distance increases, it leads to a communication gap, a psychological space of potential misunderstanding between the players which therefore needs to be bridged by carefully selected teaching techniques[3]. Traditional learning approaches will not have the capacity to meet the distance education needs for seafarer students who would like to study at sea. Work place compulsory training programs and on board workloads have increased the gap of the distance learner in that environment. Therefore the significant technological development and its new approaches need to be considered in the future delivery of distance courses for seafarer students.

Seafaring training programs have varying degrees of sea-time requirements and shore based learning requirements in different countries. Figure 1 illustrates the seafarers study pathway offered at the Australian Maritime College (AMC) in Australia. Generally it takes minimum of seven years to complete nautical study requirements to be qualified as a ship Master. It would be potentially advantageous for continuity of learning, and to speed up the learning process if the students could undertake some of the 'phase three' studies shown in the figure 1, whilst on board ship.

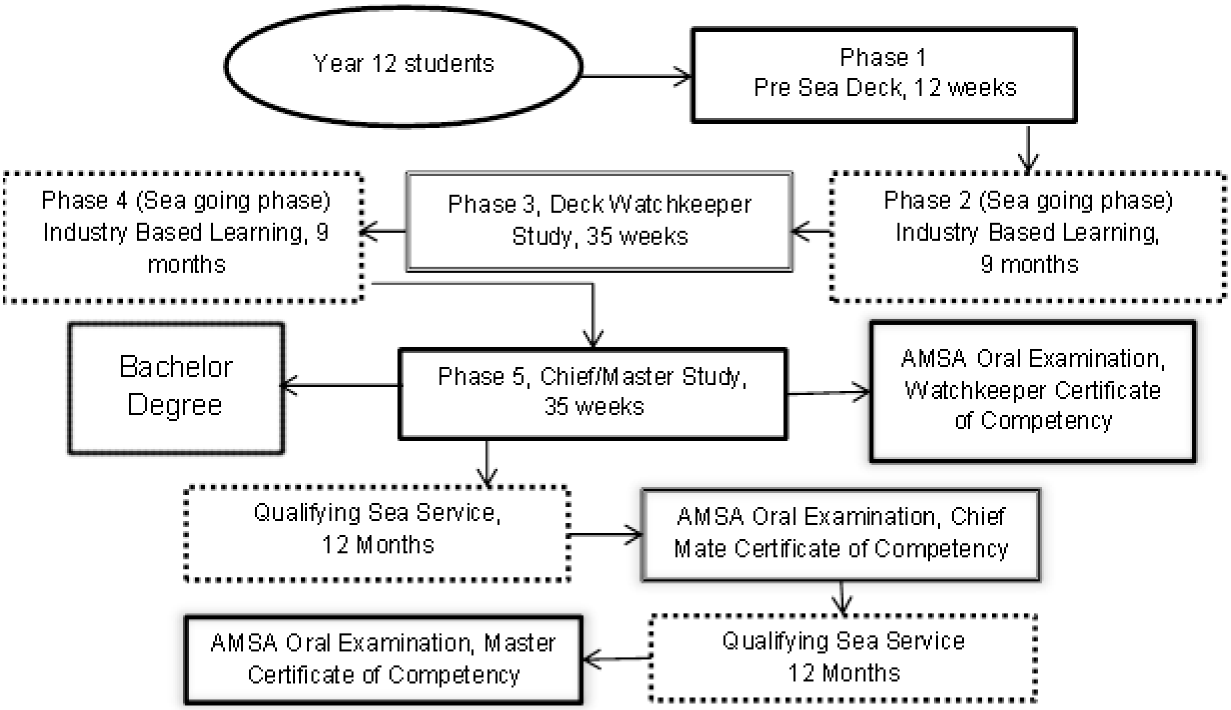

Figure 1: Seafarers study path way offered at AMC in Australia.
Source: adopted from AMC course informations [16]

This project investigated the possibility of offering distance courses for seafaring students (cadets) who undertakes their practical training at sea. Thus the objectives of this project is to develop one or more units for these students to undertake during their seagoing phase at a time and several units during their cadet period, utilising best possible learning and teaching strategies, and capitalising on available technologies**.** It also investigated how feasible is it to assume that students have periodic internet access that could be used to encourage continuous communication.

2. Methodology and data collection

A convenient method of data collection was used (web link) primarily to collect data from known maritime institutions. Some institutions in less develop countries had difficulty in using this method and therefore researchers were unable to receive good number of responses from those institutions.

2.1 Procedure

A structured questionnaire was developed to collect data samples. The survey questionnaire was pre-tested with 20 AMC students who had partly or fully completed their cadet training at that time. Therefore based on the responses the questionnaire was refined.

The final questionnaire was disseminated mainly through seven known contacts at various maritime (seafaring) related organisations. They were requested to distribute the questionnaire among seafaring members of their organisations. A Web link was sent by e-mail to each participant through the contact person of the organisation and directly through e-mails to known seafaring students. In addition a sample of 80 seafarer students, which included watch keeper and master/chief mate level students, was chosen from the AMC student data base. Out of seven locations for which the questionnaire was distributed, responses were received from five locations; namely AMC seafaring students (40 responses), Singapore Polytechnic (2 responses), Australian shipping companies (6 responses), Ceyline Shipping (10), Colombo International Nautical and Engineering College Maritime Campus (1), and University of Moratuwa, Srilanka,(1). The response rate from seafarer students at AMC was 60.8%. The responses were stored in the Survey Monkey web portal and the results were analysed using SPSS statistics software.

2.2 Analysis

Data analyses were carried out mainly to cross check different group responses. Most of the graphs were produced using Excel sheets. The original size of the open ended comments was over 5000 words and they were filtered to about 2500 words by removing repeated comments. Open ended answers were categorized under various indicators such as positives (32), negatives (18) and questions (6).

3 Results

The results shown in this paper are limited to the findings regarding the attitudes of the seafaring community to distance study. The use and availability of technology and several other findings of the survey are not presented here.

3.1 Sample characteristics

The composition of the survey response was that 60.8% of them were current students of the AMC and 17.6% were ex. students (seafarers) and 17.6% were cadet training officers and the rest 11.7% were employers or managers of the shipping companies. Nearly 58% of them had over five years of experience at sea, out of which 24% had 20 years or more experience. There were 8% with three to five years of experience and 34% of the respondents had less than three years of experience at sea.

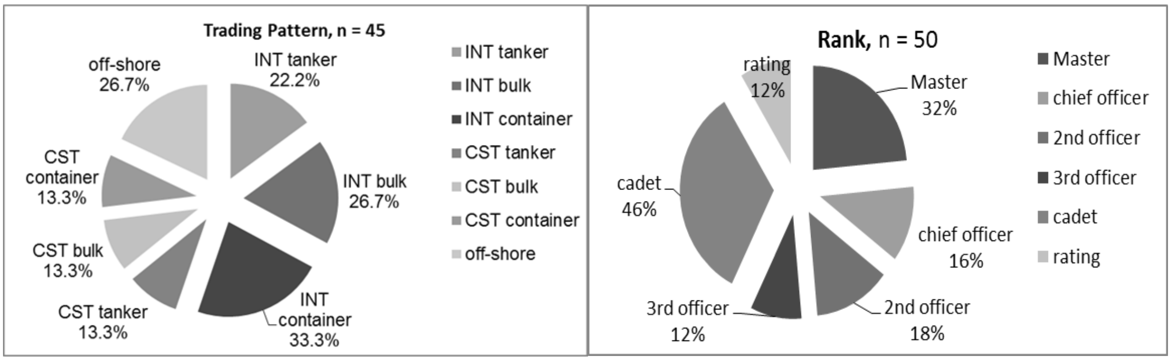

Figure 2: Composition of the participants: trading patterns and ranks

Among the respondents, (Figure 2) 78% were certified officers from different ranks, 46% were cadets and 12% were ratings and of the participants 66.7% used English as their first language and 33.3% used English as their second language.

Analysis of data on the respondents' view on providing an opportunity for distance study for cadets revealed (Figure 3) that over 69% of respondents considered it helpful. About 12.5% indicated it is not helpful at all, while another 8% of respondents had no awareness of the benefits. More importantly 54.8% of respondents indicated that the opportunity to engage in distance education during a cadetship enables them to satisfy both sea time and academic requirements stipulated by the regulatory bodies in line with Standards of Training, Certification and Watchkeeping (STCW) requirements. In addition 21.4% agreed that it also involves financial benefits to cadets and 19% agreed the overall period to complete maritime training could be reduced.

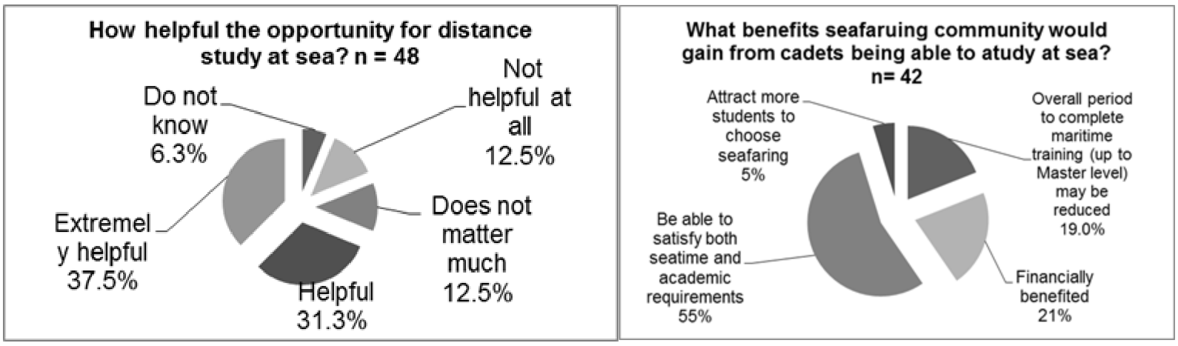

Figure 3: Opportunity and benefits as viewed by the respondents

3.2 Time availability for additional study

With regards to the time period cadets spend at sea in one contract, 14.6% spent about three months, 52.1% spent more than three months and 33.3% said it varies with the company. With regard to the time that they spend at home, 42.6% said it varies, 29.8% said it would be about three months or more than three months, 19.1% said it is less than a month and rest of the respondents, 8.5% said they stay about two weeks at home.

With regards to the time cadets would be able to spend on additional study over normal work hours, 6.3% stated their availability is less than five hours per day. However, 37.5% stated their availability is less than three hours while 45.8% stated availability of about an hour. Notably, 10.4% indicated no additional hours available over normal work hours.

A comparison of the seafarers' trading pattern against the available time for additional study (Table 1) revealed that there is a direct relationship. Respondents from the international trading group, 53.3% said that they have less than three hours for additional study and 61.8% said that they have only one hour for additional study.

Table 1: Hours available for additional study against trading patterns

Trading pattern	Hours available for additional study			
	1 hour	less than 3 hours	less than 5 hours	not available
International tanker	19.0%	26.7%	0.0%	0.0%
International bulk	19.0%	13.3%	0.0%	0.0%
International container	23.8%	13.3%	0.0%	25.0%
Coastal tanker	4.8%	6.7%	0.0%	0.0%
Coastal bulk	4.8%	6.7%	33.3%	0.0%
Coastal container	4.8%	6.7%	33.3%	25.0%
Off-shore vessels	23.8%	26.7%	33.3%	50.0%
% of Total	48.8%	34.9%	7.0%	9.3%

Serving officers indicated (Table 2) that they viewed time availability for cadets was about an hour. However, there were different views when time availability of less than three hours is considered. Masters and 3rd officers indicated that cadets could have up to three hours availability but chief officers and 2nd officers did not agree with this view.

Table 2: Hours available for additional study viewed by ranks

Rank	Hours available for additional study			
	One hour	less than 3 hours	less than 5 hours	not at all
Master	46.7%	40.0%	6.7%	6.7%
chief officer	57.1%	14.3%	14.3%	14.3%
2nd officer	55.6%	11.1%	11.1%	22.2%
3rd officer	40.0%	40.0%	0.0%	20.0%
cadet	45.5%	31.8%	4.5%	18.2%
rating	33.3%	50.0%	16.7%	100.0%
Total	46.8%	36.2%	6.4%	10.6%

3.3 Respondents views of subject suitability

The respondents' view of the subjects suited to distance study by seafarer students in order of their rank are shown below with percentage agreement in brackets.

1. Navigational Watchkeeping (bridge watchkeeping, basic ship manoeuvring), (34.8%)
2. Bridge Operation (bridge equipment, weather, nautical knowledge), (19.6%)
3. Marine Transportation (cargo operations), (23.9%)
4. Near Coastal Navigation (coastal navigation, voyage planning), (23.9%)
5. Electronic Navigation, (21.7%)
6. Ocean Navigation (off-shore and celestial navigation), (21.7%)
7. Electronic Navigation, (21.7%)
8. Ship Stability (26.1%)

3.4 Number of subjects and preferred time period

The respondents' view of the number of subjects (Table 3) suitable for distance study shows 37.2% for one or two subjects and 44.2% for two or three subjects. The time frame to complete one or two units was considered to be 12 weeks by 9.3% and 24 weeks by 20.9%. The time frame to complete two or three units was considered to be 12 weeks by 11.6% and 24 weeks by 23.3%.
Comparison of the number of subjects against required time (for two subjects) indicated that the respondents' view is more biased towards a 24 week study period.

Table 3: Number of subjects and preferred time period for study

No.of Subjects	Number of subjects and suitable time			
	12 weeks	24 weeks	36 weeks	Total
One or two subjects	9.30%	20.90%	7.00%	37.20%
two or three subjects	11.60%	23.30%	2.30%	44.20%
Three or four subjects	7.00%	2.30%	4.70%	14.00%
More than four subjects	4.70%	4.70%	2.30%	11.60%
Total	32.60%	51.20%	16.30%	100.00%

3.5 Expectation of Cadets from the Employer

The respondents' view on required support from the employers for cadets to undertake distance study (Table 4) indicated that allocation of reasonable time and to have supportive facilities for distance learning (e.g. web access) are the most important and nearly quarter of the respondents agreed to the reduction of the work load requirements and to the financial support requirement for distance study.

Table 4: Support expected from the employer

Support required from employer	Response Rate
Financial support for distance study	26.70%
Allocation of reasonable time for distance study	80%
Provide supportive facility (e.g: web access)	62.20%
Reduce work load on vessel maintenance activity	31.10%

In relation to the willingness of employers to support cadets to undertake distance education results show that (Table 5), 80% employers were supportive, 20% were not supportive. The willingness of the employers to provide financial assistance for distance study showed that 66.7% employers were supportive, 33.4% were not supportive.

Table 5: Employers willingness to support

Requirements	Highly supportive	Supportive	Moderately supportive	Not supportive	Highly unsupportive
Employers willingness to support Cadets undertake distance study	22.20%	33.30%	24.40%	6.70%	13.30%
The willingness of employers to provide financial assistance for distance study.	6.70%	22.20%	37.80%	17.80%	15.60%

3.6 View of the participants about Senior Officers support

Results show that 24.4% of the senior officers were either highly supportive or 48.9% supportive or 17.8% moderately supportive. This common view indicated that generally senior officers 91.1% were supportive for cadet to undertake distance study at sea.

4. Discussion

One of the respondents to the survey had said "*It would be good to undertake distance study given that we are able to reduce our College time and we are provided with an appropriate time frame to complete the distance units*".

There were many problems with early attempts to introduce on line learning technologies for distance education, but continuous improvements and the hard work of the educators made it possible for the deliveries of complete units by on line distance education systems[17]. Some respondents assumed that existing conditions do not have a place in on board situations, but overall results of the survey suggests that there is a lot of scope for seafarers distance education programs. One of the main questions of the survey was to identify benefits the seafaring community would gain from distance study programs. A result suggests that the majority agreed with the idea that distance education would be able to satisfy both sea time and academic requirements of the seafarers. Responses (69%) indicated that having opportunity for distance study is helpful for seafarers. Review of the literature identified that similar responses to the study conducted on seafarers views of CBT, [18] indicated among positive respondents that (97%) of them agreed it was interesting and 87% agreed it was educational.

Cadets' time spent at sea in each contract, home stays and the time for additional study vary with trading patterns and with different shipping companies. Analysis of survey figures indicated either the cadets had one hour (46%) for additional study or (38%) for less than three hours. Variation of these figures in different trading pattern is mainly due to work load and their management by the respective shipping companies. The majority view suggests that they prefer the option of two to three subjects for distance study at sea, and nearly half of the respondents indicated that they would prefer to have 24 weeks to complete the study. This reflects time availability for cadets to spend on additional study at sea. This has been recognised by one of the previous studies and according to Batrinca & Raicu, [13] one of the main barriers against development of distance education in the shipping industry is the increased workload which is common place on almost all type of ships. Chalmers University [19] revealed in an European union funded project about CBT programs that over half identified insufficient time as a problem associated with this form of on board training. Respondents also indicated (80%) that the most important support cadets require from the employer is the allocation of reasonable time for distance study. Though it is true that the time management is an important factor with most trading patterns, there are other views about the opportunities and the time management for distance study. After the analysis of the respondents comments the following were identified as valid comments for consideration.

- "*It depends on the individual student and their relationship with senior officers".*
- *"It would be good to undertake given that we are able to reduce our college time and we are provided with an appropriate time frame to complete the distance units".*
- *"Cadets should do if possible at least one distance study every six months and I think cadets should take final exams at AMC".*
- *"More attentive program can guide students to follow up these tasks much closely".*
- *"It depends on the cadet's motivation. I met so many cadets and they want to watch the movies rather than the books"*

From the above comments and the research carried out on blended learning by Brand, et al., [15] suggests that students' performance varies with age and self-managed learning attitudes and were important covariates with academic success.

Respondents view and the ranking of suitable subjects for distance study at sea suggest that their preference in order were practical subjects. However some of the open ended comments had different view for selecting subjects and one noted that "*It is a great idea for a few subjects like Bridge Equipment and Basic Engineering and Ship Structures but the subjects like Stability and Ocean Navigation need the full time of classroom for study".* These different views need to be carefully analysed against the general views of the other participants and with the findings from the other research carried out in this area.

Among the facilities cadets would like to receive from the employer, other than the allocation of reasonable time, it showed that they would like to have supportive facilities such as web access for their studies. This is a management issue that is required to be taken up with shipping companies. Rapidly developing technologies in the communication sector means, the possibilities of taking attention of the operators and providing support for the distance education for cadets at sea is not far from reality.

One respondent commented that "*There needs to be greater understanding of the role of the cadets and shipping companies should have greater responsibility towards the training of the cadet, as the college is able to offer limited services to the cadet whilst he is at sea*". This suggests that understanding of the learning requirements of the cadets and the willingness to support cadets studying at sea is critical. According to the results of the employers and the senior officers, willingness to support cadets for distance study is positive, but approval of the shipping company for a particular cadet to enrol in a distance study program is very important.

Dedicated training ships were more common in the past. Learners were put in the environment where they were going to work and learn together with the support of the instructor for their training on board. In many cases government supported departments ran these projects and cadets were given the priority for their learning. Most of those cadets were seemed to be very successful in their careers. Comparing this approach to cadets trained in private shipping companies the following differences were noted:

a. Cadets have to do their learning ashore.
b. Even if they can learn at sea there is no proper communication between the lecture and the learner.(Interaction)
c. Management may not consider giving reasonable time to study at sea.

d. TAGS program (Australian Cadets) is another work load other than maintenance work put on them to comply with reduction of sea time.

The training ship model is not a realistic proposition in the current shipping environment. However, the actual gaps between these two models today are:

i Communication gap between the learner and the teacher.

ii Employer's attitude towards cadet training programs at sea.

One of the failings in the practice of training and assessment of competency today is that seafaring students are examined outside their working environment and there is no procedure in place to measure their actual workplace performance standards. On board training and examination and "the cumulative record of the success of ability of doing all the required standard of competency can act as the prima facie evidence for administrator that the students is competent and eligible for the certificate of competency" [20].

According to Gholamreza & Wolff [20] it is important that the IMO and the examination administrators have to do more than just prepare guidelines regarding CBT but they have to arrange a proper transition process to this training concept. This transition from traditional face to face study to blended learning methods together with internet facility is opening the way to continue study at sea, spend less time studying ashore, and quite possibly improve competency. Respondents' positive view (69%) suggests that distance learning at sea can be used not only for actual study, but preparing for studies, again considering the unique availability of the ship environment and the professionals there.

5. Conclusion

This study reveals that there are groups of students who would like to engage in distance study at sea and there are other groups who identified issues to prevent them engaging in distance study. A categorisation of free text comments shows a number of thematic areas that should be considered for the design of a distance study program. These views underlie the attitudes of future student and mentors and therefore are important considerations for future course design.

The comments are listed in no order of priority.

- Time and time management is a major issue, as the survey also shows. The cadets will need support in being given enough time to perform studies. On the other hand, motivation seems to play a role – some comments indicate that officers perform self-study of subjects of their own choice.
- Internet availability must be addressed and solved.
- The subjects should be chosen to fit distance learning, also taking into account the availability for practical exercise or complementary work on board. This could include integration with existing programmes such as Tasks and Guided Study (TAGS).
- Support from academy, officers and organisation should be ensured.

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Session 2F

Human Factors, Leadership, and Risk Management

Outcomes-Based Accreditation of a Maritime Business Program

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The International Maritime Business (IMB) program was introduced in 2000 at Massachusetts Maritime Academy (MMA). It initiated a new era in an institution that had a strong tradition of training seafarers since 1891. The innovative program was designed to educate graduates well-versed in the foundations of both business and maritime worlds that include elements of international trade, logistics, ship chartering, brokerage, IT, legal and regulatory issues of maritime transportation. The emphasis on curricular design is aligned to the educational philosophy of the Academy: Learn–Do–Learn, where practical applications of theoretical knowledge are understood through internships and a sea term. However, unlike the sea going majors like Marine Engineering or Marine Transportation, there was no comprehensive external assessment tool like a USCG mandated license exam in this program. While the students graduating with a degree in International Maritime Business had excellent employment prospects and received positive feedback from internship hosts and student exchange program hosts, there was a growing need for an external outcomes-based assessment tool that would evaluate the quality of education in maritime business at MMA. In 2012, the IMB Department completed a strategic plan that included accreditation by IACBE (International Assembly for Collegiate Business Education), a leading accreditation agency to meet that need. An outcome assessment plan and a self-study were completed in 2013-14 leading up to the actual accreditation journey. This paper discusses the process of program accreditation by an international agency to ensure the quality of education in a maritime institution. The quality assurance process that involves a comprehensive set of principles pertaining to academic resources, education policies and outcome assessment is outlined. The lessons learned along the way, including the road bumps, when shared, can provide valuable insight to other IAMU member institutions that are contemplating similar initiatives now, or in the near future.

Keywords:

Outcomes-Based, Accreditation, Innovation, Assessment, Maritime Business Education

1. Introduction

Founded in 1891 by the legislature as the Massachusetts Nautical Training School, the Massachusetts Maritime Academy (MMA) is one of six state maritime academies in the US. During its 123-year history, the Academy has grown from an entering class of 40 cadets to a fully accredited, four-year, coeducational college granting Bachelor of Science and Master of Science degrees and enrolling approximately 1,200 undergraduate and 100 graduate students each year. It has also expanded beyond traditional sea going Majors like Marine Engineering and Marine Transportation to include programs that cater to the complete spectrum of the maritime industry both sea going and shore based. Introduced in 2000, the International Maritime Business (IMB) major prepares graduates to enter the maritime shipping and transportation industry as a business professional. The program includes elements of international business, finance, logistics, management and transportation with specific expertise in the maritime sector. The IMB program requires the students to complete the two co-ops which provide the students with excellent opportunities to gather practical experience in their chosen field in keeping with the 'learn-do-learn' philosophy of the institution and develop future employment prospects. The Academy also maintains a regimental system in its student body. Approximately 98% of the undergraduate students participate as cadets in the regiment and reside on campus. This applies to students in all majors, licensed and unlicensed, including students in the IMB program.

However, unlike the sea going majors like Marine Engineering or Marine Transportation, there was no comprehensive external assessment tool like a USCG mandated license exam in this program. While the students graduating with a degree in International Maritime Business had excellent employment prospects and received positive feedback from internship hosts, there was a growing need for an external outcomes-based assessment tool that would evaluate the quality of education in maritime business at MMA. The innovations in knowledge in this field also needed to be systematically incorporated in course offerings. Accreditation of the IMB undergraduate program seemed to be the path forward to achieve these objectives. Accreditation is a voluntary, independent review of an educational program to determine that the education provided is of uniform and sound quality. Being awarded accreditation ensures that a program has been evaluated and that it met the set standards of quality determined by the accrediting organization [1]. The process of accreditation helps identify suitable remedies for inadequacies in the program and take corrective action. For students, accreditation provides value related to not only judging quality of a program, but also obtaining employment, receiving student aid and transferring credits. Espiritu [2] observes that, on average; accredited institutions enjoy 23% higher graduation rate and about 15% higher full-time retention rate than non-accredited institutions.

In 2011, the Department conducted a feasibility study of the accreditation process. It carried out a comparative review of the different agencies for business accreditation in terms of history, orientation, requirements, level of recognition, cost, etc and also determined which accrediting agency would be the best fit. A recognized accrediting agency is one that has been reviewed and determined to meet the standards of an external body, such as USDE (United States Department of Education) or CHEA(Council for Higher Education Accreditation).

This paper traces the journey of a maritime business program accreditation in a traditional maritime school from inception to the submission of the self study. Section 2 discusses the initial phase of the process including the findings of the feasibility study. Section 3 explains the actual application process, the creation of the outcome assessment plan and the departmental self study leading up to the site visit. Finally Section 4 outlines the hurdles that we encountered in making this work in a traditional maritime school and a non traditional business school. It is hoped that our journey will provide some direction to similar programs in maritime colleges that are seeking external accreditation.

2. Early days

Goaded by various academic stakeholders like NEASC (New England Association of Schools and Colleges) and BHE (Board of Higher Education) to embrace some form of program specific accreditation, the IMB Department completed a feasibility study in 2011. The specific objectives of the study included:

- An assessment of the benefits and costs of seeking accreditation
- Comparative review of the different agencies for business accreditation
- Determine the best fit accreditation agency

On the basis of the feasibility study, it was determined that the chosen accreditation agency will be IACBE **(**International Assembly for Collegiate Business Education)**.** The IACBE option was selected as it was mission-driven and outcomes-based [3]. The philosophy of the IACBE is that academic quality and excellence in business education should be measured in terms of the performance of an academic business unit rather than in terms of academic resource levels. This approach was perfect for a relatively new program like IMB with significant resource constraints. According to the IACBE, although adequate quantitative and qualitative levels of human, financial, and physical resources are essential contributing factors to academic quality, the focus should be on the value of those resources in producing measurable results. The IACBE's approach to accreditation is based on a W. Edwards Deming-Michael Porter framework for quality assurance [4]. In this approach, the IACBE implements an accreditation process that focuses on the outcomes of the teaching/learning process rather than on prescriptive input standards. Also, it was observed that IACBE had accommodated niche and special mission business programs. Given the maritime linked special mission and largely teaching orientation of MMA and size of the IMB Department, IACBE seemed to provide the perfect fit as an accreditation agency.

However, the focus on outcome assessment was not without its challenges and the Department had to redefine itself in order to meet the IACBE guidelines for accreditation. Some of the characteristic features of excellence in business education as defined by the IACBE [5] needed careful consideration and subsequent action by the Department. They are listed below:

- The academic business unit has a clearly defined mission and broad-based goals that are consistent with those of the institution.
- The academic business unit strives for higher levels of overall performance as reflected in its student learning outcomes, operational effectiveness, and the accomplishment of its mission and broad-based goals.
- The academic business unit engages in a strategic planning process.
- The academic business unit has developed and implemented an outcomes assessment process that promotes continuous improvement in its business programs and its operations, and is linked to the strategic plans of both the academic business unit and the institution.
- The academic business unit encourages both internal and external cooperative relationships with other educational units and institutions that are consistent with its mission and broad-based goals.
- The missions of the institution and the academic business unit are effectively communicated to current and prospective students.
- The institution provides resources to the academic business unit that is adequate to accomplish its mission and broad-based goals.
- The curricula in business programs reflect the missions of the institution and its academic business unit, and are consistent with current, acceptable business practices.

Table 1: Accreditation Plan (Fall 2013 – Fall 2014)

Period	Activities
Fall 2013	**Data Collection, analysis, preparation and submission of Outcome Assessment Plan and Annual Report to IACBE and application for accreditation** 1. Coordinate data collection for direct and indirect measures 2. Analyze information and data 3. Prepare Outcomes assessment plan for IACBE submission 4. Complete Round 1 of outcomes assessment for 2012 -13 5. Develop measures for improvement 6. Prepare Annual Report for IACBE submission 7. Prepare an application for accreditation 8. Commence preparatory work for writing the Self Study **Action Items**: 1. Outcomes assessment plan including all appendices submitted to IACBE on 10/10/13 2. Annual Report submitted to IACBE on 10/10/13 3. Application for accredited member status submitted to IACBE on 12/5/13
Spring 2014	**Preparation for Accredited Member Status** 1. Complete Draft Self-Study 2. Complete Final Self Study 3. Complete round 2 of outcomes assessment for 2013-14 **Action Items**: 1. Draft Self-Study submitted to IACBE on 4/30/14 2. Received technical report on Self Study from IACBE on 6/20/14 3. Completed Self Study submitted on 7/20/14
Fall 2014	**Site Visit: Final Stage of Accreditation** 1. Site visit by IACBE team scheduled for 9/23/14 2. IACBE will send site visit team's report of findings (usually within 2 weeks) 3. Prepare a written response to the summary report

Accreditation status to be granted (if all goes well) in January/February 2015

Once the accreditation agency was chosen and their grading criteria known, we decided on a timeline and accreditation plan to meet the various deliverables as shown in Table 1. The period under review for accreditation was 2013-14.

3. Roadblocks and lessons learned

The commencement of the accreditation process required a thorough review of the IMB program with a view of meeting certain requirement standards in the following:

- Curriculum and syllabi
- Departmental mission statement in conjunction with institutional mission
- Outcomes assessment process
- Departmental information dissemination via college catalog, website, etc.
- Student admission and retention policies
- Level of consultation with various stakeholders (alumni, Advisory Board, employers, students)

Since IMB is not a standardized business program, being rather specialized with a maritime slant, we needed to make certain adjustments to meet the specifications set by a standard business program accreditation agency. We needed to document and justify clearly the unique aspects of the IMB program, consistent with MMA's broader mission.

We soon realized that the process of accreditation came with significant costs, both in terms of time and financial resources. I list below some of the hurdles we had to overcome on the way.

1. The need to adhere to a standardized format, even in terms of creating course syllabi, interfered with individuality of faculty members and faculty complaints of encroachment of academic freedom had to be managed effectively. Considerable time and energy was spent in data collection, information gathering and standardization of course syllabi. We also needed to make some clearly thought out curricular changes to incorporate much needed new courses and introduce more business electives without altering the overall credit load.

2. According to IACBE, the academic quality in undergraduate business programs need to cover some key content areas of business defined as Common Professional Component (CPC) topical areas. These included accounting, marketing, finance, management, economics, legal environment, quantitative methods etc. IACBE required that sufficient coverage is given to all of the CPC topical areas. We needed to identify which CPC topical areas are covered in our course offerings and complete a course syllabus for each required course, clearly demonstrating how many hours were being devoted to each CPC topic in a semester. This proved to be a major hurdle because the Economics and Law courses were housed in the Social Science Department, Business Communication course was controlled by the Humanities Department and Quantitative Methods in Management course was under the Science and Mathematics Department. Since the International Maritime Business Department was relatively new (being created in 2004), we had to

deal with in a situation where certain core CPC topical area courses were historically housed in and controlled by other departments. To get everybody across departments on the same page and provide CPC related data to be complied for the self study was an unenviable undertaking. Eventually we were able to accomplish this task in a timely manner.

3. Through a series of departmental meetings, we finally established a number of outcomes that recognized three levels of education goals. A timeline also needed to be established for achieving those goals. Once again, achieving unity in diversity was a challenge:

    - Outcomes or goals that apply to all institutions of higher learning (MMA as well as other colleges and universities)

    - Outcomes or goals that apply to all the different majors within MMA (IMB program as well as other programs)

    - Outcomes or goals that apply specifically to the IMB program

    Once this was agreed upon, we created and administered the assessment instruments (e.g. a comprehensive exit exam) and collected the relevant data. Wherever, the results fell short of our goals, we took corrective action in an attempt to close the loop.

4. The departmental website had to be completely revamped to ensure transparency and proper dissemination of relevant information to all stake holders. This too required a significant time commitment for the faculty member entrusted with this responsibility. Moving beyond just an abbreviated presence in the college catalog, we were attempting to embrace innovation not just in course offerings but also in terms of how the information was to be disseminated to the various users.

5. We also needed to demonstrate that adequate resources were earmarked for the IMB department. Although, the level of faculty qualifications was not a concern as all four full time faculty members were doctorally qualified and all adjunct members professionally qualified, we did not have an adequate number of full time faculty. A new faculty search was initiated which resulted in the hiring of an additional full time faculty member. IACBE emphasizes excellence in teaching, which depends on appropriate faculty workloads. We had to ensure that the workload did not exceed contractual obligations while preparing for the accreditation process. Wherever possible, faculty members were given release time or additional remuneration for this effort.

    We procured information from various administrative departments at MMA in order to ensure the following:

    - Work with the MMA Business office to understand the budget development and budget amendment processes of MMA and ascertain what proportion is allocated to the IMB Department

    - Gather information from the MMA Facilities department to demonstrate that the classrooms, computer laboratories and office spaces available to the students and faculty were adequate

- Procure input from the librarian, department of information technology and the Academic Resource Center to provide evidence that MMA provides adequate learning resources that are sufficient to support the IMB program.

- Work with the Admissions office and the Registrar's office to provide detailed narrative about the admission criteria, enrollment, retention and graduation data.

- Collate various student satisfaction and placement related information from the Office of Institutional Effectiveness and the Office of Career Services.

- Address discrepancies in the data gathered from the various departments.

It was only after all these steps that we were able to gather the information required to complete the Self Study which was a mammoth undertaking in itself. At this time, we are awaiting a site visit by an IACBE team and gearing up for final preparations.

Although this has been a long and arduous process sometimes fraught with tension, it was a tremendous learning experience where we took a very close look at ourselves. Often, in the day to day churn of teaching, research and administrative responsibilities, we lose sight of the big picture. The process of accreditation exposed our Achilles' heel and helped us to take corrective action to be better at our own game. The fact that the IMB program is accredited by IACBE, which in turn, is periodically reviewed by CHEA, will instill stakeholder confidence in the IMB program. The importance of outcome assessment in a bid for continuous improvement in quality or Kaizen, will henceforth be the guiding light for the IMB department at Massachusetts Maritime Academy.

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Making a Splash in the Classroom: Maritime Education in Non-Licensed Majors

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The historical foundation of American maritime education has been the licensed-track programs that grant future mariners a Third Mate or Third Engineer license after successful completion of the United States Coast Guard (USCG) Examinations. While this foundation will not change into the future, some maritime academies have begun to offer educational opportunities to cadets in the "shoreside" fields of maritime policy and management. Over the past decade or so, the California Maritime Academy, CSU (Cal Maritime) has undergone institutional evolutionary processes that resulted in the formation of the ABS School of Maritime Policy and Management that houses two non-licensed majors – Global Studies and Maritime Affairs (GSMA) and International Business and Logistics (IBL). Faculty in the emerging field of shoreside maritime policy and management education face distinct challenges rarely found at "traditional" universities. While licensed-track faculty enter their teaching career at a maritime academy having many years of experience as a mariner and up-to-date USCG licenses, non-licensed track faculty in degree-granting programs such as GSMA often enter their teaching career at a maritime academy with little or no training or experience in the maritime world. The overwhelming majority of faculty in shoreside programs and majors come from a traditional post-secondary education where the maritime world appears as no more than an occasional case study. In this paper, I describe my experiences incorporating the maritime into traditional courses and developing new social-scientific courses in maritime policy and institutions. The results of the paper and presentation offer insights into how maritime academy professors in non-licensed majors, after being trained in traditional social science doctoral programs, are able to successfully make a "splash in the classroom."

Keywords: maritime, education, shoreside, non-licensed, faculty, curriculum, pedagogy

Introduction

Many nations around the world have a long history of educating and training a merchant marine workforce well-prepared to sail merchant vessels during peacetime and, if the need arises, during wartime. In the United States, the tradition of merchant mariner education and training is carried on by six state maritime academies and the federal United States Merchant Marine Academy (USMMA). Until recently, these maritime academies have been defined almost exclusively by a corps of cadets all seeking a United States Coast Guard (USCG) license along with their bachelor's degree upon graduation. However, just over a decade ago the California Maritime Academy, CSU (Cal Maritime) began admitting cadets that would only seek and bachelor's degree and not an accompanying USCG license in new majors not traditionally offered at maritime academies. The institutional expansion of Cal Maritime in offering shoreside (or "non-licensed") majors has led to significant growth in both the corps of cadets and faculty populations on campus. It also generates challenges for new faculty teaching in shoreside majors as most come from traditional doctoral programs that do not have a specific maritime focus. In this paper, the author describes the challenges facing new faculty in shoreside majors emerging at a handful of maritime academies around the world, details personal experiences in the process of incorporating the maritime into traditional courses and developing new courses within a shorside maritime major, and offers insights into how new faculty in shoreside majors might successfully incorporate the maritime into their pedagogical evolution and course offerings.

Traditional Maritime Academy Education

The historical foundation of maritime education has been licensed track programs that grant future seamen a merchant mariner license upon successful completion of coursework and culminating examinations. In the case of merchant mariner education in the United States, the traditional maritime academy model has been the granting of a bachelor's degree and either Third Mate or Third Engineer license after successfully competing all coursework, Standards of Training, Certification, and Watchkeeping (STCW) requirements, and USCG examinations. In the overwhelming majority of licensed majors such as Marine Transportation or Marine Engineering Technology, faculty members hold all appropriate licenses and have a great deal of experience working in the maritime industry as captains, mates, engineers, and the like. Nearly all faculty in licensed majors are teaching courses in subject matter areas directly related to their lifelong training, prior careers at sea, and current standing as licensed seafarers. This structure, of course, is both appropriate and necessary as licensed faculty are training future seamen for careers at sea that require instructors to have the credentials and background to provide high both quality education and industry-specific training. The model for licensed majors and programs has not only been structured in the most appropriate manner, but it in almost all cases it has led to the production of well-trained and highly qualified new maritime industry professionals.

In addition to traditional licensed majors, some maritime academies have offered various "licensed-optional" engineering-related bachelor's degrees such as mechanical, electrical, and facilities engineering and naval architecture. Other academies have offered marine science-related degrees such as marine biology, marine environmental science, and marine fisheries that do not require a license upon graduation. While many of these programs do have a non-licensed option or do not have a license option at all, they fall outside the purview of this paper that focuses on faculty development in emerging shoreside majors that have a distinct non-vessel and non-marine science maritime industry focus such as maritime policy or international business and logistics.

Non-traditional Maritime Academy Education

At several maritime academies around the world, a new institutional model is being implemented that is expanding the scope of maritime academy education. In addition to traditional licensed majors, a number of maritime academies are now offering non-licensed, or "shoreside," majors that culminate in the conferring of various bachelor's degrees with no associated merchant mariner license. In the United States, several of the state maritime academies now offer shoreside majors where successful graduates do not receive a USCG license. A summary of non-licensed, non-engineering and non-marine science oriented majors currently offered at maritime academies in the United States is found in Table 1 below.

Table 1: Non-licensed majors offered at maritime academies in the United States

Academy name	Non-licensed majors offered
California Maritime Academy	Global Studies and Maritime Affairs International Business and Logistics
Maine Maritime Academy	International Business and Logistics
Massachusetts Maritime Academy	Marine Safety and Environmental Protection Emergency Management International Maritime Business
SUNY Maritime College	International Transportation and Trade Maritime Studies
Texas Maritime Academy	Maritime Administration Maritime Studies University Studies

As is evident in Table 1, the number of shoreside majors and degrees offered by maritime academies in the United States is rather limited when non-licensed engineering and marine science programs are not included. In most cases, these academic programs are relatively new and just beginning to grow, particularly in comparison with their licensed counterparts. It is clear that the need for growth in the overall student populations of maritime academies where traditional licensed majors are growth-limited on the basis of required facilities alone is an important component of the move towards shoreside majors that can be taught for the most part in a traditional classroom setting. Licensed programs are built on a large volume of hands-on training, much of which is STCW-required, that necessitates the use of radar and bridge simulators, engine rooms, training vessels that can only hold a limited number of students at a given time. Thus, increasing the student populations at maritime academies around the world will increasingly be generated by more non-licensed degree programs that allow for more students learning environments not limited as dramatically by available facilities and STCW requirements. However, the emergence of these shoreside degree programs that focus on issues such as maritime policy and management, international business and trade, logistics and supply chain management, and maritime history, archaeology, and culture in the case of Maritime Studies and the Texas Maritime Academy, can present significant challenges to new faculty at these institutions teaching in shoreside degree programs.

Faculty challenges in non-licensed majors

New faculty teaching in shoreside degree programs at maritime academies face a handful a significant challenges in the early phases of their careers. Faculty in the emerging fields of shoreside maritime policy and management, maritime studies, and international business and logistics education face distinct challenges rarely found at "traditional" universities. While licensed-track faculty enter their teaching career at a maritime academy having many years of experience as a mariner and up-to-date merchant mariner licenses, non-licensed track faculty in degree-granting programs such as Global Studies and Maritime Affairs (GSMA) at the California Maritime Academy (Cal Maritime) often enter the academy with little or no training or experience in the maritime world. The large majority of faculty in shoreside programs and majors come from a traditional post-secondary education where the maritime world appears as no more than an occasional case study. Of course, a caveat would be faculty in the fields of logistics and supply chain management who are undoubtedly familiar with and have a deep understanding of the importance of shipping and merchant vessels to their fields. However, many instructors in non-licensed programs do not enter their maritime teaching careers with a level of foundational, maritime-specific knowledge that is critical to successful student learning. In most cases, this knowledge and subsequent classroom application must be learned and pedagogically developed. Apart from the obvious need to learn a great deal about the maritime world and specific maritime issues relevant to the instructors field of study (which is such a basic and assumed requirement of the faculty position that it is not discussed in detail here), the way in which the acquisition of knowledge of the maritime world is then incorporated into courses and potentially built into the program curriculum is neither simple or obvious. Below, the author, having entered a teaching career at the California Maritime Academy in GSMA from traditional undergraduate and doctoral education in political science, discusses and analyses personal experiences and individually successful strategies for incorporating the maritime in the classroom early on that eventually led to the creation of several new maritime-specific courses now required in the major.

Bringing the maritime into the shoreside classroom

As mentioned earlier, the first and most obvious step in transitioning from a "traditional" scholar and instructor found at almost every university in the world to a maritime academy faculty member in a shoreside major is a commitment to learning as much as possible as fast as possible about the maritime world. This aspect, however, is not discussed further here as it is such a basic requirement that it is treated as an assumption. At Cal Maritime, the ABS School of Maritime Policy and Management houses two shoreside majors – Global Studies and Maritime Affairs (GSMA) and International Business and Logistics (IBL). In each major, the expectation of new tenure-track faculty members is to develop and incorporate maritime-specific issues, concepts, and content into courses and research wherever possible. If a desired to learn more about the maritime is not present in a prospective faculty member, a maritime academy is clearly not the appropriate institution to ply your trade. So, assuming that a new faculty member is constantly and consistently learning more about the maritime world, and in particular those issues most germane to their field of study, the next step is to incorporate this knowledge into the classroom.

The manner that this step is accomplished can and will vary across instructor. However, relying on the skill set and pedagogical tools that already exist within the new faculty member is a good place to start and can for the structural backbone of how the maritime becomes part of a course. Each instructor comes to an institution of higher education with a particular skill set that is already developed at some level. It may be in pedagogical approach and teaching style, quantitative or qualitative analysis, a deep understanding of a particular process, or anything else that a faculty member can point to as an area of teaching or research where they excel. These skills do not need any particular relevance to the maritime to be extremely important and effective in bringing the maritime into the classroom, even where it may not seem clear or obvious. For example, a faculty member may come to a maritime academy to teach in a maritime policy oriented major with a well-developed background in political institutions and policy-making but with almost no knowledge of the maritime world, significant maritime institutions, or maritime policies. The deep understanding of the institutional and policy process can become the mechanism through which the maritime is then incorporated into the course content. If an instructor comes to a maritime academy with a great skill in quantitative analysis, that skill can become a particularly effective means of bringing in the maritime. The point here is for new faculty members to use their strengths, most of which likely have no relation to the maritime early on, to overcome the challenges of teaching maritime-specific material without a maritime-oriented background.

The case-study approach can be very effective tool in the early development of curriculum in shoreside maritime policy, security, institutions, business and management, or any other topic in the broadly defined spectrum of non-engineering and non-marine science non-licensed majors. In this model, the traditional course is taught in a manner very familiar to the instructor. This can be the way they had designed and taught the course before, the way it had been taught to them previously, or simply the way they envisioned the course prior to landing at a maritime academy. In the early stages of faculty development in a shoreside major, it can be very useful to stay with what is familiar so as to not become overwhelmed with new maritime-specific material that may not come as naturally yet in a classroom environment. In staying with a familiar and more comfortable course design, the instructor can incorporate one or more maritime case studies into the course and/or lectures to add a distinctly maritime issue to the content without becoming uneasy about the ability to deliver the material as confidently as the can with their traditional knowledge bases.

Consider this example using the case study approach. The instructor enters the maritime academy with a deep knowledge of the structures and processes relevant to the understanding of international institutions. One of the courses to be taught is “International Institutions,” a course often found at many universities around the world. Using the skill set already present – a deep knowledge of institutional structure and process – the instructor can design the course and include case studies on, for example, the United Nations Convention on the Safety of Life at Sea (UNCLOS), the International Maritime Organization (IMO), regional fisheries agreements, or any other international maritime institution that makes sense to include given the structure of the course. By doing so, the instructor can begin to build maritime content into courses in a manner that is potentially more comfortable and useful for both teacher and student. This way, student questions can be answered with respect to the instructor’s knowledge of institutional structure and process without necessitating a specific focus on UNCLOS or the IMO. Of course, a basic understanding of the content of UNCLOS or the Conventions of the IMO is needed, but a deep knowledge would not be at this point because the course would still remain designed around the instructor's strengths in institutional analysis. If detailed content knowledge of particular international institutions was a critical part of the course, the instructor would still use those most familiar at this point. For example, the detailed content analysis could be on the North Atlantic Treaty Organization (NATO) if the faculty member's background is in security, the United Nations Environment Programme (UNEP) for an environmental background, and so on. The main point here is that the overall course or single class session can be designed in a manner that incorporates the maritime without disrupting the instructor's level or comfort or content delivered to students.

For tenure-track faculty members, an equally challenging task may still lie ahead even after the potentially difficult task of incorporating the maritime into their individual courses has been achieved. As in the case of the ABS School of Maritime Policy and Management at Cal Maritime, there may exist a preference or requirement for tenure-track faculty members to develop entire new courses that are maritime-centric in nature. Whether using the case study method discussed above or any other pedagogical method that works well for a particular instructor, the transition from bringing the maritime into a traditional course and developing a full maritime-oriented course is another step that requires further understanding of the maritime world and pedagogical development.

Maritime-specific course development in shoreside majors

One of the final steps in the development of a tenure-track faculty member in a shoreside major is curricular development. The central component of this phase is the development of new, maritime-centric courses where in some cases there may exist any previous courses to serve as a guide. In many ways, this is the most significant challenge facing long-term faculty in shoreside majors. After coming to the academy from a traditional, non-maritime educational and teaching background, learning how to incorporate the maritime into courses and lectures in an effective ways, they now must design and implement entire courses with a maritime orientation and focus. This step, of course, takes time to reach. Generally there are several years needed to learn and become intimately familiar with the maritime issues relevant to the faculty member's area of expertise. Once a requisite level of knowledge is reached in the most critical maritime topics and issues and the general maritime world, the development of full courses can proceed and be very effective. In this section, the author gives a detailed account of two courses maritime-specific courses created while a tenure-track member of the faculty at Cal Maritime in the Global Studies and Maritime Affairs major.

Course one: International Maritime Organizations

The course titled "International Maritime Organizations" is currently a required course in the GSMA curriculum for all students in the major. It was developed by a faculty member who fits the description detailed earlier – educated and trained in traditional undergraduate and doctoral programs with little to no prior knowledge of the maritime world prior to entering the California Maritime Academy. International Maritime Organization was taught for two full years under its original title "International Organizations." The author employed the case study method as a mechanism to slowly but directly begin to incorporate the maritime-specific international institutions and organizations into the course content. During the first year, the International Maritime Organization (IMO) was implemented as a single case study in the course. The course was designed around faculty strengths in institutional structures and process and the IMO was used and discussed in the context of broader theoretical analysis of international institutions and organizations. During the second year, and after more studying and research on international maritime institutions, the case study on the IMO was expanded and more discussion and analysis of specific Conventions of the IMO such as the International Convention of the Safety of Life at Sea (SOLAS) and the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) was implemented. After the second year, it was time to develop and implement a full course on international maritime institutions and organizations for the GSMA curriculum.

The development process for International Maritime Organizations relied on two primary components: the evolution of International Organizations over the previous two years and further knowledge development in the area of non-IMO international maritime institutions. When International Maritime Organization was originally developed and implemented in contained a core component from International Organizations, specifically the general study of institutional theory, greatly expanded the focus on the IMO, and included a detailed analysis UNLCOS. Now, the new course not only covered the structure and processes of the IMO as an organization and analysis of some of the most important Conventions, but also included detailed analysis of most of IMO Conventions currently entered into force, a detailed analysis of UNCLOS, and required students to apply institutional theory directly to the IMO and UNCLOS. The current formulation of International Maritime Organizations also includes other international maritime institutions such as regional fisheries agreements as well. It is important here to note the underlying process that led to the design, implementation and evolution of this course. It began with a slow but steady increase in the depth and number of relevant maritime case studies over the first two years along with constant but yet unincorporated study of international maritime institutions. The first design of the full course expanded again on the key case study, the IMO, and added UNCLOS. In its current iteration, it has expanded once more to include regional maritime agreements. The consistent relationship between maritime-specific faculty learning, the expansion of the maritime within the traditional course, and the eventual large expansion and implementation of a new maritime-focused required course in the shoreside major was critical to its success to date.

Course two: United State Maritime Policy

The course titled "United States Maritime Policy" is currently a required course in the GSMA curriculum for all students in the major. It was developed by the same faculty member who fits the description detailed earlier – educated and trained in traditional undergraduate and doctoral programs with little to no prior knowledge of the maritime world prior to entering the California Maritime Academy. However, U.S. Maritime Policy was developed in both different and similar ways to International Maritime Organizations and is a useful alternate way to conceptualize new course implementation. Prior to being approved as a new required course, U.S. Maritime Policy was not previous taught under a different title. Rather, it was developed based on the slow but steady use of the case study method in several traditional courses that were eventually synthesized and aggregated into the new course. Maritime-specific case studies used in four separate courses with a more general focus on domestic policy in the United States were used as the central components to design U.S. Maritime Policy. In United States Foreign Policy, United States National Security Policy, American Government, and Introduction to Environmental Policy, maritime case studies were used as a means of bringing the maritime into more traditional courses. In U.S. Foreign Policy a case study on UNCLOS was used, in U.S. National Security case studies on the U.S. Navy and U.S. Coast Guard were incorporated, in American Government case studies on a few domestic maritime policies were developed, and in Introduction to Environmental Policy a case study on coastal resource management was part of the course. In each case, these case studies served to not only bring the maritime into the courses but also to assist with faculty learning and understanding of these issues with an eye toward developing an domestic maritime policy course for the major.

The development process for U.S. Maritime Policy relied on two key components as well: the incorporation and evolution of domestic maritime case studies across four courses and continuing faculty knowledge development in the area of maritime-specific domestic policies in the United States. When

U.S. Maritime Policy was originally developed and implemented it reflected an aggregation of the maritime case studies from prior domestic policy-oriented courses and included new maritime policies and institutions of the United States that had been studied and analysed over previous years but never included in a course. The current course includes but greatly expands on the maritime policy-making process and critical maritime policies to the United States such as the Jones Act that were previously taught in American Government, an international maritime policies segment that focuses on U.S. foreign maritime policy partially drawn from U.S. Foreign Policy, a security section that expands on the Navy and Coast Guard case studies from U.S. National Security Policy, and an environmental component that includes and expanded analysis of coastal resource management in the United States originally presented in Introduction to Environmental Policy. It also includes other domestic maritime issues such as state and local maritime policy, maritime energy policy, and internal waters management that emerged during faculty study of domestic maritime policy outside of the course and classroom environment.

The development of these two courses took similar yet different paths to get to the same final destination as required courses in the GSMA major at Cal Maritime. Both used the case study method of incorporating the maritime into traditional course over several years to not only bring the maritime into course in a shoreside maritime major but also to greatly enhance faculty learning in the issue areas. The final design of both courses utilized these previous case studies as central components to the new courses as well and each expanded a great deal on those case studies to offer more depth of learning and analytical opportunities for students. However, International Maritime Organization was developed from the expansion of maritime case studies within the confines of a single course with a relatively direct focus. U.S. Maritime Policy, on the other hand, was developed by bringing together case studies and maritime-oriented materials from four separate courses, meshing them together in a new framework specified around maritime policy specifically, and adding more new material than International Maritime Organizations. As shoreside course offerings and degree-granting programs continue to emerge around the world, both models may be useful to new faculty facing these challenges.

Conclusion

Faculty in non-licensed major face challenges somewhat unique to the maritime academy environment. There are very few education institutions in the world quite like the maritime academies for traditionally trained and educated faculty in non-engineering and non-marine science programs. The maritime world is rarely a focus of the undergraduate and graduate training in the fields of these faculty members. Yet, there is a need and often an expectation to incorporate the maritime into more traditional courses taught in these shoreside majors, and for tenure-track faculty, to develop new and often original courses in the maritime issues most important to the programs. The discussion above endeavours to provide a brief assessment of these challenges and offer a detailed description of the experiences of one faculty member who has attempted to overcome these challenges in a meaningful way for both the major and the students. There are certainly alternatives to the processes discussed here that could lead to resounding success in implementing the maritime into shoreside major courses, however, this paper provides a guide drawn from actual experience that may be of use to instructors who face similar challenges as shoreside programs at maritime academies continue to expand and evolve in years to come.

Learning Pathways for 21st Century Seaport Managers

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This paper explains the dynamic environment of ports and why it is necessary for port managers to have the skills and abilities to recognise and manage disruptive events and stressors that increasingly affect supply chains. These skills and abilities are dependent in part upon education institutions offering maritime management related curriculums to expand their topics of study on port operations and management. Such expansion would include risk management modules related to logistics sustainability and resilience against disruption. We argue that maritime management institutions are presented with an opportunity if not an obligation to incorporate this important training within higher education courses, short professional short courses and ongoing revalidation/compliance training. Essentially, the paper explores gaps between the strategic and operational requirements of the regionalised port industry and the programs offered by educational institutions.

1. Introduction

The successful integration of ports into supply chain operations while minimising supply chain vulnerability is dependent upon the quality and reliability of port manager performance [1, 2]. Port performance reliability and sustainability is largely enabled by competent risk management against stress and disruptions which emerge as core port management problems. The economic and social flow-on effects of port disruptions can be substantial [3] and these aspects of today's turbulent global logistics environment actively encourage port managers to address their operational sustainability against unexpected threats [4].

Shrivastava [5, p. 121] describes today's industrial risks as '… global, pervasive, long term, imperceptible, incalculable, and often unknown. Shrivastava cautions against this environment of proliferating risks and inadequate remedies, and illustrates how management theory and practice must alter in order to cope with contemporary hazards and risk. In particular, the global shock of the 9/11 Trade Tower disaster marks the beginning of a maritime risk management renaissance, in which ports and their operations receive renewed risk management emphasis [6]. Further emphasis is provided by the newly perceived hydro-meteorological threats of climate change [7]. Port managers who just a decade ago might have employed risk management primarily against financial and legal liability are now addressing strategic and operational risks within their wider undertakings. Accordingly, port managers within the many logistics disciplines must become increasingly familiar with multiple risk management artefacts inclusive of safety planning and process, emergency response, risk mitigation, disruption management, business continuity, and corporate adaptability; all of which are argued as being necessary learning requirements for safe ports in the twenty-first century.

Haimes [8] recognises the universal need for risk-based process by all managers in all organisations within every aspect of management. However not all risk is bad – while some organisational risks present threats others may present opportunities and managers require sufficient knowledge and experience to differentiate between the two. Risk management knowledge can be acquired through self-learning and through participation with educational institutions, but without foundational risk management knowledge port managers may be managing risk from a state of ignorance [9]. Engineers and safety practitioners receive risk management and resilience education within their university modules, however maritime university teaching of risk management theory appears to be uneven in terms of its application to logistics management courses. Maritime universities are not unaware of port-related risk and resilience, because recent post graduate research investigates port risk and resilience outcomes against stress and disruptions [7, 10, 11]. However this risk-based research interest is only thinly translated into maritime logistics education. Accordingly, some maritime logistics students might graduate in ignorance of the '… organisational and personal learning and knowledge transfer' that Wu and Blackhurst [12, p. 17] contend is so essential to contemporary logistics risk management.

As exemplified by the University of Tasmania's Australian Maritime College, global maritime universities play a pivotal role in providing high quality higher education and training, and endeavour to provide centres of expertise in all major maritime fields [13]. Courses of training are offered by these universities in diverse streams and subjects, for students who consequently find employment either at sea or onshore. Shore-side employment involves port-related responsibilities in logistics and transportation fields. When new port managers enter their shore side workplace, their initial professional competence is constructed upon fields of study provided by the relevant tertiary institution, and amended according to the various electives selected by the student.

Eraut [14] contends that a student is unlikely to know what specific knowledge areas or skill sets will be relevant to future employment, and that the tertiary institution's instructors and curriculum advisors may have little or no practical experience in what they teach. Further, port-related employers may not know or may have problems in articulating what vocational and academic qualifications they require of new-entry logistics and transport professionals [15, 16]. This creates potential for training gaps within the maritime curriculum, and important shortfalls impose limitations upon newly qualified maritime logistics professionals. Empirically, port-related managers are likely to be challenged by hazards and risks in their many operational and strategic performance decisions, for example those related to infrastructure investments and IT system risks [17, 18]. Consequently port management decision making processes become dependent upon risk management awareness and professional knowledge.

2. Management performance in a dynamic port environment

Supply chain risk managers are particularly concerned with potential for delays or failure at critical transport nodes and links, including seaports and airports [19, 20, 21]. Seaports (hereon referred to as ports) are important transport nodes with more than 90% of annual international trade equating to nine billion tonnes passing through at least two ports [22]. Because ports are embedded supply chain elements and value creation components [23, 24] any major ship and cargo delay at a port can readily transform the port from being a logistics bottleneck into a congested chokepoint.

Given the port's criticality to supply chain competitiveness and effectiveness, a competitive demonstration of hazard awareness capabilities, contingency planning measures and response preparedness against port failure provides evidence of transformational business continuity capabilities. Mindful managers learn to recognise and react early to adverse events, enact proactive risk management responses and if required, adapt to dynamically changing circumstances [4, 25]. Because many actors are involved in port logistics processes, the port's mitigation responses against system failure require effective demonstrations of risk management capabilities at both individual and organisational levels [26]. Circumstances of port failure are likely to involve complex systemic failures and interactions between multiple actors and agencies, rather than failures within a focal firm or dyadic interactions between firms [27].

Analysing the effectiveness of port risk management performance against external threats is a complex task involving many variables. For example there is little evidence of leadership structure across the diverse and multifaceted port community of actors, whose behaviour is likely to be fragmented and insufficiently binding to permit coordination of risk management responses against external threats [28]. Accordingly, Dalziell and McManus [19] suggest that port risk management capabilities might be measured on the basis of organisational recovery from stress or disruption being achieved when the pre-disruption levels of key performance are regained.

Port risk management processes become complex with individual ports supporting many supply chains. Each supply chain engages varying and multiple goods and service providers from within the port system, which creates overlapping networks of roles and alliances [29, 28]. The port's regionally extended and complex adaptive network might involve many hundreds of actors while a globalised supply chain might be reliant upon thousands of logistics and transport actors across many countries [30]. This systemic complexity and multiple sources of vulnerability suggests that logistics risk managers should develop analytic risk management skills of a high order. From this perspective the role of education becomes increasingly important in augmenting risk management capabilities for the next generation of port managers.

3. Effects of port disruption

The port is a critical node within the supply chain system [23] and the impact of a major port disruption can create a rippling effect across the wider, extended supply chain system thereby creating even further logistics risks and uncertainties [31]. Port disruption and safety malfunction might arise from human failure, intentional adverse acts such as terrorism and criminality, severe weather events and climate change, earthquakes and tsunamis, logistic and financial turbulence, and rapid technology changes [6, 32].

Port risks and uncertainties adversely affect the lean business practices of a globalised and widely outsourced supply chain which likely exhibits minimal redundancies [33, 32]. The compounding of risks, uncertainties and repercussions arising from a disruptive event in port has relevance to systems theory, where an incident that cascades across a network of linked agencies may have far greater impact than the originating event might suggest [8]. The port footprint extends well into the regional hinterland [34] and relationships become blurred when trying to characterise actors and agencies as belonging to either the port or the supply chain.

Recent port disruption research focuses on climate change risks and port innovative contingency planning and resilience strategies [35, 7]. Examples of port disruption include Hurricane Sandy which shut the Port of New York-New Jersey [36, 37] plus a 10-day stevedore lockout in 2002 that closed 29 US West Coast ports [38, 39]. Recovery from a port disruption such as these involves either engineering or ecological resilience [19] whereby recovery is enabled to the previous state (engineering resilience) or, the organisation adapts to changing circumstances to assume a new steady state of equilibrium (ecological resilience). This alternative outcome process is shown in figure one, which is based upon Handfield's supply chain disruption graphics [21]. Figure one traces the logistically transmitted disruption impact from port to the supply chain, time lags in organisational awareness of the stressor or disruptive event, and potential alternative outcomes of disruption management response.

The port and the supply chain are shown here as two interconnected organisations. Within this connectivity a time lapse occurs between the inception of a disruption at the port, the port's realisation of the event and commensurate responses, and the transfer of disruptive impacts to the supply chain. Gurning and Cahoon [40] note that 53% of supply chain survey respondents generally become aware of a disruptive event affecting their organisation up to seven days after an incident, and that full recovery from a major disruptive event might take 90 days. Recovery directions following a disruption affecting the port and supply chain is shown as either Result A, where either organisation adapts to new circumstances or Result B, which is a return to their pre-disruption operating conditions. The recovery state outcome that is achieved by the port might not be one that can be replicated by the supply chain.

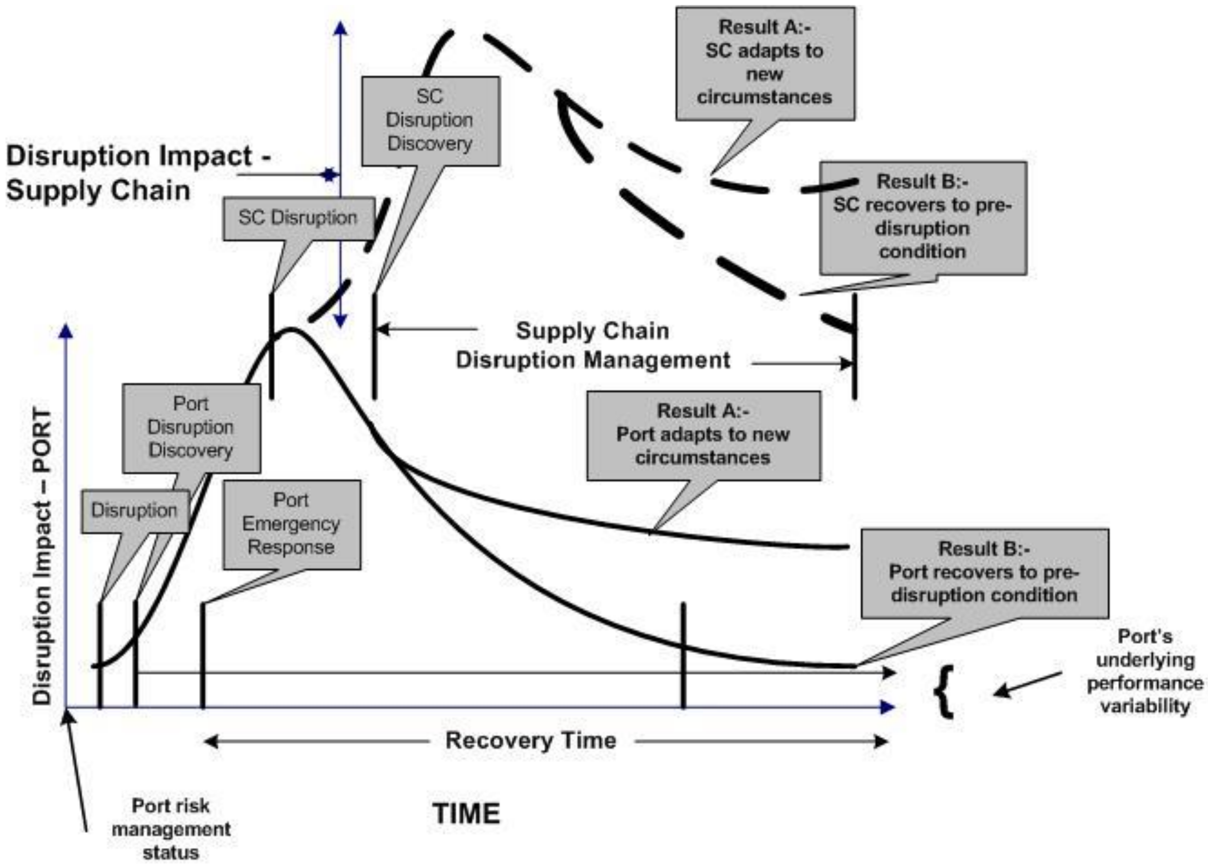

Figure 1: Port and supply chain disruption management (after Handfield 2007).

4. Port-related safety and contingency management

Conceptually, difficulty arises in perceiving how port actors' intermittent and self-interest driven operational alliances [41] can be effectively translated into a viable port organisation culture, from which positive, sustainable port safety behaviour might emerge. For example, the port organisational system has been described as a complex and potentially unstable networked system of unaligned actors, assets and infrastructure [42, 43]. From a contingency management perspective, comprehensive emergency response requires organisational regard for all hazards by all agencies [44]. Yet some port actors might not even choose to act at all in response to dynamic events, and instead adopt a 'wait and see' approach [45]. An organisational analogy that readily comes to mind is that of herding cats.

Contingency management involves planning, preparing, managing and responding to a major disruption, with the purpose of returning the port to an acceptable level of business normality [46]. In order that this might happen, the port's network of critical logistics and transport actors must be mindful in their risk awareness, and be adequately empowered to restore impaired critical infrastructure or services supply. The literature appears to overlook the study of top down port leadership effectiveness, and in the absence of evidence for port leadership or of its effectiveness, the attainment of holistic port risk management capabilities might rest upon a bottom-up driven approach. Methodology for this approach could, for example, be approached by tertiary management learning and a resultant gradual dissemination of risk management skills across the port's freight task environment.

5. Port manager education

The attainment of risk management learning and disruption management cognition becomes increasingly salient for graduates of maritime tertiary institutions. These graduates enter diverse fields of employment that are crucial to port performance, including '… logistics, cargo handling, ports and terminals management, maritime law, operational planning and management, importing and exporting' [13]. Tools for 21st century port management include the use of technology and software companies provide risk management and resilience programs for planning, predictive and risk mitigation purposes. The effectiveness of these programs is closely related to the user's knowledge of risk management and information technology [47].

Neophyte port managers should acquire knowledge and skills to exercise their complete logistics risk management responsibilities. Risk management roles involve complicated concepts and processes, shrouded in a somewhat confusing and complex array of terminology. Appellations include hazards and vulnerability, safety management and contingency planning, risk management and disruption management, crisis management and emergency management, business continuity processes and threat mitigation [48]. Desirable outcomes arising from disruption are variously described as sustainability, resilience, reliability, robustness and effectiveness.

Despite the operational importance of effectively managing external threats, the triadic relationship between port business continuity, risk management and resilience outcomes in response to disruptions appears to rarely form part of the maritime university curriculum. In the absence of maritime university training, mainstream Australian universities including Monash University, University of Newcastle, and Charles Sturt University offer emergency and disaster specialist management courses plus associated electives for domestic and international students at graduate and undergraduate levels. Overseas mainstream universities offer similar learning opportunities, for example the University College London.

Empirically, port managers rely upon on-the-job experience and the use of external consultants or workshop facilitators when developing business continuity and risk management capabilities [37]. Smaller port organisations (less than 50 employees) are unlikely to appoint a dedicated risk manager; instead they might either assign this function to a staff member as a secondary role or contract external consultants [49]. Risk consultants who are unfamiliar with specific port logistics and transport hazards and risks may not be best placed to advise port managers, and at worst, their guidance might be misleading. Maritime university short courses are conceptualised as a remedy for familiarising both port industry managers and their risk consultants. Modules within a relevant curriculum might be aligned with intermodal logistics and transportation hazard identification, risk management, business continuity, contingency management and resilience outcomes in relation to port strategic and operational risks [4, 6, 8, 11]. Such modules might also assist port organisations in their continuation training needs.

On-the-job experience is an untenable learning pathway for either port managers or consultants, because this experience may be of uncertain quality and depth, and learning gaps potentially expose ports to the ultimate risk of failure when confronted by disruption. This contention is illustrated by the post-disaster reports from Hurricane Sandy [50, 37]. From a learning perspective, a need exists for maritime management education that translates port resilience research into effective risk management practice, using well-designed learning modules based on real-life challenges [51, 52].

6. Future logistics risk learning pathways

Notteboom and Winklelmans [53] argue that the port logistics and transport environment is constantly and dynamically changing, presenting port managers with associated insecurities and risk. They note that predictive port risks include loss of clients, cost-related competitive pressures, rapidly evolving technology, larger ship sizes, rail and road company restructuring, terminal mergers and acquisitions, the imperative for future infrastructure investment, and increasing government willingness for port privatisation. Future logistics and transportation managers must manage and cope with these strategic and operational pressures, and successful, resilient and competitive outcomes across port actor networks are more probable through a sound educational basis rather than learning by shock.

From a maritime university perspective, theoretical risk management learning for logistics managers might parallel that of maritime engineering streams. Almost every engineering tertiary program carries a risk management module, and a common topic is project management risk. For example the Scottish University of Strathclyde provides undergraduate and post graduate courses with modules involving maritime safety and risk [54]. Contemporary risk management within the maritime transport sector is also taught by the World Maritime University in Sweden. This WMU course provides students with grounding in technical and operational risks, risk management concepts and procedures, and the application of risk management techniques in a maritime transport environment [55]. These engineering course subjects potentially provide templates for electives within maritime logistics course design.

7. Conclusions

Risk management and disruption management knowledge is salient to graduates from tertiary maritime management institutions who enter the many diverse fields of employment that are crucial to port performance. However there is scant evidence of logistics risk management electives, Masters' courses or even short courses being offered by maritime universities. Maritime University graduates employed in port-related logistics positions must therefore either engage in further time consuming and expensive training elsewhere, gain on-the-job experience in order to become better qualified in the risk management components of their employment, or negotiate an unenviable learning pathway through managing an unexpected perturbation.

The complexities associated with modern logistics risk management, coupled with the broad economic importance of disruption management provide well-founded grounds for introducing risk management education to the maritime logistics curriculum. Far better for port-related managers to learn these contingency planning and business continuity concepts by formal process of education as opposed to experience gained from a potentially stressful experience or disruptive shock.

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Maritime Studies at Postgraduate Level in Croatia

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Postgraduate education is one of the most important of all the activities of universities as it is the basis for the research and development in all fields of science and technology on a local and global level as well as. Croatia has a long tradition in maritime higher education, highlighted by the Faculty of Maritime Studies of the University of Rijeka, that is the oldest maritime education and training institution of higher education in south-east Europe dating from the 19th century. Currently, the Faculty of Maritime Studies in Rijeka organizes the only active postgraduate study in maritime studies in Croatia. The postgraduate study is organized as an integrated interuniversity scientific study called "Maritime Studies". The consortium of collaborating institutions is made up of three Croatian universities, two research institutes and the Croatian Navy. As the field of maritime studies is multidisciplinary in nature, the postgraduate study program comprises nine execution modules covering areas of nautical sciences, marine power and engineering systems, electronics and maritime communications, information technologies in maritime affairs and transport, logistics and management in maritime affairs and transport, hydro-graphic engineering, port systems, sea and coastal protection, and naval systems.
This paper aims at presenting the organizational structure of the only Croatian postgraduate study in maritime studies. Statistics concerning the choice of the research area, postgraduate student affiliation (academia or industry) and participation by women have been provided. The observed trends in these quantities and their possible implications have been discussed. The postgraduate study program description, as well as the enrolment requirements and procedure for the completion of the study have been given. Key issues and challenges related to the future development of the postgraduate study have been identified and examined.

Keywords: maritime education, postgraduate education, postgraduate education program, science, academic achievement, research and development.

1. Introduction

Postgraduate education belongs to the core activity of universities. The main characteristic of the postgraduate education, which makes it specific, is that the fundamental and primary component is the research. Postgraduate students have to demonstrate the capability of performing self-contained and original research within a scientific field. The number of postgraduate students has rapidly increased in recent years [1], which, together with the changes in the global labour market, represent the main encouragements for universities to carry out reforms of postgraduate study program [2, 3]. In order to prepare young researchers for careers within [4] and outside the academia [5], postgraduate study programs should match the challenges of the global labour market, technological progress, universities' and governments' strategic policy goals, and postgraduate students' demands.

Maritime, as a semantically highly complex concept, means the set of activities, skills, knowledge, science and social relations at sea or related to the sea. Maritime, except maritime economy, encompasses the eminent set of non-economy work, activities and organizations, educational, scientific – research work, health, culture, sport activities at sea, maritime medicine, maritime police, coastguard, navy and others. Maritime economy encompasses a complex set of economic activities that use sea or sea treasures or are directly related to that activities, and are divided into activities related to the production (naval architecture, fishery and others) and to the transport and services (maritime shipping, shipping agencies, transport insurance, maritime agencies, harbours and other). The basis of an adequate, high quality, development of the entire maritime economy and maritime science in general, is a suitable high–level education and scientific research and expert work in a complex domain of maritime affairs.

Educational and scientific research activities at the Faculty of Maritime Studies of the University of Rijeka date back to the year 1866, when the Austrian-Hungarian Imperial and Royal Naval Academy (K.u.K Marine Akademie) started with the regular work [6]. The scientific research fellow of the Academy was Professor Ernst Mach, the world's famous physician and philosopher. He experimentally approved one of his famous and most important theories, the theory of shock wave, just at the K.u.K Marine Akademie in Rijeka. The academy was open until 1914. Disruption in higher education in the field of maritime studies lasted until 1949, when on 4th April 1949 the Maritime College in Rijeka was established. The College was transformed into the Faculty of Maritime Studies in 1978 when it became a constituent of the University of Rijeka and continued its work up to the present day. In the domain of science research activities, the Rijeka Faculty of Maritime Studies is a complex scientific – research centre of excellence in maritime affairs directed to the interdisciplinary and multidisciplinary higher education and science projects and research activities. The Rijeka Faculty of Maritime Studies is the oldest component of the University in Rijeka and the oldest and the largest university institution in the domain of maritime affairs in Croatia. Out of the 126 postgraduate studies, which are being performed in different scientific areas and fields in the Republic of Croatia, there is only one, throughout the Croatian territory, in the domain of maritime affairs and is currently performed at the Rijeka Faculty of the Maritime Studies.

2. Postgraduate Study: Organizational Structure

The existing postgraduate study started in 2007 with the introduction of the Bologna system in Europe and Croatia. It could be considered as a continuation of the existing Master and PhD studies at the Faculty of Maritime Studies in Rijeka, which began in the year 1978. Since then, a total of 126 students have been awarded a master’s of science (MSc) degree, while 75 students have earned a doctor’s (PhD) degree.

Presently, the study represents an integrated, interdisciplinary and interuniversity scientific study with several maritime higher education institutions from the eastern Adriatic coast, two research institutes and the Ministry of Defence of the Republic of Croatia included into. The official title of the study is the “Maritime Affairs” Postgraduate University Study [7]. The responsibility for the study lies on the Faculty of Maritime Studies in Rijeka as the leader of the study, while the collaborative institutions are:

- the University of Split, Faculty of Maritime Studies;
- the University of Zadar, Department of Maritime Sciences;
- the University of Dubrovnik, Maritime Department;
- the Ministry of Defence of the Republic of Croatia, Institute for Research and Development of Defence Systems;
- the Croatian Hydrographic Institute in Split;
- the Croatian Navy.

The study provides nine execution modules [8], opened for all students, and is focused to students with a background in maritime industry. Such an organization provides the possibility for all students to research and study different areas of maritime industry according their preferences. The study represents a continuation of the higher education in accordance with the Bologna process. All students holding a Master Diploma and being allocated with 300 ECTS credits at the undergraduate and graduate study is eligible to register for the postgraduate study.

The study is financed by the student’s tuition fee. Mainly, the tuition fee is covered by the students’ employer while some of the students pay the study by themselves. The system of scholarship does not exist as yet. The postgraduate study is organized through the internal organizational structure of the Faculty of Maritime Studies in Rijeka. The vice dean in charge for research and postdoctoral study is directly responsible for the proper organization of the study at the managerial level [9]. The study consists of the following permanent bodies appointed by the Faculty's council [7]:

- Committee for science and postgraduate study,
- Advisory board of the postgraduate study,
- Head of the postgraduate study,
- Secretary of the postgraduate study,
- Administrator of the postgraduate study.

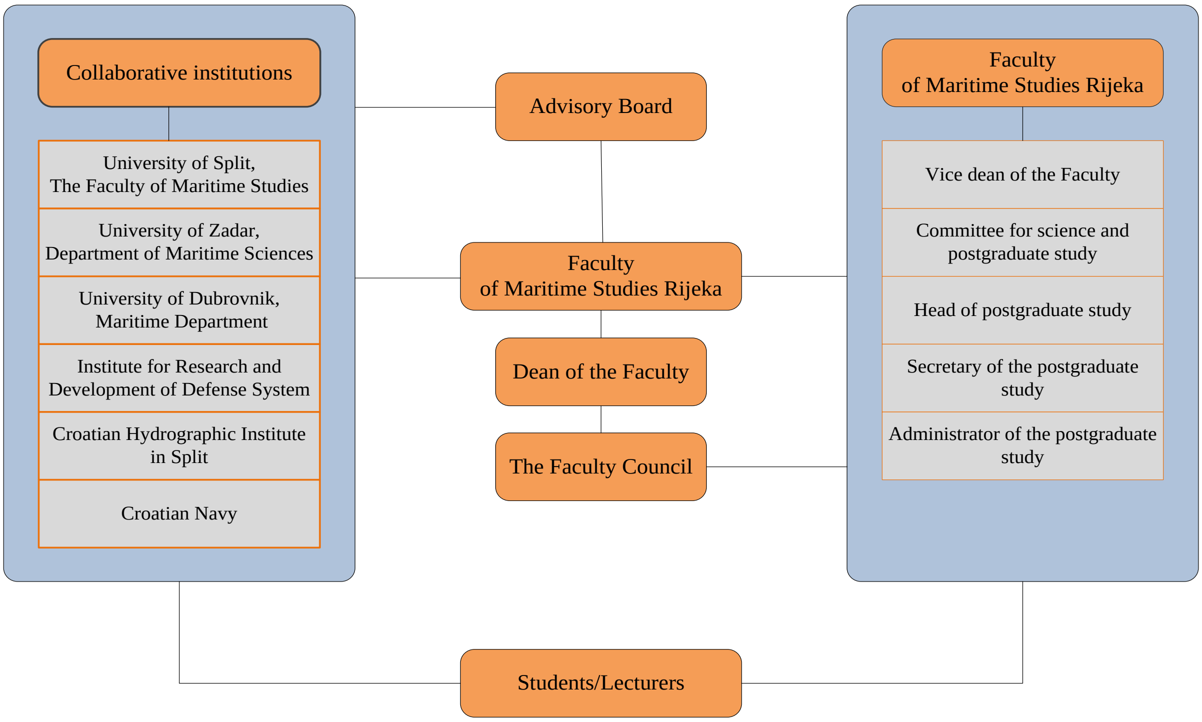

Figure 1 Organizational Structure of the Postgraduate Study

The Committee for Science and the Postgraduate Study is the operational body of the postgraduate study. It holds meetings at least twice per semester and consists of the vice dean for research and postdoctoral study, as a committee president, scientific and research project leaders, head of the postgraduate study as well as of all full professors of the Faculty of Maritime Studies in Rijeka. The main tasks of the committee are to manage, organize, run and control all activities related to the postgraduate study. Additionally, the committee has to promote the study through presenting the researches, analysing the student's successfulness and the overall teaching process as well as to make continuous improvements.

The Advisory Board of the Postgraduate Study is a managerial level body with the main goal to propose to the Faculty's council study programs, policies and strategies, and to control the realization of the overall process. The Board represented by the dean and vice-dean for science and research of the Faculty, heads of the collaborative institutions and the head of the postgraduate study. The head of the postgraduate study should be the professor from the leader institution in charge of managing and controlling the teaching process and continuously and operationally following all activities related to the postgraduate study such as planning meetings, making reports etc. The secretary of the postgraduate study organizes all administrative works, prepares documents and deals with the study enrolment process. The administrator of the postgraduate study is an assistant to the secretary.

Since the year 2007, five generations of students have been enrolled in five different study cycles. The total number of the enrolled students amounts to 128, while six students have completed the study successfully.

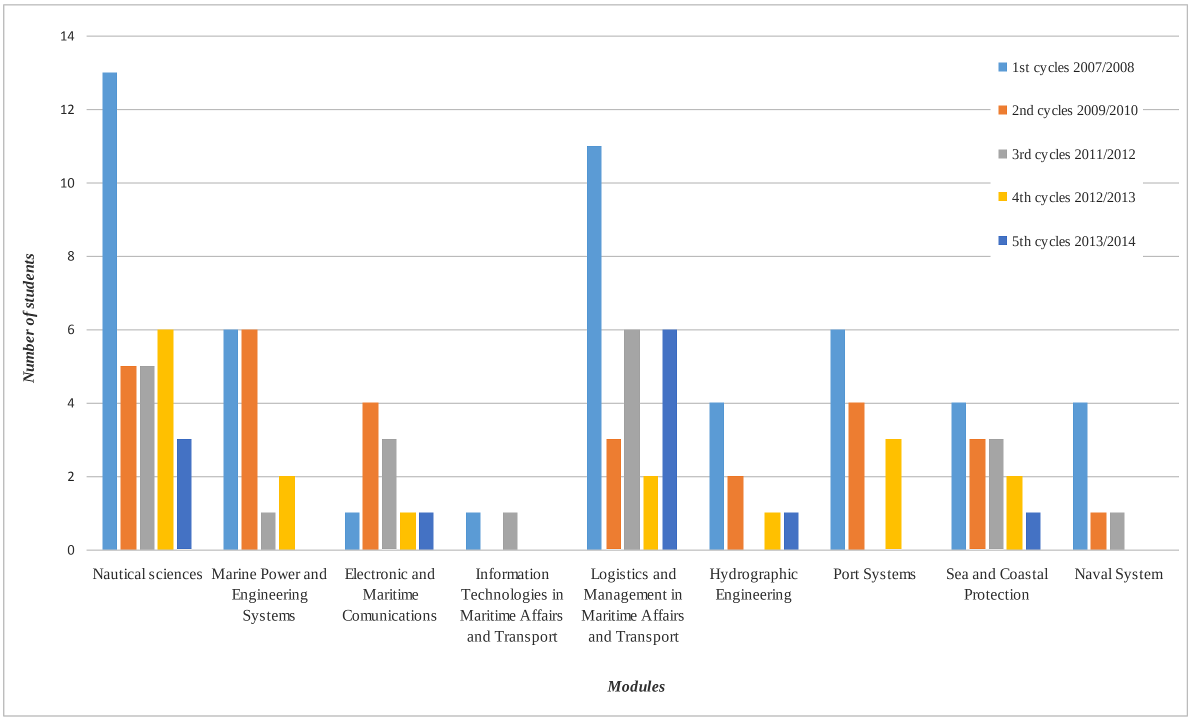

Figure 2 Graduated Students by Cycles

In most cases, students are lecturers and professors coming from the Croatian higher maritime institution and employees of different Croatian maritime related companies and organizations. Out of the total number of 128 students, 36 are employed in one of the Croatian maritime higher education institution, while the rest are employed in maritime industry (shipping, ports, maritime administrations, forwarding agencies, port agencies...). The following table shows the students' successfulness in relation to the place of employment:

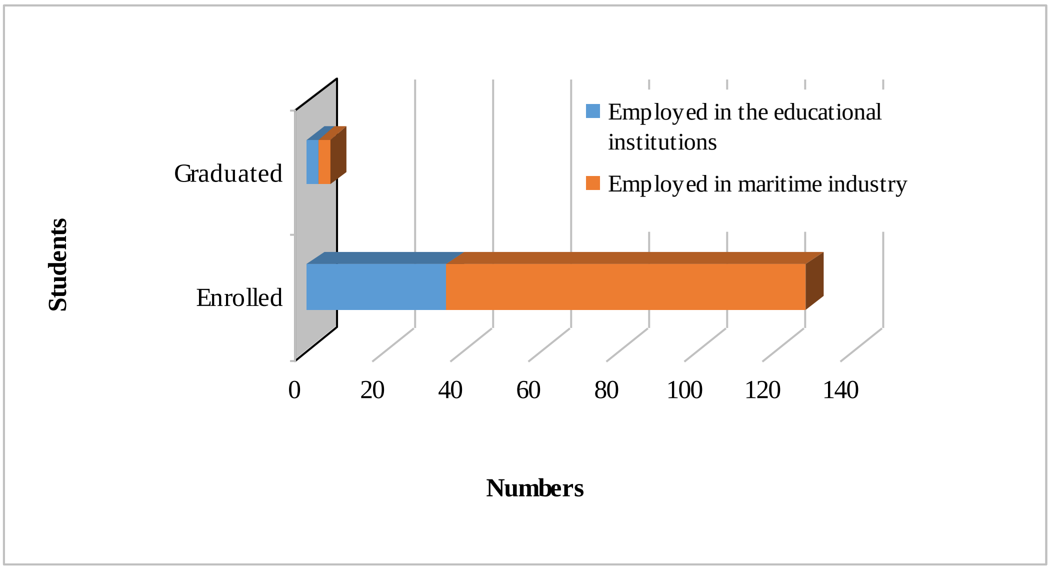

Figure 3 Students' Place of Employment

Since the very beginning, the number of enrolled students has been decreasing in all modules (Figure 2). The most probable reason for the lack of students is that Croatia, as a relatively small country, cannot provide an adequate number of postgraduate students in maritime affairs each year. Generally speaking, a relatively small number of students have earned a PhD degree. And it is really believed that this is one of the most important issues to be improved. The main reason for that is the unavailability of students to focus on research activities parallel with their regular work, especially for those students employed in maritime related companies. Namely, the Croatian system of employment does not support or even does not allow a year away from regular work for students to make researches and attend the postgraduate study. Furthermore, there is an individual responsibility of each student for the completion of the study and research program. As a specialized study, orientated to the maritime industry where men are prevailing, it should be emphasized that the study is opened for enrolment regardless of sex. At present, 25 women are attending and taking an active part in the study, thus representing 20% off the total number of students enrolled.

3. Postgraduate Study Program

The program of the postgraduate study aims at covering as much wide aspects of maritime science, industry and research activities as possible. The program consists of two connected parts with five types of activities described as activity varying from A to E [7]. The first part includes lectures, while the second part includes research activities leading to the doctoral thesis. The precondition for students to move ahead from one activity to another is regulated by the internal Regulations on the “Maritime Affairs” Postgraduate Study. Each study activity is allocated with ECTS credits. The postgraduate study student can register a total of 180 ECTS credits.

Program development process includes market examination in order to evaluate, analyse and detect needs for scientific research and development activities among relevant stakeholders related to maritime industry. Following the examination, subjects and modules are generated. It is considered that postgraduate study program is oriented to competence based educational activities rather than time based education. Students are encouraged for individual work and research approach to assigned tasks. The lectures are based on two types of courses: fundamental courses and specific courses, which are part of one of the nine specific execution modules.

All courses are optional and students have the right to choose them according to their preferences. Activity A is related to fundamental courses, while activity B covers courses of a specific module. Courses in specific modules should be chosen by students who have successfully completed activity A, what means that they have completed the postgraduate study program, have passed all the required examinations and discharged their obligations. In each module specialized courses of the module are offered. Lectures are held on the basis of an approved study program in the form of lectures, tutorials, seminars and scientific papers.

Part of the research activities will start after the activity C lectures have been completed and that is in the form of the student’s participation in the scientific or research project led by the project manager. The student’s obligations are to publish at least one scientific paper in internationally recognized scientific journals. The professor who is responsible for the student's research and work on the project must be allocated to the project manager or student collaborator. The research project provides a practical experience in the research, and is also used to estimate the student’s scientific research capability.

Activity D follows with the student’s obligation to prepare the doctorial thesis proposal. This activity includes the research with the thesis mentor and implies that after selecting the areas of the doctorial dissertation, the student can start with the research that the doctorial thesis proposal is aimed at. The doctorial thesis proposal should be presented in public and confirmed by the commission with a positive decision brought. After a formal confirmation by the Faculty Council, the student can start with the preparation of the doctoral dissertation together with the mentor appointed to.

The preparation of the doctoral dissertation represents the activity E. The student's mentor is elected among be professors who have taken part in the postgraduate study, including those from of all collaborating institutions as well. Exceptionally, outside the ranks of professors, an experienced maritime industry expert may be also appointed as a mentor. The mentor assists the student in preparing the thesis and is responsible for the student during the whole period of the student's work on the doctoral dissertation. The student must submit his dissertation to the evaluation commission within a maximum of five years from the date of acceptance of the thesis proposal. The commission should assess the dissertation and after a positive evaluation the student has to present and defend the dissertation in public and in front of the commission. Following the presentation and defence of the dissertation and the positive evaluation of the evaluation commission, the student can earn a doctor's (PhD) degree. All processes and activities are controlled by implemented institutional quality management system with fundamental objective to follow student's advancement and performance.

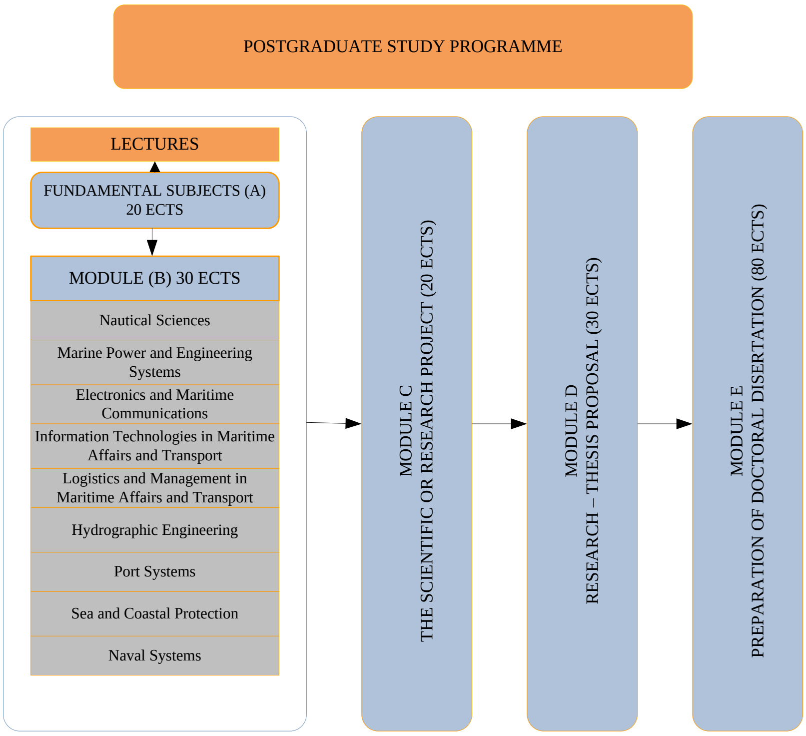

Figure 4 Postgraduate Study Program

The postgraduate study program follows the Faculty strategic policy on maritime education at the highest level where, besides the undergraduate and graduate study, the postgraduate study is also organized [10]. This program is aimed at providing a scientific research throughout the lectures and the student's taking part into a scientific and research projects for the maritime industry. The program is updated for each enrolment study cycles, following standards of quality in scientific and research activities. By being enrolled in the postgraduate study, each student has the opportunity to approach and develop scientific researches in the field of maritime affairs.

4. Challenges for Future Development

Heterogeneousness of maritime scientific disciplines has a significant impact on the organization of the postgraduate study program. Although disciplinary differences are critically important for the quality of the experience and training of postgraduate students, it is a major obstacle for a continuous update and modernization of the study program. In particular, a large number of academics with a doctorate and a senior tenured position are required to provide teaching, mentorship and research projects, covering a wide range of different disciplines. Moreover, the duration of the postgraduate study should to be adopted, as it is closely connected with funding. The students who work on interdisciplinary projects are faced with problems related to mentorship, assessment and evaluation of their work. Therefore, students may choose a less risky research topic to complete the study successfully. As a consequence, the scientific development and inter-disciplinary collaboration could be limited.

The selection of postgraduate student candidates plays a very important role in achieving expected quality of postgraduate studies. The observed trend of the slightly decrease of enrolled students (Figure 2), which is attributed to the lack of potential candidates, encourages to shift the postgraduate study to international candidates. In order to attract foreign candidates, courses program, related documents and lectures are provided in the English language. As a part of the recruitment process, in addition to the administrative requirements fulfilling (adequate diploma with excellence) and presentation of their own research proposal, the candidates may pass an exam in the English language.

Mobility and inter-institutional collaboration are an integral part of the postgraduate study at the Faculty. Although mobility and collaboration within the Croatian institutions are intensive, we consider that international mobility is an important strategic tool of the postgraduate study, which allows wider research experience and career development opportunities of postgraduate students, as well as improved collaboration between institutions. The Faculty seeks to provide appropriate international mobility and inter-institutional collaboration mechanisms to enhance students' expertise in relevant fields. However, we face numerous obstacles of a financial, legal, administrative and personal character that currently limit mobility and collaboration mostly within Croatia.

Following the intention for intensifying the international candidates enrolment, we plan to increase the number of internationally recognised experts engaged in the study (currently, three engaged professors are form foreign institutions, from Hungary and Slovenia). This kind of international cooperation would bring about more opportunities for students to participate on the international scientific and research project managed by international academic staff. We consider that the International Association of Maritime Universities (IAMU) could serve as a main pool of experts, enhancing relations between the world's maritime universities and faculties at the highest level of education.

5. Conclusion

The maritime related postgraduate education in Croatia has been presented. The only active Croatian maritime related postgraduate study, performed by the Faculty of Maritime Studies Rijeka, is organized as an interdisciplinary, integrated and interuniversity scientific study that encompasses four maritime higher education institutions, two research institutes and the Ministry of Defence of the Republic of Croatia. The program of the postgraduate study is designed to cover wide aspects of maritime science, industry and research activities. The program is based on a nine execution modules and consists of two main parts, lectures and research activities that lead to a doctoral thesis. The identified key issues and challenges related to the future development could be seen as a tool for quality improvement of the postgraduate study, its better recognition among scientists as well as among practitioners from the maritime industry, and as a tool for serving industry in scientific research activities.

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Session 2G

Seafarer Training

Ships of Change: Why Seafaring Needs to Embrace Innovation

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The modern seafarer works in an increasingly regulated environment. Whether it is navigation of the ship, operation and maintenance of machinery and equipment, or carriage of cargo, a significant amount of the modern seafarer's work is related to compliance with prescriptive rules, regulations, guidelines and codes. These prescriptive requirements arise largely out of international conventions and codes, developed with the aim of improving safety and security of shipping, managing risk and preventing marine pollution by ships. As a consequence, seafarer training tends to produce seafarers who can scrupulously follow procedures, maintain systems, and respond predictably to shipboard emergencies. This approach results in an inflexible command and control type manner of operating ships whereby there is a preoccupation with process, but novelty and change is discouraged. However, the twenty-first century shipping company operates in an environment characterised by volatility in natural, economic and social systems. In order to be sustainable, the modern shipping company needs to be resilient to change that is dynamic, turbulent, uncertain and unpredictable in nature. Research suggests that the ability to innovate is a key determinant of resilience, and hence sustainability, of complex adaptive systems. This paper argues that seafarer training should place greater emphasis on learning, experimentation and exploration of opportunities during periods of change. The paper explores: (i) how shipboard innovation may contribute to the sustainability of shipping companies and hence the sustainability of the shipping industry itself; (ii) the barriers to shipboard innovation; and (iii) how shipboard innovation may be facilitated through education and training of seafarers.

Keywords: innovation, sustainability, resilience, seafarers, shipping companies, seafarer's education and training

1. Introduction

Shipping companies face a varied and eclectic mix of challenges to their survival and growth. Since the dawn of civilisation, ships have plied their trade across the seas; braving the elements and often sailing into unexplored and uncharted waters. Many of the risks taken by mariners and ship owners in the preceding millennia would be considered unacceptable by twenty-first century corporations. However the nature of shipping is such that even today, a ship's voyage is sometimes referred to as a marine adventure. As Malbon and Bishop [1] explain, a marine adventure occurs because a ship is exposed to maritime perils that include, according to the quaint description in section 9 of the *Marine Insurance Act 1909* [2], 'perils of the seas, fire, war perils, pirates, rovers, thieves, captures, seizures, restraints, and detainments of princes and peoples, jettisons, barratry' among others. Shipping companies undoubtedly face serious consequences if they lose their ships due to storms, navigational hazards, fires, collisions, piracy and similar events. However shipping accidents are not the only type of challenge to the well-being of modern shipping companies. Similar to other 21st century organisations, shipping companies are confronting a complex competitive environment shaped by globalisation and technological advances [3]. In the modern era, volatilities in natural, economic and social systems are leading to new forms of challenges and the nature of change itself has become more turbulent, complex and uncertain [4]. Thus, events such as financial meltdowns, sabotage, terrorism, climate change, market ups and downs, geo-political upheavals, and regulatory changes, can lead to unexpected and unpredictable consequences. Greater individual, organisational and community interconnectivity [5] is further adding to the complexity. In today's world of global supply chains and interconnected networks, even remotely occurring events such as pandemics or cyber failures have the potential to cause widespread disruption and chaos as their effects cascade through interconnected entities including shipping companies. The challenge for modern shipping companies is to survive and grow in this complex, dynamic and highly competitive environment. In such an environment, conventional risk management techniques that rely on mitigating identifiable risks may be inadequate to cope with change that is unpredictable, full of surprises, and hence difficult to prepare for.

Solving complex problems requires a different approach to solving lesser problems. Consider the following simple example - the failure of an electrical power generator on a ship. If the failure occurs while a ship is tied to a wharf, the most significant consequence might be the financial loss due to delays in cargo operations. This problem is best solved by a suitably trained engineer or mechanic following the prescribed process for diagnosis of fault and rectification. The solution required to fix the generator is the same regardless of the location of the ship or the time when the mechanic or engineer is available. On the other hand, the solution for a complex problem is sensitive to time and context [6]. Thus, if the electrical power generator fails while the ship is approaching the busy entrance to the Port of Singapore, it becomes a complex problem. From the perspective of the ship's crew, dealing with the problem will require an evaluation of traffic conditions, navigation hazards, state of weather and visibility, manoeuvring options, capabilities of the ship, and communications options, requirements that may sit outside usual procedures, for example, the crew may need to quickly learn from feedback and adapt their behaviour to suit the unexpected context. The result may be a novel action which does not exist in text-books, but is nevertheless necessary to keep the ship safe at that particular time and place. Similarly, when considering management at the organisational level, reliance on existing procedures and knowledge may be inadequate to meet challenges of the modern era that typically demand an adaptive approach requiring new learning, innovation and patterns of behaviour [3].

Jansen, Cammock and Conner [7] suggest that viewing organisations as systems similar to the complex adaptive systems (CAS) found in the natural world may help develop organisational capacity to adapt to complex and changing conditions. CAS are complex because their components interact in a dynamic fashion so that system behaviour cannot be understood or predicted by studying individual components of the system [8]. CAS are adaptive because they can self-organise in a dynamic and innovative manner in response to threats and opportunities [7]. Scholarly literature on CAS can be a rich source of information to guide management thought and practice. However, it is beyond the scope of this paper to discuss how the full range of insights from CAS literature may be applied to the management of shipping companies. Instead, this paper examines how shipping companies may benefit from understanding how healthy CAS utilise their capacity to innovate to be sustainable.

2. The shipping company as a CAS

A shipping company may be conceptualised as a system by identifying it as a multicomponent entity that can be distinguished from its surrounding environment [9]. Similar to other business organisations, the boundaries of a shipping company are defined by the assets that it owns such as ships and buildings, as well as through its employment contracts with its employees [10]. The components (or agents) may be identified with reference to these organisational boundaries [10]. Depending upon the level of analysis, the agents in a shipping company may be identified as, for example, individual employees, seafaring staff, non-seafaring staff, administrative units or functional units. Similar agents can be identified within the sub-systems of the shipping company, that include its ships. The agents, that may act in self-interest, make local decisions from local information, but are interdependent and therefore influence each other [6]. It is the way that the agents interact and the results of such interactions that makes the system complex [11].

Complexity arises from the interconnectedness between the agents and the many possible alternative states in which the system or its components may exist [6]. In a complex system, inputs are changed to outputs in a non-linear way because the agents interact with one another via a web of feedback loops [12]. Non-linearity means that outputs are not proportional to inputs - some inputs are magnified (positive feedback) while others are counteracted (negative feedback) [6]. Figure 1 represents a shipping company as an open system that is in a constant process of taking inputs from its environment and returning them as outputs. For simplicity, the shipping company is shown as having just four agents corresponding to its major functional units – ship operations, technical management, commercial management and human resource management. Double headed arrows indicate that each exchange of matter, energy and information contains a feedback loop. The shipping company, input suppliers and output receivers all interact with, and influence, not just each other, but also the wider ecological, social and economic environments. Therefore the system can only be understood in the context of its environment [13]. In order to understand system behaviour, it is more useful to study the interrelationships and interactions between the agents rather than the agents themselves [13].

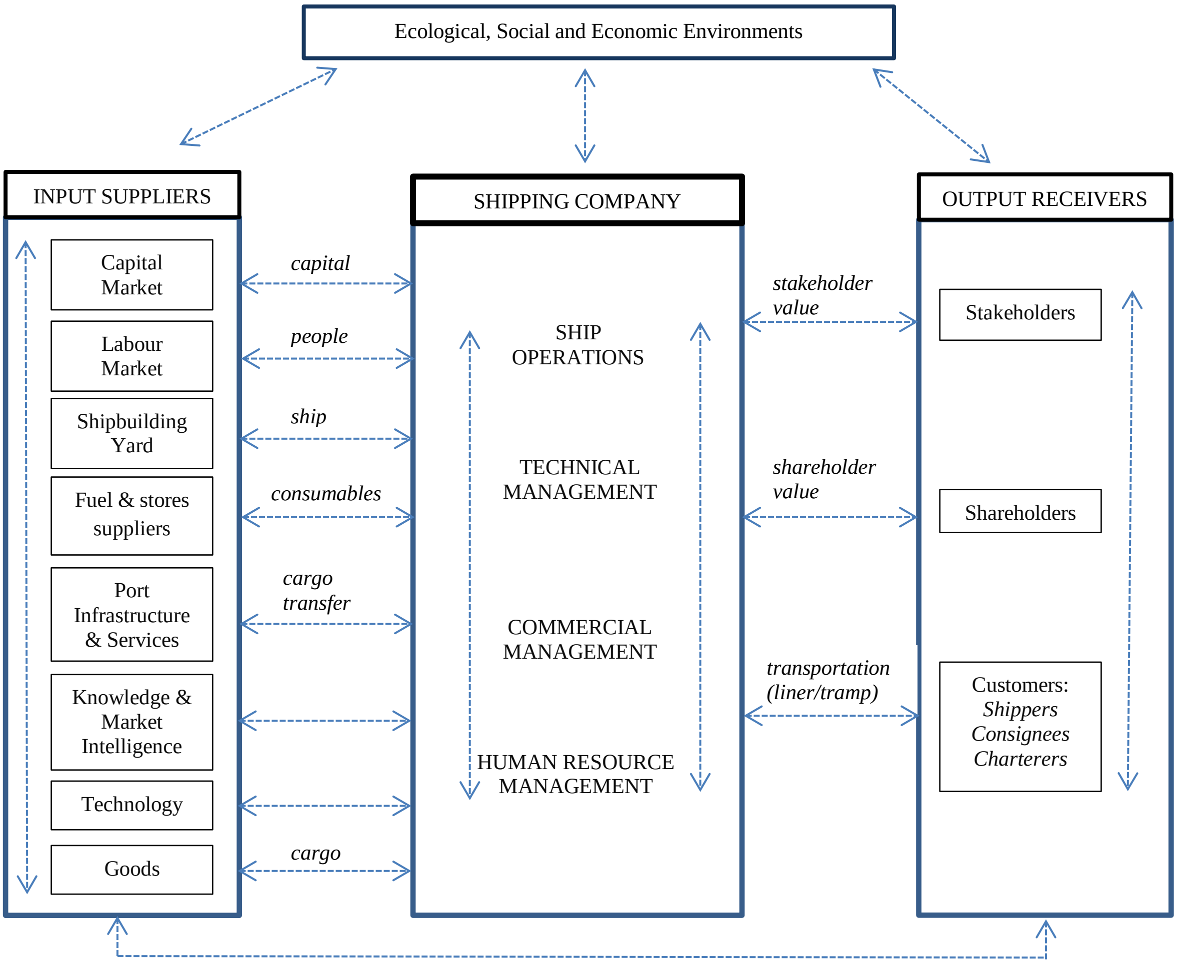

Figure 1 A systems view of the typical shipping company
Adapted from: [14; 15]

A characteristic feature of CAS is the phenomenon of self-organisation [12]. Self-organisation refers to the formation of holistic patterns of structures or behaviours from individual agents acting in their own interest, but little direction from the top hierarchy [11]. Even though the agents act independently, self-organisation occurs as a result of positive feedback loops whereby some behaviours are amplified over others, leading to collective behaviour [12]. In response to a threat or opportunity, independent agents self-organise to create emergence [7]. To illustrate, consider a hypothetical scenario of four ships converging at a single point from four different directions – north, south, east and west. In accordance with the international rules for preventing collisions at sea, each ship will alter course to starboard and attempt to pass astern of the ship on its starboard side. As a result, collectively the ships will move in a circular pattern as if they were going around a traffic roundabout.

2.1 Sustainability of CAS

Studies of social-ecological systems (SES) that are also complex adaptive systems, suggest that system sustainability is determined by the manner in which a system navigates through shocks and other disturbances while continually adapting itself through cycles of change [16]. In the SES literature, the essence of making sense of a system's sustainability lies in understanding its resilience – the ability of the system to absorb disturbance and still retain its basic function and structure [17]. System resilience is challenged by SES changing over time, continually moving between different phases of a cycle called the adaptive cycle [18; 19].

The adaptive cycle is a continuous cycle of growth, maturity, crisis and renewal where sustainability depends upon persistent change rather than a steady state [19]. In the adaptive cycle, a system commonly moves through four phases - a phase of growth where resilience is high, into a phase where the system becomes more rigid and less flexible, followed by a sudden collapse into a phase of chaotic dynamics that finally leads to a phase of reorganisation [18; 19; 20; 21]. The four phases are referred to as exploitation, conservation, release and reorganisation phases respectively [19]. The so called forward loop of the adaptive cycle is formed by the exploitation and conservation phases and is characterised by a fairly predictable pattern of growth [22]. The release and reorganisation phases form the back loop that is characterised by unpredictability and reorganisation [22]. SES spend most of the time progressing along the forward loop, becoming increasingly efficient but less flexible until inevitably, a shock triggers the start of the release phase [16]. The more efficient the system, the less is its resilience [16].

Many resilient systems go through these four phases over and over again [18]. However many systems do not necessarily follow the sequence of phases illustrated in Figure 2. Systems can move from any one phase to another except from the release phase back to conservation phase [23]. Moreover, the reorganisation phase may lead to either a repeat of the previous cycle, or a new trajectory, or collapse. Human agents in a system play an important role as they have the ability to anticipate and act with intention [24]. Although CAS cannot be controlled in the traditional management sense, they can be managed [13]. Managers can utilise CAS characteristics to their advantage rather than trying to overcome them [25]. Applying the adaptive cycle metaphor to the management of shipping companies, one can assume that managers will try to avoid the back loop where, following a crisis situation triggered by shock, the shipping company may end up collapsing rather than reorganising as desired. This is indicated by the dashed arrow in Figure 2.

During the conservation phase, a growing business starts to move towards more specialisation and greater efficiency at the cost of decreasing flexibility and redundancy [16]. This is in contrast to the exploitation phase where innovators and entrepreneurs seize new opportunities and the business grows rapidly [16]. Therefore, the key to sustainability lies in ensuring that inventions, experimentation and creative ideas that are associated with the reorganisation phase, continue to provide fuel for growth and thus prevent the system from becoming too rigid and less resilient. The challenge for managers is how to create the right environment for innovation without the whole organisation undergoing the trauma of broken structures, networks and release of capital associated with the release phase. Walker and Salt [16] suggest that managers may be able to move the system back to the exploitation phase from the conservation phase by generating small scale, rather than system-wide release and reorganization phases.

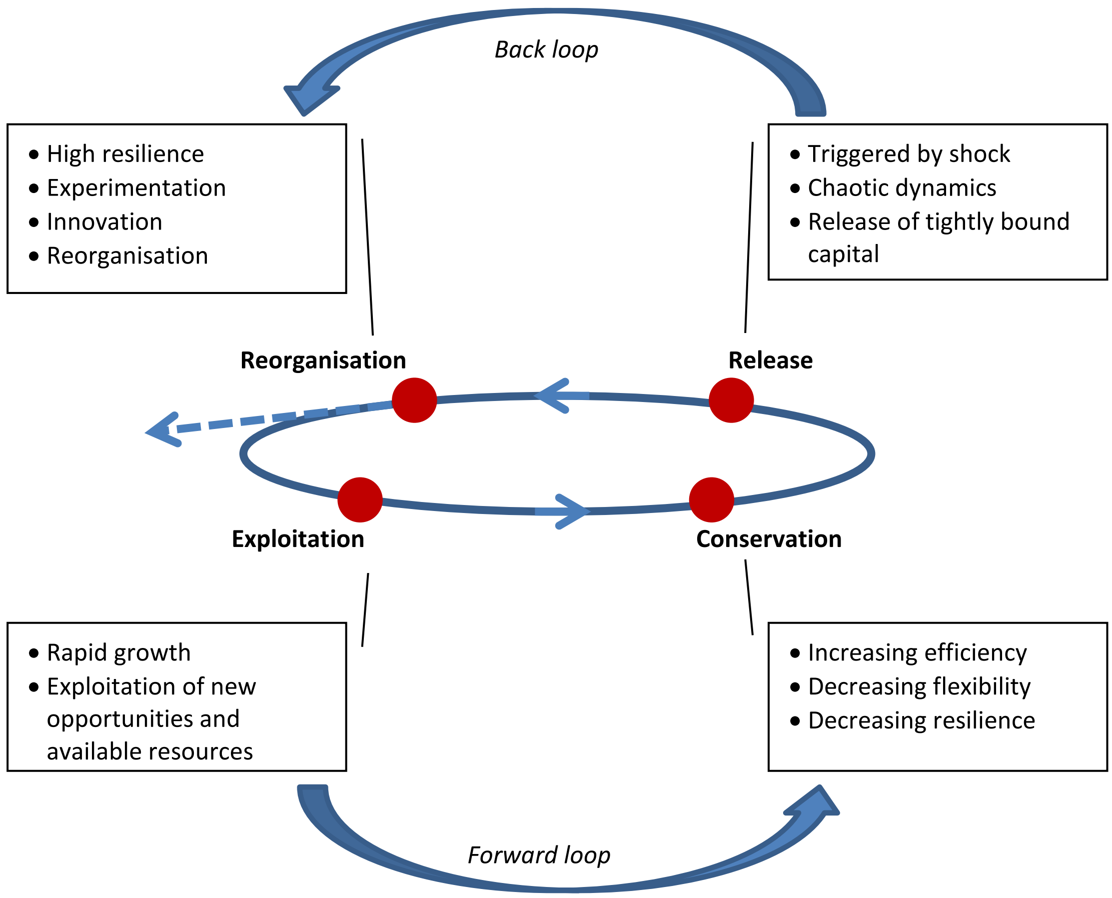

Figure 2 The adaptive cycle
Adapted from: [18; 19; 20; 21; 26]

In SES literature, scales are conceptualised as a 'panarchy' which is described as a hierarchical set of nested adaptive cycles operating over many different temporal and spatial scales [27]. According to Holling [19] the sustainability of a system is determined by the functioning of these cycles and the communication between them. In a healthy system, smaller and faster cycles of innovation invigorate the system above which in turn is protected by the accumulated processes and resources (memory) of the slower, larger levels above it [19]. Such cross scale interactions in panarchy show how sustainability is affected by the interplay between change and persistence. Adaptation is driven by innovations created during the release phase of the scale below, whereas persistence is facilitated by the memory of the scale above [19]. Thus it follows that innovations at the ship level may help a shipping company adapt to changing circumstances as well as seizing new opportunities for growth.

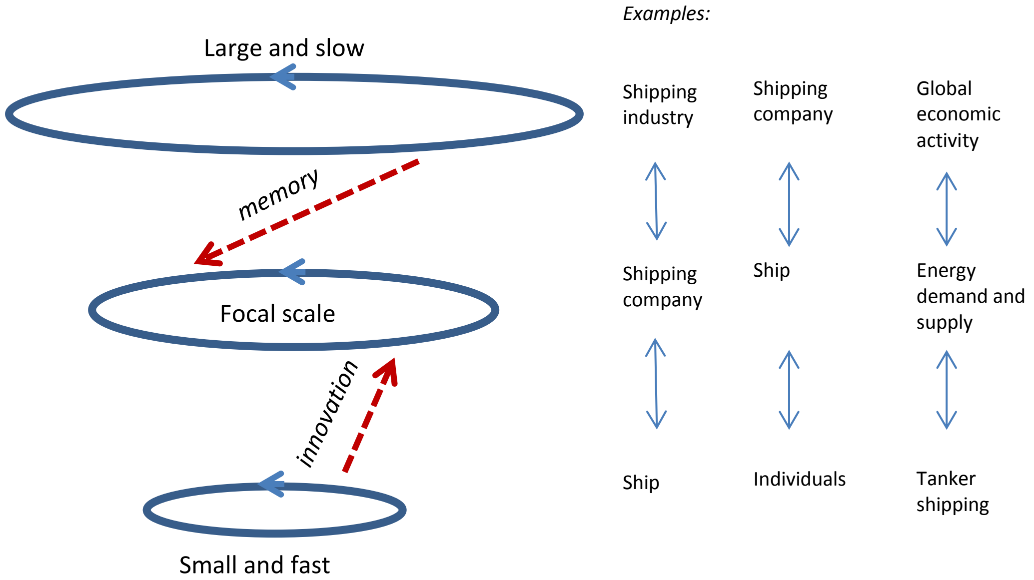

Figure 3 Panarchical interactions
Adapted from: [19; 26]

3. Shipboard innovation and the role of seafarers

Shipboard tasks and roles are heavily influenced by risk management and safety management. The emphasis on risk and safety is primarily driven by concerns about shipping accidents, as the impact of such accidents often extends beyond the confines of the affected ships. When shipping accidents result in extensive damage to life, environment and property, there is increased public attention which has a negative influence on the way shipping is perceived [28]. There is often a strong community and government response as illustrated by public anger at the loss of life resulting from the sinking of *Herald of Free Enterprise* in 1987, *Scandinavian Star* in 1990, *Estonia* in 1994 [29], resulting in new shipping regulations imposed by the United States (US) and by the European Union (EU) following the oil pollution caused by *Exxon Valdez* in 1989 and the sinking of *Prestige* in 2002 respectively [30].

Historically, safety in shipping has been regulated through prescriptive regulations set by governments and their agencies (see for example the *Marine Orders* issued by the Australian Maritime Safety Authority or AMSA). International conventions held under the auspices of the International Maritime Organisation (IMO) - a specialised agency of the United Nations (UN) - form the basis of many national regulations concerning the safety of merchant ships and seafarers. IMO conventions aim to set international standards for the design, construction, equipment, operation and manning of ships. These standards are enforced by means such as inspections, surveys and certification. Among the many international conventions and codes that focus on technical solutions, IMO's International Safety Management (ISM) code stands out for directly addressing the management and organisation of shipping companies. The ISM Code sets an international standard for the safe management and operation of ships and pollution prevention and is arguably one of the most significant documents produced by IMO [29]. The code requires shipping companies to implement a safety management system which establish safeguards against all identifiable risks. The pervasiveness of regulatory control in shipping is indicative of stakeholders' concerns about industrial accidents and their potential for wide-spread destruction. However, as a consequence of the regulatory regime, a culture of compliance has been created [29].

Hollnagel [24, p226] suggests that a compliance based approach is based on the assumption that "systems work because they are well designed and scrupulously maintained, because procedures are complete and correct, because designers can foresee and anticipate even minor contingencies, and because people behave as they are expected to – and more importantly as they have been taught or trained to do". The compliance based approach is symptomatic of a command and control type management thinking [31]. Command and control thinking is characterised by a top-down hierarchical perspective, functional specialisation and being remote from operational decision-making [32]. The command and control thinking treats organisations as machines and seeks efficiency, stability, control and obedience [33].

The typical shipboard organisation illustrates command and control thinking. There is a strict task hierarchy and the usual way of working is through instructions and orders being passed from the master to officers to the crew. Standard operating procedures are the norm and any deviation from established rules and procedures is discouraged and even penalised. Regulators determine what tasks are to be performed by seafarers, how they should be performed, and the hierarchical level of tasks – management, operational or support levels (see IMO's International Convention on Standards for Training, Certification and Watchkeeping for Seafarers [34]). Regulators oversee the training of seafarers and issue licenses to those deemed competent to perform the specified tasks. The regulators' interests, as articulated by IMO, are safety and security of shipping and prevention of marine pollution by ships [34]. Thus Regulators represent stakeholders' rather than shareholders' interests.

Some scholars (see, for example, [25; 32; 33]) suggest that the stability and efficiency seeking command and control approach provides limited ability to cope with complex, dynamic and unpredictable change. Wheatley [33] argues that a command and control management style discourages creativity by producing disengaged workers who behave like robots. Applying the CAS metaphor to organisations, the strive for greater efficiency comes at the cost of decreasing flexibility and resilience [16]. Inventions, experimentation and creative ideas occur at the reorganisation phase of the CAS adaptive cycle where agents freely seek new directions [16]. However, the environment of tension and instability conducive to innovation [13] also brings with it the threat of chaos. Jansen, Cammock and Conner [7] suggest that a management approach that is based upon an understanding of organisations as CAS is *complementary* to, and not exclusive of, the more traditional forms of organisation that are important for efficiency.

4. Conclusion

In order to be sustainable, shipping companies need to be able to adapt to unpredictable and unforeseeable change as well as take advantage of any opportunities presented. Reliance on existing knowledge and procedures may be inadequate to solve the new, and yet unforeseen, challenges of the twenty-first century arising from the continuing complexity of change and organisational dynamics. Complex problems cannot be solved by using techniques that assume a straightforward cause and effect relationship [35]. Conceptualising the shipping company as a CAS and understanding the importance of self-organisation and emergence may help to manage the company through change and provide competitive adantage.

Studies indicate that sustainable CAS rely on their ability to innovate – a key element of adaptability [16; 18; 19; 21; 23; 27]. In order to harness the full potential of their seafaring employees and go beyond simply expecting them to do as directed and follow instructions, shipping companies will need to create the right shipboard environment for innovation. This will require leadership, at both the company and the ship level, accepting that organisations don't always behave in the same way as Newtonian machines [25]. Self-organisation is necessary for unleashing creativity and adaptation [33]. Self-organisation does not imply that the present hierarchical shipboard organisational structure necessarily diminishes. Self-organisation can occur as a result of individuals working independently

[11]; it is the emergent phenomenon resulting from their actions that is important. For this to occur, there needs to be an engaging vision that is not imposed but has resonance with members of the organisation [7]. Management strategies that facilitate sensemaking, learning and improvisation are essential to take advantage of the chracteristics of CAS rather than resist them [25].

The notion of panarchy illustrates the importance of scales, both spatial and temporal, to innovation and sustainability [27]. By invigorating the system through innovation at smaller scales rather than through company-wide upheaval, shipping companies may be able to successfully balance change with persistence. The ability to reorganise after change is dependent upon *memory* – the accumulated experience and history of the system [18]. Therefore knowledge management within the shipping company attains fundamental importance.

The literature on CAS provides new metaphors and language for management [13]. It also raises potential new challenges for educators, curriculum designers and regulators. More studies are needed to answer fundamental questions such as: what are the graduate attributes of 21st century seafarers?; should stakeholders involve themselves with graduate attributes that may go beyond technical standards for safety, security and environmental protection?; can creative skills be incorporated in seafarers' curricula?; when does experimentation cross the threshold of acceptable risk?; and last but not least, does the relationship between traditional maritime academia, seafarers and shipping companies need to extend beyond the confines of STCW?

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Bringing Out the Optimum in Maritime Education and Training Enhancing Quality in Maritime Education and Training

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Across the world, quality assurance has become an increasingly dominant theme in maritime education in the past 10 to 20 years, and international maritime processes play an important role in the way quality assurances is interpreted and implemented. The concept of quality enhancement and the involvement of key stakeholders, such as students and employers, tend to be limited and, in case of employers, are relatively rare. Quality assurance touches all aspects of maritime universities life. Any project related to QA should cover quality management, quality assurance in curriculum development, staff development for quality assurance and quality assurance information systems.This applies equally to academies within the International Association of Maritime Universities (IAMU) as well as other maritime institutes not in the said association.The IAMU program, with its long and established history (about 15 years) of developing cooperative networks among IAMU universities is perfectly positioned to assist maritime institutes, shipping companies and port authorities, etc., in their countries in the development of quality enhancement and assurance mechanism. Mass access and competitive remuneration from maritime industry have put pressure on the quality of teaching: at the same time as more teachers are needed, attractive salaries are luring highly qualified graduates and experienced staff into private sector. Mobility and the demands of the international maritime market provide incentives for maritime academies to cooperate in the recognition of qualifications and to open their maritime education systems to students from other countries.

Keywords: *enhancing quality assurance, maritime education, IAMU program.*

1. Introduction

Excellence is a cornerstone for universities, academies and institutes, but the quest for quality in maritime education institutions has acquired a new insistence in recent years.Maritime education institutions are operating with increasing independency although it is supposed to work in accordance with a uniform curriculum that is STCW convention.The governmental maritime education institutions receive lump-sum funding from the government, while in return request increased amenability. At the same time there has been growth in the number of private maritime education institutions and a consequent need to establish the quality of their education and training and qualifications. Mass access and competitive support from the maritime industry have put pressure on the quality of maritime teaching and training, at the same time as more marine teachers are indeed, attractive salaries are attracting highly qualified maritime graduates and experienced staff into the private maritime teaching sector. Mobility and the demands of the maritime international market provide stimulants for maritime institutions to cooperate in the recognition of qualifications and to open their maritime education systems to students from other countries. The Arab Academy or Science, and Technology and Maritime Transport is a prime example in the Middle East of such developments and its associated need to agree to standards for quality assurance which can be demonstrated and recognized across borders.

2. Quality Assurance

Quality assurance 'QA' is a generic term in education as well as maritime education and training which lends itself to many interpretations: It is not possible to use one definition to cover all circumstances. QA touches all aspects of maritime education institution life and any project concerned. QA must cover quality management in curriculum development, staff development for QA and QA information systems. Quality in maritime education system depends to a large extent on teachers who are well trained and highly motivated. A key element of any government's strategy is a system of accreditation, enabling teachers to acquire new skills through training and rewarding them with good pay and promotion when they succeed. A host of new skills is needed also for managerial staff, as are classroom resources and technologies, especially IT, for institution management. [R1, 13 and R 22]

3. Preview of Maritime Education and quality Assurance

There is an increasing interest all over the world in quality and standard, reflecting the rapid growth of education and maritime education is not far from this growth. International maritime processes play an important role in the way QA is interpreted and implemented. Some fundamental principles which permeate QA work are:

1-The interests of students as well as employers and maritime society more generally in good quality in maritime education and training.

2-The central importance of maritime institutional autonomy, tempered by a recognition that this brings with it heavy responsibilities.

3-The need for external QA to be fit for the purpose and to place only an appropriate and necessary burden on maritime institutions for the achievement of its objectives.

This applies to academies within the International Association of Maritime Universities (IAMU) as well as other maritime institutes not in the said association.The IAMU program, with its not long and established history (about 15 years) of developing cooperative networks among IAMU institutions is perfectly positioned to assist maritime institutes, shipping companies and port authorities, etc., in their countries in the development of quality enhancement and assurance mechanism. It has done so throughout the few years of the establishment. This review introduces testimony to its achievements. It also illustrates the very specific problems some of IAMU members may face in implementing QA mechanisms that can support the need for continuously maintained excellence in knowledge societies. [R 2 and R 23]

4. Associate Maritime Institutions

It seems there is a need for IAMU program associate maritime institutions to promote the development of maritime national qualifications frameworks as an integral ingredient of QA in the institution. If QA units and offices in some of maritime education institutions have inadequate staff, programs for academic and administrative staff development should be launched and resources should be designated for the ongoing professional development of the said institutions staff. Central information systems in some maritime institutions, which are keys to good decision making, may be a weak spot.These must be upgraded and coupled with the increased use of institutional intra-nets for communication, teaching and learning as well as training. Also if the involvement of employers and students in QA and curriculum process is generally weak, such involvement must be encouraged and supported. In some maritime education institutions, there is a need to develop effective material courses for staff development and training for all levels and types of staff.

4.1 Competences in Maritime Institutions

Competences are obtained or developed during the process of learning by the student/learner. In other words, learning outcomes are statements of what a student/learner is expected to know, understand and/or be able to demonstrate after completion of learning. They can refer to a single course unit or module or else to a period of studies. Learning outcomes specify the requirements for award of credit. Competences represent a dynamic combination of knowledge, understanding, skills and abilities. Fostering competences is the object of educational programs. Competences should be formed in various course units and assessing at different stages. Competences can be distinguished in subject specific and generic ones, and it has highlighted the fact that time and attention should also be devoted to the development of generic competences or transferable skills. This last component is becoming more and more relevant for preparing marine students well for their future role in maritime society in terms of employability. The three types of generic competences:
1-Instrumental competences: Cognitive abilities, methodological abilities, technological abilities and linguistic abilities;
2-Interpersonal competences: individual abilities like social skills (social interaction and co-operation);
3-Systemic competences: abilities and skills concerning whole systems (combination of understanding, sensibility and knowledge, prior acquisition of instrumental acquisition and interpersonal and interpersonal competences required). One focal area could be leadership courses for the senior managers of maritime institutions presidents, vice-presidents, deans, and head of departments. It could cover courses for academic staff about the principles of QA, approaches to curriculum development, new teaching methods and general professional skills updating. Finally, priority support should be reserved for courses for senior administrative staff working in the field of QA and associated administrative areas. Assistance may help to develop the capacities to design models for quality enhancement and assurance mechanism. [R 22]

5. Quality Assurance in Sequence

The sequence of education is changing rapidly in the world; there should be a new connection and synergy between maritime education, research and innovation. Indeed, maritime academies are now attempting to redefine their role in this sequence; they are reacting to perceived and real threats. They are founding marine graduates, research or post graduates schools, they look for new forms of collaboration with industry and in particular maritime industry, and for new ways of financing their research and post graduates programs. They are concerned with the shift of major research funding opportunities away from academia; they are founding research parks. QA has become increasingly prevailing theme in the maritime education and training institutions in more than ten years. However, it would be a mistake to conclude from this increasing engrossment that quality has not previously been an issue for maritime education and training institutions. World Maritime University “WMU” and other MET institutions members in IAMU set education and training ambitious and far-reaching goals for excellence in the pursuit of knowledge.While it may be argued that these academic goals have been frustrated by a more instrumental approach, they still stand as important pillars linking MET and research. The pursuit of knowledge and its transmission remain at the heart of the MET mission and this is recognized implicitly and explicitly in the key documents on OA.
Within this broader sequence, new drivers can playa worthwhile role. The increasing growth in student numbers, the ratification that maritime education and training and skill levels are crucial for the economic, political and social success of the world and national economy, and the understanding that

maritime education and training have become an international and competitive market area, all contribute to the understanding of the need for more transparency and solidarity in QA. [R 9]

5.1 IAMU and Standard Guideline for QA Developments

The word 'standard' is employed in a variety of ways across the world, ranging from statements of narrowly defined regulatory requirements to more generalized description of good practice. The word also has very different meanings in the local contexts of maritime education systems. In IAMU, it may be recommended that maritime institutions should cooperate in quality assurance in maritime education and training in order for it to become more transparent and trustworthy for mariner students and scholars from other countries. The recommendation should outline the essential features of the quality assurance system. These in large part have been implemented throughout IAMU, and can be reinforced by *"The Standard Guidelines for Quality Assurance in IAMU maritime institutions".* [R 22]

5.2 The Standard and Guidelines for Quality Assurance in Maritime Education and Training

There is a set of common principles for internal and external quality assurance. The guidelines stress that QA should be independent, and accentuate the substantive importance of institutional independency with the responsibilities which this brings.The emphasis is on embedding within each maritime education institution a quality enhancement culture that garment its mission and recognizes the distinctive nature of the institution and its mission. At the same time, maritime authority, maritime society and employers need to be assured of the effectiveness and the level of process within maritime institutions.This means that they must introduce measures of continuous self- assessment, while also being subject to external evaluation by their beers and key stakeholders on a regular and systematic basis. In conjunction with this external evaluation, detailed data should be collected and published to provide further indicators of performance. Publication and transparency are fundamental to the IAMU' members approach to QA.

Increasing and improving the quality of information available to mariner students and employers about all aspects of the maritime education and training process will improve confidence and trust in the outputs of maritime education. In practice, it may be difficult to avoid any form of ranking of performance indicators being used to judge the quality of an maritime institution, and difficult to avoid such indicators developing a competitive dimension. Indeed, it can be argued that the ranking of institutions will constitute a form of benchmarking that will contribute to quality enhancement. [R 22]

5.2.1 Standards and Guidelines for Quality Assurance

- The internal evaluation is the cornerstone of quality assurance in maritime education.
- The external evaluation is a condition of the credibility of the results of the internal evaluation.
- External evaluators are accountable for the quality of their activities. A positive external evaluation is one of the conditions for being recognized as a full member (cyclical evaluation).

5.3 International IAMU Network

A number of international maritime networks of QA were established in order to manifest the international dimension of IAMU QA. It will work in collaboration with partners of International Association of maritime Universities "IAMU" in a wide range of projects evaluating the quality of Excellence for maritime educationand training.

5.4 Marine Students Involvement

In the development of quality assurance processes, there is a need to involve marine students actively and fully in all aspects, including both external and internal evaluation, as full members of the relevant institution.

Marine students' feedback in the form of questionnaires will contribute to curriculum development. National marine student surveys can provide valuable information for students applying to maritime institutes and about students' perceptions of the quality of their education. Marine students' evaluation constitutes an important performance indicator that is contributing to the new category tables and the ranking of maritime education institutions.

5.5 Quality Assurance Accreditations

QA tends to be identified with the process of accreditation either of institutions or of study programs. While QA is a fundamental aspect of accreditation, there seems to be a growing realization that distinction should be drawn between accreditation and QA.

5.6 The Framework of the Quality Assurance

The quality of maritime education has to be at the heart of the setting up of IAMU maritime education area. Maritime authorities commit themselves to supporting further development of QA at institutional, national, IAMU and IMO levels. This stresses the need to develop mutually shared criteria and methodologies of QA.

They also stress that consistent with the principle of institutional autonomy, the primary responsibility for quality assurance in maritime education lies with each maritime institution itself and this provides the basis for real accountability of the academic system within the national quality framework. [R 13]

5.7 Qualifications Frameworks

One important element of the QA is the development of qualifications frameworks. Qualifications frameworks are important elements in the quality process because they provide transparent statements for marine students and employers. Both the qualification frameworks and the *Standard and Guidelines for Quality Assurance* emphasize a student–centered approach based on "the development and publication of explicit learning outcomes". [R 13]

5.8 Related Development

The development should stress the importance of detailed and timely institutional and curriculum information, incorporating assessment processes and criteria. In the allocation of credits, it provides a basis for transparent and truthful curriculum planning based on learning outcomes and the associated workload for an average students.

5.9 Recognition

Recognition is a central objective of the quality process. In IAMU, we may stress the importance of recognition and the provision of information in order to reinforce recognition through detailed transcripts which, in turn, can contribute to another quality instrument- the Diploma Supplement. The Diploma Supplement provides, in a coherent and consistent form, easily accessible information about the content and level of a qualification together with a range of other information to assist stakeholders in its evaluation.

5.10 Staff Development

Staff development and training is a fundamental aspect of the implementation and sustainability of a QA and enhancement culture. The primary responsibility for training and development lies with maritime educational institutions. May be in some academies there are formal training requirements for new academic staff, there is a general tendency to emphasize academic qualifications as the basis for entry to the profession, and little formal training in academy teaching is given or required.

6. Quality Assurance in IAMU

There is a strong and important cultural dimension to quality which should not be obscured by the increasing search for international standards. Irrespective of the different cultural and historical contexts, a common vocabulary and understanding of concepts is developing.
The main drivers of change in maritime education and training and the incentives for introducing a national and maritime institutional QA process can be identified as:
- the growth in maritime education,
- concern to improve standard for national and regional employment and international and international recognition,
- the need to respond to an increasingly competitive environment,

The implementation of a more structured approach to QA and enhancement is a challenge for academic and administrative staff at all levels:
Leadership: The quality of leadership and the support of the senior management was a postulate. The development of leadership skills as a part of the quality agenda may be a topic which maritime institutions and maritime authorities should considered.
Teaching: For achieving change, it requires an explicit recognition of the professional importance of teaching and ongoing marine staff development. Attestation procedures which review teachers' contracts every certain year continue to place a heavy emphasize on formal qualifications and publications. The results of student feedback questionnaires play a part, but this tends to be negative rather than positive: wicked student feedback results over a period of time might, in extreme cases, lead to the termination of a contract, while in general, evidence of high-quality, effective teaching does not appear to lead to explicit reward or recognition. Indeed, the process of 'attestation' is not a substitute for a process of more regular staff evaluation within the maritime education institution, linked to a policy of continuing professional development.
Staffing: QA is a developing field and the staff is charged with responsibility for implementing this work to keep up-to-date with local, national and international developments in the area.This requires a dedicated team of professionals who will gain and keep the respect of colleagues through their commitment to professional standards. In maritime education institutions, it is essential that the QA office/department should have an appropriate full time level of staffing capable of ensuring the implementation of all aspects of QA and enhancement within the institution. It is not sufficient simply to develop full documentation of processes and procedures, which in itself is a significant and time-consuming professional task; effective implementation of the processes must be supported and maintained, and documentation kept continually up to date. Achieving this will require professional, well-qualified administrative staffs that are well supported and included in the staff development process.
Self-assessment: Self- assessment is used widely in the preparation for national accreditation. It is evident that it is demanding regular cycle. However, the focus is on meeting the demands of the accrediting body and responding to the criteria which it sets frequently with emphasis on quantitative data.

Faculty autonomy: The concept of an autonomous, responsible maritime education institution is difficult to realize in a situation where units within the maritime institution, such as faculties and departments, militate against a coherent and consistent application of QA and enhancement processes. It cannot be in the best interests of students, who will increasingly wish to study on a multi- or interdisciplinary basis and take units or modules from outside their department or faculty as part of their personal development and in preparation for the diverse needs of the contemporary maritime labour market.

Student involvement: The student's experience is fundamental to the quality debate. While marine student feedback questionnaires are increasingly becoming the norm, it should not be seen as the only way in which marine students can be engaged in the quality process. In a student –centered learning environment, students should be encouraged to develop a critical awareness and understanding of the teaching and learning process for their personal development, and an analytical approach to their experience. Increased transparency will not only help to build public confidence, it will also act as a powerful incentive to all staff and students within an institution to adopt a responsible and proactive approach to enhancing quality.

Competition: Competition is explicitly a driver for the introduction of quality procedures. The competitive environment may be generated by different factors: a selective admissions process within which marine students and their families are actually aware of what the maritime education institution is offering; the need to earn and justify higher tuition fees; an awareness of international competitors; the demand of maritime labour market; an increasing awareness of international competition for the best students. Competition for the most able professional staff also provides a powerful incentive for maritime institutions to address issues of quality in order to enhance their reputation and attract and retain the best staff.

Information systems: Institutional self-knowledge is the starting point for effective QA. It is important that maritime institutions should have the means of collecting and analysing information about their own activities. Without this will not know what is working well and what needs attention or the results of innovatory practice. The absence of effective information systems that make the fullest use of information communication technology and interactive software means that a pillar of the QA requirements is missing. It is difficult to see that effective self-assessment for external or internal purposes can take place without such information. [R 23 and 24]

7. Conclusion & Recommendations

The following is a brief set of conclusions and recommendations that are designed for both the maritime institute members in IAMU and IAMU itself:

Conclusion: It is here proposeed that IAMU should study all QA systems used in maritime institute members in order to establish one unified QA system, it may include courses for academic staff on the principles of QA, approaches to curriculum development, new teaching methods and for senior administrative staff working in the field of QA and associated administrative areas.

Recommendations:

1- Promoting the development of qualification frameworks as an integral component of QA inmaritime institution.

2- Launching programs for maritime staff development at all levels – academic and administrative, and earmarking resources for the ongoing professional development of the staff.

3- Upgrading information systems in maritime education institutions coupled with the increased use of institutional intranets for communication, teaching and learning.

4- Supporting maritime institutions in the development of an integrated institutional approach to QA and management structures.
5- Encouraging and supporting the involvement of employers and marine students at a national and institutional level in QA and curriculum process.
6- IAMU should urge maritime education institutions to continue their efforts to enhance the quality of their activities through the systematic introduction of internal mechanisms and their direct correlation to external quality assurance.

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Challenging the Current Paradigms of Seafarer Training and Careers

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For many years, the traditional Maritime Education and Training (MET) approach has been the vehicle through which seafarers are prepared to serve onboard ships. A key principle governing MET is ensuring all seafarers are trained according to the minimum standards set under the International Convention on Standards of Training, Certification and Watchkeeping (STCW). Although this principle is applied by most MET education providers, there is a general consensus in the literature that quality issues still exist for seafarer training. Apart from the low quality of some of the seafarers trained by some MET providers, other key deficiencies appear to exist for seafarer training in the 21st century.

This paper argues that the current education paradigms being used for the training of seafarers appear deficient in the face of the growing manning crisis among shipping industry employers. Specifically, the crux of the training provided by all MET institutes fails to address the varying career expectations of seafarers. To a large extent, the focus on MET has been on emergency response and technical training. Given the high rate of attrition among ship officers within the global shipping industry, it is important that current paradigms used for the training of seafarers are revised to address the long-term labour needs of shipping industry employers. This may be achievable if the current seafarer training programmes used by MET providers are extended to promote a more sustainable career path for seafarers from leaving school until retirement. From a practical perspective and as per the tenets of staff development and training in general, the changing nature of work and the work place environment requires that employees are trained to enable them to adapt and be flexible in line with future career changes.

The literature provides evidence that the retention of ship officers is a key human resource challenge that needs to be addressed. With limited career options within the shipping industry, seafarers may be compelled to seek jobs in other industries. Considering that the high level of attrition may worsen the prevailing labour crisis in the shipping industry, pragmatic measures are needed at all levels within the industry to improve retention. This paper argues that improving the current paradigms under which seafarers are trained will provide a more sustainable career path for seafarers as well as compensate for the poorer human resource practices among some shipping industry employers; identified as one of the key reasons for the difficulty in retaining ship officers onboard ships. Whereas the ship officer shortage problem could be addressed using a variety of pragmatic human resource policies and strategies, a new approach is being proposed in this paper which advocates the need for MET to be consistent with the career needs of seafarers. Essentially, this means a critical rethink of the current paradigms used in seafarer training is needed to chart a new and more sustainable career path that will ensure their eventual retention within the shipping industry.

Keywords: seafarers, retention, training, paradigm, education, career, shipping.

1. Background

Retaining ship officers at sea has been identified as one of the key human resource challenges for shipping industry employers [1, 2]. With a high attrition rate also reported among cadets [19, 24, 28], the prospects of maintaining a regular pool of seafarers to occupy the vacancies created by departing ship officers is decreasing [33]. Also, working conditions onboard ships at sea has changed tremendously over the last two decades leading to a further negative impact on the ability of shipping companies to retain seafarers. As a result, the current global seafarer labour statistics suggests a shortage of 13, 000 ship officers [16, 26]. This is forecasted to increase in the future as new generation ship officers tend to leave sea within the first ten years to pursue landside careers [1, 2]. Another important issue that helps in understanding why the retention of seafarers is challenging is the generation gap factor. The two main generations are Generation X (born between 1965 -1977) and Generation Y (born between 1978 -1994) [3, 4]. The generation gap has much influence on the progressive mobility of ship officers to landside jobs due to the differences in the level of expectations between the X and Y Generations in the seafaring industry [5]. Caesar, Cahoon and Fei [1] argues that most shipping industry employers do not appear to have a strategy that addresses the different generational expectations from their seafarers. Consequently, the differences in expectations of the two generations makes it difficult to conveniently reduce the increasing attrition of seafarers to landside jobs [1, 2, 19].

The availability of ship officers is not only necessary for the operation of a growing world fleet, but also plays a contributory role in the maintenance of a viable workforce for allied industries ashore [5, 32]. There is the need for an improvement in retention in order to prolong the number of years that ship officers spend onboard vessels before moving to landside jobs [2]. This is because, the era where people will want to have seafaring as a lifetime career is gradually phasing out. Structural changes in the industry such as advanced handling technology, reduced time in port, and the remote location of ports away from city centres have changed the very fabric of life at sea [16, 26]. Knowing how to address all these challenges are necessary from an industry perspective to attract new talents as well as keep those already working onboard ships.

Given that the underlying reasons for the shortage of ship officers in the global shipping industry are human resource oriented, employers have used many strategies to address the problem. On the recruitment side, the use of employer branding strategies to attract more people into seafaring has been advocated [5, 6]. Since the ship officer shortage is more of a retention issue, using a succession planning strategy to ensure a steady supply of seafarers and improving working conditions to avoid the breaking of the psychological contract is regarded as a more reliable approach [1, 2]. Many shipping industry employers have also been engaged in poor human resource (HR) practices such as crew poaching to sustain the supply of ship officers for the safe operation of their vessels. Crew poaching reflects the inadequacy of the current HR practices among shipping industry employers and highlights the pressing need to introduce innovative strategies to effectively address the complex range of retention issues aggravating the ship officer shortage problem in the global shipping industry [2, 27].

This paper proposes an unorthodox method to improve retention among ship officers. Specifically, a review of the current paradigms being used in the provision of MET for seafarers is advocated. The aim of such an approach is to ensure that seafarers become more career-oriented after their MET. Despite the many challenges confronting effective seafarer training [see for example, 7] the current framework under which MET institutes educate seafarers is at an all-time high in terms of the standards and revisions given under the 2010 Manila Amendments. However, improvements are needed. Firstly, authentic assessment methods are needed for seafarer training [8]. Also, current MET curriculums do not appear align with labour market needs as they primarily focus on emergency response and technical training without accommodating the career ambitions of trainees. Given the different career orientations of people who enter MET institutes to be trained as seafarers [9], training manuals should be updated to reflect and address their career needs. The design and implementation of a MET curriculum that incorporates the mapping of potential career paths could offer yet another opportunity for shipping industry employers to better understand and manage the pool of maritime labour at their disposal.

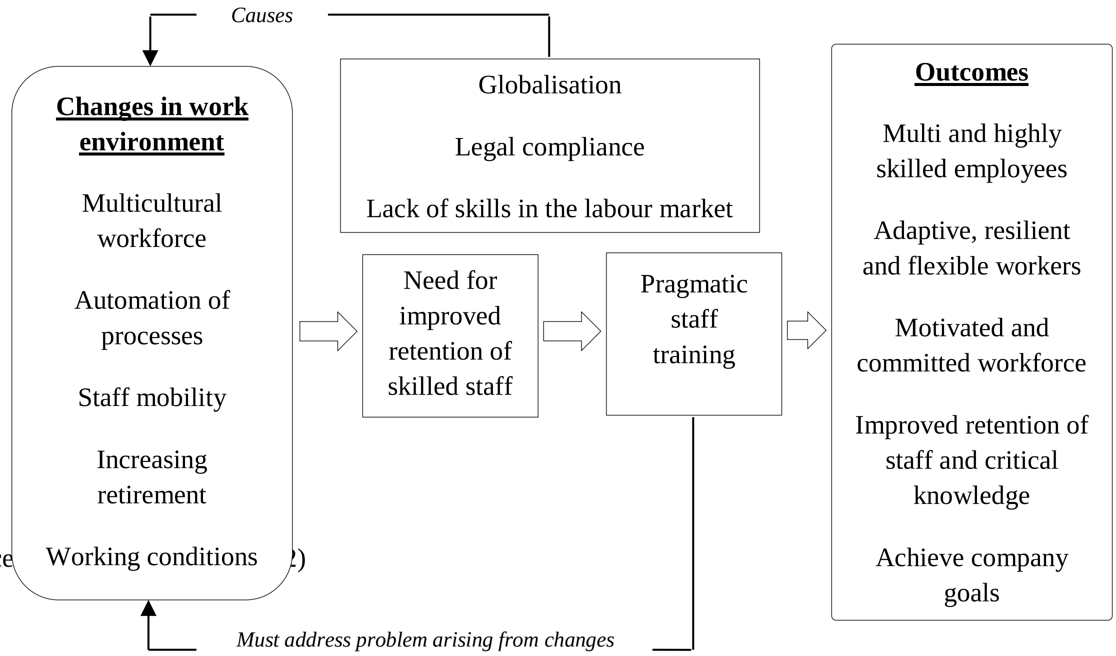
2. Human Resource Framework

2.1 Staff Training, Development and Careers

Staff training was not traditionally regarded as an organisational activity to help companies stay competitive but such a view has given way to a new approach where training and development is relied upon as a tool to improve organisational performance and manage the respective career ambition of employees. The general human resource literature suggests that it is important for

employee training and development to be undertaken that creates a workforce that is adaptive, resilient, flexible and abreast with trends in the labour market [10]. This is quite an important element of effective training as the environment within which employees work is increasingly dynamic. Changes (such as increasing cultural differences in the workforce, automation of processes and increased staff mobility) are occurring within organisations and the environment in which they operate due to globalisation [11-14]. One notable change is how working conditions are varying, which places more reliance on the skills, knowledge and patience of workers. As working conditions change, employees may respond by leaving their organisation for more job-friendly markets.
It is necessary for organisations to understand the reasons for high staff turnover [15] and to develop corresponding pragmatic measures to address the problem. This also highlights the need for the better management of tacit knowledge in organisations to alleviate the side effects of voluntary turnover [16, 32].

In addition, employees may leave an organisation as the limited access to opportunities for training and development leads to curtailing of their career ambitions [17]. This prompts a need for organisations to actively make staff training and development a key aspect of their human resource policies to influence turnover decisions in their favour. For example, where an employee is unable to adapt to changes within a job or organisation due to limited knowledge, the natural response may be to leave but an organisation that provides relevant training and development for its employees is more likely to retain them under changing conditions. Figure 1 suggests that since employees may respond to changes in their work environment by leaving, a need to improve retention under such circumstance emerges. To address the arising need, organisations may rely on the provision of pragmatic training to staff to make them better suited for new roles or be adequately prepared to move into higher positions with the retirement of upper-level managers. This can be achieved through succession planning as it provides a process for employees to be identified early for potential career advancement [10]. Career certainty may reduce the potential for voluntary turnover for some employees. The process of relying on training as a tool for improving retention means that an organisation may use skill-based systems to compensate workers alongside an effective career management scheme in which efforts are made to maximise the career motivation of employees.



Source)

Figure 1 Elements of pragmatic staff training

Given that employees may leave their job as a result of unmet expectations, lack of opportunities for training and career advancement and the feeling of being unrecognised, pragmatic training could help managers to adequately engage their workers and achieve both corporate objectives and individual career goals. Consequently, by providing employees with opportunities for advancement through career-oriented and change-resilient training regimes, organisations may be able to retain them for longer periods.

2.2 Shipping Industry: The Training and Career of Seafarers

Finding quality labour to operate the ships involved in global maritime trade should be a central aspect of recruitment efforts aimed at attracting seafarers to the shipping industry. To achieve the needed quality, seafarers must be given appropriate training. In the shipping industry, the training of seafarers is done through the traditional cadet system where trainees are expected to undergo classroom training at an accredited MET institute after which an arrangement is made for a shipboard practical experience. Although, the core reason for the existence of MET facilities is to supply quality manpower for the shipping industry through the provision of requisite maritime training [18, 19], there are many challenges and shortcomings that need to be addressed. Specifically, the literature [see for example, 19, 20, 21] discusses the following issues. First, most shipowners have partially neglected the responsibility of seafarer training; largely due to the unavailability of adequate berths and the high costs of developing seafarers into ship officers. This lack of training berths and apparently limited commitment among shipowners has led to a stiff competition for training berths among cadets. Second, there are also problems related to high wastage among cadets due to poor onboard mentorship and the lack of collaboration between MET institutes and the shipowners who employ their products (cadets). The aforementioned challenges not only constitute an obstacle to the recruitment and training of seafarers but equally endanger the future supply of seafarers to the growing shipping industry. As a result, shipping industry employers and other stakeholders need to appropriately respond to the inadequacies of MET in providing a more definite and resilient career path for seafarers.

Among the stakeholders of the shipping industry, there are also issues with the quality of training given to seafarers [7]. Problems such as the low quality of instruction and competency of the professional instructors in MET institutes from developing economies (a relatively debatable assertion) is considered as below industry criteria set under the International Convention on Standards of Training, Certification and Watchkeeping (STCW). Concerns have also been raised in relation to the assessment methods used by MET institutes for the training of seafarers [8]. These issues are however beyond the agenda of the current paper. It appears a new challenge has been opened in relation to the training and career of seafarers given the emerging trend of increased mobility to landside jobs among the ship officer cohorts – deck officers, deck engineers and junior officers. The need to address the effects of structural changes to working conditions at sea is becoming more evident. Essentially, the shipping industry needs a training regime which is not only pragmatic but equally produces multi-skilled seafarers in a globally competitive labour market. This may improve the overall retention of seafarers within the general maritime industry.

One of the elements of pragmatic training, as explained within the general human resource literature, is that it must lead to the realisation of a more committed and adequately motivated workforce. This requirement is lacking for the training of seafarers in the global shipping industry. For instance, during the shipboard aspect of MET, the seafarer's experience may erode their motivation to continue in the career of seafaring [22, 23]. Gould [21, p.280] describes the experiences of trainee seafarers with phrases such as, *"Physical confinement, restricted diet, distanced from family, unsupportive attitudes and hostility from mentors onboard".* Both MET institutes and their training partners could introduce measures into their training methods to alleviate the impact of the negative experiences of trainee seafarers since it adversely influences their career decisions and eventual retention at sea. Also, these collections of experiences largely contribute to cadet attrition [19, 24] as it is in direct opposition to their expectations – leading to a breaking of the psychological contract. Thus, the inability of the current MET system in addressing the pertinent career concerns of seafarers warrants a rethink to align current career trends in the global shipping industry.

The deficiency in the current approach for training seafarers is summarised in the word ‘reactive’. The shipping industry has always been reactive in its approach towards many issues including the management of human resources – recruitment, training and retention of seafarers [25]. A careful scrutiny of STCW 95 and its subsequent revisions reveals that shipping industry stakeholders only made changes when a particular disaster or problem occurred [7, 26]. From the perspective of acquiring and retaining skilled labour, a question needs to be asked of how shipping industry employers can become sustainable organisations for the future? This is because the current training regimes used by MET institutes and other stakeholders to train seafarers need refocusing. A long-term approach is needed for the recruitment and training of seafarers in order to ensure sustainability of supply [27]. Any MET process attempting to achieve sustainability of supply must have a career development programme for new entrants and existing employees as its foundation.

3. Current MET Education: Need for Paradigm Shift

The discussions in the previous sections explain some challenges confronting MET institutes in their training of seafarers. More importantly, it is necessary that MET institutes provide a pragmatic type of training to seafarers by taking their career ambitions and varying expectations into consideration. To achieve this, a couple of issues need to be addressed. First, there is a need for collaboration between MET institutes and shipping industry employers and with other relevant stakeholders. As Baylon and Santos [7, p.34] suggest “the role of MET institutions is vital for the success of the maritime industry. But in essence, a strengthened and amplified cooperation amongst the different maritime industry sectors – government, MET institutions, and shipping companies is crucial for the benefit of the seafarers and their family and ultimately for the success of the industry”. It is important to understand that the lack of collaboration between MET institutes and other parties connected to the training of seafarers creates dissatisfaction among cadets and eventually culminates in high attrition – disturbingly at the ‘sunrise’ stage of the cadetship [28, 29]. The difference in interests of major stakeholders connected to the cadetship was found to be responsible for the lack of collaboration among them [19]. Thus, both the employers and trainers of seafarers will need to realign their objectives in relation to training strategies towards a more workable model for the hiring and recruitment of seafarers.

Second, for MET institutes to design and offer pragmatic training to the next generation of seafarers, it is important to know who they are in terms of the level of intelligence, career expectations, and so on [31]. This may help in the designing of pedagogies that could help improve their retention. To achieve this, the psychological testing of seafarers during recruitment is needed. It seems the call to test and know the stress level and expectations of new recruits before admitting them to training and subsequently working onboard ships was made several decades ago. This is evident in the work of Kline and Rogers [30 , p.173] when they indicated that, “one of the most essential elements in recruiting as well as retaining a vigorous and vital merchant marine is understanding the merchant seaman himself – knowing where he is recruited, what his future plans are, what type of individual he actually is”. In this vein, the study manuals used for training at the MET institutes should be designed to cater for this important issue. Figure 2 illustrates how better management of the hiring process for seafarers can be achieved to improve recruitment numbers and effectively manage the varying expectations with which people enter into the seafaring career. The figure essentially suggests that people entering into the shipping industry are multi-generational which translates into different expectations and career ambitions. Pragmatic MET can be used to address these expectations with the conducting of appropriate psychological testing of entrants in the early stage of their training. When the career expectations can be addressed through requisite MET, they are more likely to continue working within the larger maritime industry as they will become multi-skilled, resilient and amore adaptive to the continuing changes in the shipping industry working environment.

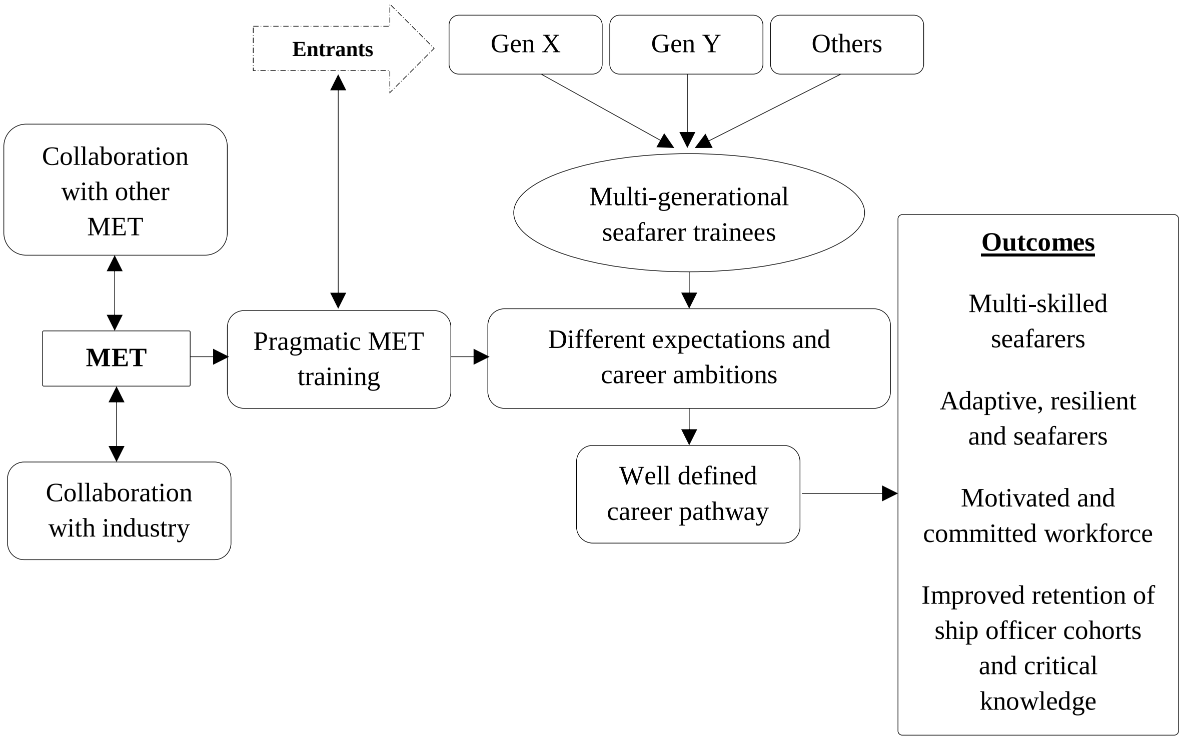


Figure 2 Pragmatic MET model

4. Conclusion and Future Directions

In this paper, the shortcomings of the current paradigms used by MET institutes in the training of seafarers are discussed by highlighting the need for a rethink of existing pedagogies to cater for the career ambitions of trainees in a highly dynamic workplace. The approach being proposed by this paper is to address the complex range of expectations of seafarers in the shipping industry to alleviate the ship officer shortage through pragmatic MET. A critical question has emerged as a result – Where does MET lead seafarers in terms of their career ambitions? This concerns the collective questioning of what is currently happening with seafarer training and then proposing a better approach. Unfortunately, the current paradigms focus on technical and emergency response to the detriment of the career needs of seafarers in the prevailing global labour market.

The foregoing discussion in this paper suggests the need for current seafarer training paradigms to be consistent with their career ambitions. Further work, collaboration and research are needed to arrive at an all-inclusive MET system where the career ambition of seafarers is taken into consideration. From the perspective of MET institutes, shipping industry employers and the International Association of Maritime Universities (IAMU), the following suggestions for future research directions are provided to develop a more pragmatic training regime and better management of the global pool of seafarers.

- An important area of research is to identify the skills and competencies needed by seafarers during the next 20 years and importantly align this to career paths as it is becoming more likely that being a seafarer for life as a career is becoming less attractive. More research is thus needed to highlight the details of the current training curriculums used by MET institutes and extrapolate their future value.

- Among shipping industry stakeholders an appropriate career path needs to be defined for seafarers where there is an integration of both sea and land office positions. This may help to keep highly skilled seafarers such as those within the officer categories from entirely leaving the shipping industry. This calls for vertical integration among the employers of seafarers and other industries where their multi-skills in operations and management may be needed. Specifically, a multi-stakeholder approach is needed to harness innovative MET schemes that could represent a practical alternative to the measures being adopted singularly by shipping industry employers to address the career aspirations of seafarers for their eventual retention at sea. As Teo and Short [30] suggest, collaboration is needed among stakeholders such as shipowners, vessel operators, ship managers, MET institutes, Flag State Administrations (FSAs), the International Transport Federation (ITF), International Chamber of Shipping (ICS), National Labour Authorities, etc. for the achievement of a reliable education and training regime towards effective global supply and retention of seafarers.

- One of the reasons for high attrition may be that companies are not aware of the diversity of people they recruit into the industry. MET institutes have a significant role to play in identifying the type and length of career of their students and whether they intend on remaining in the shipping industry at sea and on land [31]. Since it is difficult to get people into seafarer training and even more problematic retaining them at sea, a range of different career paths should be clearly articulated when recruiting cadets.

- A critical look at the outlined objectives of the IAMU on its websites reveals the following: “need to preserve highly qualified human resources in the maritime industries through effective education and training by virtue of scientific and academic rigour” and “develop a comprehensive Maritime Education System”. This objective provides an opportunity for increased collaboration among IAMU members through Working Groups and joint research projects to further consider MET for 21st century seafarers to create a sustainable industry whilst also addressing seafarers’ career aspirations.

As can be seen from the above points, what is clearly lacking for the global shipping labour market are distinct career pathways for seafarers both at sea and on land, but within the same industry due to the increasing likelihood that seafarers will not remain at sea until retirement. Defining career paths for seafarers is necessary as they will supplement other efforts aimed at improving the recruitment and retention of seafarers among shipping industry employers.

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Session 2H

Marine Engineering Training

The New Maritime Engineering Education at the Technical University of Denmark (DTU)

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Until 2010, the maritime engineering education at the Technical University of Denmark (DTU) followed the rather classical naval architecture approach with the main focus on marine hydrodynamics and strength of ship structures. The number of students was rather modest and constant. However, at that time the last major ship yard in Denmark was closing down and ship operation, together with ship design, became the main working area for the students after graduation. It was then decided to broaden the naval architecture education to a maritime engineering education taking marine logistics, management, transport optimization and engine system design into to the curriculum. Furthermore, the concept of green shipping was introduced wherever relevant in teaching modules at DTU and two new maritime engineering courses were introduced: (1) Sailing practice in a merchant vessel or DTU’s research vessel (guided by the experience gained from Australian Maritime College in a similar course) and, (2) Green transportation dealing holistically with global ship transport. Furthermore, study trips to Asia visiting ship yards have been made possible by support from the various private funds.

This new maritime engineering education has so far been very successful with the number of students increased by a factor of two and with very good job opportunities in the Danish maritime industry. A spin-off of this change is DTU's participation in a dual MSc degree engineering program: Nordic Master in Maritime Engineering where DTU is responsible for the study track Ship Operations. This change has also led to the creation of the centre Maritime DTU as a one-point entry for the industry and maritime authorities regarding R&D related maritime issues.

The paper will discuss the process and the way ahead for further strengthening the interaction between maritime industries, ship owners, maritime authorities and universities dealing with maritime engineering in Denmark and internationally.

Keywords: Maritime engineering education, engineering curricula, globalization, green shipping, holistic education

1. Background

The significant changes in the maritime industry in Denmark and the EU within the last couple of decades have of course also had implications for the maritime engineering education. Whereas ship design and ship building at numerous shipyards in Denmark defined the core topics in the education in the nineties, the shift towards focus on ship operation and ship management has led to significant changes in the education. The first major step was taken after an internal seminar (Innovation in the Maritime Industry) in Denmark in May 2011 and a subsequent survey report, [1] (in Danish), for a pointing out recommendations for a modified maritime engineering education. The most profound change was to abandon the old definition of a *naval architect* as one being solely able to do stability, propulsion, sea keeping and strength of ship structures and replace him/her by a *maritime engineer* with a more holistic background covering topics like ship management, ship route optimization, ship logistic, ship economy in addition to the classical disciplines. Of course, all of these topics cannot be covered in depth in the education and that led to a so-called T-shaped competence profile, [2], where the horizontal bar represents a broad coverage of many relevant disciplines for the maritime industry and the vertical bar the actual maritime specialization chosen by the student. The introduction of this T-shaped education has been relatively smooth so far at the Technical University of

Denmark (DTU) in the BEng and BSc education as described by Andersen and Nielsen [2] partly due to the willingness of lecturers in non-maritime courses to include wherever relevant maritime related examples and course work and partly due to the commitment of the maritime industry to give guest lectures, define relevant cases for project work and offer student jobs. The success can be measured in the number of undergraduate students with a maritime profile and this number has been doubled in the last year, raised from about 30 to 60. As the intake of new students at DTU is constant, this increase was more than expected.

The next step is to ensure that the increased interest by the students in the maritime field is kept. The focus will mostly be on:

- Increased on-hands experience with ship operation by sailing practice in merchant vessels or in the research vessel owned by DTU
- Dedicated projects with the maritime industry with focus on green technologies
- New courses on the MSc level dealing with current topics of interest by the industry (e.g. energy efficient ships, sustainability, retrofit, decision support, exhaust gas emission, arctic ship operation and use of composite materials)
- Help to prepare individual study plans for maritime students to ensure proper course selections for both the horizontal and vertical bar in the T-shaped education profile taking into account the main interest of the student. This is no trivial job given that DTU offers around 1,000 courses on a yearly basis
- Cooperation with other Nordic universities through the Nordic Master in Maritime Engineering to increase the specialization available for the students
- Study trips for the students to ship yards in the Far East

In the following sections some of the bullet points above will be addressed.

An important instrument in this effort will be the newly established centre: Maritime DTU. The centre is virtual in the sense that it covers all maritime related activities at DTU without moving people from their current research groups and departments. The centre shall act as a one-point entry to DTU for the maritime industry, the students and the researchers for information and shared knowledge about education, problems, possibilities and solutions of current interest for the maritime sector. Here the students can get advice on course selections and help to prepare their study plan. One of the instruments in the centre will be a website open for everyone from high school students to the industry. In the centre, maritime related information of new courses, guest lectures, project proposals, internship, student job, social events etc. will be made available. The website will also link to the maritime students' own website, [3], as this organisation, Nul-Kryds, is very active in the social life at the campus for students with maritime interests and also arrange company visits, study trips and information evenings.

2. On-hands Experience with Ship Operation by Maritime Engineering at Sea

One of the main recommendations from the survey in 2011 was that it would be beneficial to both students and the industry if the students get practical experience working on a marine structure in operation during their study. For offshore structures it is difficult, due to the strict safety requirements, but for sailing on board merchant vessels the situation is better. Previously, students have occasionally been going to sea for a short period typically during the summer vacation, but now a specific BEng/BSc course has been formulated:

<u>41280 Maritime Engineering at Sea, 5 ETCS</u>

The duration of the course is approximately three weeks and the actual time of the year depends on the sailing schedule of the chosen vessel. The core content is to give the students hands-on-experience in the operation of a large vessel and the possibility to relate theoretical predictions to actual measurements. The complete list of learning objectives of the course is given below and, although not all of the objectives necessarily are fulfilled during a specific execution, a student who has met the objectives of the course will be able to:

- consider the ship from a holistic point of view
- explain the overall problems designing a ship
- work in teams with people with different background
- explain the role of the crew members
- explain the overall flow in the energy systems on-board
- explain the role and function of the different components in the energy system
- calculate the exhaust emissions from the ship
- measure and estimate the noise and vibration level on-board the vessel
- measure the ship motions in waves
- evaluate the route chosen in relation to the weather encountered
- estimate a proper trim of the vessel in the given loading condition
- estimate the wave loads on the ship

Two options of the course exist:

Option 1 (A merchant vessel): Approximately 3 weeks on board a Danish merchant vessel. Max. 2 students on each trip.

Option 2 (DANA): 5-7 days on board DTU's research vessel DANA. 2-10 students on each trip.

In the first half of 2014, 13 students have signed up for option 1 and 6 students (maximum number this year) for option 2. In option 1, the ships have been or will be container vessels from Maersk Line and tankers from Maersk Tankers, but other options are also available and were used last year, e.g. DFDS and Royal Arctic Line. On board the vessels the specific topics have been inspections of ballast tanks, measurements to be used in connection with retrofit of a new bulbous bow, retrofit of lightening system, and noise measurements, to mention a few. Due to a generous funding from the Danish Maritime Fund and the hospitality of the ships and ship owners, the sailing practice takes place worldwide with port calls in China, Japan, Singapore, US, Brazil etc. without travelling expenses for the students themselves. This obviously adds to the incentives and possibilities for the students to take the course.

Option 2 is available only if DTU's marine research vessel DANA is going for a longer trip. This was the case in March 2014 where the ship was headed from Denmark to Bermuda for a marine biology study of the European eel. Six maritime engineering students could join the trip and they had a good (and due to the weather also rather tough) journey from February 28 to March 14. During the trip, when seasickness allowed for it, noise and vibration measurements were conducted with professional equipment (SVAN 959) sponsored by the Danish Maritime Fund. In addition various jobs were undertaken like new stability calculations for the vessel together with a recording of the daily operations of the vessel in harsh weather (Figure 1). Basically, the student activities on board followed the same approach as described by Thomas et al. [4] for student activities at sea at the Australian Maritime College.

Figure 1 Student experience on board the research vessel DANA in harsh weather

3. Dedicated Projects with Industry with Focus on Green Technologies

The Danish maritime industry has taken up the recommendations from the survey report very seriously and the industry has been much more visible at the university the last couple of years. Companies are very positive as regard students going to sea as described above, but also in providing guest lectures to courses, student jobs and offer interesting proposals for BEng, BSc and MSc projects. The project proposals cover all aspects from the maritime field and come from ship consultancies, ship owners, offshore oil drilling companies, engine manufacturers, marine equipment suppliers and the Danish Maritime Administration. Currently, about 35 proposals can be found on the DTU website, but continuously new proposals arrive at DTU Maritime, where the projects are scrutinized and modified such that they satisfy the university requirements for project work. These project proposals deal primarily with energy efficiency, safety and environmental issues, but logistics, life cycle cost and operational management are also part of many of the proposals. Often they contain an innovative design aspect as, e.g., in new vessels for installation and/or maintenance offshore wind turbine parks. All this fits nicely into the new holistic maritime engineering education, the T-shaped profile, and the students thereby already in their study see applications and the need of the broader education profile.

4. Courses on the MSc Level

The dedicated MSc courses in maritime engineering are limited to four by the university as a part of the desire to limit the overall number of courses offered. The four courses, all taught in English, are:

41216 Structural Assessment of Ships, 5 ETCS: The main emphasis is on the determination of the global response of a given ship sailing in waves. Safety against global failure of the hull girder will be evaluated under normal operation conditions. Accidental loads (collision and grounding) will also be covered as well as rational rule development.

41221 Ship Propulsion and Manoeuvring, 10 ETCS: To provide students with the necessary theoretical background for applying modern scientific methods for analyses of flows with lift, free surface and cavitation, i.e. flows over ships, rudders and propellers. The students will be able carry out hydrodynamic analyses and optimization of propulsion and manoeuvring of ships.

41222 Wave Loads on Ships and Offshore Structures, 5 ETCS: After completing this course, the student should be able to use linear potential flow theory to predict the wave induced motions of floating maritime structures. An understanding of the strengths and weaknesses of different numerical solution techniques will allow the student to make the appropriate choice depending on the application. The primary focus for example applications is on ships, offshore wind turbines and wave power devices.

41275 Ship Operation, 5 ETCS: The overall aim of the course is to provide an understanding of the engineering and mathematical analyses that form the basics of monitoring and decision support systems used for on board/navigational guidance of ships. These techniques are used by naval architects and engineers in the technical departments of ship owners, in classification societies and ship consultancies. Moreover, the student will be trained in advanced methods to evaluate ship operations with regards to the increased focus on energy consumption by and emissions from ships.

All four courses have been modified to accommodate the recent change towards a more holistic maritime engineering education but not as much as the BEng and BSc courses, see [2]. The reason is that the vertical bar, the specializations, in the T-shaped engineer basically consists of methods learned in MSc courses. However, changes have been made regarding the course work examples, and a greater use of guest lecturers and industrial visits. This is especially so in the course Ship Operations where three assignments: Risk of Cargo Loss in a Container Vessel, Analysis of Full-Scale Measurements and, Route Optimization of a Container Vessel reflect the overall changes towards an integrated approach involving mechanical, logistical and management tools. Detailed information of all the courses can be found on web page for DTU, [5].

The prerequisites for the students for these MSc courses are knowledge of the general arrangement of ships and offshore structures as e.g. learn in the BEng/BSc course 41271 Ship Design (10 ETCS). This course was developed some 15 years ago, [6], in close cooperation with experienced naval architects from the Danish maritime industry and the textbook made summarizes the experiences from a vast number of actual ship designs. The textbook is currently under revision to include the rapid change in ship types and ship sizes as well as with a larger focus on energy efficiency and environmental problems.

In addition to the annually running of four MSc courses mentioned above usually 1-2 additional and optional MSc courses are offered each year within a maritime topic of strong current interest. For instance, in 2013 two courses were given on Arctic maritime operations by Professor Pentti Kujala from Aalto University in Finland with a large number of students and participants from the maritime industry.

5. Nordic Master in Maritime Engineering

With the limited number of maritime MSc courses and the associated small staff, not only in Denmark but also in other Nordic countries, it was found appropriate to investigate whether some of the universities could join forces in a common MSc program. It was not an easy task mainly due to different administrative procedures and semester structure. However, a two-year dual degree program Nordic Master in Maritime

Engineering was finally established in 2011 between the five Nordic Universities: DTU in Denmark, Aalto in Finland, KTH and Chalmers in Sweden and NTNU in Norway with the following agenda, see [7]:

The Nordic Master in Maritime Engineering is based on the expertise of the participating universities within naval architecture, offshore engineering and maritime engineering. The programme targets international students wishing to profit from the Nordic Five Tech universities' long standing tradition and competence in the field and Nordic students wishing to specialize in a specific area of expertise offered within the alliance.

The education is based on first principles within design, construction and operation of ship and offshore structures, including hydrostatics and stability, hydrodynamics, wave and wind loads and structural analyses. The teaching comprises lectures, assignments, workshops and project work. Theory is supported by experimental work and computer simulations are used intensively.

The students enrolled in the program will spent the first year in one of the countries and the second year in another of these countries. The choice of university depends on the interest of the students, and to facilitate their decisions five study tracks have been formulated: Ocean structures (NTNU), Passenger ships (Aalto), Ship design (Chalmers), Ship operations (DTU) and, Small craft (KTH), with the leading university in each track in parentheses. Admission to the study requires a BSc or BEng including a strong knowledge of mathematics and applied mechanics. The prerequisites within naval architecture depend on the university chosen for the first year. More information on the Nordic Master in Maritime Engineering program can be found on [7].

The program has had a good start with about 30 international students applying each year, but would like to see more Nordic students engaged in the program. So far most of the students come from Asia and the EU.

6. Study Trips for Students to Ship Yards

Sailing practice as described earlier gives the students a very good feeling of what a ship is and how it is operated. However, many students will in their professional life be involved in design of ships or other marine structures and hence some practical experience with actual production of these huge and complex structures will be beneficial. Such a practical experience can hardly be gained in Denmark, nor in the EU as most of these structures today are built in Asia. Therefore a study trip of one week’s duration each fall for mainly MSc students was found to be a perfect opportunity, if a financial solution to the travelling expenses could be found. In 2013 four private funds provided a very generous support to a visit to Singapore for 26 students. The outcome of the study trip was rated very high by the students, who visited Keppel FELS yard (Jack-up rig for Maersk Drilling) as well as harbour terminals and design offices. In 2014, a similar study trip is being organised to Korea, visiting mostly ship yards.

In addition to these study trips, also shorter visits to maritime companies closer to Denmark are organized. DNV-GL in Høvik in Norway has been the host several years for annual one-day visits where the students have learned about the various tasks performed by a classification society, including the research and development needed in order to update the rules and regulations.

7. Conclusion

The paper has outlined recent changes in the maritime engineering education DTU initiated by a very fruitful discussion in 2011 between the Danish maritime industry and academia. It has so far been a very prosperous journey from the classical naval architecture education to a more holistic maritime engineering education with a continuous and strong support both from the industry and the university. Not only more students now choose the maritime engineering track but also internally at DTU maritime engineering has become more in focus with the establishment of Maritime DTU, a virtual centre to encompass all maritime engineering activities at DTU.

The feedback from the students has been very positive especially as regard the hand-on experience at sea. This is clearly an important, but also expensive new element in the education and in the future more specific tasks on-board the vessels might be needed in order to improve the immediate gain for ship owners taking students on-board for 2-4 weeks.

Other maritime engineering institutions have of course been looking in the same directions as we have done for strengthening the visibility and attraction of the education among engineering students. A good example is the *Proceedings of the International Conference on Education and Professional Development of Engineers in the Maritime Industry* in which [4] is found. However, most of the important information available for us have been received by personal communication at conferences and meetings.

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Employment of Project Oriented Approach in Training of Marine Engineers

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Project oriented approach in training at the ONMU is considered in this Article. Implemented and suggested ideas provided in this Article are elaborated on the basis of competitive and project oriented approach in the training. Project oriented educational system formation at the Maritime University has been performed grounding on systematic approach with the use of decomposition methods.

Keywords: competitive approach, project oriented approach, educational system, maritime transport.

1. Introduction

Project oriented approach in training has been successfully and continuously employed at various universities, though, the level of extension and frequency of use of the said method in Ukraine unfortunately are not enough.

The aim of the Article is to generalize the experience and form further directions for the use of project oriented approach in training at the ONMU and therefore to increase marine engineers' capacity and the University competitiveness on the training services market. .

2. Project oriented approach in training at the ONMU

2.1 Competitive approach in training at ONMU

Competitive approach is the basic one for nowadays development of higher education of Ukraine taking into consideration its orientation to the European standards of education.

As it is well known, the general idea of competitive approach is development of not just a knowledge system but a system of competencies, i.e. abilities to solve particular problems in definite sphere grounding on knowledge and skills.

Distinguishes in competencies and other final products of educational process are in the fact that the former ones are integral and exist in a shape of activity not just in a form of knowledge about the ways of activities. Professional competency exists as a union of key, basic and special competencies.

Special competencies become available for the student in the process of mastering disciplines that belong to his professional block. Special competency reflects specific features of a definite objective sphere of professional activity and, finally, makes this very graduate distinguishable not only comparatively to the graduate of the other institution but his very mates he has been studying with. Such qualitative training can be achieved only when precise competency pattern built in compliance with requirements of modern labour market is available. Let us also clarify that this model is quite flexible structure and it reacts to the variations of employers' requirements and achievements gained due to scientific and technical progress in the given sphere.

Odessa National Maritime University (ONMU) possesses the following adjustment system for competency patterns of graduates (Figure 1).

Therefore, the ONMU developed constant connections with employers and graduates; consequently, some of latter also have a tendency to become employers for the further generations of the graduates. This system of feedbacks allows to consider in full amount the requirements of modern labour market while training the experts in maritime transport sphere.

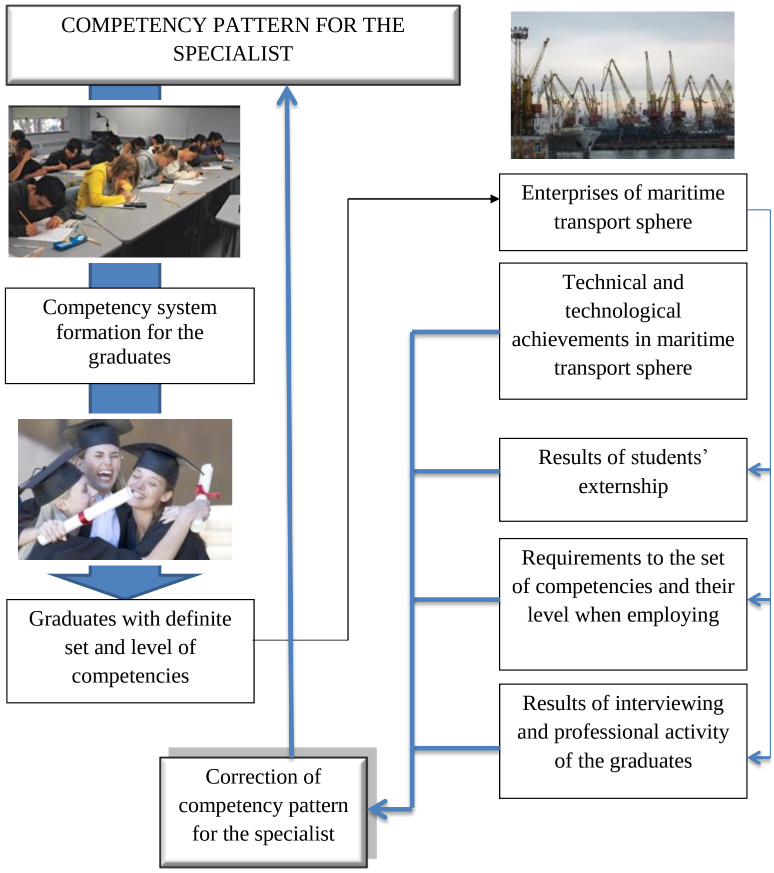

Figure 1 Adjustment system for competency patterns of graduates at ONMU

2.2 Experience of project oriented training at the ONMU

Implementation of competency approach in specialist formation is impossible without use of specific educational forms, one of which is project oriented training. The aim of project oriented training is "education via experience". Basic distinctive features of the given training:

- Students deal with real problems instead of exercises and imaginary situations;
- Students learn not only from teacher but from each other;
- Students work with data of real processes;
- Students learn to think critically.

At present the project oriented approach in the training is applied in two versions at Odessa National Maritime University (ONMU).

The first version reflects solution of technical milestones arisen in practice for the enterprises of maritime branch (port terminals and shipping companies that cooperate with the University). The given project category foresees collaboration of the Masters from different faculties in frames on the joint team. Activities over the project are implemented in specifically equipped Centre of Marine Engineering. The Project for Port Operator "Brooklyn-Kiev" Development in Odessa Port can serve as an example to show the solution of tasks in such a manner:

- Students of Hydro Technical Faculty are designing new berths;
- Students of Port Engineering are identifying the content of equipment complexes (grain, container);
- Students of Faculty of Economics and the Faculty of Transport Technologies and Systems are studying demand, clarifying pricing policy, analyzing future terminals' competitiveness, drafting business-plan, and developing the concept of informational tools to secure the functioning of the future terminals.

Similar project implies continuous exchange with the certain activities outputs among the stakeholders that facilitates the gaining of such skills: team work, use of “brain-storm” approach, appropriate processing of research results, and the most vital one – ability to use theoretical knowledge in real operational conditions. The students can be motivated with the opportunity to get employed or obtain recommendations to commence the PhD studies. Certain project results can be used by students while elaborating their Master’s thesis.
The second version of the project oriented approach in the study process at the ONMU is connected with such subject as “Theory of marine transport services market” studied at the University. The objective of this subject is to gain skills in market research, forecasting and assessment of commercial and investment risks in maritime business. Students form teams of “experts” and each of them obtains a certain task related to a separate sector of maritime business (e.g. time-charter section of dry cargo tonnage freight market). To solve the given task students use knowledge base for the disciplines they have studied before: Marketing, Maritime Transport Economics, Statistics, Probability Theory, Operations Research, Information Technologies.

2.3 Project oriented training as a tool secure competences’ availability for the ONMU Graduates

Further development opportunities for the project oriented approach in education can be introduced in a shape of a system, which would include all the educational levels and all the basic competencies of maritime engineers. To construct the said system primarily we need to form the following:
- Hierarchic structure of competencies and numerous corresponding disciplines;
- Assembly of instruments employed within the project oriented approach in education.

Figure 2 shows the example of three systems’ integration: “Project oriented training”, “Educational subject” and a block of particular competencies of “competency model” for professional sphere “Commercial maintenance of transport process” (Figure 3) in specialty “Transport Technologies” for Bachelor’s Degree. The given sample is a part ONMU educational system implemented since 2014.

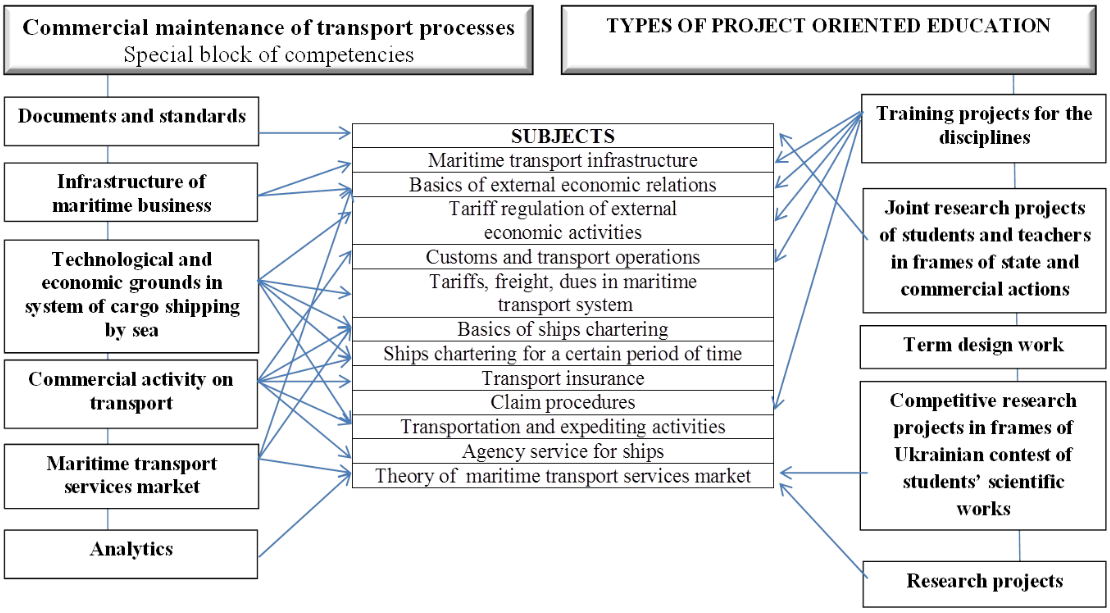

Figure 2 Three systems’ integration

Besides special competencies students ought to gain the following skills within the project oriented training [1]:
- Social – is a skill to make joint decisions and responsibilities, ability for team working and interact with representatives of various cultures and religions;
- Reflective – is the ability to make a notice of own mistakes, analyze and adequately assess the work of the others and to provide self-assessment in the given social surrounding;

- Communicative – is the ability to verify and stand up for taken decisions, to express thoughts, to set out inter-individual connections, to choose the most appropriate style of communication in various situations, to master means on verbal and non-verbal communication and to perform knowledge exchange;
- Informational – is the ability to gain new informational technologies. Therefore, the assembly of development, correction and continuous monitoring in system of special competencies (skills), set of disciplines and students' projecting works allows to maintain efficient level of students training at ONMU, so that they would comply with requirements of modern labour market in sphere of maritime transport.

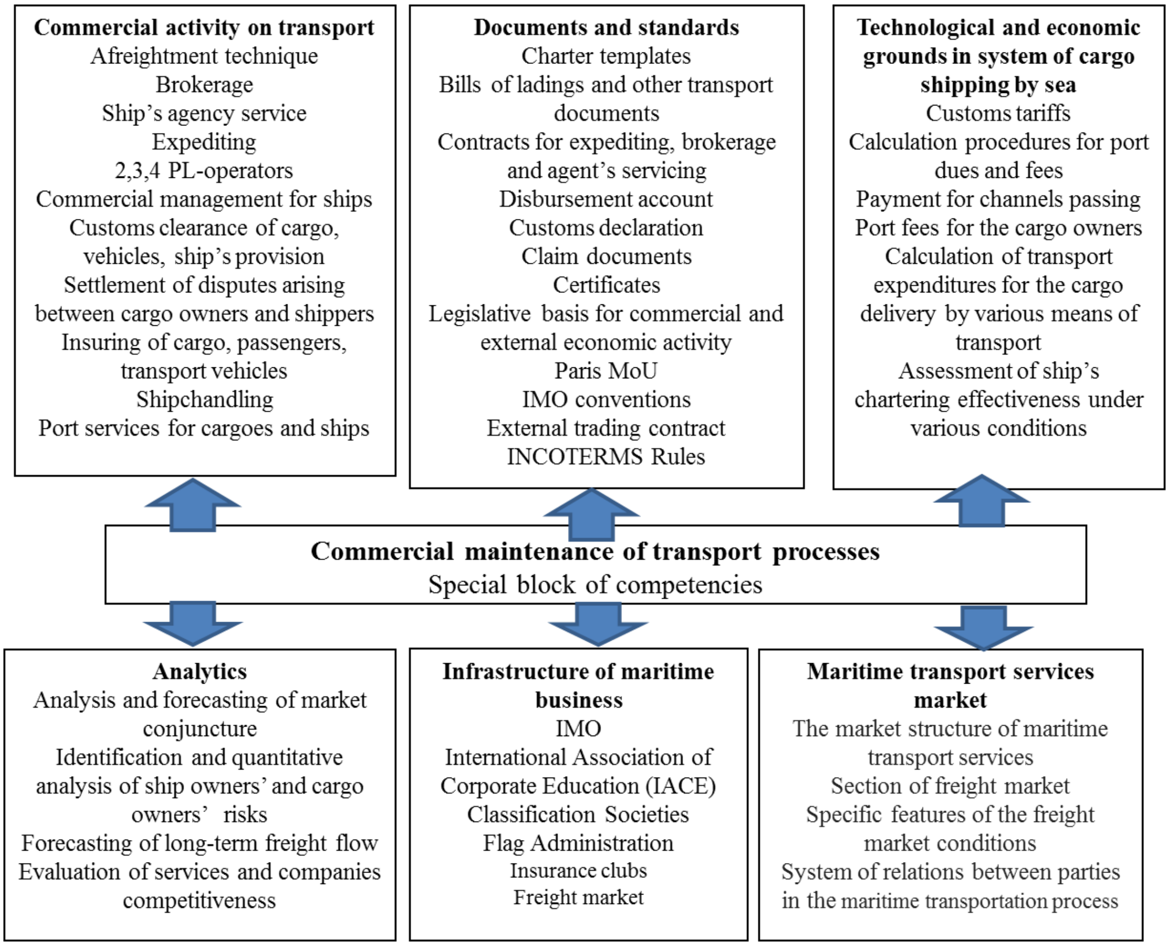

Figure 3 "Competency model" for professional sphere "Commercial maintenance of transport process"

The result of project oriented approach in training implementation in Maritime University is as follows:

- Improvement of trained specialists' competence;
- Compliance of knowledge and skills gained by the alumni with the requirements;
- Mutually beneficial cooperation of the university with the enterprises of maritime industry;
- Improvement of the University status on the market of the educational services.

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Closing the Gap Between the Training Needs and Current Training Practices for Modern Marine Engineers

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The training of marine engineers around the world traditionally tends to target the competencies outlined within Standards of Training Certification and Watchkeeping (STCW) and its interpretation by the relevant national regulatory authorities. Although the regulations are developed with input from the relevant stakeholders, it is argued by many that they do not always meet the changing requirements of an industry that is continuously modernising both in technology and work practices, nor are programmes tailored to address the needs of diverse cohorts of trainees entering the industry. This has resulted in a number of employers developing in-house training, not only in specialised areas, but also to address shortcomings in the fundamental knowledge and skills of new graduates. Thus, it is important when developing integrated training programmes to consider a range of parameters, much broader than those stipulated within the regulations. Issues that influence modern seafarer programmes include: quality and competencies of new entrants, facilities and staff at Marine Education and Training (MET) institutions, programme curricula and delivery/assessment strategies, and industry training philosophy and methods.

MET providers must also address present and future specialist training needs, which stem from current industry demands and operational requirements. It is generally accepted that the traditional role of the marine engineer is changing due to the modernisation of systems, different operational requirements, new regulations, modern work practices, and the drive for increased efficiency. Thus, competence requirements by the modern marine engineer are significantly different to that in the past. However the competence requirements specified in STCW and its interpretations in various nations struggles in many instances to upgrade adequately, or more likely in time, to meet the demands of the industry. There is a trend among some towards resisting change and viewing flexibility as diminishing the quality of the training, rather than considering them as opportunities to enhance learning.

Thus, engineering graduates from MET institutions do not always meet the expectations of the industry nor are sufficiently competent to deal with a rapidly changing industry. In many cases, the training does not take advantage of modern learning and teaching practices or the use of technology based training strategies. This paper looks at these issues and suggests some options within the boundaries of the current regulatory framework to improve the competence of the graduates to bridge the gap between industry needs and the competence of modern marine engineers.

Keywords: Maritime Engineering Education, Seafarer Training, STCW requirements.

1. Introduction

Although shipping is more than 5000 years old, a standard for seafarer training and certification was not established until 1978, when the first International Maritime Organisation (IMO) Standards of Training Certification and Watchkeeping (STCW) conference was held in London. The IMO Maritime Knowledge Centre [1] states:

> "The 1978 STCW Convention was the first to establish basic requirements on training, certification and watchkeeping for seafarers at an international level. Previously these standards for officers and ratings were established by maritime authorities in respective countries, usually with little reference to practices in other jurisdictions. As a result standards and procedures varied widely, even though shipping is the most international of all industries. The Convention prescribes minimum standards relating to training, certification and watchkeeping for seafarers which countries are obliged to meet or exceed."

It is however widely accepted that the intentions of the IMO was not achieved by the first convention, which resulted in two subsequent major amendments in 1995 and 2010. The 1995 amendments addressed the competence, knowledge requirement, and assessment criteria, which were relatively vague in the previous 1978 standards. This vagueness in the 1978 document led to different interpretations of the convention and the regulations there-in by member countries, resulting in the dilution of the very purpose that the convention was meant to achieve. The 2010 Manila amendments were adapted to address a raft of outstanding issues, including:

- new certification for Electro-Technical Officers (ETO);
- new requirements for Electronic Chart Display Information Systems (ECDIS);
- new requirements for security training, leadership and teamwork, environmental awareness, and liquefied gas tankers'
- new training guidance for polar waters and Dynamic Positioning (DP) systems; and
- introduction of modern training methodology including distance learning and web-based learning.

The intent of this paper is to investigate the past and current marine engineer training methodologies and explore the gaps which are not identified and addressed by the current practices in Maritime Education and Training (MET) providers to suit the current and future trends in marine engineering. It also explores the possibilities of using modern training methodology, including distance learning and web-based learning in the context of marine engineer training for the future.

2. Background and past training pathways

In the pre-STCW era, there were a number of pathways for school levers to become marine engineers on merchant vessels [2]. Gospel [3] points out that the most common pathway in the past in Commonwealth countries was the apprenticeships route, which attracted the school leavers to commence a four-year training programme heavily skewed towards practical training, reflecting the knowledge and skills required by the traditional marine engineer. Major ship building/repair/maintenance establishments offered apprenticeships to school leavers at a very early age, even as low as 16 years. The apprenticeship usually commenced at a ship building or repair yard or maintenance workshops, culminating in on-board, on-the-job training as a junior engineer on a merchant vessel. After a stipulated sea service requirement, the junior engineer appeared in front of the relevant marine authority for written and oral examinations (with or without following a pre-examination college based training course) to gain the relevant Certificate of Competency; first as a second engineer, followed by further sea service and examinations to a chief engineer.

According to Brooks [4], many European and some Asian seafaring nations offered training berths to school levers to start as ratings in the engine-room or as a deckhand, enabling them to experience sea life in general, before deciding on the path they wish to pursue. Those electing to become marine engineers followed a structured shore and ship based training programme spread over five to six years, where the trainees commenced at the bottom of the ladder and worked their way up with the accumulation of the required sea service and successful completion of the relevant written/oral examinations. However, the sea service requirements, as well as the frequency and level of examinations (if any) varied between nations, governed by their respective marine authorities.

In the post STCW 78 era, a shift from the traditional general cargo ships to containerisation and the upward trends in world shipping during the 1980's made way for marine engineer cadet training programmes, initially complementing the four-year apprenticeships. The cadet training programmes had more compact competence based training carried out in shore establishments, with the on-board training conforming to the recommended minimum durations in the STCW Code. In many cases the on-board training was directed and monitored through training record books, usually administered by the MET institutions but overseen on-board by the vessel's crew. It was distinctly different to the workshop and college training given to apprentices. This trend towards cadet training has continued and has evolved to encompass competence standards and structured on and off-the-job training, becoming the preferred cadet training mode for shipping and recruiting companies worldwide.

The journey to become a chief engineer, either through apprentice route or cadet pathway was a long-term sandwich training programme, consisting of intermittent sea service and college training. The factors that influence the training outcomes of modern competent marine engineers include:

- quality and competencies of new entrants to the industry;
- facilities and staff in MET institutions ;
- programme curricula and delivery/assessment strategies; and
- industry training philosophy and methods.

These will be discussed in detail in the following sections.

3. Quality and competencies of new entrants to the industry

Various socio-economic factors will influence a school lever’s decision for a career at sea. One of the major factors is the high remuneration associated with the industry evidenced by the advertisements in many countries offering wages well above the national average. Many school leavers who join the industry attracted purely by these high salaries find it difficult to adjust to the maritime world and thus leave the industry before making a career as a professional marine engineer.

Many countries struggle to attract high achieving school leavers to careers at sea, as they are exposed to a plethora of attractive career opportunities from competing industries. Thus, in many instances those selecting careers at sea may lack the required educational background or aptitude to chart a rewarding career in marine engineering or push the boundaries within the industry. This leaves the MET institutions with unenviable task of moulding competent marine engineers from student cohorts that in many cases lack the motivation and/or aptitude to engage with the higher level knowledge competencies. The issue is compounded as the institutions compete among themselves for the diminishing ‘cream of the crop’ and the need to secure sea training berths for their cadets.

Gare [5] argues that in general, the average standard of education in schools worldwide deteriorated during the last three decades, especially in the areas of science and mathematics which are essential elements within any engineering discipline. The academic level of new entrants to the marine engineering field is no exception to this trend. Unlike traditional tertiary engineering programmes, the entry standards to courses for students aspiring to be marine engineers on merchant ships vary significantly across the world, although minimum competence in mathematics is expected. The model marine engineering courses developed by the IMO [6] states:

> “Administrations will wish to specify their own educational standards for entry. With this in mind, attention is drawn to the fact that while the mathematical standards of the courses to be followed are not high, trainees continually use fundamental mathematics as a tool throughout the whole of their training;…”

Technical subject within engineering programmes are generally complex in nature and usually include a considerable mathematical content. According to Wilcox & Bounova [7], these together with the inadequate fundamental mathematical knowledge and skills in some students, have traditionally posed frustration in students learning engineering. Thus, MET institutions are faced with the uphill task of educating ill prepared students entering marine engineering programmes to meet the standards stipulated and required by the industry.

4. Facilities and staff in MET institutions

In addition to the above problem, many MET institutions struggle to employ qualified and dedicated trainers. Many trainers joining MET institutions are either retired marine engineers or active marine engineers who have chosen to be ashore for a period of time to attend to various external or personal reasons, with the intention of returning to sea once the issues are resolved. Both these categories of trainers in many instances lack the passion for teaching, the devotion necessary to be an effective teacher, and the motivation to embrace and introduce innovative delivery and assessment strategies. The lack of commitment and innovation from the teachers will affect the quality of teaching and learning.

Although STCW insists that new trainers and assessors undertake ‘Training of Trainers’ (ToT) programmes, innovation and pedagogy are heavily dependent on self-motivation. Many trainers and assessors, who were recruited by MET institutions in the early stages of the maritime training and education boom in the eighties and nineties, settled into purely following the IMO model courses to the letter. It is therefore important to attract educators who are passionate about training and are motivated to create and innovate, thus taking the lead in developing programmes and delivery/assessment methodologies to levels that will attract good students, motivate existing students to think beyond just ‘passing’ examinations, and ultimately provide the industry with competent marine engineers.

The facilities available at MET institutions also play a vital role in effective delivery of engineering courses. Unlike the navigation cadets, who undertake most of their practical training on-board a vessel, the marine engineer cadets receive a significant proportion of their hands-on skills in shore based establishments. It is not viable to sustain a workshop with significant capital investment unless it is also operating for purposes other than training, such as a fabrication workshop or a repair yard. Thus, the MET institutions usually outsource the training involved with workshops to third parties. Although some MET institution operate selected resources such as workshops and laboratory equipment, it is rare to find an institution that can provide a well-rounded practical training programme covering all the required competencies without accessing external providers.

The introduction of simulators to impart higher level knowledge and skills, also require significant initial outlay as well as ongoing maintenance and upgrade costs. It is interesting to note that although navigation simulators and their associated programmes have been made mandatory within STCW, the same is yet to be achieved in the marine engineering discipline.

5. Programme curricula and delivery/assessment strategies

As mentioned previously, the curricula for marine engineer training courses adopted by MET institutions were mostly based on the IMO model courses. However, it can be debated as to the extent the model courses align with the competencies actually required by marine engineers to function effectively within a changing industry. This is especially the case since the STCW Code does not explicitly state the performance level, criteria, or context, which can encourage individual interpretations as to what benchmarks should guide competence assessment, resulting in regional weakness in assessment against the STCW Code.

This is exacerbated by the slow pace of upgrading these programmes undergo to meet the development of technology in the engineering field. Although IMO insist that the model courses must be used only as a guide, many MET institutions and their respective regulatory authorities have embraced these programmes as mandated courses, thus adhering to them as rules rather than guidelines.

The influence of various industry standards in countries also dictate terms to programme curricula of marine engineer training. For example in Australia, training providers have to follow the Australian Quality Framework (AQF) and the Transport Industry standards. Another important stakeholder in this group is the labour unions. Depending on the country and their industry regulations, they can exert significant influence on the training curricula and practices.

Many MET institutions tend to hold on to tradition, with their programmes reflecting structures and outcomes that reflect the past that was linked to the old apprentice route, rather than developing programmes that embrace modern education practices and those that suite the modern student. Many are yet wedded to the old theoretical Part A and the professional Part B sections that 'must' be delivered separately and in a predefined order. This conflicts with modern engineering education that promotes integration across theory and practice promoted by many such as Johns-Boast & Flint [8], nor is it a requirement within STCW, even to the extent where it is not reflected within the model courses. However, old practices are hard to change.

Current STCW regulations require an approved assessment strategies for marine engineer training. However, assessment methods adopted by many MET institutions are heavily skewed towards formative assessment patterns. Although a number of marine jurisdictions are trialling out new assessment techniques, many marine administrations tend to favour the traditional processes such as written and oral examinations. Properly executed they do provide rigorous outcomes, however they may in some circumstance affect the validity and restrict the use of innovative assessment techniques that can target a wider range of competencies and students. In marine engineering the use of simulators in assessments is yet in its infancy, although they are highly advanced in other areas, such as aviation and navigation.

6. Industry training philosophy and methods

Complementing the shore based MET institution programmes is the on-the-job training component carried out on-board vessels. Although many companies have designated training officers on their vessels, their role have become one of monitoring and validating what the trainees have done rather than guiding them through the tasks and providing the environment and tools to make the learning a success. The ship's training officer may not have undergone a formal 'Training of Trainers' programme to effectively impart the required knowledge and skills or to create a conducive learning environment for a new entrant within the engine department and the vessel to provide quality learning.

The end users of the marine engineer trainee are the shipping companies, who often find that the trained engineers lack certain specialist knowledge required to meet the operational requirements on their vessels. Thus, companies resort to providing this specific training through other means. Berg & Skotgard [9], states "often large shipping companies would establish and operate their own training centres for these specialised training, as it proves much more effective than to rely on MET institutions."

As stated in the introduction, the shipping industry is over 5000 years old but international standards for training and certification was established a mere 25 years ago. A downside of the delayed introduction of the standards is that the industry yet lacks a coherent training philosophy. The philosophy and culture that dominated marine engineer training and assessment for decades before the introduction of STCW continued, as marine authorities and training institutions grappled with changes to regulations and learning practices, unfortunately at a much slower rate than within comparable industries such as the aviation industry.

Lewarn & Ranmuthugala [10] suggest that a reason why the personnel within the seafaring industry are reluctant to change is the rigid and authoritative hierarchical management structure prevalent in most ships. This is possibly a carryover from the naval links in the past and a perceived need to have absolute obedience to avoid dangers at sea, and some MET institutions tend to follow this practice within their administration, and teaching and learning practices.

Although some companies and MET institutions have moved away from traditional class room teacher centric learning to student centric learning using new technology, there is yet a long way to go before it is globally accepted and practiced within the industry.

In this backdrop, the role of most marine administrations within training is restricted to enforcing the national legislation and to facilitate the state remaining on the IMO white list. The development of new training philosophy or actively promoting the modernisation of the curricula or the programmes remains with the MET providers and the industry. However, the legislation enforced by the marine administrations can and will influence the training regimes, thus changes have to be brought about with agreement between the MET providers, industry, and the relevant marine administrations. Some marine authorities are influenced by past training regimes before STCW was introduced that they were involved with, and may display some reluctance to actively promote change. However, it should also be noted that others are willing and indeed leading change, although the impact is yet relatively low. In some nations, the seafaring community lacks the necessary influence to convince their respective governments to legislate changes to training and attract funds to support those changes.

7. Emerging training needs for marine engineers

Thirty years ago a main engine unit of a motor ship was pulled out and overhauled after 6000 – 8000 running hours. A turbo-charger of this main engine may have been overhauled at intervals of 10,000 running hours. The time between major overhauls of a diesel engine generator was similar. These tasks involved skilled personnel, spare parts, and most importantly time. In contrast, a modern main engine unit according to MAN ME Engines [11] need not be opened even after 20,000 running hours, as technology involved in the design, manufacture, and maintenance of such machinery have evolved. With the possibility of Liquefied Natural Gas (LNG) replacing Intermediate Fuel Oil (IFO) 380 in the future, the frequency of maintenance of engines may further reduce, as Condition Based Overhaul (CBO) replaces the current Time Between Overhaul (TBO) practice.

New developments in modern large marine diesel engines have resulted in the replacement of many traditional components and systems by a fewer number of integrated systems. For example Woodyard [12] suggests that components and systems such as the Hydraulic Power Supply (HPS), Hydraulic Cylinder Units (HCU), and the Engine Control Systems (ECS) have replaced a plethora of essential components and systems such as the chain drives, camshafts, fuel injection systems, exhaust actuators, governors, starting systems, etc. Thus, modern training programmes and outcomes have to target these technology replacements, while maintaining the skills to service the older technology that is still in use. MET institutions have to provide a balanced programme that mixes technology advancements, modern work practices, and student expectations with the broad and diverse nature of the industry. In addition, it has to be done within a tight time span dictated by legislation and industry demand.

A control room of a modern ship has a number of computers and touch screen mimic panels instead of the older dial gauges and instruments. Most of the controls for the machinery is available through these touch screens. Boris, Butman, & Butturini [13] state that the engineers check the 'health' of main engines by diagnostics rather than taking indicator cards. In essence, the engineers can operate, monitor, and control highly sophisticated machinery by very simple means.

Electric propulsion is another area gaining ground in marine engineering where IMO and most MET institutions are in the process of identifying the potential and the requirements. It is evident from a number of accident reports published round the world that this is an area that needs upgrading of legislation and training. For example the Marine Accident Investigation Bureau (MAIB) [14] report dealing with the harmonic filter explosion on the Queen Mary II in 2011 emphasise the importance for ship's crew to gain a thorough understanding of the issue of harmonic distortion and harmonic mitigation equipment, so that they are better able to appreciate the importance of the equipment on-board and take timely action if such equipment fails or deteriorates. A similar recommendation is made by MAIB [15] on the accident report on MV Savannah Express, where the engineers had very little knowledge on the working principles of the electronic control system of the main engine.
MAIB reiterate that the modern vessels increasingly rely on complex, integrated control and operating systems. Often these systems cannot be separated to enable operation of the equipment in a 'limp home' mode. The rapid introduction of such technology has placed an ever-increasing demand on the shipboard engineers, who have often not had the requisite training with which to equip them to safely

operate, maintain, and fault find on this complex equipment. Another specialised training requirement is high voltage, with many ships and offshore vessels employing such systems [16]. This again is an area that needs specialist training as it is can result in life threatening situations.

STCW stipulates only the basic generic requirements for competence in the operation of electrical and electronic control equipment. In reality, individual shipping companies are requesting maritime training institutions to provide specific technology centred training courses to supplement the basic training given to marine engineers at the STCW level. Unfortunately, it is unlikely that all shipping companies with such requirements recognise a training deficit for their engineers and provide remedial action, or are willing to absorb the additional financial and time penalties, rather accepting that the STCW requirements are sufficient to cope with developing technology. The inability to effectively diagnose faults in these complex systems can put vessels, their crews, and the environment at considerable risk. In many cases the present generic training requirements of STCW are insufficient to cope with the 'system engineering' aspects of complex, integrated engine control and operating systems of modern marine systems [17]. Thus, it is important that these training requirements are reviewed to determine their present and future effectiveness.

8. Conclusion

Current training in many MET institutions focuses on the STCW competencies, which may not always address or lag behind the changing requirements of the industry and technology. In an effort to develop integrated training programmes, issues influencing modern seafarer programmes and the need to change the competence requirements for modern marine engineers were discussed.

As Lewarn and Ranmuthugala [10] state, it is important that the global maritime industry develops clear and appropriate competency standards targeting the roles of the modern seafarer on modern ships. Thus, STCW must have clear and targeted competencies for the relevant performance outcomes, linked to the appropriate attributes to enable and assist MET institutions to develop suitable programmes to meet changing industry needs. However, as this is a relatively long drawn process, MET institutions in collaboration with the national marine authorities, can modernise training programme curricula to reflect modern practices, and employ modern technology and innovative methodology to deliver training. Given the diverse nature of the global fleet it is important that the programmes are sufficiently flexible to incorporate the older technology while embracing the new to train marine engineers for the future.

Thus, it is important that MET institutions take the lead in developing and introducing modern and innovative delivery and assessment strategies. They must exploit modern technology and strategies to the fullest to deliver their courses from a modern training context. Delivery and assessment should include tasks contextual to the workplace situations that will replicate the complexities and challenges students will confront in the real world, which will develop the necessary transferable skills. Although some are moving towards modernising their training methods, the industry as a whole lags behind many compatible sectors. It is important to recognise the strengths and weakness of the modern learner and provide them with suitable integrated information packages utilising modern technology to achieve the required competencies.

Change is important, and should be across all aspects that influence learning, including STCW competencies, programme outcomes, programme structure, innovative delivery, assessment strategies, and teaching tools. MET institutions and those regulating the processes must realise the need for change and actively seek solutions and strategies to train students from varying backgrounds to meet changing industry and environment needs. Modern training technology and methodologies need to replace or at least complement older methods, which require a change in mindset of those who train, develop training, and implement related policy.

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Essentiality and Practicability of Engine Room Simulator (Ers) Training Course Onboard Ship

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John B. Lacson Foundation Maritime University, Philippines

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

Keywords: *Engine Room Simulator Training Course, special program cadets, operation and functions of machineries, onboard training, engine officers.*

1. BACKGROUND AND THEORETICAL FRAMEWORK

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

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

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

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

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

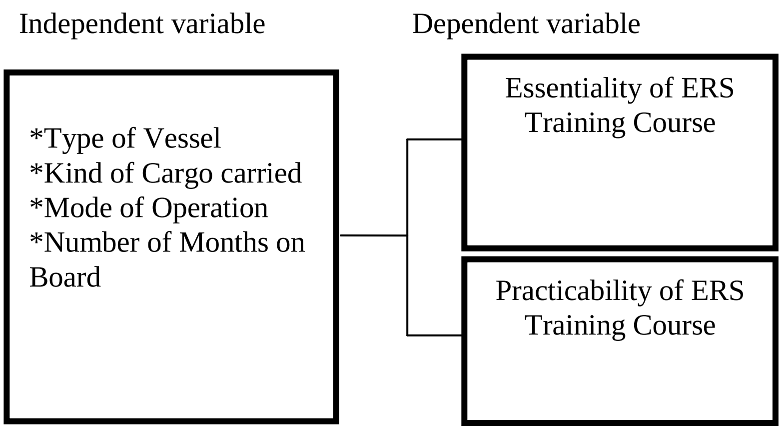

Figure 1 Practicability and essentiality of ERS Training Course

2. STATEMENT OF THE PROBLEM

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

1. Is the Engine Room Simulator Training Course essential to special program cadets of John B. Lacson Foundation Maritime University (JBLFMU)-Molo Inc. when taken as a whole?
2. Is the Engine Room Simulator Training Course essential to special program cadets of JBLFMU-Molo Inc. when grouped according to a) Type of Vessel; b) Kind of Cargo Carried; c) Mode of Operation?
3. Is the Engine Room Simulator Training Course practicable to special program cadets of JBLFMU-Molo Inc. when taken as a whole?
4. Is the Engine Room Simulator Training Course practicable to special program cadets of JBLFMU-Molo Inc. when grouped according to a) Type of Vessel; b) Kind of Cargo Carried; c) Mode of Operation?
5. How does the Engine Room Simulator training Course help the special program cadets of JBLFMU-Molo?

3. SIGNIFICANCE OF THE STUDY

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

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

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

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

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

4. RESEARCH DESIGN

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

5. THE PARTICIPANTS

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

6. DATA GATHERING INSTRUMENT AND STATISTICAL TOOLS

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

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

7. RESULTS OF THE STUDY

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

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

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

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

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

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

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

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

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

8. CONCLUSIONS

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

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

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

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

9. IMPLICATIONS FOR THEORY AND PRACTICE

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

10. RECOMMENDATIONS

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

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

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

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

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

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Session 3A
Blended Delivery

Collaborative Learning and its Impact on the Resilience Quotient and Academic Performance of Maritime Students

Capt. Luis G. Evidente, Dr. Emeliza T. Estimo
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Major components of the STCW 78/95 convention were modified during the last revision made in June of 2010 and one of these changes focus on “training in leadership and teamwork,” cited by Ungureanu-Chirea & Constantinescu (IAMU AGA 14) in their paper “Ways to Implement STCW Manila for Training in Leadership and Teamwork.” In relation to this, STCW 2010 provides among its requirements to non-technical skills the Application of Leadership and Team Working Skills (Reg. A-II/I, A-III/I and A-III/6). John B. Lacson Foundation Maritime University, recognized as a pioneering institution for the development of maritime education and training in the Philippines and known for its contribution to global manpower, continues to find ways to enhance its role of providing quality maritime education and training. On top of the university’s goal is to train maritime students to develop higher order thinking skills which move beyond mere acquisition of knowledge and comprehension to higher dimensions such as application, analysis, synthesis and evaluation. These dimensions are seen at the peak of Bloom’s (1956) Taxonomy, revised by Anderson (1990). Development of skills at the higher level allows a student to develop judgment not just in the context of his own self but in relation to others. To develop such mindset requires a good sense of personal vision, flexibility, social connectivity, and interpersonal competence among others, skills which are considered very important in producing competent future seafarers. To propel the students towards this direction, the university forms as part of its culture the development of resilience, excellence, agility, and leadership. Hence, continuous experiments have been explored with the aim of determining which teaching approaches and strategies could work best to train students to imbibe this culture. This quasi-experimental investigation was aimed to determine the impact of Collaborative Learning (CL) in Small Group Discussions (SGD) on the students’ Resilience Quotient (RQ) as well as on their academic performance in Maritime English. The design of this paper is anchored on the concept that resilience can be learned, measured, and have lasting effects on academic performance (Waxman & Huang, 1999) and that it is closely connected to learning in a collaborative environment (Rutter, 1990).To measure the students’ RQ, a standardized instrument designed by Russell Consulting, Inc. (2009) was adopted in the study while academic performance was measured by administering a pretest and post-test as well as a summative test to the control and the experimental group. Using various statistical tools such as *mean* and *standard deviation* and *t-test for dependent and independent means*, the study revealed that exposing students to collaborative learning through small group discussions has a significant impact on their academic performance and on the development of certain components of their RQ. The study recommends that further research must be done on resilience of seafarers with particular attention to the following components: interpersonal competence, social connectedness, proactive attitude, self-assurance, personal vision, flexibility, ability to organize, and problem-solving skills as all of these components play a very crucial and functional role onboard ship.

Keywords: Maritime English, collaborative learning, small group discussion, Resilience Quotient, academic performance

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This study was conducted in collaboration with Dr. Lourdes C. Arañador, Academic Director of John B. Lacson Maritime University. Dr. Arañador also handled the statistical component of this paper.

1. Introduction

Major components of the STCW 78/95 convention were modified during the last revision made in June of 2010 and one of these changes focus on “training in leadership and teamwork,” cited by Ungureanu-Chirea & Constantinescu (IAMU AGA 14) in their paper “Ways to Implement STCW Manila for Training in Leadership and Teamwork.” In relation to this, STCW 2010 provides among its requirements to non-technical skills the Application of Leadership and Team Working Skills (Reg. A-II/I, A-III/I and A-III/6).

John B. Lacson Foundation Maritime University, recognized as a pioneering institution for the development of maritime education and training in the Philippines and known for its contribution to global manpower, continues to find ways to enhance its role of providing quality maritime education and training. On top of the university’s goal is to train maritime students to develop higher order thinking skills which move beyond mere acquisition of knowledge and comprehension to higher dimensions such as application, analysis, synthesis and evaluation. These dimensions are seen at the peak of Bloom’s (1956) Taxonomy, revised by Anderson (1990). Development of skills at the higher level allows a student to develop judgment not just in the context of his own self but in relation to others. To develop such mindset requires a good sense of personal vision, flexibility, social connectivity, and interpersonal competence among others, skills which are considered very important in producing competent future seafarers. To propel the students towards this direction, the university forms as part of its culture the development of resilience, excellence, agility, and leadership. Hence, continuous experiments have been explored with the aim of determining which teaching approaches and strategies could work best to train students to imbibe this culture.

Along with this aim of developing the right values is the goal of sustaining a high level of academic performance among students. Because of this, continuous experiments have been explored on teaching strategies which could work best but because there is no prescriptive method tailored to different groups of students, teachers and those in the academe continue to investigate on what conditions could work best to enhance their students’ academic performance. But much as the maritime industry considers the importance of academic performance, those in the field also give importance to resilience as basic in training future cadets. Resiliency is the capacity to cultivate strengths to positively meet the challenges of living; the ability to bounce back from adversity while maintaining personal and corporate integrity[1]. Parallel to this, the university considers the development of resilience as a crucial element in preparing its cadets for the realities that go with their profession and work environment.

Research experiments have revealed strong evidence connecting resilience and academic success. Resilience is also believed to be a key component of social emotional learning and as being a critical facet of education. It is believed that a highly resilient person has the ability to succeed in school despite adverse conditions such as poverty or abuse. He appears more confident, has a good sense of well-being, is positively motivated, and is able to set goals and accomplish these goals despite adverse situations. A resilient person relates well with others, and is able to deal with stressful situations. Research shows that resilience can significantly affect school and life outcomes for youth, including academic success, even for students who are faced with great adversity and that these skills can be learned, measured, and have lasting effects on academic performance. For instance, Waxman and Huang [2] found out that students who ranked in the 90th percentile on the standardized tests in mathematics were highly resilient, reporting significantly higher levels of task orientation and satisfaction, social self-concept, achievement motivation, and academic self-concept than their counterparts who ranked below the 10^{th} percentile. In another study by Scales et al. [3], it was found out that higher levels of resiliency traits are strongly correlated with higher grade point averages (GPAs) among middle and high school students. Hanson and Austin [4], in their own investigation, gathered that nearly every measure of resilience was positively related to concurrent test scores. The highest increases in test scores occurred in schools where the students reported high levels of resilience. Highlighting on the importance of resilience and academic performance, this experimental study was conducted to find out the effect of small group discussion as a collaborative strategy on the resilience quotient (RQ) and academic performance of students in Maritime English.

1.1 Theoretical Framework

Resilience is a significant factor in enhancing academic performance.Waxman and Huang [5]believe that this ability can be learned, measured, and have lasting effects on academic performance. Supporting this notion, Rutter [6] tries to propose a connection between collaborative learning and resilience. He claims that students learn best when they are actively involved in the process of learning. In addition, researches made by Beckman [7]; Cooper and Associates [8]; Goodsell, et al.[9]; and Johnson and Johnson [10]; report that, regardless of the subject matter, students working in small groups tend to learn more of what is taught and retain it longer than when the same content is presented in other instructional formats. Students who work in collaborative groups also appear more satisfied with their classes.

The theory of collaborative learning (also referred to as cooperative learning) assumes that learning is facilitated when direct instruction is removed from the classroom and when students are placed in small groups to work as a team on an assignment or project. Collaborative learning changes the traditional classroom structure by reducing competition and increasing cooperation among students. Tension and possible hostility between students is diminished, thus raising academic achievement. Bernard [11], in his own investigation, concluded that classrooms in which students are given an opportunity to respond, engage in cooperative learning environment, and participate in setting goals are more likely to learn and achieve better. All of these characteristics help students develop a sense of belonging and involvement and help reduce the feelings of alienation and disengagement. With that kind of connection in school, students will have more of a protective shield against adverse circumstances as they face life difficulties.

1.2 Conceptual Framework

This investigation anchors itself on the framework of Collaborative Learning (CL) [12] particularly in using small group discussions (SGD) as a useful tool in promoting resilience which is believed to be a significant factor in enhancing academic performance. The concept of the study is shown in the following paradigm:

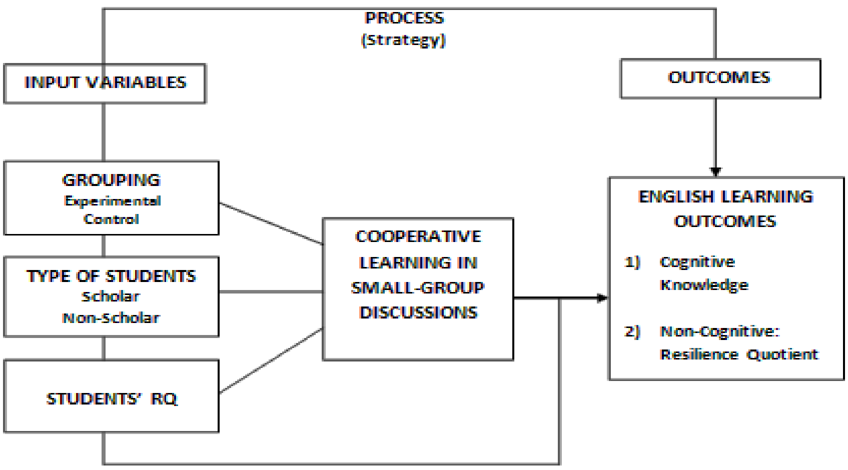

Fig. 1 The research paradigm showing the input, process, and outcome variables

The teaching and learning environment in the present study is seen as a process or strategy which shows the input variables on one end and the output variables on the other. The input variables are composed of grouping where the classes are divided into experimental groups that are exposed to CL in SGD environment and control groups that are taught using the traditional method of instruction; the type of students categorized as scholars and non-scholars; and their Resilience Quotient which was determined before the experiment. With these input variables, the intervention, when administered, is deemed to promote better learning. In this intervention, the collaborative learning environment, specifically the application of small group discussions, is employed with the experimental groups while the usual traditional method is to be used with the control groups. As an outcome, the intervention is expected to create an impact on the students' cognitive knowledge as measured by their academic performance and non-cognitiveskill, particularly their resilience quotient which comprises the following components: self-assurance, personal vision, flexibility and adaptability, organizing skills, problem-solving skills, interpersonal competence, social connectedness, and proactive skills.

1.3 Objectives of the Study

This study advances the use of collaborative learning insmall group discussions as an intervention to develop resilience among students and to improve their academic performance specifically in Maritime English.Specifically the study was conducted to answer the following questions:

1. What are the scores of the control group and the experimental group in the eight components of Resilience Quotient before and after the intervention on the basis of the following groupings?
    a. between groups of scholars
    b. between groups of non-scholars
2. Is there a significant difference in the scores of the control group and experimental group in the eight components of Resilience Quotient before the intervention on the basis of the same groupings(between groups of scholars, and between groups of non-scholars)?
3. Is there a significant difference in the scores of the control group and experimental group in the eight components of Resilience Quotient after the intervention on the basis of the same groupings(between groups of scholars, and between groups of non-scholars)?
4. Is there a significant difference in the mean scores of the control group and experimental group in the pretest and posttest andin the summative test on the basis of the same groupings (between groups of scholars, and between groups of non-scholars)?

1.4 Hypotheses

The following were the hypotheses of the study: (1) There is no significant difference in the scores of the control group and experimental group in the eight components of Resilience Quotient before the intervention on the basis of the same groupings (between groups of scholars, and between groups of non-scholars); (2) There is no significant difference in the scores of the control group and experimental group in the eight components of Resilience Quotient after the intervention on the basis of the same groupings (between groups of scholars, and between groups of non-scholars); and (3) There is no significant difference in the mean scores of the control group and experimental group in the pretest and posttest and in the summative test on the basis of the same groupings (between groups of scholars, and between groups of non-scholars).

2. Methodology

2.1 Research Design

This study employed the quasi-experimental method using the pretest-posttest control group design. In this design, all four groups were given the RQ Test and the pretest prior to the experiment. The experiment lasted eight (8) weeks during which the experimental groups were taught using cooperative learning in small group discussions while the control groups were taught following the traditional method. After the 8-week intervention, the same groups were given the post-test using the same instrument used in the pretest with some modifications. The RQ test was again administered to record their scores in the eight components after the experiment. Scores taken from the summative test were also used to further describe the impact of the intervention on the students' cognitive skills.

2.2 Participants

The participants in this study were first year students enrolled in the Bachelor of Science in Marine Transportation Program of JBLCF-Bacolod. Four intact sections were selected prior to the experiment where two were randomly assigned as the control groups representing both scholars and non-scholars. The control groups were composed of 19 students (scholars) and 38 students (non-scholars) respectively. Another two classes were assigned as the experimental groups. The first group was composed of 36 students (scholars) and the second having 38 students (non-scholars). The selection was made in such a way that the experimental groups match with their control group counterparts in terms of mental ability. This was done on the basis of their weighted average during their first semester with the school.

2.3 Instruments

The instrument on Resilience Quotient by Russell and Consulting[13] was used to determine the RQ of the participants. The instrument has eight components namely: self-assurance, personal vision, flexible and adaptable, organized, problem solver, interpersonal competence, socially connected, and proactive. The maximum score for each of the components of RQ is 24. In addition, the instrument used for the pretest and posttest was a form of an achievement test prepared by the experimental teacher and validated by three other experts in the field. It was intended to measure the academic performance of the participants before and after the intervention. The other instrument used was a summative test consisting of a total of 60 multiple-choice items.

2.4 Statistical Tools

Mean was used to determine and compare the scores of the students in the eight components of RQ as well as their performance in the pretest, post-test, and summative test. To compare the scores of the experimental and control groups in the eight components of resilience, the t-test for dependent and independent samples were used.

3. Results and Discussion

Figure 1 compares the RQ scores of the control group of scholars before and after they were taught using the traditional method.

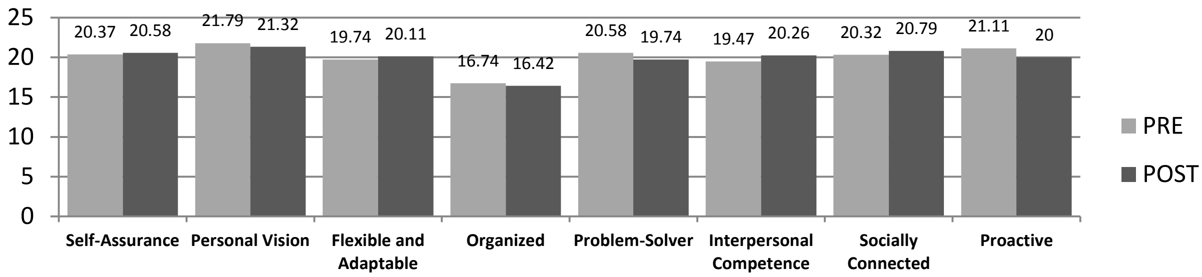

Figure 1 *RQ* Scores of the Control Group (Scholars)

Among the eight components, the control group of scholars who were taught using the traditional method improved their scores in only four components: self-assurance, flexible and adaptable, interpersonal competence, and socially connected. Their scores for personal vision, organized, problem-solving, and proactive declined after the intervention. It is surmised that since they were taught using the teacher-dominant mode of instruction where the teacher ruled the floor for most of the activities, their skills on these aspects were not maximized and activated. Too much reliance and dependence on the teacher could have created a passive attitude on their part in the teaching-learning process thereby affecting their level of resilience especially on the said components. Figure 2 compares the RQ scores of the experimental group of scholars before and after they were exposed to the intervention, that is, the use of collaborative learning in small group discussions.

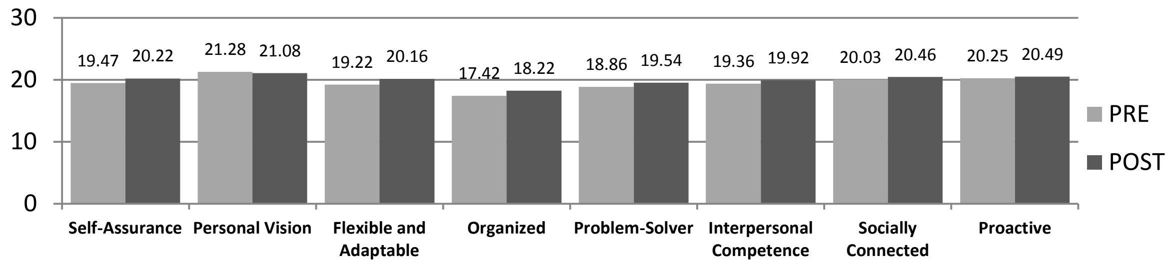

Figure 2 *RQ* Scores of the Experimental Group (Scholars)

Except for personal vision, the group of scholars who were exposed to the intervention showed improvement in all the other seven components of the *RQ*. This could mean that the intervention has created a positive impact on their level of resilience. The decline in their score for personal vision could possibly be due to their experience in working with their groups. As they began to work as a team, their perspective could have changed in that they were thinking more in line with their group's goals rather than just their personal interest in the learning process.To examine further, results were compared between the control groups and experimental groups of non-scholars. More interesting observations were noted in the data. Figure 3 compares the *RQ* scores of the control group of non-scholars before and after they were taught using the traditional method.

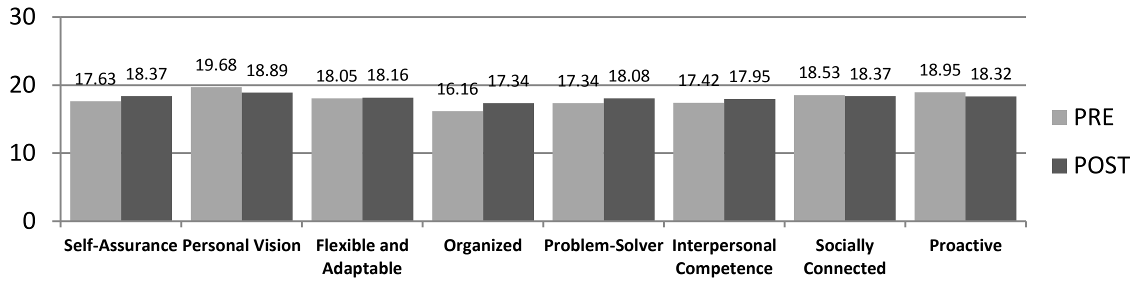

Figure 3 *RQ* Scores of the Control Group (Non-Scholars)

Among the eight components of RQ, the control group of non-scholars improved in terms of self-assurance, flexible and adaptable, organized, problem-solver, and interpersonal competence. This means that exposing them to the traditional method has positively improved their level of resilience in these components. A decline however was noted in terms of personal vision, socially connected, and proactive. The control group of non-scholars showed some improvement on the aspects of problem-solving and organization. This could imply that since the approach was more teacher-oriented rather than student-centered, each student was left to cope with the lessons presented while tapping his own resources; hence, becoming more organized and analytical in the whole process of learning. It is also possible that the teacher could have used other strategies which could have influenced the development of these aspects of their *RQ*.

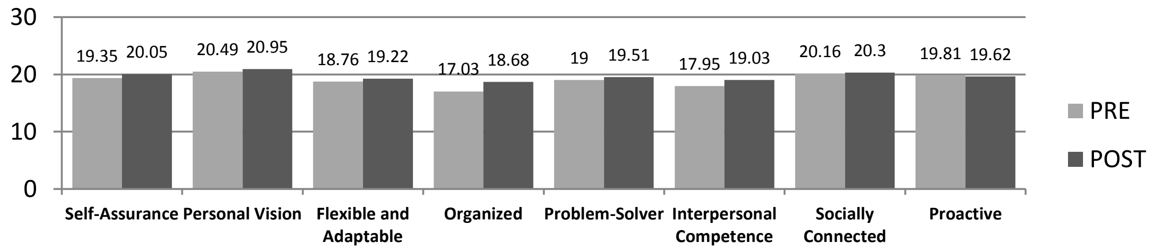

Figure 4 *RQ* Scores of the Experimental Group (Non-Scholars)

The experimental group of non-scholars who were exposed to the intervention showed improvement in the seven components of their *RQ* except on being proactive where a slight decrease was noted. Figures 3 and 4 also reveal that both control and experimental groups of non-scholars have declined in their level of proactive involvement. This lower level of assertiveness could be due to their not being scholarly. In the classroom, whatever the teaching method is, low-performing classes are normally quiet and dependent on the cues given by the teacher especially when exposed to very challenging tasks and in the present study, even the intervention did not really effect a positive change on this aspect.

To test if there is a significant difference in the scores of the control groups and experimental groups in the eight components of RQ before the experiment, a comparison was made between groups of scholars and between groups of non-scholars using the t-test for independent samples.

Table 1*T-test showing the means and standard deviation in the eight components of RQ of the control group and experimental group before the intervention (between groups of scholars)*

Components of*RQ*	N	Mean	sd	t	df	Sig. value
Experimental Self-Assurance Control	36 19	19.47 20.37	2.26 2.01	1.45	53	.153
Experimental Personal Vision Control	36 19	21.28 21.79	1.98 1.27	1.161	50.76	.251
Experimental Flexible & Adaptable Control	36 19	19.22 19.74	1.71 2.90	.710	24.76	.484
Experimental Organized Control	36 19	17.47 16.74	2.82 3.23	.874	53	.386
Experimental Problem Solver Control	36 19	18.86 20.58	2.88 2.19	2.27	53	**.027***
Experimental Interpersonal Competence Control	36 19	19.36 19.47	2.31 2.37	.171	53	.865
Experimental Socially Connected Control	36 19	20.03 20.32	2.58 2.69	.388	53	.700
Experimental Proactive Control	36 19	20.25 21.11	2.43 1.63	1.38	53	.175

$\alpha < .05$, significant *

Between the groups of scholars (Table 1), the control group significantly appeared to be better problem-solvers than the experimental group. For the rest of the components, the two groups showed comparable results. Between the groups of non-scholars (Table 2), a significant difference in scores in favor of the experimental group was notedin terms of self-assurance, problem-solver, and socially connected.

Table 2*T-test showing the means and standard deviation in the eight components of RQ of the control group and experimental group before the intervention (between groups of non-scholars)*

Components of *RQ*	N	Mean	sd	t	df	Sig. value
Experimental Self-Assurance Control	37 38	19.35 17.63	2.21 2.55	3.11	73	**.003***
Experimental Personal Vision Control	37 38	20.49 19.68	2.24 2.94	1.33	73	.189
Experimental Flexible & Adaptable Control	37 38	18.76 18.05	1.59 2.30	1.55	65.86	.127
Experimental Organized Control	37 38	17.03 16.16	2.32 3.02	1.40	69.24	.166
Experimental Problem Solver Control	37 38	19.00 17.34	2.33 2.97	2.68	73	**.009***

Experimental Interpersonal Competence Control	37 38	17.95 17.42	3.56 2.72	.719	73	.474
Experimental Socially Connected Control	37 38	20.16 18.53	2.77 2.54	2.66	73	**.010***
Experimental Proactive Control	37 38	19.81 18.95	2.20 2.37	1.64	73	.106

α< .05, significant *

After the 8-week intervention, a retest on RQ was administered and the following results were revealed.

Table 3*T-test showing the means and standard deviation in the eight components of RQ of the control group and experimental group after the intervention (between groups of scholars)*

Components of *RQ*	N	Mean	sd	t	df	Sig. value
Experimental Self-Assurance Control	37 19	20.22 20.58	2.33 2.36	.548	54	.586
Experimental Personal Vision Control	37 19	21.08 21.32	2.22 2.43	.363	54	.718
Experimental Flexible & Adaptable Control	37 19	20.16 20.11	2.25 2.13	.091	54	.928
Experimental Organized Control	37 19	18.22 16.42	2.94 2.99	2.15	54	**.036***
Experimental Problem Solver Control	37 19	19.54 19.74	2.95 2.70	.242	54	.809
Experimental Interpersonal Competence Control	37 19	19.92 2026	2.17 2.23	.558	54	.579
Experimental Socially Connected Control	37 19	20.46 20.79	1.95 2.42	.552	54	.583
Experimental Proactive Control	37 19	20.49 20.00	2.12 2.86	.793	54	.431

α < .05, significant *

A significant difference in favor of the experimental group was noted in the scores of the groups of scholars in terms of organizing skills. This means that their exposure to the intervention has significantly improved this component of their *RQ*. It should be recalled that before the intervention, the two groups scored comparably in this particular component. Another interesting observation is that before the intervention, it was found out that the control group significantly appeared to be better problem-solvers than those in the experimental group. After the intervention, the difference is not anymore significant. This is a remarkable progress because it appears that as problem-solvers, the experimental group has leveled up with the control group where before they appeared inferior.

For the groups of non-scholars, results of the retest on RQ after the intervention as shown in Table 4 reveala significant difference in terms of the following components: self-assurance, personal vision, problem-solver, socially connected, and proactive. For the rest of the components their scores are comparable. It should be remembered that before the intervention, the experimental group of non-scholars significantly scored better than the control group in terms of self-assurance, problem-solving skills, and social connection. After the intervention, they were able to maintain this advantage and in addition, significantly did better than the control group in terms of personal vision and pro-active skills. It is clear that the intervention has improved the extent of their resilience.

Table 4*T-test showing the means and standard deviation in the eight components of RQ of the control group and experimental group after the intervention (between groups of non-scholars)*

Components of *RQ*	N	Mean	sd	t	df	Sig. value
Experimental Self-Assurance Control	37 38	20.05 18.37	2.24 2.67	2.96	73	**.004***
Experimental Personal Vision Control	37 38	20.95 18.89	2.08 3.48	3.09	73	**.003***
Experimental Flexible & Adaptable Control	37 38	19.22 18.16	2.08 3.07	1.75	65.26	.085
Experimental Organized Control	37 38	18.66 17.34	2.79 3.59	1.79	73	.077
Experimental Problem Solver Control	37 38	19.51 18.08	2.74 2.79	2.24	73	**.028***
Experimental Interpersonal Competence Control	37 38	19.03 17.95	2.46 3.38	1.58	73	.119
Experimental Socially Connected Control	37 38	20.30 18.37	2.23 2.75	3.33	73	**.001***
Experimental Proactive Control	37 38	19.62 18.32	2.38 2.73	2.20	73	**.031***

$\alpha < .05$, significant *

Tables 5 and 6 present the scores of the control and experimental groups in the pretest, posttest, and summative test between the groups of scholars and non-scholars.

Table 5*T-test showing the means and standard deviations in the pretest, posttest, and summative test of thecontrol group and the experimental group (between groups of scholars)*

Group	N	Mean	sd	t	df	Sig. value
Experimental Pretest Control	38 19	39.61 43.42	4.51 5.37	2.82	55	**.007***
Experimental Posttest Control	38 19	47.42 51.53	3.53 3.75	4.06	55	**.000***
Experimental Summative Control	38 19	39.92 41.32	4.79 3.15	.019	55	.985

$\alpha < .05$, significant *

It can be observed in Table 5 that the control group has significantly scored higher in both the pretest and post-test. Data further reveal that their scores in the summative test did not significantly differ. One possible explanation to this is that because the number of students in the control group was much smaller, a semi-individualized form of instruction could have been made possible in a teacher-controlled class setting. Students could have been given ample time to interact and to clarify the lessons with the teacher. The comparability of their scores in the summative test could be an indication that the initial advantage on mental ability of both groups of scholars is a big factor in determining their success in class.

Table 6*T-test showing the means and standard deviations in the pretest, posttest, and summative test of thecontrol group and the experimental group (between groups of non-scholars)*

Group		N	Mean	sd	t	df	Sig. value
Pretest	Experimental	38	34.53	5.53	1.93	76	.057
	Control	40	31.93	6.31			
Posttest	Experimental	38	42.21	6.36	2.37	76	**.020***
	Control	40	38.73	6.63			
Summative	Experimental	38	36.76	4.99	4.10	76	**.000***
	Control	40	32.45	4.84			

α < .05, significant *

Results in Table 6 show that both control and experimental groups of non-scholars have started off on the same level before the intervention. This was revealed by their scores in the pretest. It is interesting to note however that after the intervention, the scores of the experimental group appeared significantly higher compared to those in the control group both in the posttest and the summative test. This raises a point that the intervention has significantly improved not only the level of resilience of the students but also their academic performance.

4. Conclusion

Students who have high resilience quotienthave their own way of coping with the lessons, so they could readily adapt to the absence or the inclusion of any form of instructional intervention. When compared to the traditional method where the teacher plays a major role as the lead actor in the teaching and learning process, using the collaborative learning approach in small group discussions can strengthen the students' resilience and can be an effective approach in developing specific components such as organizing skills, self-assurance, problem-solving skills, social connectedness, and proactive skills.The method can also create a significant impact on test scores of students particularly among those who are not academically advanced. Initial evidence from this study however revealed that some aspects of resilience, specifically on organizing skills and problem-solving skills, take some time to develop. It is possible though that given a longer span of time for the intervention, they could also hone these skills to a higher level. Too much dependence on the teacher as the main source of learning in the traditional approach could lead to some decline in personal vision. Since students are dependent on the instruction that takes place and not much is really expected on their part, they tend to develop a passive attitude thereby lowering their sense of personal vision. Moreover, it was also noted that attaining a high RQ can also be related to other factors, one of which is the teacher.This was evidenced by the improvement of the control group in some components of the RQ even without exposure to the intervention. Findings of this study supported the earlier assumptions that using the Collaborative Learning approach by engaging the students to small group discussions could significantly improve not only the level of resilience of the students but also their academic performance.

5. Recommendations

Findings from the study have highlighted several pedagogical issues. First, it is important to capitalize on tapping the affective domain in the teaching and learning process by providing a protective work climate between and among the teacher and the students. This means establishing a connection which nurtures a caring and supportive relationship to promote a more effective learning process. Second, it is important to emphasize that instructors must be role models of resiliency. They should help create an atmosphere which promotes expression of ideas by all members of the class who perform their complementary roles for the attainment of group goals. This sense of assertiveness and spirit of working together is paramount in preparing the cadets for the actual nature of their job and work environment. This focal turn on "training in leadership and teamwork" is supported by one of the changes in the major components of the STCW 78/95 convention made in June of 2010 that was also highlighted by Ungureanu-Chirea & Constantinescu [14] in their paper "*Ways to Implement STCW Manila for Training in Leadership and Teamwork"*(IAMU AGA 14). STCW 2010 provides among its requirements to non-technical skills the application of “leadership and team working skills”(Reg. A-II/I, A-III/I and A-III/6). It is also recommended that the university should underscore thevalue of meeting the standards of expectation of the maritime industry.In helping the students achieve this, they must hold a strong belief on their students’ innate capacities, provide them more challenging tasks, offer them support when needed, focus on strengths instead of weaknesses, and promote a student-centered instruction to encourage individual participation in a collaborative atmosphere. Instructors should empower their students to take responsibility by allowing them to work interactively with others in the class, reflect, think critically, and express their opinions openly.

While a multitude of studies on collaborative learning have been conducted over the years, it is recommended that this method should be further explored in different contexts across disciplines. Further research must be done on resilience of seafarers with particular attention to the following components: Interpersonal competence, social connectedness, proactive attitude, self-assurance, personal vision, flexibility, ability to organize, and problem-solving skills as all of these components play a very crucial and functional role onboard ship.

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Maritime International Exchange (MIX): Designing Blended, Application-Focused Exchange Programs to Increase Cross-Cultural Learning

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Given the global nature of shipping and maritime business, cross-cultural awareness is a critical competence for maritime professionals. In order to address this need, a Maritime International Exchange (MIX) is presented as a maritime education and training (MET) program structure intentionally designed to improve cross-cultural learning and other maritime competencies. Using an instructional design process, a simple needs analysis was performed to evaluate MET student cultural awareness. Since MET students indicated they lack the knowledge, strategies, and communications necessary for high cultural awareness, the MIX program was developed. The MIX program is a blended-learning program that joins maritime students from MET institutions in different nations for engaged learning by bringing the various student cohorts and cultures together (initially online and ultimately together in person). The MIX program effectively exploits the following learning modalities: distance learning (including just-in-time skills building and explicit cross-cultural/language learning) and problem-based learning (including working in global virtual teams and in-residence maritime consulting). This paper presents the MIX program and provides a framework by which we can improve and assess MET student cultural competence.

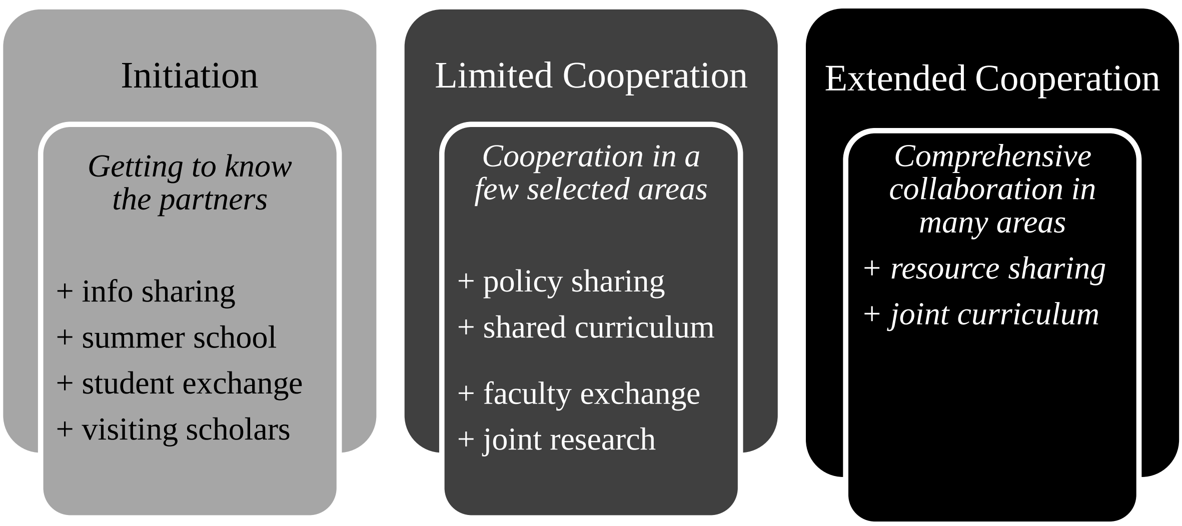
Keywords:

Maritime Education and Training, Study Abroad, Culture/Language Acquisition, Blended Learning, Global Virtual Teams, Problem-based Learning, Maritime Consulting

1. Introduction

Crews aboard ships are typically multinational [1] and tensions can arise from these differences [2]. Therefore, cross-cultural awareness is a critical competency for maritime professionals [3], [4] , [5]. The traditional approach to developing these cross-cultural competencies is through semester-long study abroad programs. However, creating these programs can prove difficult; there are challenges around curriculum matching, disruptions to and alignment of academic schedules, reciprocity agreements, differences in language/culture, and added expenses to both students and administrations. Furthermore, there is also evidence that semester-long programs result in less cultural exchange than some shorter programs [6]. Additionally, faculty-organized short programs can provide more powerful, focused learning [7] and these short programs can effectively increase cross-cultural adaptability [8]. Although there are numerous opportunities and programs that sponsor international collaboration between students, like the European Union-based Erasmus program, these tend to be longer exchanges (Erasmus programs are all between 3 – 12 months). Longer programs require serious commitments, are sometimes logistically impossible for students to partake in, and often result in participants forming cliques with other students with similar backgrounds, which decreases their effectiveness [6]. Shorter programs that require shorter, yet more intense bursts of communication and collaboration between students are easier for students to fit into their busy schedules, and also avoid some of the pitfalls of more traditional exchanges. Given these challenges and opportunities, many universities have embarked upon developing a variety of different study abroad [9] and exchange programs.

Figure 1 Model of phased cooperation among universities



Source: Adapted from Schwald [10, p. 55]

1.1 International Collaboration

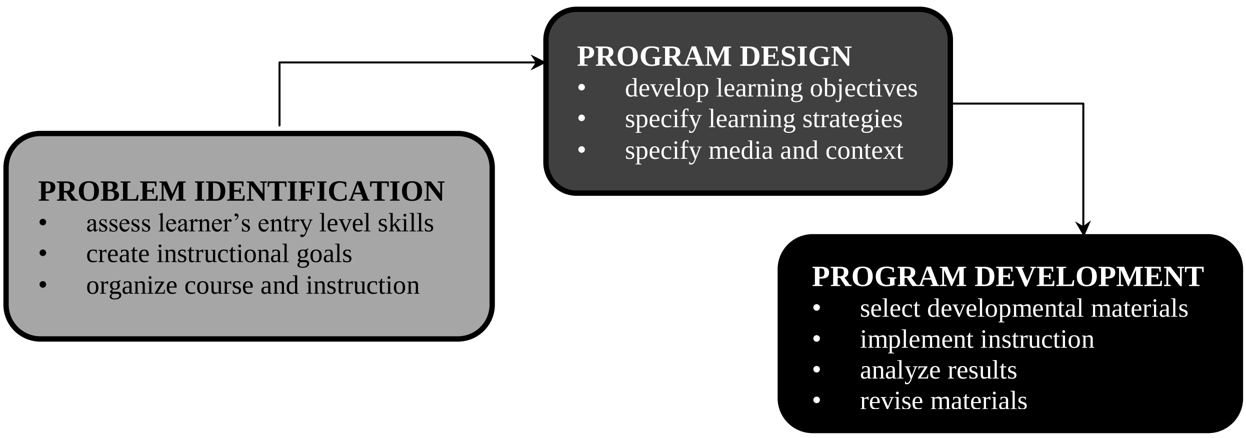
This paper proposes a model by which maritime education and training (MET) universities can partner in individual and collective efforts to develop the cultural competence of its students. It is envisioned that the *Maritime International Exchange* (MIX) program, which is a MET program structure intentionally designed to improve cross-cultural learning and other maritime competencies, will become a pilot by which enhanced cooperation and collaboration among MET universities can occur. This pilot study represents an initiation step in developing a partnership between the respective universities of the authors (see Figure 1).

1.2 Cultural Competence

Given these challenges and opportunities, it is envisioned that the MIX program will serve as a beneficial and economical way to help maritime students develop their cross-cultural awareness and maritime competencies.

Since students absorb and learn more effectively in their chosen professional context [11], [12], the MIX program puts maritime students into global virtual teams [13] to leverage problem-based MET learning [14] and solve real-world challenges for maritime sponsors. To develop the enabling cross-cultural competency [15], the MIX program will explicitly focus on cross-cultural awareness by promoting meaningful opportunities for foreign language communication and intercultural exchange (e.g., [16], [17], [18]) which helps them succeed in a global environment and successfully cope with unfamiliar situations [19]. The authors have developed a prototype of the MIX program and are deploying it using a pilot study framework [10].

Figure 2 Knirk and Gufstason instructional design model



2. Maritime International Exchange (MIX) Program:

The Knirk and Gufstason instructional design model [20] was used as an organizing frame for developing the MIX program. Figure 2 shows this model as comprised of three phases: problem identification, design, and development.

This paper describes the work accomplished in the first two phases of developing the MIX program. It is envisioned that additional work on program development and implementation will take place in the coming year and years.

2.1 Problem Identification

In order to create a program that will focus on areas that students feel are important for developing their own cultural competency, an instrument was needed that could be used for both a simple needs analysis (in terms of students awareness of their own cultural knowledge levels and realizing a need for improvement) and as a tool for students to track their own cultural competency development. After evaluating a number of available tests [21], it was decided that a new instrument should be created designed to specifically address the key points of MIX.

The Cultural Awareness Test (CAT) that was used in this study was created by slightly adapting and simplifying Earley and Ang's Cultural Quotient (CQ) test in order to ensure maximum relevance to the university students participating in the survey. The CQ test [22] measures self-reported assessments of student motivation, cognition, metacognition, and behavior via a five-point Likert scale. In 2008, the CQ test was tested for validity by van Dyne, Ang, and Koh [23], who found it to have a robust four-factor structure which was stable across samples, time, and different countries. The CQ test was also found to have discriminant and incremental validity, and to be a reliable and valid measure of cultural intelligence.

The following are the five factors of CAT:

- <u>Motivation</u> – factor/construct remains unchanged from CQ
- <u>Knowledge</u> – cognition factor/construct remains unchanged from CQ, but name changed to provide clarity to non-native English speakers
- <u>Strategy</u> – meta-cognition factor/construct remains unchanged from CQ, but name changed to provide clarity to non-native English speakers
- <u>Communication</u> – new factor/construct because communication is a core skill for developing intercultural competence – one of the overarching objectives of the MIX program
- <u>Needs</u> – new factor/construct taken from what remained of behavior in CQ after communications was removed and placed into its own factor/construct

For each of the five factors of CAT, five-point Likert scale responses were used to assess the participants' intercultural competency (where the "1" indicated strong disagreement with the prompt and "5" indicated strong agreement). A full version of the CAT prompts (without the Likert scales) is provided in Appendix 1.

Thirty-six students currently enrolled as juniors and seniors at the Massachusetts Maritime Academy and forty-nine sophomores and juniors currently enrolled at Kobe University took the CAT in the form of an online survey. In general, the vast majority of students reported having a moderate levels of self-assessed cultural awareness (see Figure 3).

Figure 3 Student Self-Assessment of Cultural Awareness

The cultural competence of the US students was not statistically different from that of the Japanese students (T=4.634, df=66, P=0.0000174 at the 95% level). In fact, there was no statistically significant difference between the two groups of students for any of the five factors on the CAT. This would indicate that both of these groups are essentially similar in their need for increased cultural awareness and would benefit from cross-cultural instruction.

Given that most students indicate that they have moderate cultural awareness, the cross-cultural element of the MIX program will be focused on particular areas (i.e., specific factors/constructs within the CAT) to improve cultural awareness. Figure 4 provides the mean response scores (on the five-point Likert scale) for both groups of students in each of the five factors of the CAT. With the exception of communication, US students generally self-assessed more highly on all skill levels of cultural awareness. Despite this difference, the order of the factors/constructs of the CAT in which students from each cohort self-assessed cultural awareness was the largely the same (see Figure 4). While most students indicated they possess motivation and needs toward cultural awareness (which indicates an awareness and openness on the students' behalf to further develop their intercultural communication skills); they lacked knowledge, strategy, and communications skills.

Figure 4 Ranking of self-reported cultural awareness using CAT (Greatest to Lowest Need)

	Japan	USA
Knowledge	2.4	2.9
Strategy	3.1	3.5
Communication	3.3	3.2
Motivation	3.3	3.9
Needs	3.9	3.9

For a more detailed description of student self-reported cultural awareness from each cohort, see Appendix 2.

With this needs analysis in mind, determining the instructional goals and course organization becomes a clear-cut task: students need to focus on how to increase their cultural knowledge by learning new cultural awareness strategies, which will in turn spur improved communication techniques.

2.2 Program Design

With the problem identified (i.e., insufficient cultural awareness), it was determined that the predetermined overarching goal of improving cultural competence was accurate and appropriate. Next, in the program design phase; learning objectives, learning activities, and learning assessments were identified.

When students successfully complete the MIX program, they should be able to:

- Demonstrate a high level of cultural competence (including communication and language).
- Work effectively in global virtual teams.
- Apply foundational knowledge to address a real-world maritime challenge.

These outcomes are aligned with the student learning outcomes of both institutions, but could be adapted or altered depending upon the specific needs of the students and programs involved in the MIX program.

Using these outcomes, the MIX program will be a blended-learning program that joins maritime students from MET institutions in different nations for engaged learning by bringing the various student cohorts and cultures together (initially online and ultimately together in person). The MIX program effectively exploits the following learning modalities: distance learning (including just-in-time skills building and explicit cross-cultural/language learning) and problem-based learning (including working in global virtual teams and in-residence maritime consulting).

The MIX program will use existing measures to evaluate development of the learning outcomes across the selected series of learning activities. The program intends to measure virtual learning [24]; team performance, conflict, and satisfaction [25]; trust and behaviors of the global virtual team [13]; language-learning [26] and cultural awareness using the CAT.

3. Summary:

Building upon the continued success of the IAMU Student (IAMUS) program that coincides with the AGA Conferences, the authors hope to explore new opportunities for student exchange utilizing the strong infrastructure provided by IAMU. While IAMUS has served as an important entry point for member institutions to offer MET students a chance to interact with each other in an academic environment, it is vital for member institutions to expand their international ties, and also important for IAMU as an organization to become a launching point for projects like the MIX program which can operate outside of the typical conference format. The MIX program is a bold attempt at providing a new model for intercultural exchange that IAMU institutions can incorporate into future plans for strengthening ties between members on various levels: between researchers, educators, and perhaps most importantly, the future generations found in our student ranks.

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Appendix 1: Cultural Awareness Test (CAT)

CA Motivation:

1) I enjoy interacting with people from different cultures.
2) I am confident that I can socialise with people in a culture that I am unfamiliar with.
3) I believe I can cope with the stresses and anxiety of adjusting to a new culture.

CA Knowledge:

1) I know about the legal and economic systems of other cultures.
2) I know about the history, cultural, and religious beliefs of other cultures.

CA Strategy:

1) I am aware of the cultural knowledge I use when interacting with people in intercultural situations.
2) I am constantly looking to learn new cultural knowledge when interacting with people from a culture I know little or nothing about.
3) I check the accuracy of my cultural knowledge as I interact with people from different cultures.

CA Communication:

1) I know the rules (vocabulary, grammar, etc) of at least one foreign language.
2) I adjust my verbal communication (accent, tone, speed, pronunciation, etc) when a intercultural interaction requires it.
3) I adjust my non-verbal behaviour (gestures, posture, facial expression, eye contact, etc) when an intercultural situation requires it.

CA Needs:

1) I feel like I need more exposure to different cultures to expand my world view.
2) I think that intercultural exposure helps to increase my overall communication skills.
3) So far in my life, I have had many chances for intercultural interaction.
4) In the future, intercultural interactions will be an important part of my life/job.

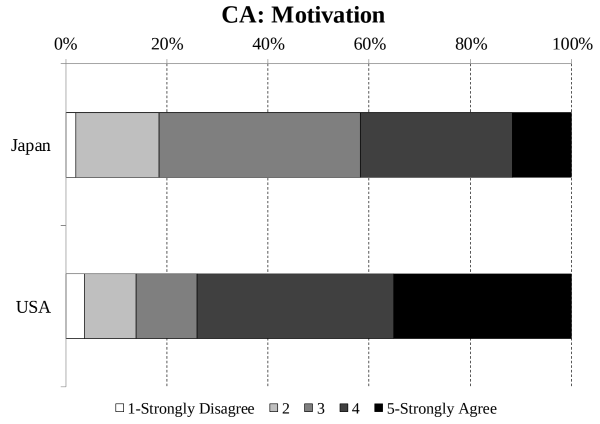
Rubric:

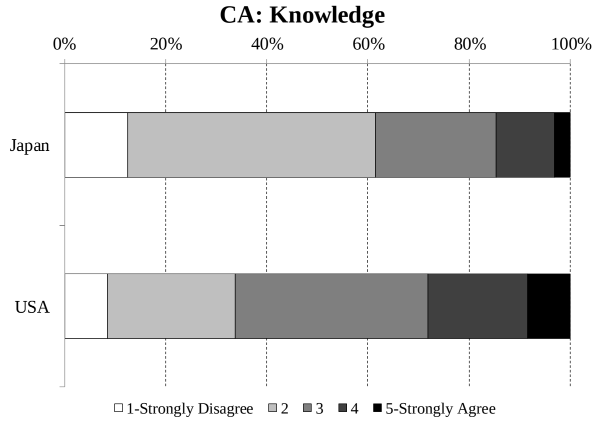
15-26 points: You see yourself as having low Cultural Awareness. It is important for you to think about general ways that you can improve your cultural knowledge and increase your motivation to do so.

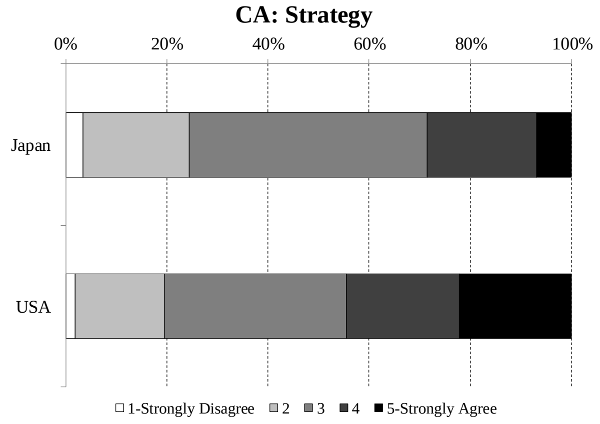
27-60 points: You see yourself as having moderate Cultural Awareness. You can focus on specific points to enhance your awareness and improve your drive in areas where you scored poorly on the test.

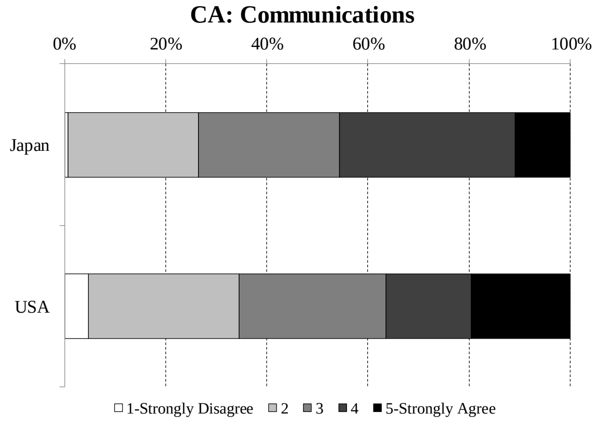
61-75 points: You see yourself as having high Cultural Awareness. You can still finely hone certain areas where you may need to complete your development into a truly well-rounded, culturally aware individual.

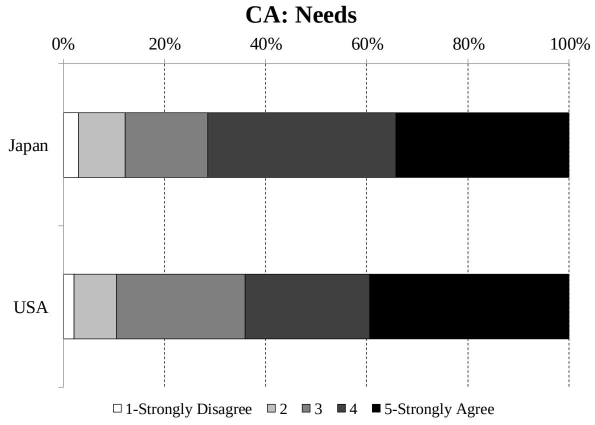
Cultural Awareness Test (CAT): Results of Cultural Awareness Survey











Cooperation Projects in Maritime Education

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This paper focuses on the cooperation projects in maritime education, that is considered as response to challenge of globalization of maritime activities, multi-cultural crew composition and increase of specialized ships. Maritime Universities continue to endeavor to improve methods of teaching, to develop technologies directed to training of highly skilled professionals, capable to work in the field of merchant shipping. Difficulties and problems which are encountered by Maritime universities during arrangements of the projects are presented. It is shown that partnership, working in collaboration on base of the international and national requirements aims to contribute and harmonize the Maritime Education and Training. It is proved that an international successful maritime training requires improved pedagogical methods and new ways of cooperation, which allow it to bring together like-minded maritime educators to network and share ideas and best practices.

The Educational Project which provides opportunity not only to strengthen connections among member institutions, by enhancing the sharing of experience and knowledge, but also promotes next step of evolution of maritime education is submitted.

Key words: cooperation project, maritime education and training, Maritime universities, pedagogical method, educational space, educators, partnership.

Introduction

The urgency of this article is proved by modern conditions of the world transport system; scale of transformations in the maritime industry, necessity of development of new approaches to a substantiation of strategy of its development; challenges from the maritime community; requirements to quality of transport service of the population that follows from a policy concerning development of sea activity as a whole.

The growth of the ships capacities is obvious and it has tendency for development. This process is resulted in increasing quality of operability, bringing onboard the ship the newest technology and people able to work in these new conditions. The constant improvement of technology and its implementation onboard ships, requires highly skilled specialists to perform professional functions.

Modernization of maritime education requires from all members concerned in it, actions on its optimization. Modern maritime universities today have the maritime education system including mechanisms assuming:

– support of the maritime content directed on formation at student of maritime universities fundamental and special knowledge;

– differentiation of knowledge in view of new knowledge and new technologies;

– curriculums on the basis of invariant parts of the basic state curriculum and the educational information, aimed at formation of professional competences;

– integration of subjects within the frames of the special subject fields focused on the decision of industrial problems, arising in branch of navigation;

– expansion of interactivity of the high school and shipping companies;

– satisfaction of social requirements, needs of educational sphere reflected in the State educational standards and external requirements of a labour market, defined on the basis of productive-target model for an estimation of quality of marine specialists' training and completeness of achievement of the purpose in the allocated productive directions;

– creation of conditions providing adaptability of pedagogical process [5; 6].

Moreover, in order to correspond to challenges from maritime community maritime universities must review from time to time the different provisions in their manuals to see its appropriateness brought about by technology changes. But of course, it isn't enough. The educational process has a great impact on the career of future maritime officers and the issues of the safety and security are essential and to be taken into attention by educators in order to avoid catastrophes and for saving human lives. International cooperation in maritime education has great opportunities and it is difficult to overestimate it. In this connection any attempt to extend frames of training through educational projects and participation in educational grants must be greeted.

Part 1. Educational project

The quality of training of the seamen capable to cope with difficulties of their future work on board ships mostly depends on the lecturers and instructors. Keeping up with the trend of globalization of maritime activities, multi-cultural crew composition and increase of specialized ships, Maritime Universities continue to endeavor to improve methods of teaching, to develop technologies directed to training of highly skilled professionals, capable to work in the field of merchant shipping. In this connection we consider as compulsory to provide high skill for the personnel involved in maritime education, especially in the academic field. In this way, Admiral Ushakov Maritime State University (AUMSU) has been developing a number of projects dedicated to initial and continuous training of its stuff, both beginners, i.e. young lecturers in the maritime educational system and experienced lecturers. An international successful maritime training requires improved pedagogical methods and new ways of cooperation, which allow to bring together like-minded maritime educators to network and share ideas and best practices.

In this connection AUMSU has developed a number of projects among the there is a project «Educational Space», the urgency of which is proved by:

– challenges facing maritime education and training providers, and the Maritime industry;

– constantly growing requirements to quality and a level of future sea experts training;

– effective improvement of Maritime Education and Training standards first of all Standards for Training, Certification and Watchkeeping (STCW) Convention and newly proposed changes admitted at Manila and famous as Manila amendments [2; 7];

– implementation of new methods of teaching, development of technologies directed to training of highly skilled sea professionals;

– development of cooperation among universities in promoting intercultural exchange and cooperation among professors, lecturers and instructors of the maritime educational space.

Lectures, who want to participate in this project, are required to:

– possess high skill, academic and practical mastery of the taught field;
– be able to produce new knowledge based on multidimensional character of science;
– have a good communicative skill, covering scientific and foreign language (English) speaking;
– develop and independently cooperate in sphere of multilingual and multicultural projects;
– be responsible for his/her activity and conduct research according to good scientific practice.

Main purpose of the Project is to assist Maritime Education and Training institutions as well as their teaching staff in arrangement and introducing new training courses or in enhancing, updating or supplementing existing training material in order to improve quality of Maritime Education and Training system as a factor which strongly impacts worldwide the competitiveness of the shipping sector.

A further unique element of the program is the involvement of Visiting Professors. Under the mentioned Project renowned maritime experts come to the AUMSU from a very diverse range of countries and institutions, including sea companies and maritime academies and universities. The Host University provides students of required department, technical facilities for lecturers, minimum technical requirements for lecturer’s hardware. It is agreed that Universities should support professors, lecturers and instructors who wish to teach an educational course outside their own University. Also in order to minimize time costs professors, lecturers and instructors can use video conferences and distant learning systems.

Part 2. The concept «Educational Space»

Choice of the name of the project «Educational Space» is not accidental. Recently in pedagogical works the concept «educational space» is used very often. Authors of different pedagogical publications consider the general essence of concept «space» and on the basis of knowledge which has been developed, open its features in separate areas of education.

Studying essence of educational space, teachers address to philosophical sources in which the patrimonial concept «space» is given, and to the characteristic of other adjacent general scientific concepts, to the ideas which have been put forward by great thinkers of the past, and to modern methodological works.

For example, according to Aristotel [1], the space is a property of objects which are in it, and a place in which the object settles down, is something difficultly seen. I. Kant [4] understood space as the form of all phenomena of external feelings, about impossibility of understanding that spaces can't be. Researchers also grounded on statement of M. Heidegger [3], according to which the place is some point of space for existence, arrangements of object in it.

Gradually knowledge about space as about an arrangement of objects in emptiness developed. Last decades teachers even more often use concept «educational space» with consideration of sets of various pedagogical circumstances. Opinions of different authors on the maintenance of this concept essentially disagree. However it becomes clear, that the success of process of training depends on correct construction of educational space.

We've distinguished the basic attributes of educational space. They are:

– filling of emptiness by material and (or) virtual educational objects;

– prevalence (concerning objects and their quantity) and coherence of educational objects;

– determination of educational objects of space [5; 6].

Educational objects include: the contingent of learners (pupils, students, etc.), the staff of teachers, state standards of education, the educational literature, educational-material resources, hostels, etc. Prevalence of objects is characterized by their «volume» and quantity. Determination of educational objects consists in the following. Each of them has the sphere of existence, the borders, differs from others. Objects of one level of the maintenance consist of objects of another (more concrete, detailed).

Part 3. Pedagogical parameters of educational space of maritime university

Creation of elite maritime university assumes conformity to the certain parameters. Pedagogical parameters of educational space of maritime university are: a place of educational interactivity; lectures; learners; means of training; the order for preparation of specialists; the content of education of specialists; educational techniques and technologies and ways of interaction with manufacture of the customer. The account of the specified parameters is obviously necessary for development of elite maritime university, as component of the world educational space.

There is an opinion, that all higher education is elite on quality of the given education accessible to the most prepared and creatively focused part of youth. But practically it is very difficult to create elite high school now days, even already because the elite means the selective, the best. The high school in Russia does not presume to select and teach students only with a high level of preparation with the purpose of formation of elite. Elite formation assumes the big competition, but use of results of uniform graduation examination – opposite, denies it. The idea of uniform graduation examination is theoretically attractive and in the certain measure is justified. But its lack that it passes in the form of the test. Transition to this form of examination leads to decrease of a level of the mass graduate. The general education is stratified: on education for mass and another absolutely different education for elites.

Admiral Ushakov Maritime State University in Novorossiysk (Russia) is the largest educational maritime institution and a unique higher educational institution in the south of Russia, training marine specialists for shipping companies, ship-building and shipyards, ports and transport terminals. AUMSU has a good reputation and among its characteristics the term «elite high school» is often heard. Of course, the creation of the elite high school is a very complicated task, which demands hard work of great number of people. Its task is not only to prepare specialists for navigation, engineering and shore side activity, but to bring up elite professionals capable to be leaders, to influence the behavior of others so that contribute to organizational success, survival and growth.

In connection with the reform of marine education, AUMSU has become the center uniting the whole complex of maritime educational establishments on territory of Southern Federal Area. Such association is caused by:

– necessity of financing of branch educational system due to federal public funds, means of branch business, as basic consumer of its graduates, and commercial educational activity of high schools;

– urgency of the coordinated action of branch and regional plans for development of academy and its transition in the status of university;

– entering of Russia in the world economic space and adaptation of the Russian educational system in the European and the world educational space;

– necessity of understanding of developments of marine professional training for the Russian Federation [6].

Transition of AUMSU in the status of university put forward new problems which demand the prompt and productive decisions. This transition is connected with development of sea branch and the international character of activity that compels high schools to refuse from earlier narrow branch orientation in training of specialists, and to pay attention to fundamental education of future marine specialists, to raise not only their special level, but humanitarian knowledge too.

Modern high schools and AUMSU, too, play the leading part in transferring the advanced knowledge, in formation of highly educated intellectual elite. Management of educational space of the academy assumes the expansion of functions of activity of subjects of education, integration of the content of common cultural, professional and social training, change of set and unity of all components, environments, structures and levels of educational process, change of the social and economic mechanism of management of the establishment.

Part 4. Personnel criterion in estimating educational space

The special attention should be paid to personnel criterion. Though constantly increasing role of material base of educational complexes, skill of their pedagogical staff remains a major factor defining quality of performance of the main functional problem – maintenance of a level of training of the command staff of fleet according to the international and national requirements.

Scientific qualification of teachers, their professional-pedagogical competence influence on the formation of new generation of specialists – educated, with a high level of the general and professional culture, intellectual, capable to be competitive, to perform active professional and social activity in the changed social and economic conditions [8; 9].

The basic personnel problems of educational complexes in modern complex economic conditions are: leaving of the skilled teachers in commercial structures; reduction of quantity of the young specialist acting in postgraduate study and doctoral studies and wishing to devote itself to teaching work; «the latent migration» of highly skilled lecturers of the higher school who are compelled to be engaged because of economic difficulties in the activity which has been not connected with educational process that leads to loss of their qualification, to decrease in interest to teaching work and the responsibility for results of the work. In this aspect it is necessary to organize practice of carrying out of methodical conferences and seminars on actual questions of training seamen according to requirements of State educational standards and in compliance with the requirements of STCW Convention and Code [2; 7], and also carrying out of certification of teachers on conformity to the specified requirements.

For regular increase of skill level of teachers, especially of special disciplines it is necessary to make active their periodic practice on vessels for work on regular command positions, and also as heads of practice of cadets, to provide passage of practice by them on corresponding sea simulators.

The primary goal of personnel selection of educational complexes consists in perfection of training system, improvement of professional skill and retraining of the scientific and pedagogical staff, increase of prestige of their work on the basis of material and moral incentive, in maintenance of high requirements to this category of workers on the basis of spent competitions and an estimation of their activity according to final results.

Pedagogical skill is not acquired during training in high school. It is formed only during practical activities and postgraduate training. Conditions for becoming the teacher on a way of perfection of pedagogical skill can be provided only by the organized system of postgraduate education. In this connection the AUMSU conducts work on creation of special structure, namely, pedagogical laboratory. The estimation of a level of individual training, creative scientific potential, pedagogical qualities define an elitism of the staff, and, hence, and an elitism of high school.

The AUMSU launched the international educational center which provides the resources for advising and effective guidance to lecturers and students regarding educational projects and other academic matters. The important essential fact is the teaching and business language is English and so competency in speaking, reading, writing and listening in English is essential. In this connection extra attention is given to the process of English studying both for lecturers and students. Another important step in achievement of set tasks is preparation of lecturers for teaching special subjects in English language. It is new enough for Russian Universities, because under State educational standards all material must be provided in national language. This training of lecturers is also provided in frames of International education center in the AUMSU.

Conclusion

International by its nature, shipping is creating connections among countries and nations, with a great value for economical changes and transport activities. The world economy and maritime industry, as a part of it, are changing and the requirements become more and more complicated.

1. The development of the maritime transportation and activities connected with it imposes the necessity of having more trained people involved in operation, able to perform functional responsibilities in their work. This ability can not be considered as a native one, and it must be developed through academic studies and specific training, including both theoretical knowledge and also practical skills.

2. Partnership, working in collaboration on base of the international and national requirements aims to contribute and harmonize the Maritime Education and Training. To achieve these new challenges is necessary to redesign the training system. It isn’t easy to change the actual format of maritime training system and mentalities. And extending of maritime universities’ activity through educational projects based on partnership is of great value. It should be mentioned that projects are not only scheme to act but opportunities for new search, lecturers’ innovation and creativity.

3. Creating database in the frame of educational projects for mobile lecturers and students in order to help them to choose courses offered at other universities within the network which are equivalent to the course at their home university provides not only academic compatibility but further development of both universities and maritime education as a whole.

4. The Educational projects developed and suggested by the AUMSU are open and flexible ones, able to easily adapt to all requests coming from maritime universities. These Projects will be profitable for all who involved in the maritime educational system, because they have been elaborated according to the Conventional requirements and directed to increasing of lecturers competencies through promotion of knowledge’s and technologies in the academic maritime field.

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Let Numbers Speak: Cultural Awareness, Job Opportunity and the International Student Exchange Program between Maritime Universities

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For six years, Massachusetts Maritime Academy (MMA) of the USA has been facilitating a student exchange program with Shanghai Maritime University (SMU) of China. The program, conducted in two countries that differ massively in culture, history, social values, economic systems and governmental structures, imposes huge challenges on the participants. The exchange students need to survive cultural shocks, overcome language barriers and adapt successfully to the new environment. Presently the exchange program has become increasingly popular at MMA; the number of participating cadets has risen from 11 in the year of 2010 to 27 in 2013. The participating students, who have been "gold gilded" in China, tend to stand out in the job market upon graduation, especially in comparison to their peers who have not participated in the international program.

The paper presents an empirical analysis of how the international student exchange program affects future job opportunities and enhances outstanding qualities of participating cadets. Applying a case study methodology, drawing on school-wide surveys, analyzing questionnaires, and applying data collected over the course of six years, the paper examines the relationships between the international experiences and job market success for participating students upon graduation and their subsequent career development after graduation.

The findings indicate that MMA cadets who went to China obtain more lucrative job offers than those who did not. Maritime companies hiring cadets who traveled to China tend to be larger in terms of their asset values or multinational corporations with branches in many parts of the world. The results also show that the exemplary qualities needed of exchange students, such as language proficiency, cultural adaptability, flexibility, initiative, world vision, genuine curiosity, and perseverance, are displayed and encouraged, allowing the participating students to reach their full potential. Furthermore, it is clearly demonstrated that the program-participating students are more successful in their career development after graduating from the institution.

Keywords: international exchange program, labor market competitiveness, entry level salary, cultural adaptability, international experiences and job offers.

I. Introduction

As the world has become increasingly interdependent, especially in the maritime industry, more and more maritime institutes are engaged in various exchange programs in the hope to broaden their cadets' international views, enhance their capabilities of conducting cross-cultural business and their abilities to get along with the more diversified workforce of the maritime industry. For 6 years, Massachusetts Maritime Academy (MMA) of the USA has been conducting a student exchange program with Shanghai Maritime University (SMU) of China. Every spring term, about twenty cadets are selected from each institution and sent to the other campus to study for one semester. Strictly speaking, it is an exchange of Maritime Training and Education (MET) between two maritime institutions, since the participating students pay tuition, room and board to their home school while studying at the host university. The program, conducted in two countries that differ massively in culture, history, social values, economic systems and governmental structures, imposes huge challenges on the participants. The exchange students need to survive cultural shocks, overcome language barriers and adapt successfully to the new environment. Presently the exchange program has become increasingly popular at MMA; the number of participating cadets has risen from 11 in the year of 2010 to 27 in 2013 and 23 in 2014. The participating students, who have been "gold gilded" in China, tend to stand out in the job market upon graduation, especially in comparison to their peers who have not participated in the international program.

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The paper is structured as follows: Section II describes the fast growth of the MMA-SMU exchange program. Section III presents the changes brought about to the MMA campus due to the international program and the underlying reasons that account for the success of cadets participating in the program. Section IV looks into the fact that the fast growth in both the shipping industry and Chinese economy creates great opportunities for American maritime students. Section IV offers a conclusion.

II. Cultural Awareness and the International Exchange Program

The MMA-SMU student exchange program started with 11 cadets of two majors, Marine Transportation and Marine Business in 2010. Now it has expanded to well over 20 cadets from 5 majors, adding Marine Engineering, Marine Protection and Facility Engineering to the list. Table 1 shows how quickly the number of MMA cadets participating in the exchange program has grown over the course of 5 years. We will then present some explanations which account for the popularity and success of the exchange program.

Table 1. Participation number of MMA cadets in the MMA-SMU/DMU exchange program 2010-2014[1]

	2010	2011	2012	2013	2014
Female cadets	1	2	2	6	7
Male cadets	10	14	16	21	16
Total	11	16	18	27[2]	23[3]

[1] Starting from the Spring term of 2013, MMA began to send five cadets over to Dalian Maritime University (DMU) of China and receive the equal amount of DMU cadets each year. The data was obtained from MMA registrar's Office

[2] 22 MMA cadets going to SMU, while 5 to DMU in 2013

[3] 19 cadets going to SMU, while 4 to DMU in 2014

2.1 The basic facts about MMA

Massachusetts Maritime Academy is a principal maritime educational institute in the US with a focus on excellent ocean centric majors like Marine Engineering and Marine Transportation. However, as a state college, the great majority of cadets enrolled are from Massachusetts and other local areas in New England, a region in the northeastern corner of the United States. The academy has shown, more or less, the features of homogeneity and conservativeness. Thanks to the vision and courage of President Gurnon, MMA has stepped out of its comfort zone in response to the proposal of SMU in China and set up the MMA-SMU exchange program in 2008. The exchange program was the first international exchange program at MMA and is still the only successful international exchange program with Chinese maritime universities among all American maritime institutes. The following school-wide survey of 109 cadets in 2011 how prepared they were in regards to international travel.

Table 2. The world travelling by MMA cadets

Destination of travel	Percentage of survey participants
China	3%
Asian Countries (except China)	7%
European Countries	31%
Caribbean, South &Latin American Countries	97%
Canada	78%

Table 2 indicates how extensively (or not quite) American students travelled outside US and places they felt comfortable going to. Only a few American students had gone to Asian countries (except China), such as Israel, Jordan, India, Japan, etc. and three had visited China, including one American-born Vietnamese. Around three-fourths of responding cadets made trips to Canada; a country that holds similar political, economic, social and cultural systems to the USA. And yet out of the eighty five students who had visited Canada, all of them went to English speaking areas like Toronto, Vancouver and Ottawa, and only one third had gone to French speaking areas like Montreal and Quebec City. About 31% of the respondents toured European countries, and the highly frequented destinations were Italy, Ireland, Portugal and England. To a great extent, this is due to the fact that many of the respondents are descendant of the British, Italian, Portuguese and Irish, can still speak the language, or have family members living in Europe. One cadet explained that his grandfather lived in a village outside of Rome and has more than 20 Italian cousins.

The statistics in Table 1 also shows that nearly all of the MMA cadets paid visits to Caribbean, South and Latin American countries, such as Mexico, Barbados, Puerto Rica, Evader, Panama, Costa Rica and Tortola. That is mainly because cadets at MMA are required to take sea destination when the cadets take voyages with the school training ship.

2.2 Cultural Awareness and the Exchange Program

With the on-going exchange program, 2 surveys were conducted at MMA in 2011[4] and 2013[5] respectively to see how MMA cadets perceive the exchange program.

Table 3 . Answers to questionnaires (2011 &2013)

Survey Questions/ Answers	Positive	Negative	Neutral	Year
The impact the China program would impose on MMA?	81.9% 84.5%	0.9% 0%	17.4% 15.5%	2011 2013
How will the China program influence you?	33% 39%	2.8% 1.5%	64. 2% 59.5%	2011 2013
Do you want to go abroad for jobs or studies?	56% 63%	22.9% 15.1%	21.1% 21.9%	2011 2013
What do you think of the Chinese students?	75.2% 78.1%	0% 0%	24.8% 21.9%	2011 2013
Do you want to be the roommate of a Chinese cadet?	19.3% 21.2%	71.5% 69.4%	9.2% 9.4%	2011 2013

Table 3 presents the 5 principal questions raised in the survey and the answers the participating cadets selected. For each of the 5 above-listed questions, the cadets have 3 choices, "positive", "negative" or "not much either way", and they can only pick one choice to each question. For the second question "how would the China program influence you?", one third of the respondents selected "positively", about two thirds (64.2%) picked "not much either way" and only 3 students chose "negatively" .

The MMA cadets expressing positive opinion about the program focused mainly on the three points: developing good relations between countries and people, allowing MMA students to gain experiences of different cultures and a great opportunity to meet the cadets of the same major from other countries.

We can see that, though 81.7% of the MMA cadets believe that the China program would bring positive effects on MMA, and none have negative opinions about Chinese students (see the answers to the 4th question), most MMA cadets would prefer not to have too much involvement with China program/students at the personal level, such as becoming a roommate of a Chinese visiting student. When being asked the reason, several MMA students said that they would like to have a roommate who could be quite similar to themselves, same personalities, same background, and same hobbies, as one student put it, "I want to room with one of my friends." Some others were worried that rooming with a Chinese exchange student would be a big, time consuming responsibility, since they would be expected to introduce SMU students to American culture and show them around.

Both Table 2 and Table 3 clearly state that many MMA cadets did not go too far away from their comfortable zones, and they were still looking for, as much as possible, similarities rather than differences.

[4] 109 respondents from all majors at MMA
[5] 102 respondents from all majors at MMA

The exchange program prepares MMA students to meet the challenges of the increasingly cross-cultural maritime industry, and encourage them to take that extra step to embrace the different.

It is also worth mentioning that over the course of four years, each group of Chinese students has brought the fine qualifications of diligence, strong work ethic, and determination to succeed; many MMA cadets and faculty members have been greatly impressed. Though Chinese exchange students would experience cultural shocks and language barriers, they have made impressive efforts to blend in and excel in the classrooms. One MMA professor of Internal Combustion Engine said: "It is a pleasure to have the Chinese students in my class. They work so hard and get the best grades."

On the first day of the Spring term of 2014, one questionnaire was conducted in the Chinese Economy class. The following two tables sum up the answers from 20 participating cadets registered for the class, which shows how much MMA cadets, mostly seniors and a few juniors, knew about China when they sign up for the class, and how eagerly they would like to learn about the country.

Table 4. Answers to the question: list five things you know about China (March 2014)

Categories of answers	Answers
Politics	communist government, internet control
Economy	fast economic growth, high ranking in merchant fleet, big trading partner of US, big shipping industry,
Society	long history, rich culture, lots of ethnic minorities, good food, most populated country, 2008 Olympics, small families
Geography	capital is Beijing, the Great Wall,
People	Confucius, Mao Ze Dong

The answers to the question "Please list five things you know about China" can be put into five categories, politics, economy, society, geography and people. Table 4 tells that MMA cadets knew some general information about China, such as political structure, rapid economic growth, maritime industry in China, culturally rich society and good food. However, they only have some general ideas about the country, not much in the way of details.

Table 5. Answers to the questionnaires (March 2014)

Answers to the question: Why would you take the Chinese Economy Class?	Percentage of cadets surveyed
To know more about the country and its economic growth	30%
To fulfil the requirement of an elective course	20%
Both of the above	45%
Other reasons, such as to know more about Asian culture, seems to be an interesting class, etc.	5%

Table 5 shows that 75% of the registered cadets for the Chinese Economy class intended to know more about the country and its rapid economic growth. One student wrote that the reason he signed up for the course was "to learn more about one of the most growing countries in the world". Another one wanted to know more about "US and Chinese trade regulations and differences in culture that may affect economy". One cadet would like to find a job in China after graduating from MMA, as he loved the country after spending one semester as an exchange student at DMU. One cadet even wanted to "discover whether it is good to invest in China".

III. Job Market Success for MMA Cadets Participating in the Exchange Program

Most of MMA exchange students are juniors, only a few would go as sophmores. Usually they will graduate the following year after spending one spring term in China. At this point we only have four groups of MMA cadets graduating from the academy since the exchange program started in 2010 and most received good job offers upon graduation. In this section, we will look at the companies who offered the exchange cadets jobs during their senior year and how much their experiences in China contributed to their current jobs and later promotions. We see three trends clearly from the available data collected by the Office of Career and Professional Services of the academy: companies that employed the cadets tended to be large with many international elements, cadets received decent salary offers, and they are on steady rising track of career development.

The first group of 11 MMA exchange students went to SMU in the spring term of 2010, nine of them graduated in June 2011 and two in June of 2012. Five cadets responded to the school survey with jobs, and they happened to be all maritime business majors.

Myra, the first female who went to China in 2010, received a job with SpecTec upon her graduation as a regional sales manager. SpecTec is a premier provider of asset management solutions for the marine, offshore & energy, defense and yachting industries all over the world . Her responsibility is to identify and evaluate sales opportunities in the United States, Canada, and Latin America. After working at SpecTec for two and half years, Myra switched to DNV GL Group, the world's largest ship and offshore classification society of the maritime industry, a leading technical advisor to the oil & gas industry, and a leading expert in the energy value chain including renewables. The company has 16,000 employees across 300 sites in more than 100 countries and gains revenue of EUR 2,500 million per year. Myra works as Sales Support Manager and she loves her challenging and rewarding job.

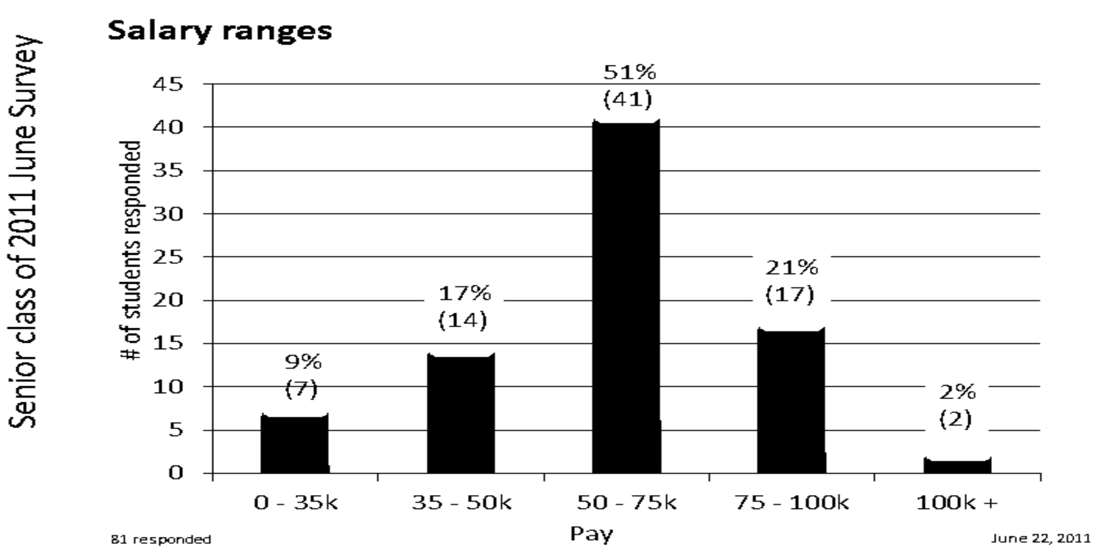
Johnathan was offered a job as a techinal coodinator by Canada Steamship Lines (CSL). CSL is a Montreal based company which brings highly-efficient, gravity-fed, self-unloading capability to bulk shipping and transhipment markets throughout the world. Only two years out of college, White has completed project work in China for CSL International and is now based in England, working for CSL Europe and their Technical Operations Director conducting analysis and development of fleet wide operational, financial and energy efficiency improvements. The young gradute also assists in development of a monitoring system to improve the CSL Europe safety program. As the front page article of MMA website put, "this young grad hopped on CSL's sturdy corporate ladder and started climbing!"

Two cadets received jobs at Back Office Associates (non-maritime ashore), which is a Massachusetts based software and services company focused on data migration, information governance, master data management (MDM) and data quality for enterprise systems. The two cadets work as Data Migration Analysit and Consultant with salary range of $50,000-$75,000 and $75,000-$100,000 respectively.

Two cadets worked for maritime related on-shore jobs upon graduation. One works as a Freight Trader at Heidmar with entry level salary in the $50,000-$75,000 range. Heidmar is one of the world's leading commercial tanker operators with a fleet of approximately 100 vessels. From offices in the U.S., U.K., and Singapore, our staff provides around-the-clock service to major oil companies and oil traders on a world-wide basis. Another was hired as assistant to marine operations at APM Terminals upon graduation with salary range of $50,000-$75,000. APM Terminals is is an international container terminal operating company headquartered in Hague, Netherlands. Starting from January 2014, the graduate works as Sr. Outbound Analyst at Johnson & Johnson. Johnson & Johnson is an American multinational medical devices, pharmaceutical and consumer packaged goods manufacturer founded in 1886. Its common stock is a component of the Dow Jones Industrial Average and the company is listed among the Fortune 500.

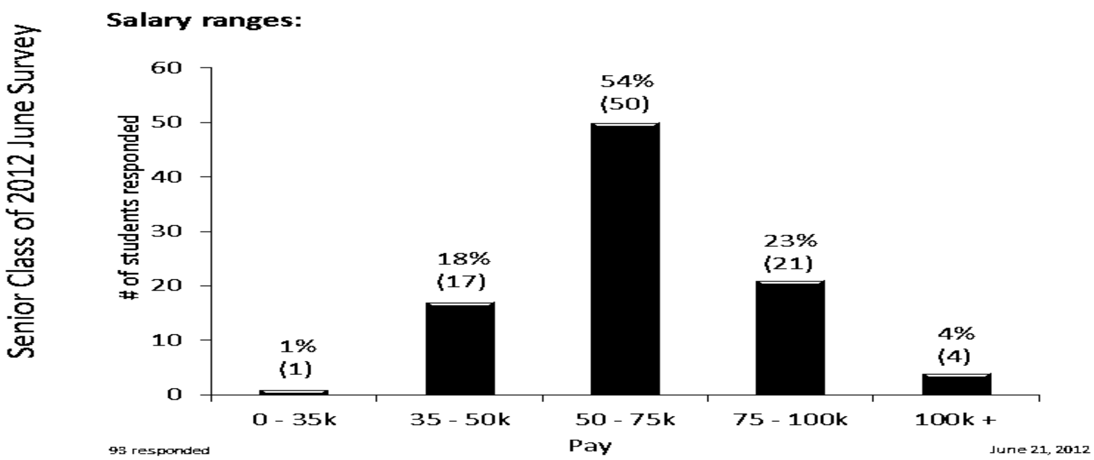
The salary range of the 5 responding cadets from the first group has the following distribution, one in the range of $35,000-$50,000, three in the $50,000 -$75,000 and one in the $75,000-$100,000. And these 5 cadets happened to be Marine Business Majors and customarily, non-sea-going majors receive 15%-20% less than sea-going majors at MMA. When we compare the whole academy's salary range reported for the year of 2011, which includes the seagoing and nonseagoing graduating cadets, it is obvious that the 5 cadets stand out for not only the prestigious companies they work for, but also the salaries they received upon graduation. The following graph shows the salary range from 81 MMA seniors graduating in the year of 2011.

Graph 1: Salary ranges of MMA seniors in 2011



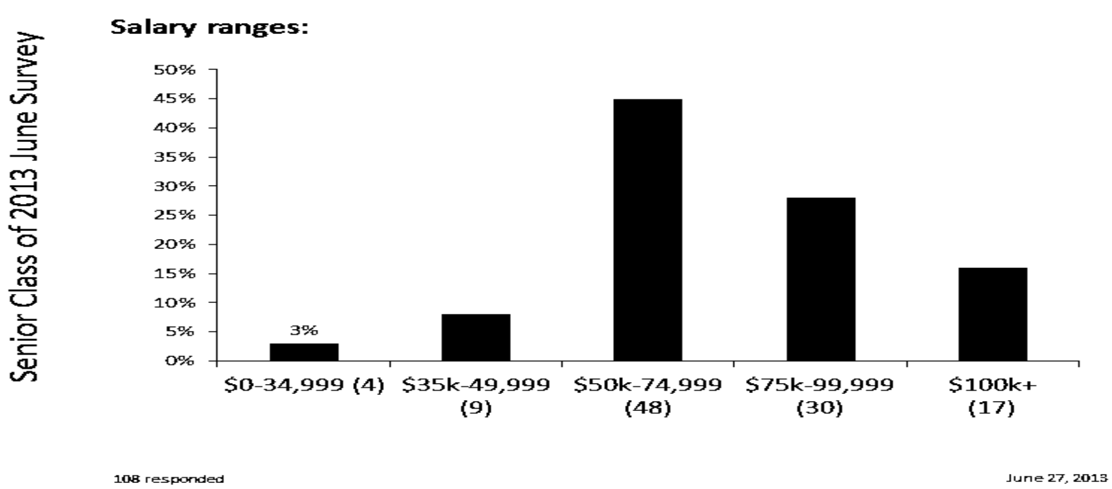
The second group of MMA cadets that went to China graduated in June of 2012 with two majoring in Marine Transportation (MT) and eight majoring in Marine Business. For the two MT cadets, one was hired by Military Sealift Command as 3rd Mate and the other at Hanjin Shipping Company as 3rd Mate and both received the entry level salary in the $50,000-$75,000 range. Military Sealift Command, part of US Navy forces, is the leading provider of ocean transportation for the Navy and the rest of the Department of Defense – operating approximately 110 ships daily around the globe. Hanjin Shipping is a South Korea based global shipping and logistic company and one of the top ten container carriers in the world. The eight Marine Business (MB) graduates got jobs as either maritime ashore or non-maritime ashore. Two female cadets work for Canada Steamship Lines (CSL), and the others work for respectable companies. Five MB cadets reported their salaries; two receive the range of $35,000-$50,000 and three at the $50,000-$75,000. In comparison to the salary range at MMA, as reported in the following graph, the exchange students certainly had an edge over the peers who did not participate in the program.

Graph 2: Salary ranges of MMA seniors in 2012



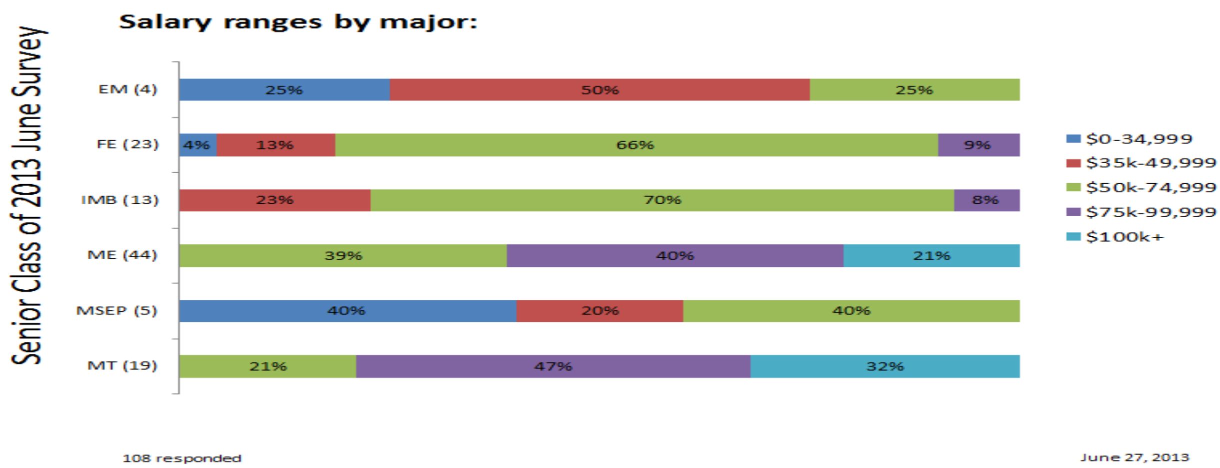
There are 6 MMA exchange cadets who responded fully to the survey conducted by the Career & Placement Office in June of 2013. The six cadets were hired as good entry level positions, and by the huge multinational companies. Four MB cadets worked for BP, GE, General Dynamics, and McLaughlin, One MT cadets at Military Sealift Command as the third mate and one MSEP at Able Services as regional Safety manager. The salaries were reported as the following: one falling in the range of $35,000 - $50,000, four in the ranges of $50,000-$75,000 and one in the range of $75,000-$99,000. In comparison to the seniors of the whole cohort at MMA, the cadets participating in the MMA-SMU exchange program were obviously in advantageous positions.

Graph 3: Salary ranges of MMA seniors in 2013



Since the year of 2013, the MMA Career and Placement Office added one more category in data collection to put the salaries seniors receive into different ranges according to their majors. Graph 4 shows in details the salary ranges for six majors at MMA. Two seagoing majors like Marine Transportation and Marine Engineering get higher entry level salaries than non-sea going majors like MB, Emergency Management (EM), MSEP and Facility Engineering (FE).

Graph 4. Salary range by majors in 2013



The MMA cadets going to China certainly gain an edge in the job market upon graduation and their later career paths. MMA President Gurnon made the comments: "The unique international experience adds an extra level of value to the job applicants. Big companies would be greatly impressed when they see our qualified cadets have the courage to travel to another country and be successful in a different environment." The director of Career and Placement Office has the similar observation, "in job market, the cadets make themselves stand out among many applicants when they add the China experiences to their resumes. Big companies love the students who have overseas experiences."

III. Positive Experiences and Great Opportunities in China

3.1 Positive experience of American students gain in China

Each year the participating cadets from the academy gained very positive experiences during their stay in China. They believed the program helped them in the following three areas: developing good relations with Chinese people by experiencing the country first hand, putting them in more advantageous positions in different cultures and among different people, and meeting cadets of the same major from other countries. One student wrote in his report of the exchange program: "It is a great opportunity to meet people from other countries in similar fields of study." Another cadet said that "It allows exchange of cultures and offers a new unique experience. It also helps educate everyone in the school about the Chinese culture, not just those who get to go."

Many participating cadets from the first groups became strong advocates of the exchange program and promote the program in every possible way. The cadets present papers about the program and their own personal experiences at international and domestic maritime conferences, hold positions in the student council, serve as cadet officers of foreign exchange program, give talks to cadets' parents, and encourage other MMA students to join the program.

To participate the MMA-SMU student exchange program, the cadets not only show their fine academic qualities by expressing language proficiency, intuitive vision, and genuine curiosity and perseverance, but also their spirit and personality through determination, cultural adaptability, flexibility, and the capability to overcome all difficulty which goes above and beyond the expectations the Chinese would have for the first overseas students. Here is a good example: Myra was the only female cadet going to China in the first year. On top of being the best student in the class, averaging 85.2, while the class mean was an 82, Myra joined the soccer team as the eleventh member representing MMA to play against SMU and other university teams in Shanghai. It turns out that she scored the most in the games, and although she was once injured badly on the field and rushed to the hospital in an ambulance, her optimism and determination made a deep impression on her teammates, the Chinese cadets, and the doctors who treated her in the hospital. One Chinese faculty at SMU exclaimed, “Wow, fragility, your name is not American women.”

The cadets from all these years have been trying to maximize their time in China. They travelled extensively to gain first-hand experience of Chinese tradition, history, culture, and society. They sampled various types of Chinese foods, learned unique customs, met people from other parts of the world, and built life-long friendships.

3.2 Fast Growth in China and Opportunities for Maritime Cadets

For three decades, China has developed tremendously and despite the Asian financial economic crisis in the late 1990s, the Chinese economy continued to grow at rapid pace, with an average annual growth rate of almost 10% between 1991 and 2010. China’s total international trade of goods in 2013 reached $3,982 billion, surpassed USA’s $3,848 billion, and made China the largest trading country in the world. In 2012, China’s GDP, valued at $8.358 trillion, surpassed Japan’s $5.96 trillion dollars and became the second largest economy in the world, just next to USA ($16.245 trillion).

During the same period of time, there has been a dramatic development in the Chinese shipping industry. In 2013, eight Chinese ports were on the top ten of the global cargo throughput rankings.

Table 6: Global cargo thoughput rankings (in 10 thousand T) [6]

Year	Ports	Port Cargo Throughput (10 thousand T)
2013	Ningbo-Zhoushan	80,978.00
2013	Shanghai	77,600.00
2013	Singapore	55,958.00
2013	Tianjin	50,000.00
2013	Guangzhou	45,512.00
2013	Suzhou	45,430.00
2013	Qingdao	45,000.00
2013	Tangshan	44,620.00
2013	Rotterdam	44,046.00
2013	Dalian	40,840.00

[6] China Shipping Database, Port Throughput Ranking http://www.shippingdata.cn/free/item.do?toplmid=6354E42BC8844DB7B0874F603935CAAB&lmid=CCC4347CA99345E7B47A6AE90D7761BF

China's shipping industry and container transportation has reached international standards both in handling efficiency and building networks. In 2009, China reached 26.1 million TEUS in containerized cargo shipping, surpassing the USA, and has been ranked the largest exporter of containerized cargo shipping country ever since.[7] The Chinese government has not only set up massive shipping companies like China Ocean Shipping Company (COSCO), but has also invested heavily in the water transport infrastructure, constructing new ports and rebuilding and enlarging older facilities.

Shanghai is the largest city in China and has become the center of international finance and global shipping. Many international corporates set up branches in Shanghai and intend to hire personnel with training in their own field and with a world vision. The MMA cadets with China experiences would be considered as highly valued candidates to work for the international companies. For instance, a couple of years ago, an American waste management company (Wheelabrator Technologies) announced plans to construct five waste-to-energy facilities in the suburbs of Shanghai and intended to hire MMA cadets with China experience and with training in marine engineering and environment protection to work in Shanghai, and would offer internships to MMA cadets even before graduation.

In late May of 2014, the Deputy Chairman of Foremost Group visited MMA and intended to hire graduates who were familiar with China. Foremost Group is a New York-based shipping, trading, and finance enterprise that have recently expanded their business to Asian countries, including Hong Kong and Shanghai. All potential job opportunities greatly encourage the MMA cadets to participate in the international exchange program and gain foreign experiences.

IV. Conclusion

Looking at the available data, it is clear that the exchange students are given an edge over their peers. In regards to international experience that can easily be applied to future jobs, cadets who choose to take this opportunity find themselves much better candidates within a rapidly expanding market. When combined with qualities of leadership, risk-taking, language proficiency and cultural adaptability, it becomes an invaluable tool to help exchange cadets stand out in the increasingly competitive job market.

The international corporation between two maritime institutes, such as the MMA-SMU student Exchange program, would be very effective to help the participating cadets enhance their self-confidence, broaden global vision, and adapt to a new environment with ease and grace. The successful experiences of the MMA-SMU program are applicable not only to the maritime universities of USA and China, but also to the institutions located in two other culturally diverse countries, like the UK and Vietnam. When the participating cadets prove that they can survive and perform well in two completely different cultures, they demonstrate that they have all the necessary and sufficient skills to be successful within any type of job they are offered. And this is exactly what the potential employers are seeking of all graduating maritime cadets nowadays.

With the on-going development of the exchange program and availability of additional data of the female cadets at MMA, more rigorous statistical analysis could be applied to the research, generating more significant conclusions. To do so will unquestionably help us to see how the exchange program

[7] World Shipping Council, http://www.worldshipping.org/about-the-industry/global-trade/trade-statistics

enhances cultural awareness, educates maritime cadets to embrace the differences, and fosters leadership qualification of cadets of maritime institutions.

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Session 3B

Green Ships and Technology

Safety Enhancement in Maritime Transportation: SEAHORSE Project

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Human factors have been the main cause and a major contributing factor of numerous maritime accidents, such as the Exxon Valdez, Herald of Free Enterprise and the Costa Concordia. Despite the fact that safety standards and technological developments in maritime industry have been increased, accidents are still occurring since the limitations of the human being is underestimated. The aviation industry which is in many aspects similar to the maritime sector has been approaching the same problem systematically and developing advanced methodologies and techniques. The EU FP7 funded SEAHORSE (Safety Enhancements in transport by Achieving Human Orientated Resilient Shipping Environment) project aims to transfer the effective and successful safety concepts utilised in the aviation industry, adapting and tailoring them to the unique needs of maritime transport. The project has the potential to create a significant impact, at not only a European level but also an International one, in making the ship operation a safe, resilient, attractive and efficient environment. In this study, an overview of the SEAHORSE project is presented. Recent progress and future directions of the project is given in conclusion.

Key words: Resilience, maritime, aviation, safety, SEAHORSE project

1. Introduction

Human factors is a complex subject which effects many different aspects of all different transport modes and involves the study of all aspects of the way humans relate to the environment around them, with the aim of improving operational performance, safety, through life costs and resilience.

Currently within the maritime industry, the modern seafarer is expected to be multi-disciplined with a high level of technical skills, have broader deck officer responsibilities, manoeuvre the vessel he/she is working on at short notice and be prepared to work long hours with very limited days off and outside social contact. These working conditions and this environment are seen as one of the reasons causing accidents. It is well reported in the studies of transport related accidents that 80% of shipping accidents are attributed to Human Error [1], [2], [3]. The statistical research of Rothblum [4], O'Neil [5], Darbra and Casal [6], and Toffoli et al. [7] has identified human error as the primary factor in the majority of maritime accidents [8]. Maritime accidents are the result of error chains rather than single events [9].

Traditionally safety has been addressed both by designers and regulatory bodies such as the International Maritime Organisation (IMO) through structural, mechanical, electrical and technological solutions with the aim of minimising damage and prevention of loss of life and ships/floating structures. Prevention of accidents has only recently gained the deserved attention, as the maritime community has realised that despite all the increased safety standards and technological developments, accidents are still occurring and the system is not resilient to errors at various levels. Furthermore, it has been often ignored that the human element of the maritime system has not been evolving in the same way that technology is developing; with the physical capabilities and the limitations of the human being overlooked.

The air transport sector, which is in many ways similar to the maritime sector have been facing similar human and organisational factors that affect operational safety. However the airline industry has been managing these issues by approaching the same problem systematically and developing much more advanced methodologies and techniques that can be adapted to the maritime industry while utilising the experience of air transport.

The SEAHORSE [10, 11] project proposes to address human factors and safety in maritime transport by transferring the well proven practices and methodologies from air transport to maritime transport in an effective, collaborative and innovative manner. This will be primarily achieved by introducing the principles of resilience engineering and smart shortcuts methodology in an integrated framework which will result in multi-level resilience that linking individuals, team, multi-party teams and organisations in ship operation that ultimately enhancing shipping safety.

The SEAHORSE Project consortium is shown below:

- Unıversıty Of Strathclyde, United Kingdom
- Nederlandse Organisatie Voor Toegepast Natuurwetenschappelıjk Onderzoek – TNO Nederlandse Organısa Netherlands
- Deep Blue Srl, Italy
- Lloyd's Register EMEA, United Kingdom
- Sakatunta Maritime Faculty, Finland
- Calmac Ferries Ltd, United Kingdom
- Danaos Shıppıng Company, Cyprus
- Kahn Scheepvaart Bv Jumbo, Netherlands
- The Provost, Fellows, Foundation Scholars & The Other Members Of Board Of The College Of The Holy & Undivided Trinity Of Queen Elizabeth Near Dublin Tcd, Ireland
- Instituto De Investigacion En Seguridad Y Factores Humanos – Esm, Spain
- Ap&A Ltd, United Kingdom
- Kratis Training And Consulting Limited, Cyprus
- Istanbul Technical Unıversity Maritime Faculty, Turkey

The SEAHORSE project’s aim will be realised through the implementation of the following objectives:

I. Identification of the key human/organisational factors, which lead to operational successes and failures in maritime transport and air transport and perform gap analysis in marine practices in comparison to air industry
II. Investigation of how errors and non-standard practices were managed successfully in air transport and check the feasibility of applying best practices and resilience concept adopted in air transport for maritime to improve human/organisational errors and safety
III. Development of the Technology Transfer Framework from air to maritime for successful implementation
IV. Introducing a smart SHORTCUT methodology in marine operations to identify and assess non-standard procedures carried out on board ships to quantify the positive/negative effects in order to enhance overall resilience.
V. Development and validation a multi-level resilience model and virtual platform as well as guidelines for maritime transport which encompasses individual, team, multi-party and organisational resilience that linked and integrated. The SEAHORSE Platform addresses:

    - The crew needs and limitations that may affect their resilience with regards to navigation/operation of the ships
    - System design, equipment and procedures which promote/add/remove, by design or accident, resilient and/or shortcutting behaviour
    - Shared situational awareness, leadership, organisational drift, insufficient/non-existing safety culture, team work
    - Suitable training materials to implement the multilevel resilience

VI. Implementation and evaluation the benefits of the SEAHORSE multi-level resilience tools through the comparison with traditional maritime safety methods and operations in training, simulator and actual ship environment.

VII. Educating stakeholders within the maritime transport industry of the benefits of resilience engineering and the SEAHORSE concepts.

The work packages to fulfil the *SEAHORSE* project's innovative concept is shown in figure 1.

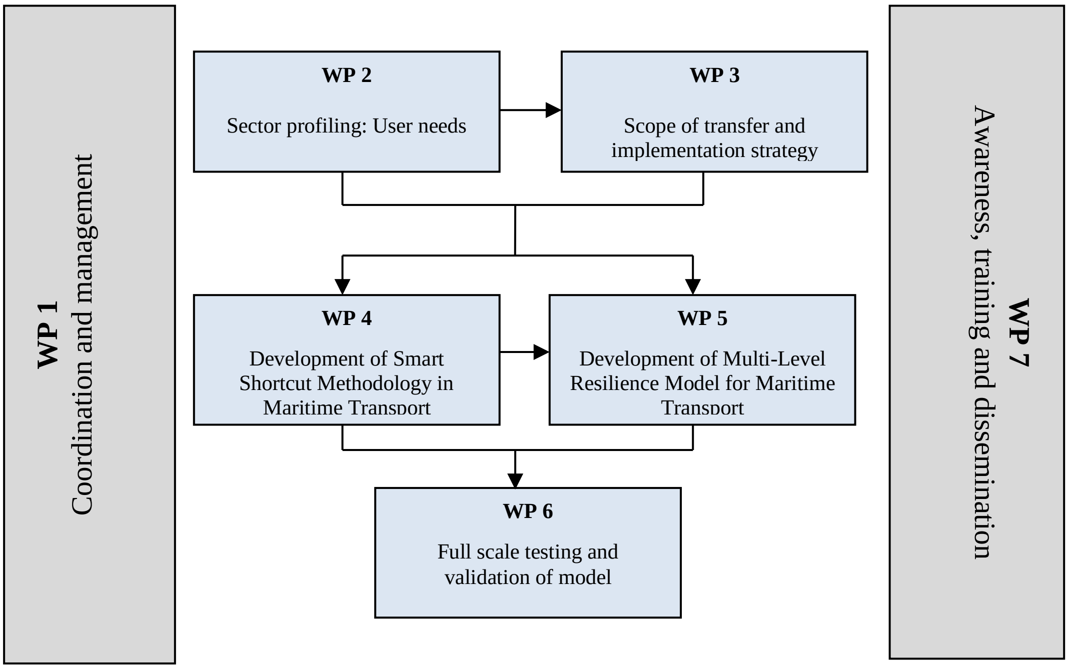

Figure 1. Work packages of SEAHORSE project

2. SEAHORSE Approach

The rapid development of new technology has changed the nature of work and has increased the complexity of systems within a variety of industries [12]. Aviation operations that require a tight coupling between both technical and human subsystems is one one of them [13]. Within the aeronautical industry having safe and reliable operations is critical in preventing accidents and mistakes that can potentially cause a huge loss of life and destruction. The influence of human factors on operational safety is one area were the aeronautical industry has led the way in terms of understanding and implementing tools, methodologies and systems to combat human error within a system.

One such principle which has been highlighted as being particularly successful is the integration and adoption of resilient engineering principles. As the number of accidents and incidents have been decreased through the utilisation of resilience engineering concepts, it seems that resilience engineering within the aeronautical industry has been very useful on board.

In addition, the psychological and social-economic elements, identified in the University of Strathclyde's survey of seafarers, relating to the societal status and perception of the crew and its effect on motivation and performance will also be addressed. Through utilising the air industry's approach of crew empowerment and promotion within society, this will be an important area of transfer between aeronautics and marine. This may also develop a pathway of the mitigation of low retention and employment rates within the maritime sector.

Within the SEAHORSE project the aim is to transfer the effective and successful safety concepts utilised in the aeronautical industry, adapting and tailoring them to the unique needs of maritime transport.

In order to achieve the successful transfer and adaptation of the techniques and tools being utilised in the aeronautical industry, the SEAHORSE project will adopt the following approach;

- Analyse and study the effect of different business environments between aeronautics and maritime sector including the way that psychosocial and social-economic issues of crew are addressed. Determine the effects of contracts, pay levels, working and living conditions as well as the image of the seafarers/aircrew in the eyes of society, on the performance and motivation of seafarers and aircrew.
- Identify the best practices in aeronautical industry for managing errors and non-standard practices
- Assess the regulatory framework in air transport and carry out gap analysis in maritime transport to identify any potential gaps that may be affecting the successful implementation of safety management
- Evaluate implementation of resilience engineering principles within the aeronautical industry for different levels in terms of
    - Experience gained
    - Identifying the successful outcomes of resilience and the reasons of the success
    - Identifying the areas where resilience principles did not provide any measurable benefits and the possible reasons
    - Identifying the possible implementation gaps in multilevel resilience principles in air transport
- Adapt the identified resilience engineering principles of the aeronautical industry to the unique needs of maritime transport
- Develop a ‘Multi-level Resilient Maritime transport Framework’ to facilitate the integration and management of resilient human and organisational factors along with the required implementation steps and training needs.

3. Innovative multi Level Resilience System Developed for Marine Operations

An innovative topic integrated in to the objectives of the SEAHORSE project is the relatively new research field of resilience engineering. Resilience is the intrinsic ability of a system to adjust its functioning prior to, during, or following changes and disturbances, so that it can sustain required operations even after a major mishap (or in the presence of continuous stress).

In Resilience Engineering, failures do not stand for a breakdown or malfunctioning of normal system functions, but rather represent the converse of the adaptations necessary to cope with the real world complexity. Individuals and organizations must always adjust their performance to the current conditions; and because resources and time are finite it is inevitable that such adjustments are approximate. Success has been ascribed to the ability of individuals, groups, and organizations to anticipate the changing shape of risk before damage occurs; failure is simply the temporary or permanent absence of that.

In order for the operational procedures on board to be able to deal successfully with safety critical operations and harsh environments; system resilience is required. Therefore the SEAHORSE project’s approach will be to implement resilience engineering principles in an integrated and innovative manner, taking into account the knowledge generated and experience gained by the aeronautical industry. By utilizing the SEAHORSE project's innovative approach, the user will be provided with new resilience resources to prevent a decrease in system performance, allowing the system to return to baseline performance much more quickly and display greater resilient behavior.

Resilience is subdivided into four *abilities* which are considered as the functional cornerstones.

- *Anticipate* events beyond current operation, applying a broader perspective
- *Monitor*: know what to focus on, be able to perceive significant change in performance and environment, using valid lead indicators
- *React*: detect, recognize and assess events in time, know when and how to react, having resources available and ready.
- *Learn*: promote, facilitate and enhance learning from both good and bad experiences

The SEAHORSE project will introduce and develop a multi-level interlinked resilience structure, representative of the functions and systems onboard the ship, which will provide detailed relationships and interactions of the following 4 resilience levels:

1. Individual resilience (e.g., resources for the ability to react, such as shortcutting; and the use of pictograms instead of written procedures, particularly for crews that face reading challenges)
2. Team resilience (e.g. resources for the ability to anticipate such as safety buddies; or the ability to learn, such as debriefing. This seems promising, since that can be done at a point in time without time pressure.
3. Multi-party resilience (e.g., resources that describe how to work with subcontractors, stevedores, guests; Briefing before an operation can be regarded as an example ability to monitor. However, briefing is always conflicting with available time, which is an issue at the organisational level). Also resources that improve the gap between the ship and the shore organization; currently, an often heard saying is "what happens on board stays on board". Resources as trust etc., might be important here)
4. Organisational resilience (e.g., resources as an ability to anticipate, such as safety culture, a management that provides budget for safety campaigns etc.)

To deal successfully with operational demands (e.g., changes, disturbances, stressful situations), the project will develop new or improve existing resilience resources that can be optimally applied to one or more abilities at one or more resilience levels.

Resilience concept of the project and Multi Level Resilience matrix are demonstrated in Figure 2 and Figure 3, respectively.

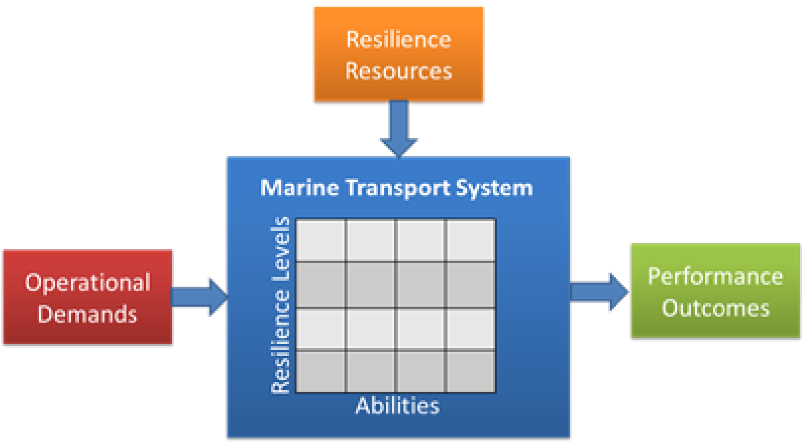

Figure 2. Resilience concept of SEAHORSE project

Level / Ability	Anticipate	Monitor	React	Learn
Individual *Operational Demand / Resilience Resource*	New crew members needs time to familiarize --- Let new crew members express lack of experience with specific situations	Tiredness induced concentration loss --- Enhance recognition of significant change	Foreign crew members face reading challenge --- use of pictograms instead of written procedures	Lack of ship type specific knowledge --- Delta Learning
Team *Operational Demand / Resilience Resource*	Lack of team competences --- Team Dimensional Training	Reduced crew atmosphere --- Discuss information flow, initiative/ leadership, communication, supportive behaviour	Suboptimal team performance --- Support Team awareness	Blame culture on board --- Structural Debrief of good practices
Multi-party *Operational Demand / Resilience Resources*	Crews and stevedores have different safety culture --- Structured Briefings at start loading/unloading	Insufficient trust between ship and shore organisation --- Virtual social sessions	Inter-party confusions --- Introduce time outs	mutual experiences do not last --- Celebrate successful partnerships
Organisation *Operational Demand / Resilience Resource*	Economic pressure on board --- Increase awareness of negative consequences	Insufficient insight in strength of safety regime --- Registration of successful deviations from plans	Insufficient safety resources --- Resilience Model based safety investments	Underexplained accidents --- FRAM-based accident analysis

Figure 1. SEAHORSE Multi Level Resilience Matrix.

By adopting this new and innovative SEAHORSE multi-level resilience model, it will be ensured that the transfer of the resilience engineering principles utilised in the aeronautical industry will be achieved successfully to the unique needs of maritime transport. Through utilising the aforementioned multi-level structure, it will ensure that an intervention to improve resilience at one level does not create a negative impact on another level(s).

The main SEAHORSE outputs will be in six different forms:

- Multi-Level resilience model and procedures for maritime sector
- Assessment tool (software) for shipping companies on the basis of multilevel resilience framework.
- Crew Quality Audit tool
- Multi-Level Resilience design tool (software):
- Training material to provide the training to crew and management
- Guidelines for whole shipping industry to address the human/organisational

4. Smart Shortcuts Concept

Accidents attributed to human error have been closely analysed by governmental organisations as well as many researchers [14,15,16,17,18,19,20]. Common well known human factor problems are well identified however the findings of the studies conducted by different researchers or studies based on different accident databases tend to contradict each other.

In current accident databases information is being recorded for what people deem to be the most obvious accident factors. However it can be argued that the underlying factors which are really causing the accident are being unintentionally ignored which can led to the confusing situation described above. A good example of this comes from research of the MAIB's accident database where in the last 19 years of information, noise is only mentioned as an accident factor only twice. Compare this to the latest research in the field of noise and the impacts it has on the human, the comparison between reality and the database is contradicting. Therefore the approach of the SEAHORSE project does not rely solely on the accident statistics and subsequently, in order to capture the real design mistakes and occurrences of human error, a unique and innovative human error and measurement methodology will be developed.

SEAHORSE project aims to investigate human performance problems and human error through innovative 'SHORTCUT' methodology as part of developing individual resilience with the multi-level resilience system that SEAHORSE is proposing.

The definition of the term "shortcut" can be found as "a more direct route or action than the prescribed procedure" as well as "a means of saving time or effort". Shortcuts in the context of SEAHORSE Project are "the deliberate changes that the crew have applied to standard procedures and to the equipment on ships, due to practical and other needs". Shortcuts are the direct indicator of design problems on ships and can be considered as a usability fix applied by the end user after design. SEAHORSE projects main aim is to take this valuable information into consideration during the design stage.

Figure 4 shows a methodology to identify and assess current shortcuts and proposes a methodology that influences the design of ships and operations accordingly.

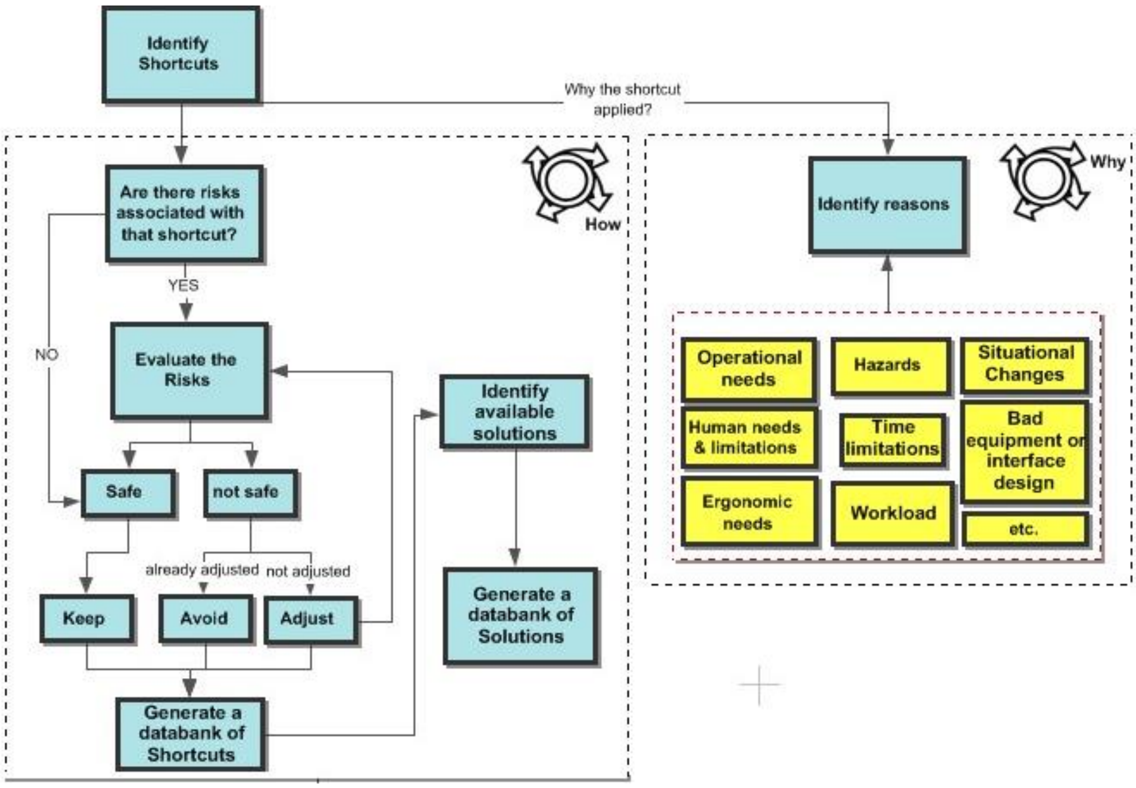

Figure 2. Methodology for identification and assessment of current shortcuts.

5. Development Innovative Resilience Tool

SEAHORSE, by taking into account the experience and successes achieved in air transport and utilising the multilevel resilience approach adapted and enhanced for Maritime transport, will be developing a Maritime Resilience Tool, which will provide the platform for companies to support them in their safe ship operation.

The SEAHORSE Virtual Platform will be the integration of all the created tools, databases and guidelines that will assist and support the end users in developing, assessing and maintaining a resilience structure that is tailored to their particular needs and operational requirements.

The SEAHORSE Virtual Platform is defined as:

1- Database Section: The database section will be designed to accommodate the following databases:
   - Crew database: It stores profiles of the individual crew including education skills, experience, certificates and involvement in accidents etc.
   - Ship Database: It provides the operational profiles of the vessels including technical details, routes, type of cargo they carry, number of crew they have in each department, onboard procedures, involvement of in any accident
   - Company Database: This will involve size of the company, ships that they operate, existing procedures,
   - Non-standard acts database: This database will be recording all the incidents, mishaps, non-standard actions including shortcuts
   - Rules and standards database:

2- Tools Sections: Tools will be developed to assist the company towards developing and maintaining the customised resilient structure for safe operation these tools are:
   - Individual and team Crew Quality Audit Tool (Software): The tool, by utilising the databases, audits the crew quality at individual as well as at team levels and identify the strengths and weaknesses of the crew and identify the training needs or suitability for type of ships for operation.
   - Shortcut assessment and smart short cut development tool (Software): This tool will utilise the shortcuts database and assess them according to the procedure described in Figure 4: The Smart shortcuts will be further assessed and developed and best practice procedure as part of multi-level resilience structure
   - Assessment tool (Software) of shipping companies on the basis of multiparty resilience framework: The tool will allow the safety managers to assess the company in terms of resilience compliance and identify the gaps/weaknesses/non-compliance that may lead to errors and accidents
   - Multi-level Resilience design tool (Software): This tool will assist the shipping companies to design/develop procedure to build the multiparty resilience structure, develop procedures to eliminate the gaps /weaknesses

3-Output Section: This part of the platform generates the customised reports using the results of each of the tools and there will be two types of outputs:

- Output reports for each assessment
- Customised multi-level resilience structure and relevant procedures for the specific company

Within the scope of the SEAHORSE project, the Virtual SEAHORSE platform will be initially developed in an offline personal computer based format. However after project completion, i.e. the platform has been successfully validated and tested, it is envisaged that a future research programme will be the transference of the Virtual SEAHORSE platform to a secure and interactive online format.

An outline of the Virtual SEAHORSE platform and the resilience tools can be seen in Figure 5.

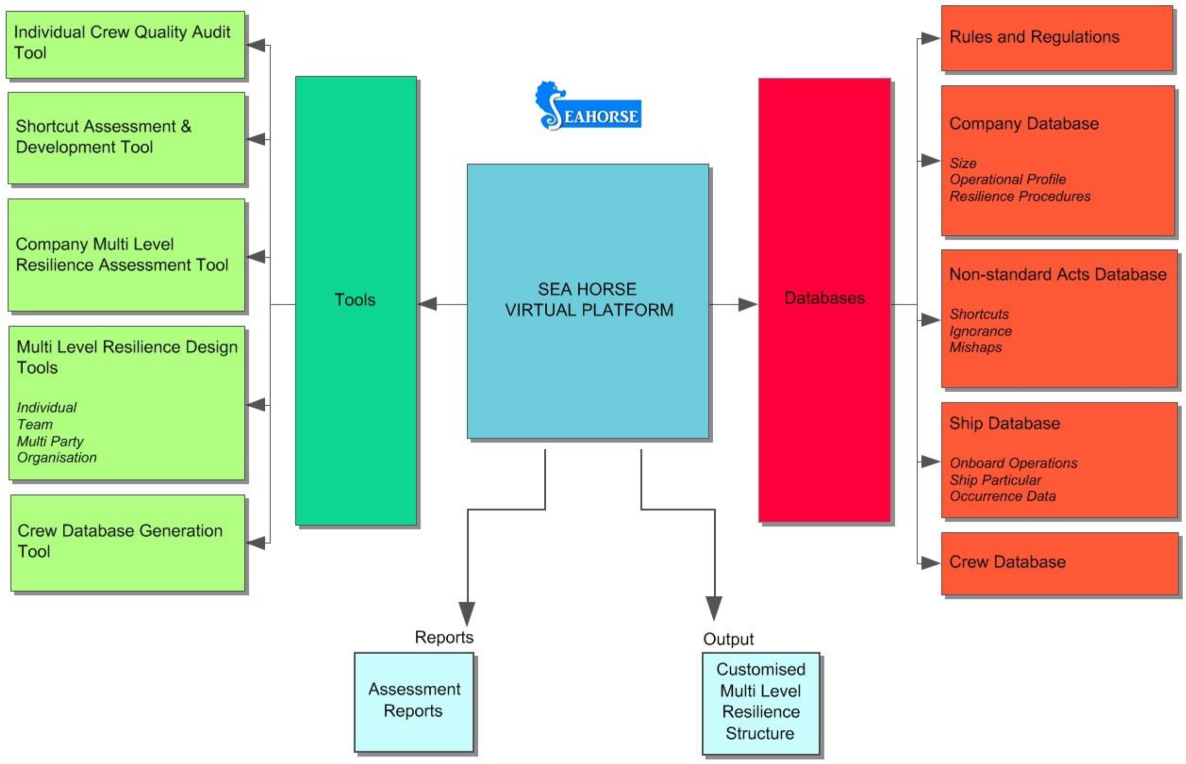

Figure 3. SEAHORSE Virtual Platform for Multi level Resilience in Maritime Industry

6. Innovative Data Collection, Observation and Validation Approach

In order to support the development, validation and refining of the multilevel resilience system for maritime transport, SEAHORSE will be utilising 8-12 ships of different type (tankers, bulk carriers, containerships and passenger vessels) and operational environments/routes to collect data from shortcuts and operational practices. The developed multi-level resilience system will be implemented and utilised on-board test ships in order to benchmark against ships not using the system and assess the envisaged benefits. This will be achieved by:

- Field observations and data collection on 8-12 ships to record good and bad practices in different operational conditions (normal and safety critical conditions).
- Implement 4 level resilient systems on ship operations: This will be done using the same ships that data is collected for and categorised into similar ship sizes, operational area and profile.
- One of the ships will be operated after implementation process of multi-level resilient system principles and compared with other vessels that will continue using the standard operational principles.

- Benefits of the resilient system will be evaluated and any potential adjustments to the proposed approach will be identified and implemented.
- Final results and findings will be disseminated to partners and industry.

7. Conclusion

Safety is still very crucial issue in maritime industry. Similar industries such as aviation industry are also safety sensitive industry.

SEAHORSE (Safety Enhancements in transport by Achieving Human Orientated Resilient Shipping Environment) project is a EU FP-7, Technology transfer in the area of Transport Project which is aiming a leap forward towards shipping safety achieved through technology transfer from air transport to maritime transport focusing on human factors problems in an innovative, integrated and multidisciplinary manner towards safer and more resilient shipping operations.

In this study, an overview of the SEAHORSE project and present safety gaps are discussed.

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Integrated Test Bed for Save and Efficient Maritime Systems

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"Safe voyage from berth to berth": This is the goal of all e-navigation strains, driven by new technologies, new infrastructures and new organizational structures on bridge, on shore as well as in the cloud. To facilitate these efforts suitable engineering and safety/risk assessment methods have to be applied. Understanding maritime transportation as a sociotechnical system allows system engineering methods to be applied. Formal and simulation based verification and validation of e-navigation technologies are important methods to obtain system safety and reliability. The modelling and simulation toolset HAGGIS provides methods for system specification and formal risk analysis. It provides a modelling framework for processes, fault trees and generic hazard specification and a physical world and maritime traffic simulation system. HAGGIS is accompanied by the physical test bed LABSKAUS which implements a reference port and waterway. Additionally, it contains an experimental Vessel Traffic Services (VTS) implementation and a mobile integrated bridge enabling in situ experiments for technology evaluation, testing, ground research and demonstration. This paper describes an integrated seamless approach for developing new e-navigation technologies starting with virtual simulation based assessment and ending in physical real world demonstrations.

Keywords: eNavigation, eMaritime, testbed, safety assessment, simulation

1. Introduction

Seafaring is and was always a joint undertaking between humans and their technology. Taking into account the impact of nature, such as wind, waves, etc. the reliability of technical equipment and its correct usage ensure safe voyaging. This holds true also for the implementation of e-navigation technology.

The e-navigation implementation process is accompanied by International Maritime Organization's (IMO) NAV and COMSAR sub-committees which merged into the NCSR Committee 2014, as well as the International Hydrographic Organization (IHO) and the International Association of Lighthouse Authorities (IALA). The NAV subcommittee IMO (IMO 2012) did a comprehensive gap analysis as a part of their development of a joint implementation plan for e-navigation which is leading to an updated strategic implementation plan to be presented at MSC94. Regulatory safety rules like SOLAS with the International Safety Management-Code (ISM) for safety management on board or the IMO resolution MSC.252(83) for integrated navigation systems define a set of features to be implemented to guaranty safe voyage under the actual state of the art derived from formal safety assessments (see IMO MSC 85/17/1).

The new guideline focuses on software quality and human centered design. To ensure safety of e-navigation technologies a holistic approach is required taking the whole sociotechnical system (man and machine) in its environment into account.

This paper introduces a system oriented approach for the development of new e-navigation technologies focusing especially on safety and risk assessment. This approach is already adopted in as similar way for accident analysis (IMO decision A.849(20) and A.884(20)) and consequently it should be applied in system analysis for new e-navigation technologies also. Model driven technologies support the safety analysis during the design phase by using formal analysis methods and simulation based on a simulation framework named HAGGIS. For scientific grounding and in situ experiments HAGGIS is accompanied by the physical test bed LABSKAUS with experimental Vessel Traffic Services (VTS) Systems, Bridge Systems, reference waterways and port areas.

2. Systemic Design and Safety Assessment

Engineering new systems requires a broad understanding of technologies to be selected and applied to the design and methodologies to handle complexity of the undertaking. Therefore, engineering applies methodologies (to define engineering activities and their order), methods and tools (to support the engineering activities) in addition to technological knowledge [1]. Engineering itself is an iterative process of synthesis and analysis activities. During synthesis, concepts and technologies are selected, applied and the design is elaborated: The system is under design. Then engineers validate (is the system fulfilling the right requirements?) and verify (are the requirements implemented correctly?) their design. Thus engineers can validate and verify their design developments as early and iteratively as possible to reduce costs and safe time. In electrical engineering Bell Laboratories introduced the concept of system engineering in the 1940s [2]. To understand the product under development as a system with dedicated sub elements, a system border and defined relationships can help to manage complexity. With the advent of technologies to describe elements and relationship in a reusable way by using computer models, this approach became popular also in other engineering domains.

Reusable computer models of the system under design (the system model) allow continuous flow of information between the different tasks and simple implementation of the mentioned synthesis/analysis loop [3]. Paying attention to the early phases of system design (to identify and validate/verify the concepts of the product) reduce the risk of later costly design changes. The concept of frontloading aims at improving design efficiency by reusing models from the early phases in the subsequent design, validation and verification. The propagation and transformation of models along the phases of the design process is called model driven design.
The process of developing new e-navigation technologies starts with the analysis of processes for using existing systems to identify existing hazards. A functional model is the first result which describes the system under development. For early testing and safety assessment, the functional implementation of the new control or e-navigation systems can run as a simulated software subsystem which is embedded in a simulation (software in the loop). Input from sensor systems and from communication to other systems is generated by the simulator. For user tests the functional implementation has to be connected to the virtual representation of the user interface in the virtual bridge to communicate with the user agents (see Figure 1). The models in the first step are executed by a process execution engine (MasCAS) or by cognitive model simulation (CasCAS) to simulate human and machine actions. The example in Figure 1 shows how the user interface is tested. The functional system model is executed in the simulation environment. User input is generated by user agents acting on a virtual bridge with a virtualized user interface. The virtualization is required to simulate the human interaction by software user agents. The user agents use the virtual user interface in the same way a human would use the real physical user interface. For testing a bridge system in traffic simulation a maritime traffic simulator generates the required test cases and data to be used.

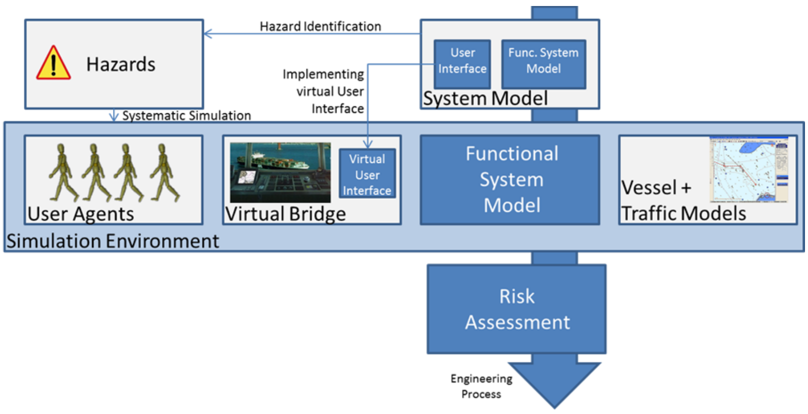

Figure 1: Simulation based Risk Assessment

The focus while testing the new systems in the virtual environment is on safety assessment and hazard detection. The identified hazards are used by the simulation environment to systematically seek risky/hazardous situations using rare event simulation techniques[4]. The behavior of the system is protocolled for further consideration in the engineering process.

After successful assessment in the virtual environment and subsequent analysis and synthesis iterations for improvement, the assistance system then can be assessed in a physical test bed. Our architecture described in Section 3 allows for direct deployment of the software systems on physical test platforms without adaptation to the new platform. This transparency of platforms is known from other platforms like Player[5], ROS[6] or DOMINION[7] in the robotics and automotive domain. Changing the test environment to the physical platform is done by deploying the software on an experimental VTS or a mobile bridge for example. The virtual user interface will be substituted by the real user interface and test persons will perform the actions that have been simulated by the user agents.

3. A platform for seamless development of e-navigation technologies

One of the main challenges in the design and development of new e-navigation technologies is the test environment. Ship-based e-navigation technologies are used in a rough environment (on sea), in which real world testing is not always possible. Therefore, simulation-based testing of new concepts is necessary and for this a very detailed and realistic simulation platform has to be used. However, still a gap between simulation and real world will remain. To reduce this gap we developed a model based approach for design and development of new e-navigation technologies based on a seamless architecture covering simulation and real world assessment that is shown in Figure 2.

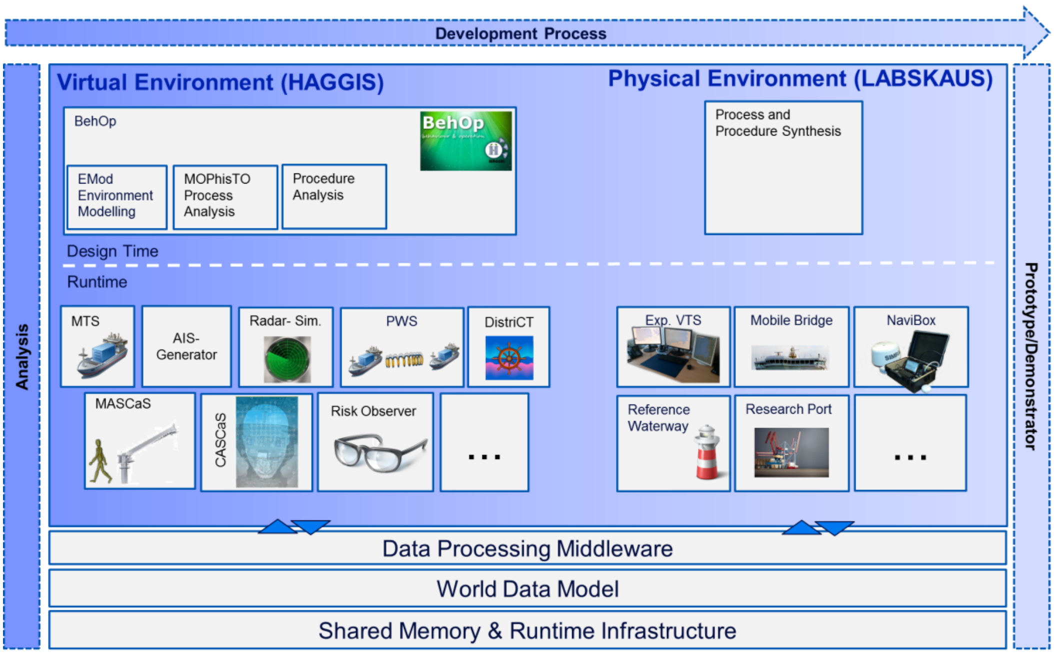

Figure 2: Architecture for seamless testing of new e-navigation technologies

This architecture allows the early testing of new e-navigation technologies in a complex simulation environment and the seamless transfer of these technologies into a physical testbed. The basis of the architecture is a shared memory and runtime infrastructure, a common world data model and data processing middleware. The shared memory & runtime infrastructure currently is a modified high level architecture implementation. This infrastructure allows the communication between different simulation components in a co-simulation environment but also the communication with developed software and physical testbed systems.

The world data model is the common semantic basis for all intelligence implemented in the simulation and new developed e-navigation technologies. It takes into account IHO S-100 aspects and is the virtual representation of the physical world. All simulation components as well as physical components like the mobile bridge work with this data model to generate high value semantically enriched information. The data processing middleware transforms data from different formats like NMEA 0183 and 2000, Asterix, IVEF etc. into the world data model. It furthermore, is an easy to extend sensor fusion middleware for generating high value information depending on what is necessary for the e-navigation technology under development.

This architecture supports the development of completely new e-navigation technologies like assistance systems for vessel guidance. Support is given from the analysis phase until the development of prototypes and demonstrators. The improvement to product quality level is done later phases of the development process.

4. Simulation Environment

System engineering shows that models are well suited to support the engineering process and to provide a valuable basis for validation and verification of the system under development e.g. for safety assessment.
This can be done formally by analyzing the model of the system and informally by using simulation tools. That requires that the models are sufficiently formal and executable. In addition, the test environment has to be defined (modelled) as well. Therefore, we split the simulation environment HAGGIS in a modelling and formal analysis toolset and a co-simulation environment.

4.1. Modelling and Formal Analysis

Figure 3 shows the general approach for modelling and formal analysis. For the safety analysis of new e-navigation systems (e.g. like a new integrated navigation system on bridges) a ground research is done by analyzing guidelines, accidents reports, nautical maneuvers etc. We use a generic hazard list to identify potential harming issues in the system. Process models are used to describe the activities (e.g. operations) and they are enriched by defining information availability, requirements and generic hazards. Formal model checking technology can applied to analyze whether bridge systems allow the required situation awareness of the crew. Further, automatically generated fault trees serve as a tool to identify and quantify the potential risks.

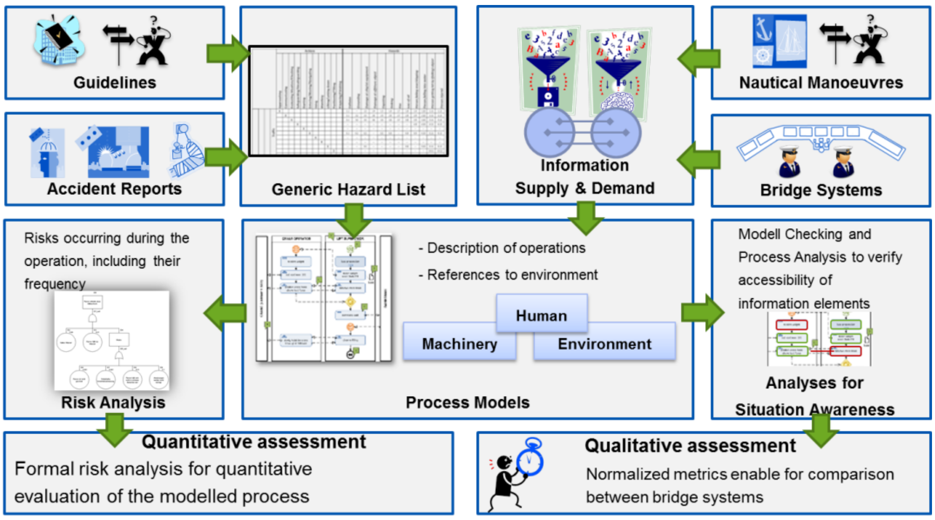

Figure 3: Modelling and Analysis Process

The analysis results in quantitative or qualitative risks / safety assessments. To support the assessments a number of tools are available: MOPhisTO – Maritime Operation Planning TOol, ShiATSU - Analysis of Situation Awareness on Ship Bridges and FTA – Fault Tree Analysis. This toolset is accompanied by EMod – Environment MODelling tool for defining the system environment for analysis by simulations. An overview about the modelling and assessment tools is given in Figure 4.

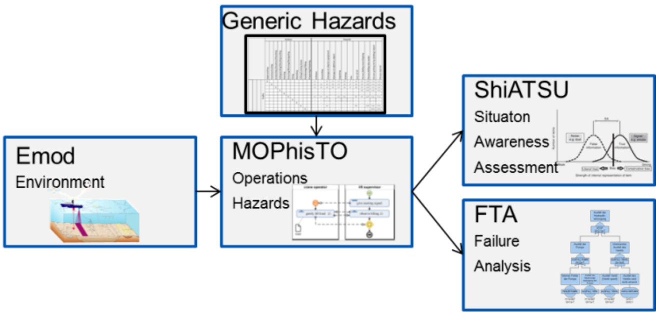

Figure 4: Modelling and Formal Assessment Tools

EMOD – Environment MODelling
EMod is an editor based on the Eclipse framework. EMod provides a system model that allows setting up a static scene according to a predefined scenario. This system model contains the fundamental components/entities of all used resources, actors and environmental factors. The user is able to load 3D geometric models of e.g. ships. The properties of these objects can be set according to the user´s need.

MOPhisTO – Maritime Operation Planning TOol
MOPhisTo enables maritime domain experts to graphically model processes of the operations defined for their field of expertise [8]. The process models are enriched by linking them to required information supply and demand as well as hazards from the generic hazard list. This information is used for information gap and automatic risk analysis. Additional benefit of the models is the option to use them for training and documentation purposes. MOPhisTo can make references to the data modelled with EMOD. MOPhisTo supports the description of normative behaviour for maritime personnel (e.g. individual tasks of an officer) and maritime machinery (e.g. behaviour of an adaptive display). The process modelling language is based on BPEL [9]. BPEL is extended to express the required references to EMOD entities failures etc.

ShiATSU – Situation Awareness Tool SUite for Ship Bridges
ShiATSU is a tool suite for analysis of situation awareness [10] on ship bridges during design time. It allows for analysis of socio-technical ship bridge system setups consisting of a ship bridge, operators and organizational aspects. Operators' interactions with information elements are extracted from MOPhisTO's normative processes and considered as information flows between human operators and the ship bridge. An automatic analysis is used to assess the information flows by facilitating multi-dimensional models of the ship bridge. The analysis comprises a verification of information accessibility, measurements of the spatio-temporal information access and supports engineers by identifying causes for situation awareness errors by consideration of distributed situation awareness. The measurement results in normalized metrics, which allow for system optimization and comparison.

FTA – Fault Tree Analysis
MOPhisTO is used for formal description of normative processes and the annotation of hazards and failures. The integrated FTA tool performs an automatic fault tree construction by using the modelled hazards and failures [11]. Resulting fault trees are the basis for a formal quantitative and qualitative risk assessment.
The tool enables a graphical presentation of generated fault trees to the user as well as manual construction of fault trees. Additionally, they are used for automatic generation of textual risk assessment results e.g. to construct Health Safety and Environment (HSE) plans [12].

Since identification of hazards and failures is important in early project phases, the tool supports users by suggesting hazards and failures modelled in the past. Therefore, it comes with a formal approach to learn data from performed analyses for later reusability of modelled hazard/failure combinations.

4.2. Co-simulation Environment

The sociotechnical model is analyzed in a simulation environment. The process models and the environment models are used to describe the system under analysis. The Generic Hazard List and the process models are used to define the normative behavior and provide a basis to identify critical situations during simulation. For human behavior a cognitive simulation is used. The approach is shown in Figure 5 and the general architecture of the co-simulation is sketched in Figure 6. Inputs are normative behavior and environment models. A maritime traffic simulator and a n-body simulator provide the required environment of the e-navigation experiments.

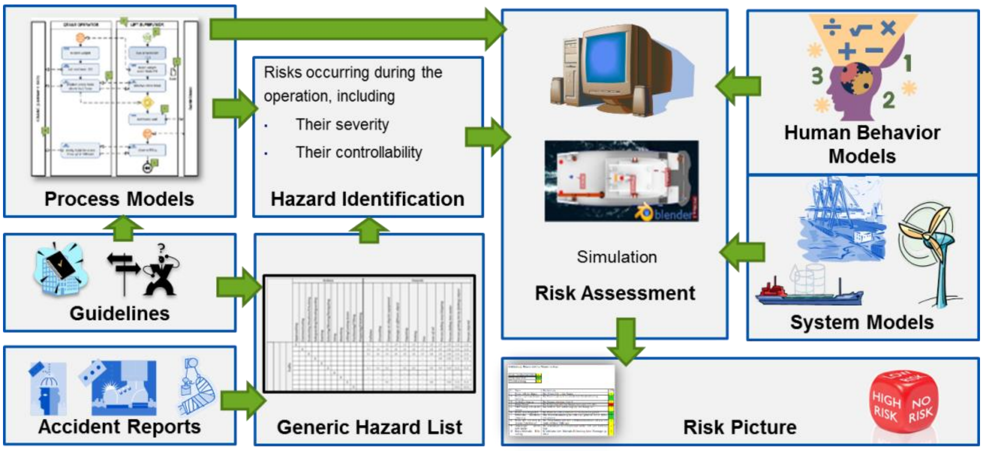

Figure 5: Simulation Based Risk Assessment

Agents are brought to live by MASCAS. MASCAS is executing the defined behavior. CASCAS is a cognitive simulation that implements the real human behavior by performing designated tasks [13]. The implementation currently uses High Level Architecture (HLA) as a co-simulation architecture with data specification of the world data model in HLA specific object model template (OMT) files. HLA is defined under IEEE Standard 1516. OMT provides a common framework for the communication between HLA simulations. Standardized wrappers are used to speed up the simulator integration. All data exchanged by the simulators is defined by the semantic world data model. A simulation control tool runs simulations automatically and supports the detection and provocation of rare events in combination with observer components for observing the simulation. The observer components are automatically generated by using the models defined with MOPhisTo.

Maritime Traffic Simulator

The MTS is a flexible usable maritime traffic simulation for implementing, executing and observing the behaviour of multiple vessels in a realistic context. Each of these vessels has a dynamic model that describes its behavior regarding environmental influences, like waves, current and wind. In addition each vessel is steered by an intelligent agent to follow a predefined path or find its own path according the maritime law regulations. The MTS is used to provide all necessary data about the traffic situation that is required by a statistical analysis or other simulators.

N-Body Simulator

The N-Body simulator simulates the physical interactions of rigid bodys inside the simulated environment [14]. That could be: The displacement of the cargo due to a collision with another object or the rapid (heave/sway/surge) movement. It contains a collision detection capability that allows for checking constraints like man under the cargo or man overboard.

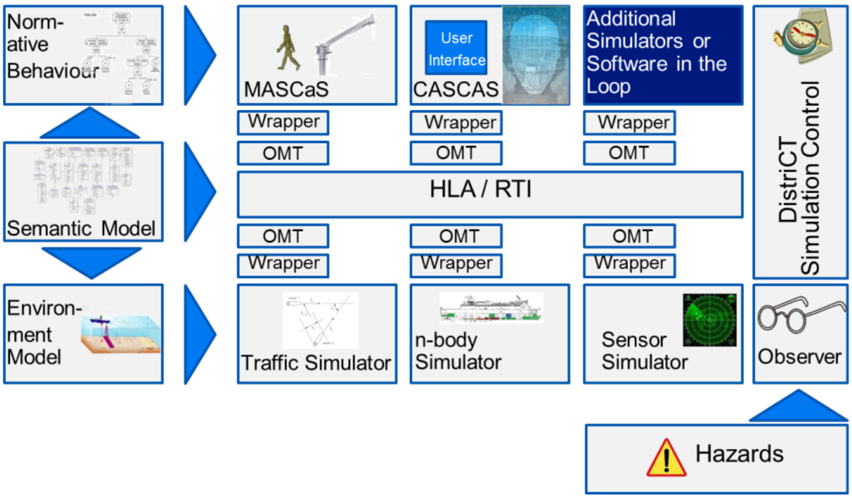

Figure 6: HAGGIS Co-simulation Environment

Sensor Simulation
The sensor simulation is used to generate realistic sensor measurements from a simulated context, e.g. the context of the maritime traffic simulation. The generated measurements can be extended by statistical, systematic or context-sensitive error models. In combination with a traffic simulation the Sensor Simulation generates AIS or Radar data for example.

MASCaS
In order to simulate simplified agents models by MOPhistTO, a simple model interpreter (MASCaS) has been implemented in Java. Changes of agent states are communicated via HLA to their related avatars in the N-Body simulation or Maritime Traffic Simulation. For example, MASCaS can give the avatar a motion command that is implemented by a description of the behavior of the avatar or the movement is directly controlled by the agent.

CASCAS
The cognitive architecture CASCaS (Cognitive Architecture for Safety Critical Task Simulation) is used to model human behaviour. CASCaS models generic domain independent cognitive processes in a modular way taking into account human perception, memory, knowledge processing and motor skills [13]. A key concept underlying CASaS is the theory of behavior levels which distinguishes tasks with regard to their demands on attentional control dependent on the prior experience: autonomous behavior (acting without thinking in daily operations), associative behavior (selecting stored plans in familiar situations), cognitive behavior (coming up with new plans in unfamiliar situations).

DistriCT (Distributed Controlling Toolkit)
DistriCT can be used to set up and control simulation components on different distributed systems. This involves starting and stopping of simulation components as well as receiving and sending objects/attributes to them. This can be used to inject failures or perform a systematical parameter exploration. Additional observers are used to evaluate the system state and the logical or physical distance to hazardous situations. They identify minima in these distances and guide the simulation in the direction of critical situations to find rare events and to reduce the required number of simulation runs.

5. Physical Testbed

The virtual environment is accompanied by the physical environment and testbed LABSKAUS (laboratory for safety critical experiments at sea). LABSKAUS is a living lab for experiments and traffic surveillance and provides a grounding for the HAGGIS simulation experiments and itself is based on the same world data model and the same architecture as HAGGIS. LABSKAUS offers services for e-navigation experiments. Services are a reference waterway, a research port, a mobile bridge system and a Vessel Traffic Services (VTS) System. One generic element for its implementation is the Navibox for mobile sensor systems.

5.1. Reference Waterway

The Reference Waterway covers the Elbe and Kiel Canal Approach near Brunsbüttel, Germany. It covers a basic maritime surveillance infrastructure with three Naviboxes (including AIS, Radar, cameras) and broad band communication via satellite and LTE. The system is used as an experimental platform and for demonstration of new technologies as well for setting up a database with travel patterns and near collisions.

5.2. Research Port

The research port addresses experiments for sensor data fusion in port areas. The small port Gestemündung in Bremerhaven, Germany has a ferry terminal, berths and an entry to a popular double lock. The research port is equipped with a mobile sensor network of Naviboxes especially to experiment with optical systems (visual light, IR and UV) in cameras and laser systems. The Naviboxes set up an ad hoc sensor network with broadband communication.

5.3. Mobile Bridge

For bridge experiments in lab and on ship a mobile bridge system allows set up of an experimental bridge on board without interfering with the vessels navigation systems. It provides a Raytheon Integrated Bridge in its standard configuration (other software is optional) and is linked to a Navibox which provides required navigational data such as compass, GPS, AIS, log, lot, radar, as well as a broad band communication system. This mobile bridge is used for experiments with assistance systems and for human centered design analysis.

Its mobile design consists of a controlling unit, modularly mounted with a PC station. The controlling unit enables ship steering e.g. put the rudder (in areas where permissions are given for this). The PC works as Electronic Chart and Data Information Systems (ECDIS) and radar display as common on ship bridge systems. The overall mobile bridge system is transportable within a box including display components, and ready-to-use for experimental applications with or without external power supply.

From the software perspective it is possible to connect simulation environments to the mobile bridge e.g. to send simulated sensor data. Intelligence from new developed e-navigation assistance systems is based on the world data model. E. g. collision detections uses the already mentioned world data model for analyses of the current traffic situation and for generating adequate alarms.

5.4. VTS System

An experimental VTS system was implemented by the company Signalis at the maritime research center in Elsfleth. It can be linked to the Reference Waterway and the Research Port as well as to the virtual environment HAGGIS. It consists of a PC system and multi-touch display components, which are used for HMI research applications in order to improve designs of current state of the art.

5.5. Navibox

The Navibox is a mobile, connectable sensor data hub which provides navigational data on board as well data for maritime surveillance systems. Sensors can be configured ad libitum. The Navibox provides WLAN and Broadband WAN communication facilities. The box is an aluminium case and comes with a radar pole.

6. eMaritime Reference Platform

LABSKAUS and HAGGIS are part of the open eMaritime Reference Platform a lead project and demonstration system of the German working group for civil maritime safety to implement the strategic national master plan in maritime technologies. In addition to the presented simulation system and physical test bed, eMIR covers also the Research Port at Rostock for experiments with satellite technologies and resilient Position Navigation and Timing (PNT).

7. Conclusions

Safety and dependability in combination with efficiency are the design goals of e-navigation systems. Model driven technologies support the efficiency of the development process and enable early design assessments, especially safety requirement verification and validation. To support a system engineering approach for e-navigation systems the paper introduced the eMaritime Reference Platform eMIR with a virtual simulation based environment (HAGGIS) and physical environment and test bed (LABSKAUS). HAGGIS supports modelling and formal analysis of e-navigation systems and a co-simulation environment with traffic and n-body simulation systems as well as human agent models for human centered design engineering. LABSKAUS provides an experimental VTS System, a mobile ship bridge and a reference port and a reference waterway for e-navigation experiments and systems demonstration. Both are based on a common architecture and data model to allow for a seamless development of new e-navigation technologies.

The approach is also directly linked to training and education of seafarers. Simulation environments are already an established elements on seafarer training. Training is possible with key user while the system is under development. An agent based approach is also able to improve bridge simulation systems by providing realistic behavior other vessels.

Of course the mentioned approach is limited to a encapsulated and restricted artificial test environment and final tests in real world environments cannot be avoided.

8. Acknowledgements

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Resizing Study of Main and Auxiliary Engines of the Container Vessels and their Contribution to the Reduction of Fuel Consumption and GHG

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The maritime industry has great potential for improving energy efficiency in both new builds and existing ships. It is, therefore, necessary to identify the areas where improvements can be made to reduce fuel consumption, and influence to the shipowners, shipyards and designers of ships on the need to implement these improvements in energetic efficiency and to achieve a reduction of between 25% and 75% of CO2 emissions as IMO report 2009 provides, making ships even more environmentally friendly.

The study was conducted focusing on one type of ship such as containership, compiling a database of these ships built from 2000 to 2014. The 3618 ships comprising the study were taken from the database of Lloyd´s Register of Shipping. With all the technical data on each of the ships, we proceeded to relate the main and auxiliary power, with the operating speed of the vessel, its displacement and GT, by size, age and generation ships.

All the above comparisons were made according to ship sizes, graphically and analytically in which interesting conclusions could be drawn in the relevant dimensioning of the main and auxiliary engines, as well as the operation of the ship. Because of the current crisis some owners have already begun to change their size criteria of propulsion and auxiliary engines of these vessels, their management and operation as well as their speed.

Another significant finding was the identification of some shipyards that build their ships with an oversize and exaggerated power of the main and auxiliary engines, regardless of the effect on increasing fuel consumption and impact on the environment.

Finally, we have performed a comparative study of EEOI of these vessels by size and age to determine the environmental signature and their evolution.

All this leads us to determine a set of measures to be applied, for example, power reduction or derating, etc. on existing ships and applied to new designs, thus reducing the propulsion and auxiliary power of these ships and collaborating to reduce greenhouse gases.

Keywords: Energy efficiency; Energy management; Energy policy; Shipping economic.

1. INTRODUCTION

As explained in the abstract, the objective of this study is to further deepen the measures that can be implemented in container ships during its design and construction, and later in its operational life.
The first step in this study was to perform a database of all existing container ships, and then classified by size, age and generation, from 2000 until 2014.
The database used has been to Fairplay that is associated with the classification society Lloyd's Register of Shipping, and it is the most complete and reliable that exists in the maritime world. The total number of vessels including all sizes is 5119, and they all took their characteristic data such as identification IMO, dimensions, displacement tonnage (GT), propulsion and auxiliary power and speed.
The classification was made of container ships by size is as follows: Feeder (100-500 TEU), Handy (1.000-2.000 TEU), Sub-Panamax (.2000-3.000 TEU), Panamax (over 3.000 TEU) , Post-Panama (over 4.000 TEU) and Super-Post-Panamax (over 10.000 TEU).
Once realized the database container ships from 2000 to 2014, and the classification by size has come to make, for each vessel size, relationship and comparison of the propulsive power to the auxiliary power; of the propulsive power to auxiliary power and speed; propulsive power to the auxiliary power and displacement; propulsive power with the auxiliary and the GT; propulsion power with displacement and velocity; propulsion power and speed with GT.

2. FEEDER

In Figure 1 the propulsion and auxiliary power is related to the speed, called feeder container ships which have entered 474 vessels with a gross tonnage of between 499-10.965 GT, and we can observe the following: the propulsive power is from 1.800 kW to 9.500 kW. In this power range we can consider five groups: the first in a propulsive power of 3.500 kW, a second 6.200 kW, 7.200 kW a third , a quarter of 8.500 kW and 9.500 kW fifth .

It can be inferred that the range of propulsive powers that cover this type of ship is divided into the five powers before mentioned with the exception of extreme cases in both directions.

In the same Figure 2 the speed of this type of vessels ranging from 12 to 20 knots, and it is found that there is a strong parallel between the propulsion power and speed in which we highlight four groups: the first one has a 6.200 kW propulsion power for a displacement of 12,000 t; Then, propulsion power of 7.200 kW for a displacement of 13.000 t; the third, a propulsion power of 8.500 kW and a displacement of 15.800 t, and the last group has a propulsion power of 9.500 kW for a displacement of 17.500 t. All this indicates that to cover the range of feeder vessels are several series that cover according to the above values except in exceptional cases.

Regarding the auxiliary power of these vessels, it goes from 300 kW to 2.500 kW with a few exceptions ranging from 3.500 kW to 5.000 kW, very high powers which may be due to the supply of electricity to large number of reefer containers. If we compare the electrical power of these ships with propulsive power, the range is from 6% to 13.8% of the propulsion power.

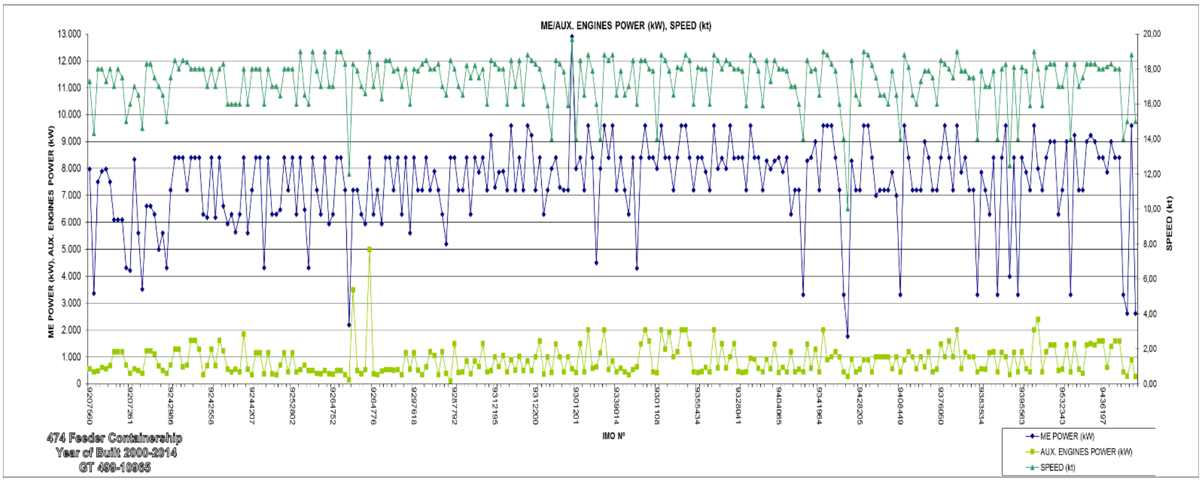

Figure 1

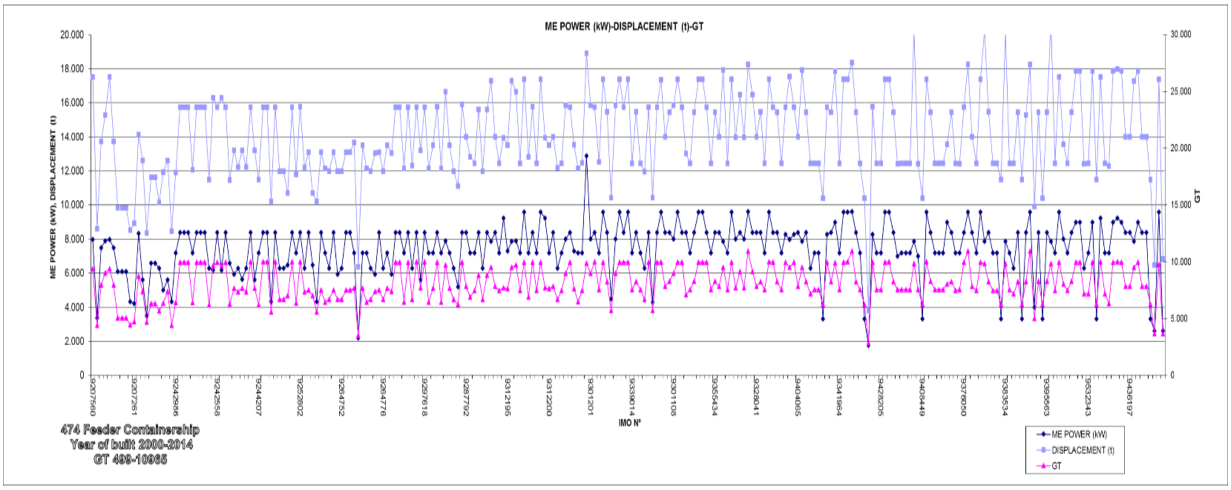

Figure 2

3. HANDY

In Figures 3 and 4 are compared the propulsion power, auxiliary power and displacement of these ships and we can establish the following: the range of propulsion power ranges from 6.000 kW to 21.700 kW, and can establish six series of groups such vessels linking the propulsion power and displacement. The first is that of vessels with propulsion power of 7.500 kW and a displacement of 17.500 tonnes, the second propulsion power of 11.000 kW and 22.500 t displacement, the third of propulsion power of 12.500 kW and 25.000 t displacement, fourth of between 16.000 and 17.000 kW for a displacement of 32.000 t, the fifth for propulsion power of 19.000 kW and a displacement of 37.000 t and the last of propulsion power of 21.500 kW and a displacement of 35.000 t.

In the above groups can be seen that this type of vessels, Handy, are quite segmented within the capacity range of containers that move (between 1.000 and 2.000 TEU) .

The speed range of these vessels is broad and ranges from 15.5 to 21 knots, and there are cases of ships with speeds between 22 and 23 knots , requiring high speeds and high propulsion power of up to 21,500 kW , which an increase of fuel consumption very high.

The auxiliary power of these vessels ranging from 500 kW to 2.000 kW with a range of between 5% and 9% of the propulsive power, low values, since such vessels do not usually have loading and unloading , so that your electrical needs are moderate. There are vessels in which its subsidiary powers are higher , reaching up to 3.000 kW possibly by an increase in electricity demand to transport a large number of reefer containers .

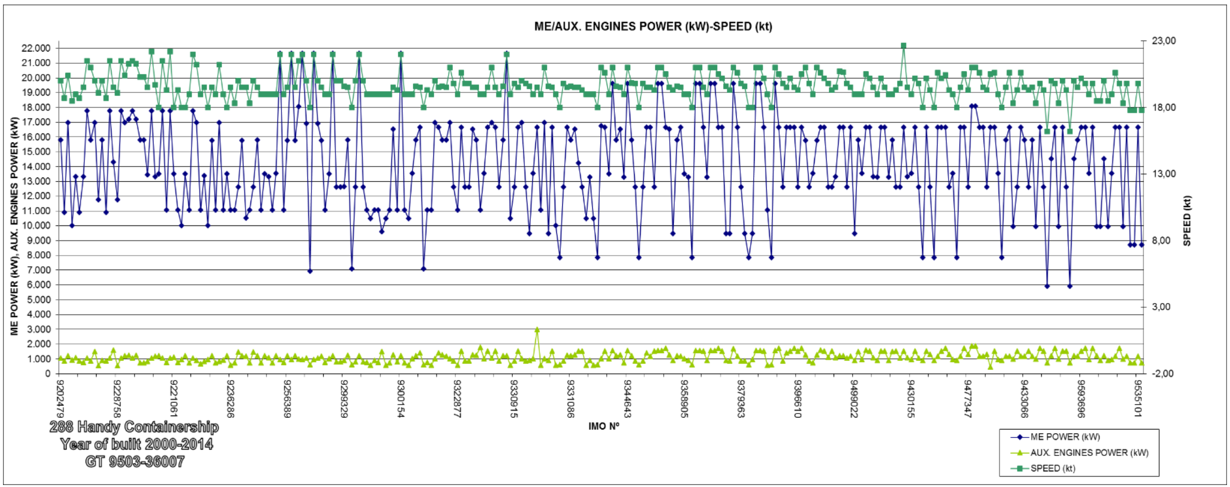

Figure 3

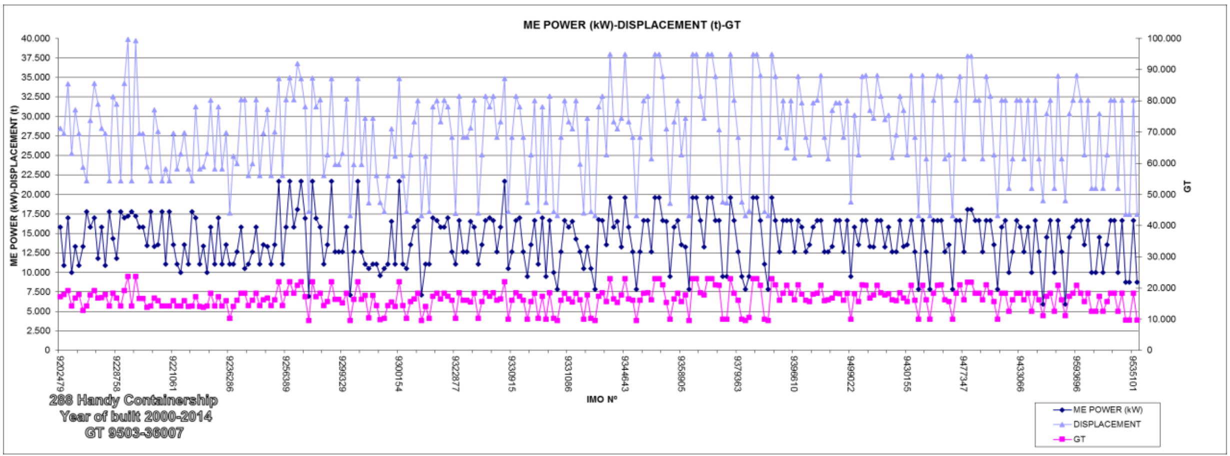

Figure 4

4. SUB-PANAMAX

In these ships the propulsion power range goes from 13.500 kW to 32.000 kW. Looking at Figures 5 and 6, the first one we can see that in this type of vessel we can establish six series of propulsive power covering called vessels sub -panamax and that would be 18.000 kW , 20.000 kW , 21.000 kW , 21.700 kW, 25.000 kW and 29.000 kW. The largest is 21.700 kW followed by 25.000 kW. There are also isolated cases at both ends where the propulsion power is 13,500 kW or 32.000kW. These two extremes of power are marked by a small or very high speed.

Speeds for the propulsion power of these vessels ranging from 21.5 to 23.5 knots, very high speeds, requiring propulsion powers like the above with excessive fuel consumption.

In these ships there are also low speeds like 16 knots you only require a propulsion power of 13.500 kW for a displacement of 43.000 t , which is the best example of efficiency in fuel consumption and environmental friendliness . Otherwise we have a vessel with a speed of 25 knots requiring power 32.000 kW for a displacement of 48.000 t, clear example of high fuel consumption and air pollution.

Comparing powers of propulsion vessels displacement in this type of vessel is as follows: for the propulsion power of 18.000 kW displacement is 42.000 t, for between 20.000 and 21.000 kW displacement is 45.000 t, for the displacement of 21.700 kW is between 47.000 and 52.000 kW, 25.000 kW for the displacement ranges from 52.000 to 55.000 t, and the displacement of 29.000 kW ranges from 52.000 to 57.000 t. It is noted that this type of vessel rewards speed with some dire consequences for the environment because the speed from 20 knots penalized exponentially to the 4th power demanding high propulsion power for the same displacement with consequent overconsumption of fuel.

In regards to the electrical power of these vessels, this ranges from 1.000 kW to 2.500 kW, which means between 5% and 11.6 % of the propulsion power .

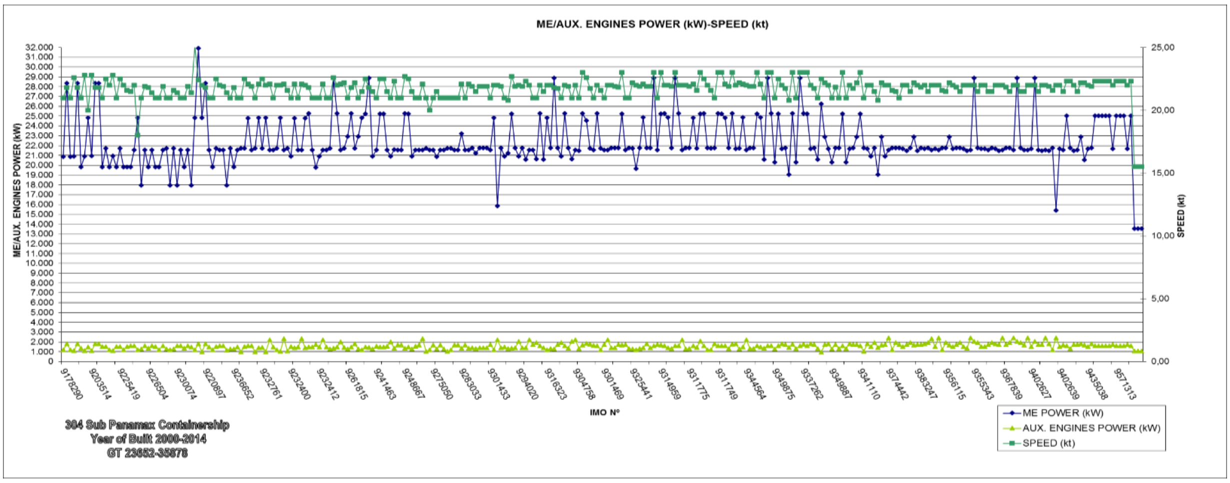

Figure 5

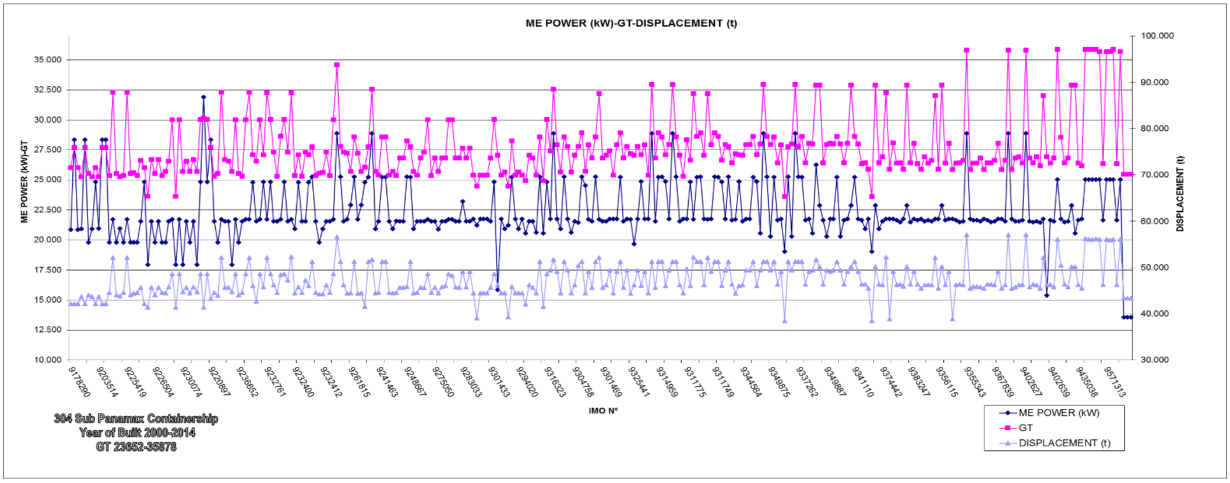

Figure 6

5. PANAMAX

Figures 7 and 8 relate us propulsive power with the auxiliary, the velocity and displacement of the Panamax container ships. In the first one the propulsion power series of vessels up to Panamax category and see that this ranges from 25.000 kW to 69.000 kW, and can be grouped into several groups being the first one that goes from 26.000 kW to 29.000 kW, 32.000 kW the second , the third and the largest having 36.000 kW , the fourth which ranges from 40.000 kW to 41.000 kW, 46.000 kW fifth , the sixth of 52.000 kW and the seventh of 69.000 kW.

This type of vessel has increased its capacity in terms of economies of scale and in turn speed that has led to its potency were to increase in an excessive manner which has resulted in high fuel consumption and consequently a high air pollution. The speed of the vessels is from 20 to 26 knots , with higher speeds using the 22, 23 and 24,5 knots. All these very high speeds , rather than cause further economic performance , with high fuel prices and the drop in the number of containers to be transported, causing a rise in costs and high pollution.

In regard to the relationship between the motive power and the displacement of these vessels have the first group having a propulsion power of between 26.000 and 32.000 kW for a displacement of 56.000 t, the second with a power of 36.000 kW displacement 67.000 t, the third to a power between 40.000 and 41.000 kW , a displacement of 87.000 t , fourth to 46.000 kW power a displacement of 87.000 t, the fifth group for a power of 52.000 kW a displacement of between 78.000 and 85.000 t, and the last group with a power of 69.000 kW a displacement of 85.000 t.

In the relationship between propulsion power and movement we can see that the driving power increases with the displacement up to vessels greater propulsion power but no major displacement and this is due to the high speed that has been given to this type of vessel.

The auxiliary power of these vessels ranging go from 1.000 kW to 4.500 kW, the average value is 2.000 kW and the propulsion power ratio of between 4% and 7.7 %. Very moderate powers because these vessels do not possess ancillary services such as loading and unloading, among others, demanding a higher electrical power.

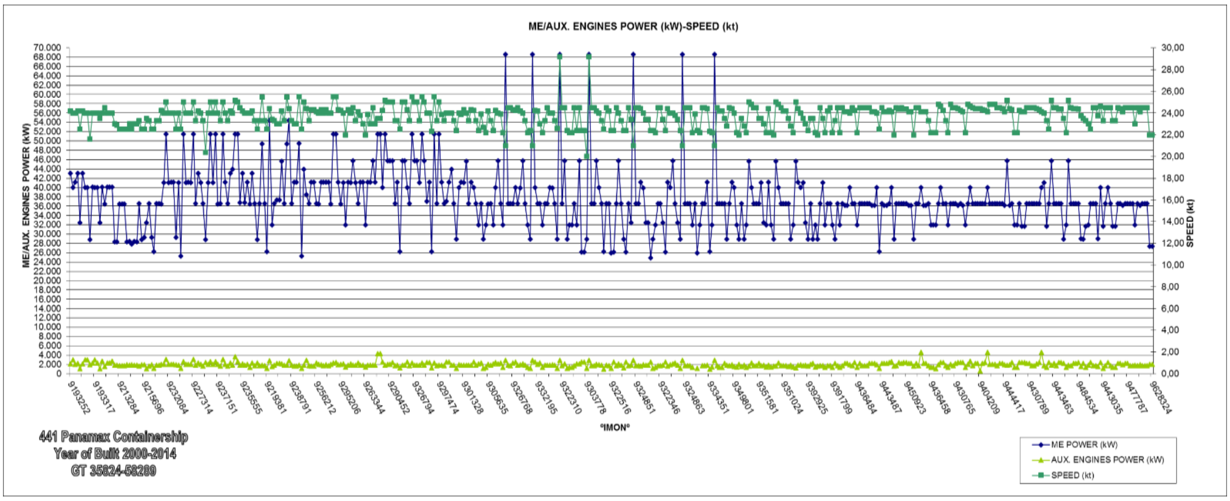

Figure 7

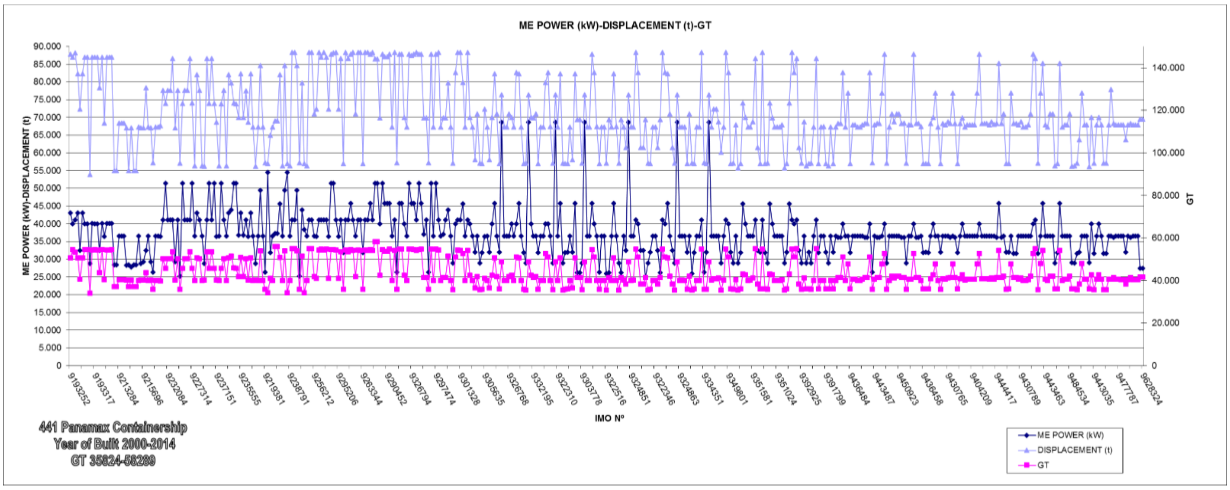

Figure 8

6. POST-PANAMAX

For Post- Panamax vessels propulsion power ranges from 27.000 kW to 77.000 kW and series that make up this type of vessels grouped them into seven groups: the first with a propulsion power of 42.000 kW, 45.000 kW the second , the third of 55.000 kW 58.000 kW fourth , the fifth and largest 62.000 kW and 77.000 kW last, a high power which are demanded due to the high speed of these vessels .

The speed of the Post-Panamax vessels ranging from 22 to 26.5 knots, the velocity of the increased use of 23 knots, all of which are also very high unnecessary for sustainable development.

If we relate the displacement and propulsion power, we need to propulsive power between 42.000 kW and 45.000 kW displacement is between 98.000 and 120.000 t, to power 55.000 kW and 58.000 kW displacement is between 105.000 and 125.000 t for the 62.000 kW power a displacement of 120.000 tons , the propulsion power of 68.000 kW a displacement of between 155.000 and 175.000 t, and to the power of 77.000 kW a displacement of 170.000 kW .

The auxiliary power of these vessels ranging from 2.000 kW to 7.000 kW, which is about the propulsion power of between 4.5 % to 7.1%, with a rate mean of 3.000 kW.

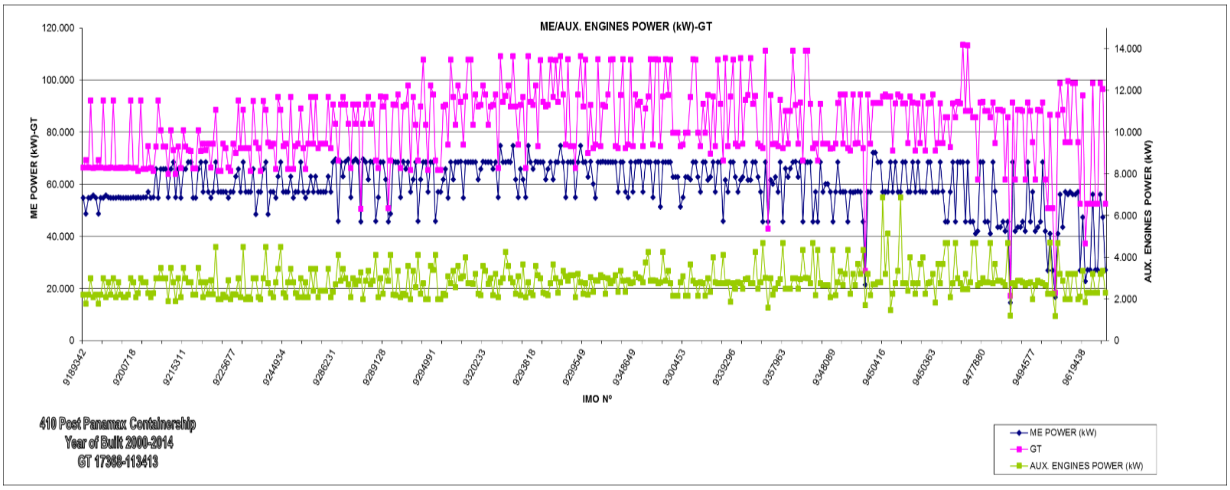

Figure 9

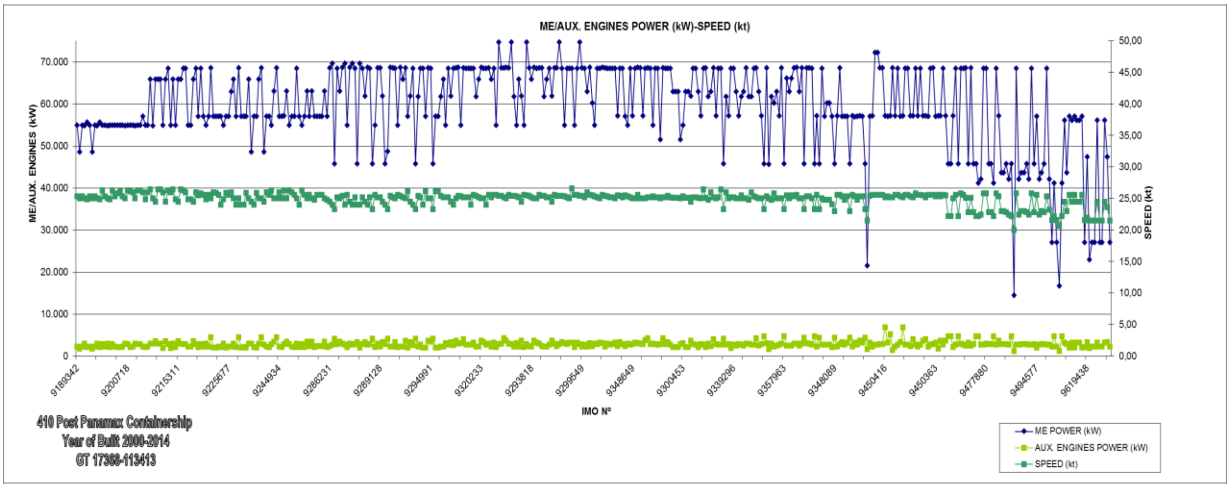

Figure 10

Figure 11

7. ULSC

Finally we have the Ultra Large Ship Containers ships having propulsion power between 58.000 kW and 80.000 kW, and grouped them into three series, the first one for the propulsion power of 62.000 kW, 72.000 kW the second and third 80.000 kW. All Propulsion power of which have qualified as those of previous vessels outrageously high.

The speed of these vessels ranges from 24 to 26 knots, been the most common of 25 knots.

The relationship between the propulsion power and displacement are set into a first group of propulsive power of 62.000 kW at a displacement of 110.000 to 120.000 t, the second with a power of 72.000 kW and a displacement of 125.000 t and the third to a power 80.000 kW and a displacement of 135.000 t.

The electrical power ranges from 2.200 kW to 6.000 kW, being between 3.2% and 5.3 % of the propulsion power, and with an average value of between 3.800 kW and 4.200 kW.

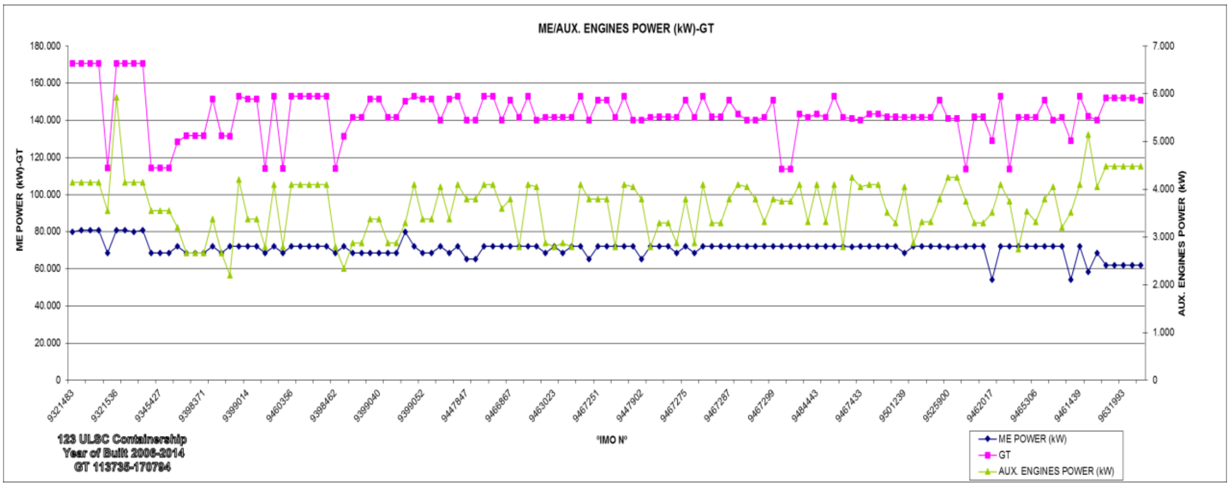

Figure 12

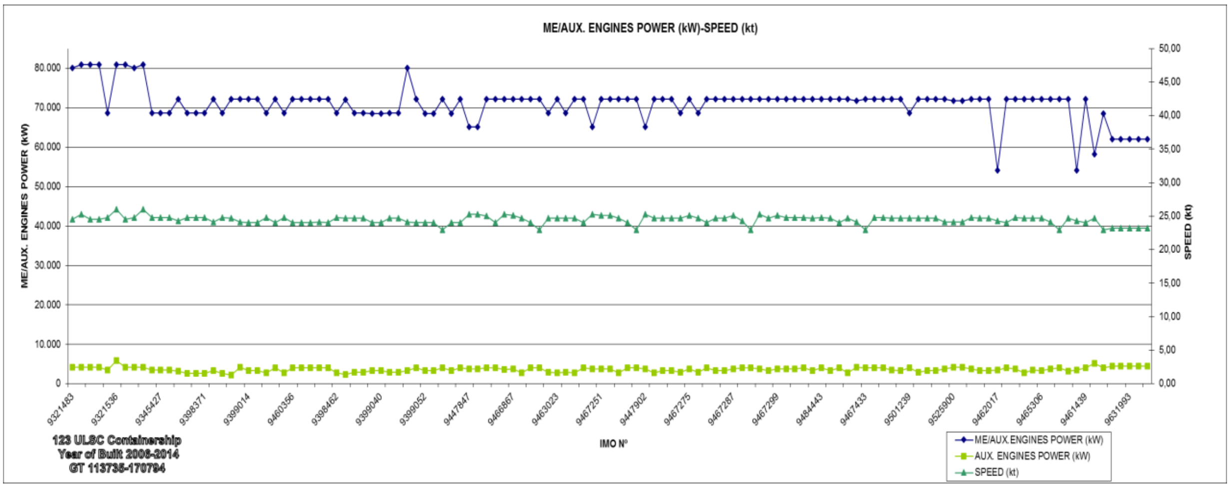

Figure 13

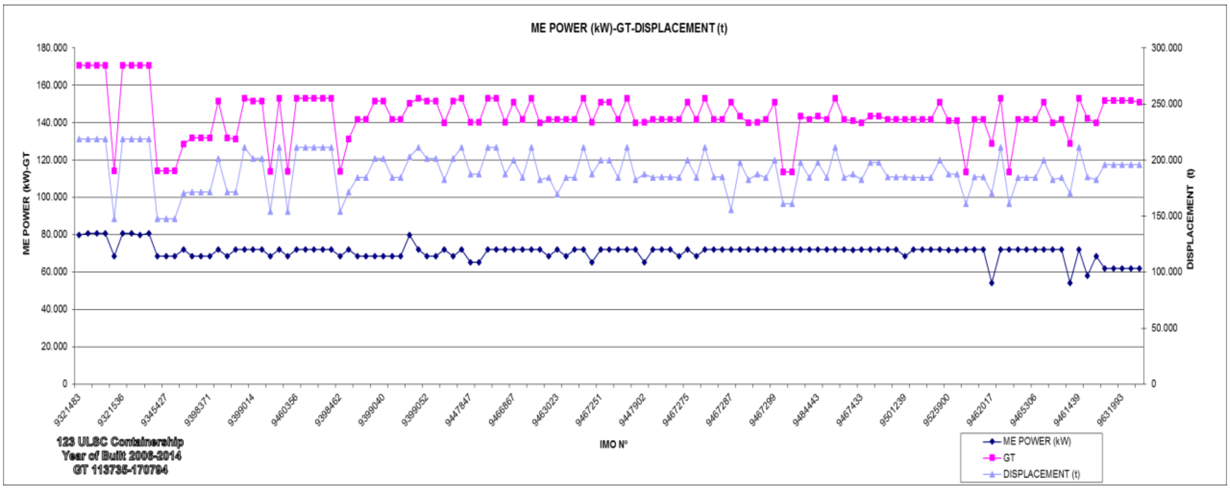

Figure 14

8. Efficiency Energy Operation Index EEOI

Has been carried out to calculate the energy efficiency operational index, EEOI, of each type of container ship considering a day of sailing at its maximum speed, the total number of containers that can transporter, fuel consumption at maximum power and engine auxiliaries of considering 50% of the installed auxiliary power and the values obtained are:

IMO Nº	Feeder 9287792	Handy 9331086	SubPanamax 9301433	Panamax 9305635	PostPanamax 9320233	ULSC 9466867
EEOI tCO_2/TEU NM	0.00036	0,00026	0,00022	0,00022	0,000155	0,0001078

Of course, these values are approximate, but very close to reality, and they can see that CO2 pollution per TEU and nautical mile sailed is lower in larger container ships, but this is misleading, since it is due the economy of scale to be increasing the number of containers and reduce the cost of transporting them, but if we were to reduce the speed of these vessels between 2 and 4 knots, EEOI would be substantially reduced and the operation of the vessel would remain almost at the same level, and at the same time would reduce greenhouse gases.

9. Conclusions

Container ships are characterized by being designed to operate in general terms, as a ship with high speed.

The high speeds at which these vessels operate, and fundamentally the cause larger potencies of these are excessively high, because going from 20 knots of speed, propulsion power is increased exponentially to fourth power.

The high power to that sail these ships, the daily fuel consumption is higher than 300 t, representing a daily air pollution exceeding 1000 t CO2.

Although there is a certain parallelism between propulsion power and displacement, this is broken by increasing the rate of one or two knots.

The auxiliary electrical power of this type of vessel is medium size because, in general, have no means of loading and unloading

The experience and the current economic crisis has shown that the oversized power of these vessels due to its high speed, has been a serious error of design and planning of the operation of the vessel, causing the de-rating of the propulsion engines to reduce power and breakdowns.

Powers and speeds show, generally speaking, good correspondence between them. There are isolated cases that show big variations with very high main and auxiliary power that can be due to severe operation conditions.

In many instances, main and auxiliary powers are oversized and this can be explained for different reasons like a lack of detailed study for each ship and submission to the conditions of the yard or the engine builder. There are yards that generally install oversized powers.

The relationship between main power and electric power varies of the following way:

	Feeder	Handy	SubPanamax	Panamax	Postpanamax	ULSC
MAIN ENGINE (kW)	1800-9500	6000-21700	13500-32000	25000-69000	27000-77000	58000-80000
AUX. ENGINE (kW)	300-2500	500-2000	1000-2500	1000-4500	2000-7000	2200-6000

It is the possibility to adjust main and auxiliary powers to a minimum values in order to have a substantial fuel saving and, thus, of greenhouse gases.

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Active Method to Manage the Use of Fuel Oil Onboard of Ships

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The fuel consumption in maritime transportation is a big fuel consumer. However, to use and to manage the fuel in maritime transportation field is still not proper to actual expect in many countries including Vietnam. The present fuel management on board ships is only based on the set fuel use norm of a country, but not on the actual operating conditions of ships. Therefore, such management method of fuel is not matched to the target of using efficiently and saving energy, but also creates good conditions for crewmember to pilfer the fuel for private profits.
So, in order to overcome the situation, we propose a new method to manage the use of fuel on board a ship. This method is based on "online information" about the actual operating parameters of a ship including the main engine and sea conditions, then a suitable plan of ship operation with optimum fuel consumption will be set and sent to a ship for realization. This method is named as an "active method to manage the use of fuel oil onboard of ships".

***Keywords**:* Active method, parameter, operation regime, main engine, generator, boiler, fuel consumption, fuel loss.

1. Introduction

According to statistics of the International Maritime Organization (IMO), the number of global sea freights are over 90% of the total freights and the sea transport have consumed annual over 300 million tons of fuel oil[3]. However, the fuel management and using are still insufficient. The present fuel management method is mainly based on the fixed number norm, without the basic of the operating mode and the operation conditions. This method is not based on saving goals only, but also creating a loophole for dishonest reporting of seafarers and creating residual illegal fuel for sale by seafarers.
For solving this phenomenon, we have given proposal on a new actively method to manage the use of fuel on board a ship. This new method is based on the online information collecting on the technical operating situation, the actual voyage situation of the ship, after that, the shipping operation plan at reasonable fuel consumption will be made out. The method is named as an "active method to manage the use of fuel oil onboard of ships".

2. Fuel consumption characteristics of marine propulsion plant

According to preliminary statistics, Vietnam's fleets with a tonnage of over 06 million tons (2012) have consumed annual over 03 million tons of DO & HFO. Besides, the inland waterway fleets with main engine's capacity of over 06 million HP (horse power) have consumed annual over 02 million tons of DO. Thus, if we save 05% of this fuel consumption, the businesses will save 250.000 tons of fuel (in Vietnam) & 15 million tons of fuel (in the world) and we also will restrain harmful emissions to the environment [1].
Almost fuel consumption equipment equipped in Vietnam's fleets and the world's fleets are diesel engines and boilers. The marine diesel engines consist of 02 types: propeller driven diesel engines (also called as main engines) and generator driven diesel engine (also called as auxiliary diesel engines). A main engine is designed to drive directly/indirectly FPP (fixed pitch propeller) or CPP (controllable pitch propeller). The basic technical feature of a main engine is operated in accordance with the propeller characteristic [2], in which, the consumption power measured at the hub of propeller is 3rd proportion with propeller revolution: $N_e = C \cdot n^x \left(x = 3\right)$ and using heavy fuel oil (HFO). The most important parameters to assess the operation load of a main engine are the engine revolution and the fuel rack of high-pressure pump (load indicator).

The number of generator engines equipped on board ships is often from two to three units, in which, almost diesel engines are medium-speed or high-speed engine which use DO.
The boilers onboard a ship are usually auxiliary boiler combined with economizer boiler to make use of heat energy in main engine.

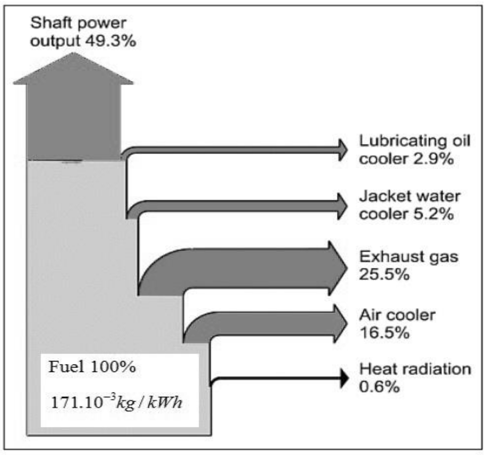


Figure 1 Thermal energy distribution of the modern main engine

Currently, according to the trend of economical and efficient use of energy with the advancement of technology, the thermal efficiency of a main engine in modern ships can achieve 50% (Figure 1).

2.1 Fuel consumption

The fuel consumption in a period of time can be calculated by the measurement of fuel amount between the two time points (excluding the extra supplied fuel):

$$G_t = G_{t_2} - G_{t_1} \quad (1)$$

Where: G_{t_1} is the amount of fuel on board at the time t_1; G_{t_2} is the amount of fuel at the time t_2 ; and G_t is the amount of fuel consumption in the period $t = t_1 - t_2$;
The fuel consumption of ship G_t is separately calculated for each type of fuel consumption on board including different components such as: fuel consumption of main engine, generators, boiler; fuel loss due to leakage, discharge sludge from filters, purifiers...
The fuel consumption of diesel engine in 1 hour (main engine and generator) is determined based on the effective power of the engine and specific fuel consumption:

$$G_h = N_e \cdot g_e \quad (2)$$

Where: G_h is the amount of fuel consumption in an hour (kg/h); N_e is the effective power of diesel engine (kW); g_e is average effective fuel consumption of engine, g/(kW.h);
For generator, the effective power N_e can be determined by power that presented on the main switch board. For a main engine, the effective power is difficult to measure or specify calculating in operation.
The fuel consumption of boiler is determined by the formula:

$$G_b = g_b \cdot t \quad (3)$$

Where: G_b is the fuel consumption of boiler, (kg); g_b is the capacity of fuel injector, (kg/h); t is the burner time of boiler,(h);

Basically, the fuel consumption of boilers are largely depended on the oil burning time of boiler.

2.2 The fuel loss in ship operation

Currently, the cost of fuel in shipping is highly occupied in comparison with the other costs, sometimes up to 60 % of total ship operating costs. For reducing the fuel costs, we should implement methods for keeping the economical operation mode and reducing the fuel loss (loss). The fuel loss consists of two kinds: objective losses and subjective losses.

2.2.1 Objective losses

The fuel loss which belongs to the objective losses in operation G_{OL} [5], consists of:

- Sludge of purifier: Depending on the quality of fuel, the sludge discharged from the centrifuge purifier may occupy from 0.1 to 0.5 % of fuel consumption on board. Sludge discharged from the centrifuge purifier often is called «sludge», stored in sludge tank;
- Drained sludge: Depending on the quality of fuel, the sludge from sludge tanks, filter and backwash filter,… may occupy from 0.1 to 0.2 % of fuel consumption on board. Sludge often is stored in drain tank;
- Fuel loss due to the leakage: The fuel loss from flange, the crack position, the leakage…which is little in engine room bilge tank... are depending on technical situation of engine ;
- Fuel loss to delivery : Almost contracts are required measurement amount of the fuel supply. In addition, the delivery is not enough due to the difference of temperature, density, air bubble even when supplying of fuel,...
- The other losses: the other losses may include: broken pipe, leaky pipe and others.

According to statistics, the total fuel losses in exploitation may take from 01 to 03 % of fuel consumption, especially may exceed 05 to 10 % [5].

2.2.2. Subjective loss

The fuel loss is caused by dishonest report in exploitation G_{SL} , the essence of this problem is the fuel stolen by crew and selling off or selling to fuel supplier. This fuel has the following characteristics:

- The company has no plans for operation and appropriate fuel management;
- The data is created from the fictitious increasing of fuel consumption of diesel engines and boilers;
- The technical tricks are used to make residual fuel for personal purposes;

According to formula No. 2, the fuel consumption is calculated as: $G_h = N_e \cdot g_e$ and the power of main engine is calculated as: $N_e = C \cdot n^3$, C - constant depending on weather conditions, ship hull and propeller technical conditions. It suppose that the operator reduce the revolution of main engine in from n_0 to n_1, then if the value of g_e is not significant change, the fuel consumption will be:

$$k = \frac{G_{h(1)}}{G_{h(0)}} \approx \left(\frac{n_1}{n_0}\right)^3 \tag{4}$$

When reducing the revolution of main engine, the revolution of propeller is reduced, and therefore, the ship speed is reduced in according to first order relation. In this case, the reduction of ship speed is very often explained as the bad weather condition or effected by sea current.

Example: The operating speed of main engine is 125 (rpm), ship speed is 12 knots, actual fuel consumption is 17(MT/d). If the operating speed of main engine is reduced to 122 (rpm); actual fuel consumption is 15.8 (MT/d), and thus, ship speed will be reduced as 11,6 or 11,7 knots. This is evident that fuel consumption can be saved as much as 1.2 MT/d while the reduction of speed of the ship is only 7.2 knots/d.

For the generator, which is calculated with highest load; For the boiler, burner time is longer than reality.

The operating loss of fuel oil is normally take from 5% to 10% of total fuel consomption, especially, it can be exceed 20 % or 30 %.

3. Features of fuel oil management of Vietnamese fleets

Normally, fuel consumptions is determined by datas of average fuel consumption amount per hour and actual operating of the engine.

For the main engine, mileage from A to D can be deviced into the following modes: AB - Maneuvering mode, BC - Sailing mode, CD - Maneuvering mode. Based on the operating mode, engineers will give the suitable kinds of fuel oil and fuel consumption.

For the generator, there are some modes as sailing, loading and unloading mode, anchoring… in accordance with kind of fuel oil and fuel consumption.

For the auxiliary boiler, there are also the operating mode and fuel consumption.

According to research results, the authors found that the general method for managing fuel oil is not effective and managers of shipping companies can not control correctly the fuel consumption of ships. The shipping companies can only get the all data of fuel consumption of ships only by reports. So the current applied method of managing fuel oil consumption is called «inactive method». This form of fuel use management has disabled the request of ship owners, managers aim to increase savings and fuel efficiency.

4. Active method to manage the use of fuel on board of ships

Our research results showed that the Vietnam shipping companies, as well as many worldwide companies annually have lost a large amount of fuel due to operation causes and technical management causes of the marine propulsion plant.

For the operation causes, the crew member, as well as the technical manager have not given operation plans for ships as well as for their propulsion plants in various operating conditions. Therefore, the ship's operation causes relate to the following factors:

- The type of charter party – C/P (voyage C/P, time C/P, bareboat C/P) ;
- The weather conditions on voyage;
- The draft and even keel;
- The ship's cruise speed.

For the technical causes, this is a problem relating to working quality of main engine, generator and technical quality of hull, propeller, especially the matching load between the diesel engines and hulls, propellers. Therefore, the technical causes relate to the following factors:

- The maximum generated power of diesel engine;
- The technical state of hull (the ratio of fouling, distortion, ..) ;
- The technical state of propeller (the deformation ratio of propeller's blades, the erosion ratio and sea-acorn, ...);
- The balance of torque between diesel engine and propeller.

In fact, two mainly parameters that affected to the fuel consumption of a ship are the revolution of diesel engine and the unbalanced state between generating torque of diesel engine and load torque of propeller (this state is called overload torque - torque-rich).

In Figure 2, this is research into the variation of operation power characteristics of a diesel engine at torque rich state. If we implement carefully researches in period of one-year operation , we will record the data of variation of engine characteristics affected by load v/R_c ; Where: R_c - the resistance of all components (kN, kG) and ν- the variation in their technical state.

The bad technical condition due to reduction of air supply caused by the poor performance of exhaust gas turbine system, and the unsuitable fuel supply caused by the excess clearance of fuel supplied equipment. Besides, there are the variation of propeller due to adhered of sea-foul, erosion and deformation of the propeller's blades.

When the power of diesel engine is reduced due to bad technical conditions, propeller also change the technical state and raised the power consumption, it will lead to the phenomenon known as "Heavy propeller", in this time, the diesel engine will be overloaded by torque (torque rich) [6]. In the same operation condition, the propeller characteristics curve will be the curve /2/ and the fuel consumption characteristics curve will be curve /3/on Figure 2. Thus, the fuel consumption will be higher than the standard operation mode (curve /4/- propeller characterictic) as showed by curve /5/ (fuel consumption). The large or small loss of fuel due to bad technical condition of ship strictly depending on the overload level of diesel engine.

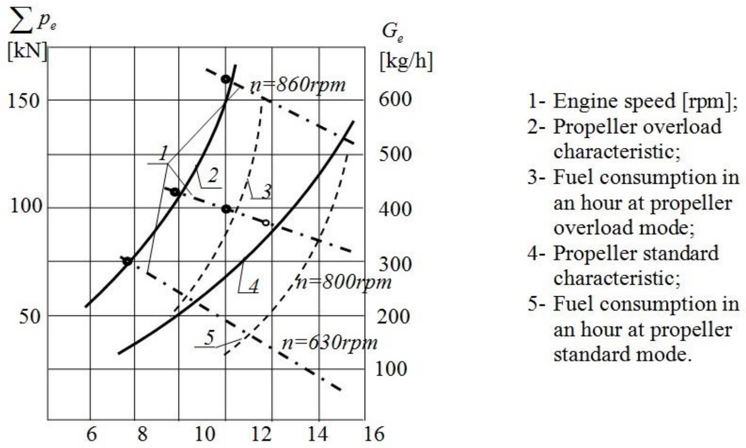


Figure 2 Change operation power range of diesel engine

Therefore, for efficient management of fuel use onboard, we propose the new idea "Active method to manage the use of fuel on board a ship".

4.1 Management and selection of the best operation state

Selection, measurement and continuous storage of information that is relating to operating regime and using fuel oil of propulsion plant;

- Management, calculation of the operating regime and decision of the optimal operating regime;
- Data transfering and 'online' management ability for operators;
- Ensuring two-way communication between ships (providing information and implementation) with the operators (after information processing, computational optimization, extraction mode, ...);

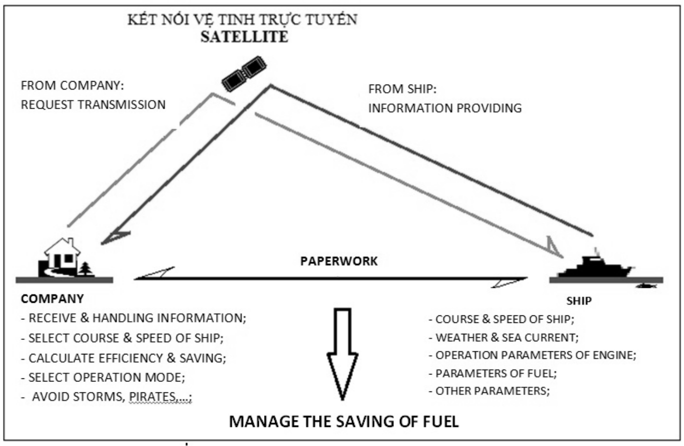


Figure 3 Exchange and process information on ship management

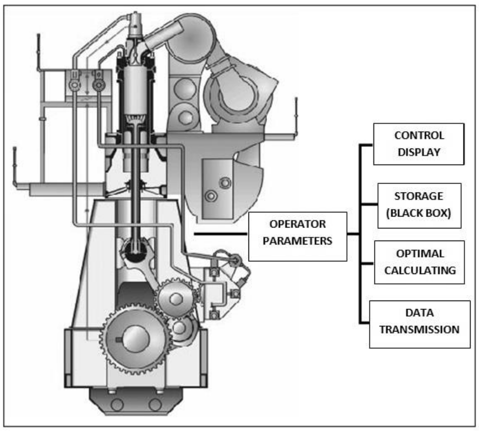
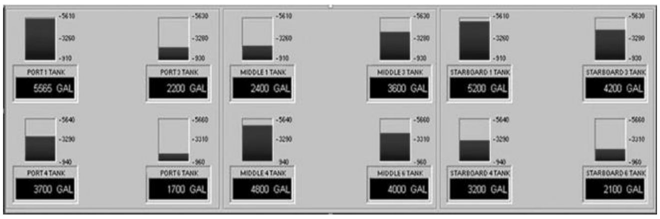


Figure 4 Measure the operation parameters of the engine

«Active method to manage the use of fuel onboard of ships» based on online exchange of information (Figure 3) is different from previous passive management (offline of exchange information). The information on the operating mode of the engine, ship speed and direction of ship sail, weather conditions,... is transmitted to the ship management office (via satellite). The manager can determine, calculate option, ... and make decisions or recommendations operating mode to use fuel savings and increase fuel efficiency.

Selecting a continuos information measurement to determine operating mode of engine and operating regime is seen as an important first step, as the basis for calculation optimal operating (Figure 4). Along with information on the operation of the engine, the information related to fuel use is also constantly updated and store in "Black Box" (Figure 5).

The information is displayed in the engine control room for the serving vessel operators, is stored as a report data source (Figure 6).



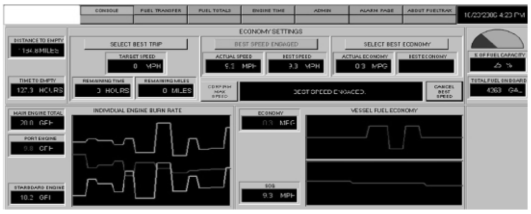


Figure 5 Measure the amount of fuel used on board

Figure 6 Analysis and determining the optimal operating regime

In addition, the information should be selected properly in order to analyze actual operating regime of propulsion plant for the purpose of Economical and Efficient use of energy.

The system allows updating data transmission status of ship operator (Figure 7) which includes sea conditions (weather, waves,...).

With the ability of online communication, the system returns commanding role and regime control for operator at shore side. This management system is not only simply to control fuel consumption on board of ships but also manage ship operator. The system will work exactly with meaning of the terms which have been put by the author: “Active management” alternative to form “passive management” before.

In fact, the Black Box which required by the Ministry of Transport, is attached on road transport vehicles, may have a certain sense similiar to this management system. In addition, the management system has been also implemented at some countries in the world. However, building a system that is suitable for ship operators in Vietnam, requires a lot of effort by scientists.

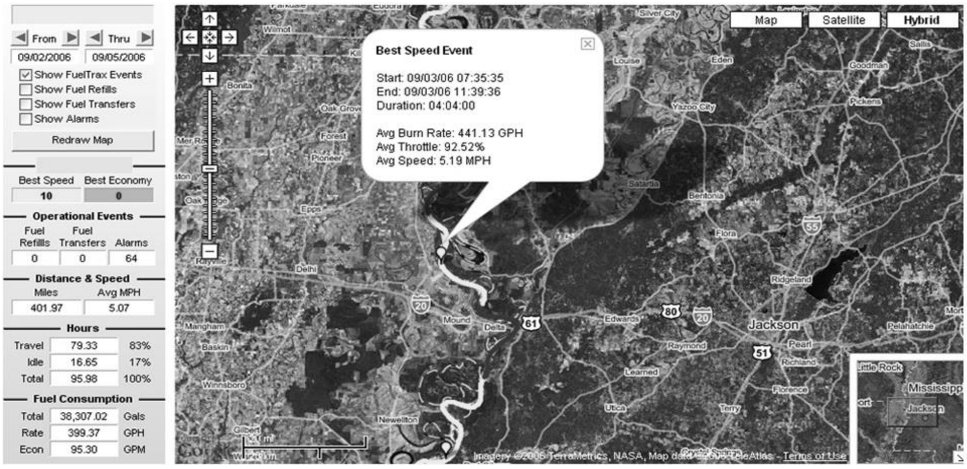


Figure 7 General view of ship operation

4.2 Management and technical handling of marine propulsion plant

- Management and technical handling of diesel engine;
- Management and handling overload in torque of diesel engine (torque rich).

The technical situation and the power producing abilities of diesel engine are depended on the age and maintenance quanlity. The manufacturers give the recommendations and maintenance procedures, engine recovery under the strict regulations of the International Register Association. However, despite how matter, the engine power always reduced after a period of operation and this one can be up to 30% of rated power and even larger. Thus, if the ship is operated with designed tonnage, the main engine will be an overload in torque, then leading to the fuel consumption will increase significantly. For solving this problem, we must necessarily go in a different direction which is treating the propeller structure.

As we well-known, a power characteristic and a torque characteristic of the propeller depend on a revolution, a pith factor and dimension of propeller:

$$N_{cv} = f(n^2; H/D; D^4; S) \quad \text{[N]} \qquad (5)$$

$$Q_{cv} = f(n^2; H/D; D^5; S) \quad \text{[Nm]} \qquad (6)$$

Where: N_{cv} và Q_{cv} - are power and torque required by propeller;

n- revolution of propeller [v/p] ;

H/D- pitch ratio;

D- diameter of propeller [m];

S- The total area of the propeller blades [m^2].

Thus, for changing power and torque required by propeller, it only needs to impact on one of variables in the equation No. 5 and No. 6. However, for specific propeller, it can not change pitch ratio (H/D), it can only impact on the diameter (D) or the area of propeller blades (S). If it tries to impact on the diameter, a certain level of pitch ratio will be changed and lead to the changing of thrust coefficient:

$$K_T = \frac{T}{\rho.n^2.D^4.9.81} \quad (7)$$

and torque coefficient:

$$K_Q = \frac{Q}{\rho.n^2.D^5.9.81} \quad (8)$$

and make consequence of chaostic control of propeller features. The our research results show that the best way is to effect on the surface area of blades with lineal impacts to the power and torque of propeller, and easier to control the propeller characteristics after handling.

5. Practical application

Currently, the fuel using management of Vietnam shipping company is not relly effective. The huge prodigality are caused by consciousness of seafarers, unsuitable operation plans and dishonest reporting of seafarers to steal fuel oil for sale. The authors also believe that, some countries in the region as well as in the world have the similar fuel management problem. Due to such fuel using management, the research team cooperates with some Vietnam shipping companies for implementation a part of "active method to manage the use of fuel onboard" and we have achieved some positive results.

5.1 Fuel oil management at Vietnam Ocean Shipping joint stock company (VOSCO)

The research team applied "active method to manage the use of fuel onboard of ships" for M/V Fortune Freighter and M/V Fortune Navigator in accordance with "management of operation parameters" and proposed suitable operation plans.

5.1.1 Ship's particulars

Table 1 Ship's particulars

Ship' name	Deadweight /DWT/	Speed /hl/h/	Power /kW/	Revolution /v/p/
Fortune Freighter	8,937	23	6,062	176
Fortune Navigator	8,515	22	5,983	210

Both vessels have generator YANMAR 6N165L-SN (03 sets) and generator Yanmar S165L-ST (3 sets), boiler TAKUMAX TW - 800SE and composite boiler MKSC 16-700/700.

5.1.2 Methods to manage the use of fuel

a. Selection of operating states

Container ships are normally equipped with high speed and large power engine. However, due to increasing fuel costs, the selection of suitable operating states or revolution of engine while ensuring operating schedule with advanced total fuel consumption for a voyage is necessary choice. Data analysis and calculation operation states for vessel, the authors raised result: For the vessel Fortune Freighter is 137 r/m, and for the vessel Fortune Navigator is 173 r/m.

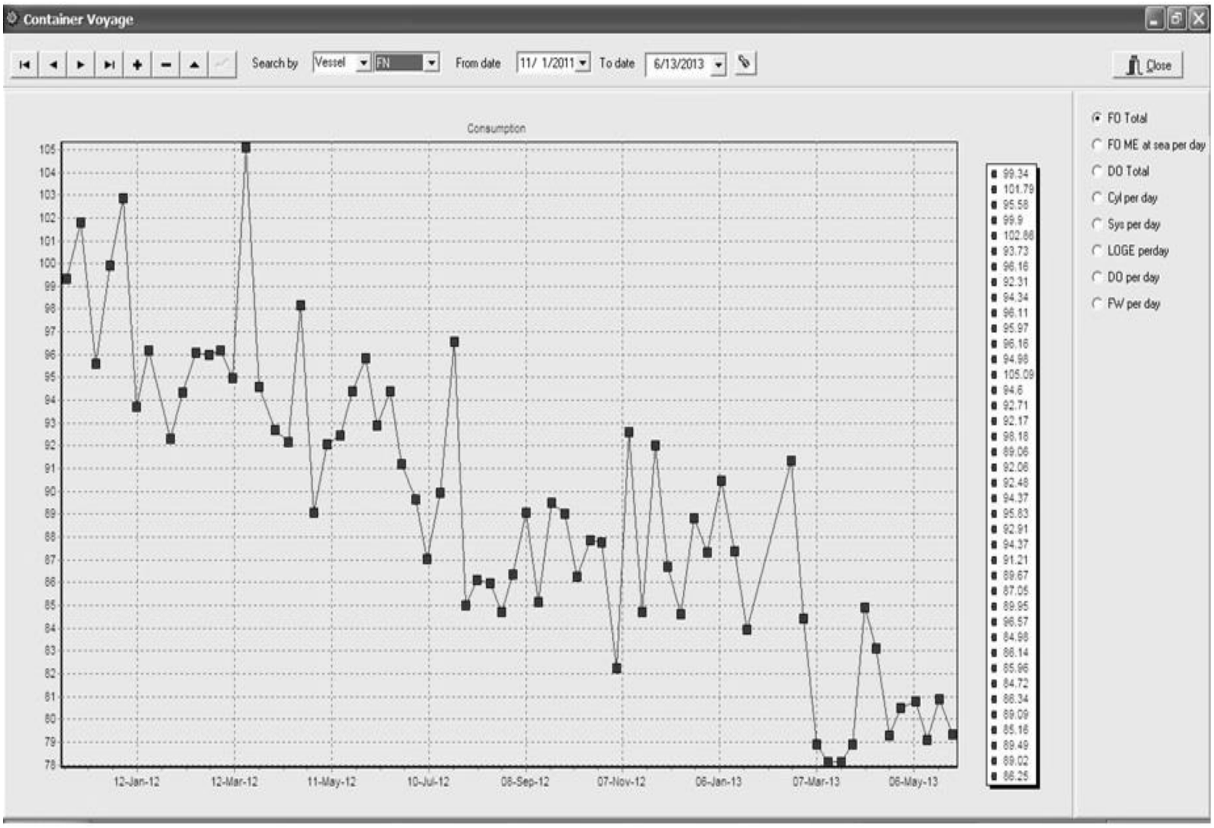


Figure 8 Analysis the fuel consumption (Source: VOSCO)

Figure 8 above statistics the fuel consumption for one voyage Haiphong - Saigon - Hai Phong in time for mentioned 2 container ships of the company.

b. Strengthening the management of operating parameters

Figure 9 Operating parameters on main control box

Aims to ensure the accuracy of the reports from the ship, the company has installed cameras to monitor and record the operating parameters of the main engine and periodically transfer data to company for considering, in comparison with reports from ships. Thus, daily parameters report of ships ensure the accuracy and the fuel consumption is more accurately. The operating parameters to be managed (Fugure 9) including: revolution of the main engine (ME rev), fuel rack indicator (ME FO pump mark), the revolution of the turbine turbocharger (TC rev ME);

c. The achieved fuel cost reduction

By the solutions above and together with enhance maintenance equipment, ensuring equipment are always in good technical condition, through continuous follow-up time decreased fuel costs markedly.

For the main engine, in the same quarter of the year (3 months) of two vessels before and after layout solutions of decrease FO consumption, the FO consumption decreased approximately 250 tones / 2 ships. For the boiler, fuel consumption decreased from 1 MT / day to 0.5 MT / day.

5.2 Apply the management methods and processing techniques

The research team has applied treatment techniques for ship propellers to reduce fuel consumption. This method was applied to MV Glory Star of K Marine shipping company, which located in Vung Tau, Vietnam.

5.2.1 Techniques methods

Before handling, the voyage with operating parameters as prescribed, the ship main diesel engine is often overloaded in heat (high exhaust gas temperature), fuel consumption in one hour quite high and cause some incidents such as damage of valve, fuel injector ...especially, broken crankshaft. The research team carried out inspect the ship's propeller at factory named SG Shipmarin dated 27/10/2012, and main result basic data as follows:

- Difference from actual weight is more than 8,000 kg in comparison with 7,327 kg of design weight;
- Pitch (H/D) is 3,080 in comparison with 3,026 of design pitch;

Basically, the authors can consider that the propeller of Glory Star ship is similar to the original design. However, blades of the propeller of Glory Star ship, though in the error scope, are identified towards to so-called as “heavy propeller”.

For the data after the survey, the research team decided to handle the technical alternatives:

- Aims to reduce the load for the propeller from 7 to 9%;
- Improve operating power of main engine from 6 to 7%, and to be able to achieve target from 12 to 15% compared to previously operation.

To reduce the propeller load, the research team agreed with the owners to carry out a treatment on blades of the propeller through reducing area of the blades as shown in Figure 10. Research team calculated the cutting location and an amount of cutting area of the blades very carefully. Finally, treatment method is as follows (starting from the first blade):

Cutting position is placed on external area; Cutting line (red color- cut edge) starts from 0.5R to 0.6R, along to top line shape. Edge (water vane edge) is not cut;

Depth of blade cut from 47 mm to 55 mm; No. 1 blade after cutting will be taken to deploy positive for the other side;

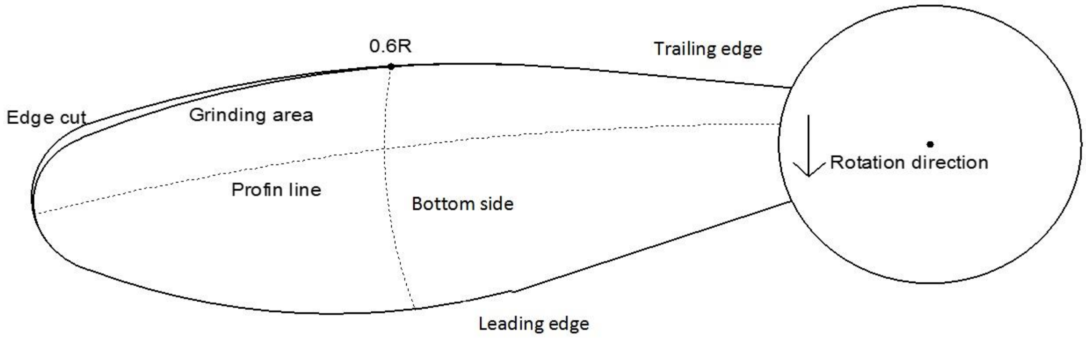


Figure 10 Deploy the cutting line of boarder blade

After taken off, thickness of cutting area from 8 mm to 10 mm (thick blades not the same), the next task is to identify and deploy profin or broth and grinding to create a new exit areas;

After making cuts and sharpen, propeller has checked static balancing with 2 kg determined weight. Sharpen aims to restore balance were conducted in opposite areas on the basis does not change the blades profin.

Measure the pitch after sharpen, determine pitch blade the average of 3,020.

5.2.2 Assessment after handling techniques

After completely technical processing, the vessel was put into operation with routes Jakarta

(Indonesia) - Singapore; Singapore - Saigon (Vietnam); Hon Gai - Vung Tau (Vietnam). In this voyage, the parameters of the main engines and the ship are fully and accurately recorded. Table 2 following bellows is the operating parameters before and after handling techniques.

Table 2 Operating – Techniques parameters of engine before and after handling techniques

Techniques parameters	Before	After
Ballast condition		
Fuel oil [T/24h]	17.09	14.37
Exhaust gas temperature [^oC]	460	458
Fuel rack indicator [point out]	37.2	33.4
Ship speed [hl/h]	12.4	11.8
Charged pressure [kG/cm^2]	1.7	0.9
Tubo-charge revolution [v/p]	16,000	15,500
Full load condition		
Fuel oil [T/24h]	17,68	15,58
Exhaust gas temperature [^oC]	466	464
Fuel rack indicator [point out]	39	34,2
Ship speed [hl/h]	11,4	11,8
Charged pressure [kG/cm^2]	1,9	1,2
Tubo-charge revolution [v/p]	19.000	18.000

Remarks:

- After processing, the operating parameters of the main engine are greatly improved in comparison with those pretreatment. The engine is no longer overloaded by torque;
- The amount of fuel consumed in a day of main diesel engine reduced approximately 2T/24h compared with before processing techniques;
- During the voyage from 5/7/2012 to 7/12/2012, the specifications of the propeller driven diesel engine, as well as the motivation of the whole system are stable.

6. Conclusion

Actually, fuel consumption management for vessels in Vietnam is still insufficient and causing huge losses. Therefore, fuel consumption management in general and for ships in particular is very urgent. To solve this problem in order to contribute to implementing the national target programme on saving the use of fuel, need to be urgently done :

- To change thought of shipping company leaders on the management of fuel on board ships, quickly moved from passive management to the active management;
- «Active method to manage the use of fuel on board of ships» is the modern method that has many countries effectively applied. For this method, the shipowners not only well manage fuel consumption but also increase the safety of the ship in bad weather and piracy;
- In addition to the radical of the ship owners, the government should have specific action plans, management issues put to use to save fuel on ships into national law is considered opinions and obligation force;

The research team of the Vietnam Maritime University are going to carry out research on active manage method the use of fuel oil, and do hope the method will be applied by companies, ship owners soon.

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