iamu

international association of maritime universities

PROCEEDINGS

Third General Assembly of The International Association of Maritime Universities

September 23 – 26, 2002

Rockport, Maine
United States of America

Sponsored by: 日本財団 The Nippon Foundation

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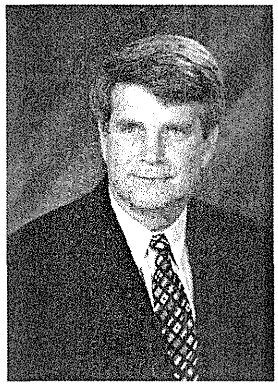
Contents



September 23, 2002

Dear Friends,

On behalf of the officers and directors of the International Association of Maritime Universities, I am pleased to welcome all delegates and guests to Rockport, Maine, for this Third General Assembly.

In addition, the faculty, staff, and students of Maine Maritime Academy join me in extending a warm greeting to our counterparts from North America, Europe, Asia, Africa, and Australia. We are delighted to have you here, and we hope that you will avail yourselves of the opportunity to visit our campus in nearby Castine, to investigate the Academy's facilities and programs.

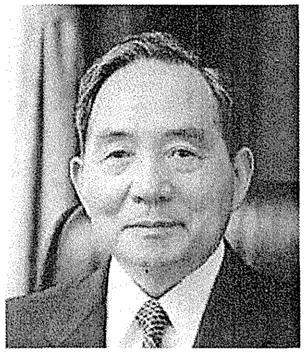
It appears that we will have the largest attendance which IAMU has yet experienced, including several new members. The Association is honored by your presence, and we hope that your involvement in our endeavors will prove to be rewarding in every sense.

The quality of maritime education and training is our mutual concern and responsibility. Surely, the papers to be presented at this Assembly, covering a wide range of topics, will aid us in meeting the global challenges of today and tomorrow. Moreover, I am confident that they will contribute to the advancement of transportation standards throughout the world.

Again, a warm welcome to the lovely and historic coast of New England.

Sincerely yours,

Leonard H. Tyler
President



"Work together for maritime universities in the future "

It is a great pleasure to celebrate with you the 3rd General Assembly of IAMU in 2002.

We held the Inaugural General Assembly of IAMU at Istanbul Technical University in Turkey in July 2000 and the Second one in Kobe, Japan. In the meantime, we have seen an increase in membership from 28 universities at its establishment to 33 today. And more universities are eager to join IAMU. That shows the fact that growing numbers of people in the world appreciate our activities and agree with IAMU idea "Work together and think about the future in maritime universities".

Humans have utilized the ocean and benefited from its vast resources for our life. However, we now have to give precedence to the protection of the ocean environment in our activities. That has become a human responsibility. Therefore, not only the technology with which we utilize and protect the ocean, but also the social systems and measures are indispensable for us. Under such circumstances, maritime universities have to assume responsibility for education and research development in order to meet that social demand.

The maritime society has been developing beyond national boundaries as the continents are linked by the oceans. IAMU is a global network in maritime universities and its activities are important for maritime education and research for the next generation.

Maine Maritime Academy is going to host the 3rd General Assembly. On behalf of all the member universities, I would like to express my sincere appreciation to President Leonard H. Tyler and the organizers who have provided great support for this assembly.

I am looking forward to the discussions at this event and to proposing concrete plans for the future in the maritime world. And I wish this assembly all success.

Professor Dr. Kiyoshi Hara
Chair of IAMU

Mission of the International Association of Maritime Universities

The International Association of Maritime Universities (IAMU) was formed in 1999 and grew rapidly until it now it includes 33 member universities from around the world with 5 other applicants under consideration. Its major sponsor is the Nippon Foundation. The objectives of the organization include:

- Fostering a common vision among IAMU member universities with a focus on excellence in maritime education and training, as well as maritime safety management
- Providing unique opportunities to discuss crucial maritime education and training issues from a scientific and academic perspective
- Establishing an effective system to promote safety management within the maritime industry based on a scientific and academic approach
- Establishing an appropriate globally recognized system for passing down maritime knowledge and skills to future generations

The IAMU goals consist of a scientific and academic focus on:

- A new comprehensive and objective maritime education system
- A maritime safety management system under the framework of an international maritime society
- Uniformity in undergraduate curricula and international competency certification systems

International Association of Maritime Universities Membership

Member Universities

Arab Academy for Science, Technology and Maritime Support
Australian Maritime College
Admiral Makarov State Maritime Academy
The California Maritime Academy
Constanta Maritime University
Dalian Maritime University
Dokuz Eylul University, School of Maritime Business and Management
The Marseilles Merchant Marine Academy (E.N.M.M.)
Faculty of Nautical Studies, Polytechnical University of Catalonia
Far Eastern State Technical Fisheries University (Dalrybutuz)
Fisheries and Marine Institute of Memorial University of Newfoundland
Gdynia Maritime Academy
Istanbul Technical University, Maritime Faculty
Korea Maritime University
Kobe University of Mercantile Marine
Kyiv State Maritime University
Liverpool John Moores University
Maine Maritime Academy
Massachusetts Maritime Academy
Mokpo National Maritime University
National Taiwan Ocean University
Nicola Y. Vaptsarov Naval Academy
The Nippon Foundation (Major Sponsor)
Odessa State Maritime Academy
Rijeka College of Maritime Studies
Satakunta Polytechnic Sector for Technology and Maritime Management
Shanghai Maritime University
State University of New York Maritime College
Szczecin Maritime University
Tokyo University of Mercantile Marine
University of Cantabria
University of Plymouth
U.S. Merchant Marine Academy
World Maritime University

Candidate Universities

Bremen University of Applied Science Faculty of Maritime Studies
Estonian Maritime Academy
Latvian Maritime Academy
University of Portsmouth, Faculty of the Environment, School of Environmental Design & Management

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The Nippon Foundation

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The Nippon Foundation was founded in 1962 as the Japan Shipbuilding Industry Foundation, a private, nonprofit organization to promote shipping and shipbuilding and to prevent marine hazards. The foundation was established by legislation that set aside 3.3 percent of the revenues from the motorboat racing industry to be used for philanthropic purposes. Those funds have created the largest philanthropic organization in the world, one which supports projects in Japan and overseas. The Nippon Foundation funds four types of activities: social welfare and public health, volunteer support, maritime shipping and development, and overseas assistance. Under this last category, since 1971 it has disbursed more than $1 billion for projects in more than one hundred countries.

The Nippon Foundation is a grant-making organization and does not run projects itself. Finding good partners and creating working partnerships are the secrets to success. To build those partnerships, it works with individuals, both for-profit and nonprofit organizations, governments, and international organizations. The Nippon Foundation believes in empowering communities so they can take charge of their futures. Its main concern is teaming up with the most knowledgeable and motivated partners and helping them do what they can do best.

Overseas Activities: The Foundation's overseas support covers a wide range of areas, including welfare, human resources development, academic and physical education, health care, population, agricultural and rural development, human rights, environment, hunger relief, refugee aid, and international understanding. All proposals in these areas are welcome, but those aimed at covering operational costs, debt repayment, physical infrastructure development, or the promotion of commercial, religious or political purposes, will receive low priority in the Foundation's funding decisions.

Some of the Foundation's current major projects are:

- Agricultural development in Africa to foster self-sufficiency in staple food production (since 1986);
- Establishing fellowship funds at major universities around the world that support post-graduate studies;
- Leprosy control, in collaboration with WHO (since 1975);
- Promotion of primary health care in developing countries, in collaboration with UNICEF and local government (since 1992).

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Setting safety standards is achieved through the establishment and application of technical standards, known as Rules, for the design, construction and operational maintenance of ships and other marine structures. Classification is a process that certifies adherence to these Rules. A classed ship or other type of marine structure can be considered to possess the structural and mechanical integrity required for its intended service.

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CONFERENCE SCHEDULE

22-Sep Sunday

Recommended Arrival Day For All Participants

Recreation Time

Golf, Tennis, Swimming Walking, Jogging, Exercise Center

Shuttle Available to Rockland for Sightseeing

16:00
Steering Board Meeting

17:30
International Executive Committee Meeting

20:00
Dinner

23-Sep Monday

Shuttle Available to Rockland for Sightseeing

A.M.

8:00
Registration

8:30
IAMU Joint Steering Board and International Executive Committee Meeting

10:00
Coffee Break

10:30-12:00
Continuation of Joint Meeting

P.M.

13:00
Editorial Board Meeting

14:30
Coffee Break

15:00
General Assembly Special Meeting

17:30
Welcome Reception Dinner

24-Sep Tuesday

A.M.

8:00
Registration

8:30
Opening Ceremony
IAMU General Assembly

10:00
Coffee Break

10:30
Academic Papers (Session I)

P.M.

12:00
Lunch

13:30
Concurrent Academic Papers (Session IIA) & (Session IIB)

15:00
Coffee Break

15:30
Concurrent Academic Papers (Session IIIA) & (Session IIIB)

17:30
Bus Departs For Trip To Camden
Dinner on your own

25-Sep Wednesday

A.M.

8:00
Academic Papers (Session IV)

9:50
Coffee Break

10:10
Academic Papers (Session V)

P.M.

12:30
Load Bus Trip to MMA
Box lunch Provided

14:00
Student Presentations

15:00
Tour of Campus and Training Ship (Wear walking shoes)

18:00
President's Reception

19:15
Lobster Bake

20:30
Bus Departs For Hotel

26-Sep Thursday

A.M.

8:00
Academic Papers (Session VI)

9:30
Coffee Break

10:00
Academic Papers (Session VII)

P.M.

12:00
Lunch

13:30
Academic Papers (Session VIII)

15:00
Coffee Break

15:30
Annual IAMU Meeting/
Closing Session

17:30
IAMU Reception and Dinner

27-Sep Friday

A.M.

9:00
Optional Trip to Acadia National Park and Bar Harbor

ACADEMIC PAPERS*

Tuesday, Sept. 24	Paper Title	Author	Affiliation
10:30-12:00 Session I (WGI)*	A New Educational System of Maritime Science in 21st Century, proposed by KUMM	Toshimichi Fukuoka	Kobe University of Mercantile Marine
	Policy on Reforms and Improvement of Maritime Education in China	Wu Zhaolin	Dalian Maritime University
	High-Level Management Functions in MET	Damir Zec, Serdjo Kos, Robert Mohovic	Rijeka College of Maritime Studies
	Problem-Based Learning in Maritime Education	Okan Tuna, Guldem Cerit, Hakki Kisi, Serim Paker	Dokuz Eylul University, School of Maritime Business & Management
13:30-15:00 Concurrent Papers Session IIA (WGII)*	The Importance and Contributions of VTS towards the Establishment of the Global Safety Management System for the Safety of Maritime Transportation	B. Sitki Ustaoglu Masao Furusho	Istanbul Technical University, Maritime Faculty Kobe University of Mercantile Marine
	A Ship-Based Approach to Determine the Effectiveness of VTS Systems in Reducing Vessel Accidents	Ender Asyali	Dokuz Eylul University, School of Maritime Business & Management
	The Ways of Enhancing the Safety of Navigation	A.S. Maltsev	Odessa State Maritime Academy
	Development of PSC Officers Training Using Marine Simulators and Real Vessels (Entering Odessa Sea Port)	Dmytro Zhukov	Odessa State Maritime Academy
13:30-15:00 Session IIB (Simulations)*	Simulation and Modeling: A Tool for Public Policy Research	Anthony Patterson and Leslie G. O'Reilly	Fisheries & Marine Institute of Memorial Univ. of Newfoundland
	Computer Simulator Training Systems in the Professional Training of Seafarers	Ivan I. Kostylev	Admiral Makarov State Maritime Academy
	Development of Performance Evaluation System Using Marine Simulators	Okzan Poyraz	Istanbul Technical University, Maritime Faculty
	Marine Simulators: Technical and Performance Specifications — A Paradoxical Parallelism?	Johnson O. Olaiya	World Maritime University
15:30-17:00 Concurrent Papers Session IIIA (WGIII)*	Evaluation of Maritime Universities/Faculties Based on the Qualifications of the Academic Staff	Takeshi Nakazawa	Kobe University of Mercantile Marine
	MET in the EU — How Can Maritime Administrations Support MET?	Malek Pourzanjani	Maritime Expert
	The Need for Preparing Maritime Personnel for Working in A Multi-Cultural Environment	Jan Horck	World Maritime University
	Implementation of Quality Management Systems in Romanian Maritime Education and Training	Costel Stanca	Constanta Maritime University
15:30-17:00 Concurrent Papers Session IIIB (Simulations)*	Shiphandling on Simulated Seas	Cynthia Smith	United States Merchant Marine Academy
	The Challenge of Management of Abnormal Situations due to A Failure in the Automatic Navigation and Steering System of a Ship	Sauli Ahvenjarvi	Satakunta Polytechnic Sector for Technology & Maritime Mgt.
	Fault Simulation and Emergency Training of Engine Room Simulator	Hu Yihuai, Wang Xihuai, Hu Xianfu	Shanghai Maritime University
	Establishing A Simulation, Training and Research Center: Achieving the Vision	Philip B. Arms	California Maritime Academy

* *Academic papers within session relate to the working group (WG) or topic matter specified.*

ACADEMIC PAPERS*

Wednesday, Sept. 25	Paper Title	Author	Affiliation
8:00-9:50 Session IV (Maritime English)*	Verbal Communication Failures and Safety at Sea	Vladimir A. Loginovsky	Admiral Makarov State Maritime Academy
	Some Aspects of the Seafarers' Language Competence Development	Natalya V. Borodina	Far Eastern State Technical Fisheries University
	Maritime English Training for Non-Native Speaking Mariners	Yulia Yakushechkina	Kyiv State Maritime Academy
	A Comparative Analysis of the IAMU Schools to Teach and Test Proficiency in Maritime Education	Funda Yercan Donna Fricke, Susan Loomis, Laurie Stone	Dokuz Eylul University, School of Maritime Business & Management Maine Maritime Academy
10:10-12:00 Session V (Information Technology/Distance Education)*	Information Technology and Distance Learning: Keys to Global IAMU-MET Collaboration?	Peter Muirhead	World Maritime University
	Successfully Incorporating Internet Content and Advanced Presentation Technology into Collegiate Courses: Lessons, Approaches and Demonstration	Ronald F. Smith	Massachusetts Maritime Academy
	Practical Solutions for A Veritable Maritime Online Library	Eugen Barsan	Constanta Maritime University
	Distance Learning Courses for Seafarers	Jerzy Hajduk	Szczecin Maritime University

* *Academic papers within session relate to the working group (WG) or topic matter specified.*

ACADEMIC PAPERS*

Thursday, Sept. 26	Paper Title	Author	Affiliation
8:00-9:30 Session VI (WGI)*	Seafarer Training: Does the System Defeat Competence?	Barrie Lewarn	Australian Maritime College
	The Development of the Master's Course in Maritime Safety by CMU – A 1st Step Toward A Virtual Maritime University	Diona Carp	Constanta Maritime University
	Improvement of Marine Engineering Curriculum Using the Engine Room Simulator	Ismail Cicek Makoto Uchida	Istanbul Technical University, Maritime Faculty Kobe University of Mercantile Marine
	Simulation and Application of Auxiliary Machinery Systems for Seafarers' Training	Hu Xianfu	Shanghai Maritime University
10:00-11:30 Session VII (WGII)*	Development of An Integrated Simulation System for Analyzing the Swinging Movements of A Ship at Anchor and Its Application for Educational Use	Kinzo Inoue, Hideo Usui, Rong Ma	Kobe University of Mercantile Marine
	Proposal of A Mathematical Model for Optimizing the Use of Resources in Marine Rescue	Francisco Jose Correa Ruiz, Francisco Sanchezde la Campa, Maximo Azofra Colina	University of Cantabria
	Port and Intermodal Security Initiative	Jon S. Helmick	United States Merchant Marine Academy
	Augmented Reality: A New Tool to Increase Safety within Maritime Navigation	Chuck Benton	Maine Maritime Academy
13:30-15:00 Session VIII (WGI)*	Contributing to the Acquisition of High Quality Seafarers: The Strategies of MET	Kong Fan Cun and Ruan Wei	Shanghai Maritime University
	Shipboard Training for the Efficient Maritime Education	Chung Do Nam	Korea Maritime University
	Fire Fighting Training for Officers and Captains: A Problem Based Learning Approach	Selcuk Nas and Serim Paker	Dokuz Eylul University, School of Maritime Business & Management
	The Ethical and Professional Obligations of Academic Staff Towards Technological Development of Students	Mohye Eldin Mahmoud El-Ashmawy and El-Sayed Abdel Galil	Arab Academy for Science, Technology and Maritime Transport

** Academic papers within session relate to the working group (WG) or topic matter specified.*

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Session I - WG 1

Chair: Dr. V. Forbes

A New Educational System of Maritime Science in 21st Century, proposed by KUMM
Toshimichi Fukuoka
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Okan Tuna, Guldem Cerit, Hakki Kisi, Serim Paker
Dokuz Eylul University, School of Maritime Business and Management

A New Educational System of Maritime Science in 21st Century proposed by Kobe University of Mercantile Marine

Toshimichi FUKUOKA
Department of Ocean Electro-Mechanical Engineering,
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Email : fukuoka@cc.kshosen.ac.jp

Abstract

Kobe University of Mercantile Marine (KUMM) is going to be integrated next year as one faculty of Kobe University, one of the representative large-scaled national universities in Japan. KUMM regards the integration as the most important and crucial moment to realize *VISION 21* projects. The outline of *VISION 21* was introduced two years ago at the Inaugural General Assembly of IAMU in Istanbul, where the emphasis was placed on the new curriculum and educational system for undergraduate students. The new curriculum has been working well since April 1, 2001, and has been given a good reputation from KUMM staffs and students. KUMM now intends to make further progress with the integration.

In this paper, the outline of KUMM strategy concerning the integration is introduced, i.e., how the concepts of *VISION 21* is to be realized. First of all, the organization of a new maritime faculty, Faculty of Maritime Science , is briefly explained including its graduate school. When integrated with Kobe University, an epoch-making educational system is planned. That is, the students studying in Faculty of Maritime Science can attend the lectures provided by the other faculties such as Law, Economics, Business Administration, Science and Engineering, etc. It is expected that those distinctive educational systems significantly enhance the education quality of Faculty of Maritime Science. Incidentally, KUMM is also asked to provide some sea-oriented subjects for students studying in other faculties.

KUMM strongly hopes to be *the center of excellence* of maritime science and related areas through the integration, both domestically and internationally. This paper also aims at providing the information of a new educational trend of maritime science in Japan.

1. Introduction

Kobe University of Mercantile Marine (KUMM) is to be integrated with Kobe University (KU) on October 1, 2003. The integration was approved in December, 2000 between KUMM and KU. The integration plan was signed in July, 2001. Since then, intensive meetings have repeatedly been held in order to make the integration as the threshold of a new maritime education in Japan.

In this paper, it is shown how the *VISION 21* projects are to be realized through the integration . KUMM is to join KU as one faculty.

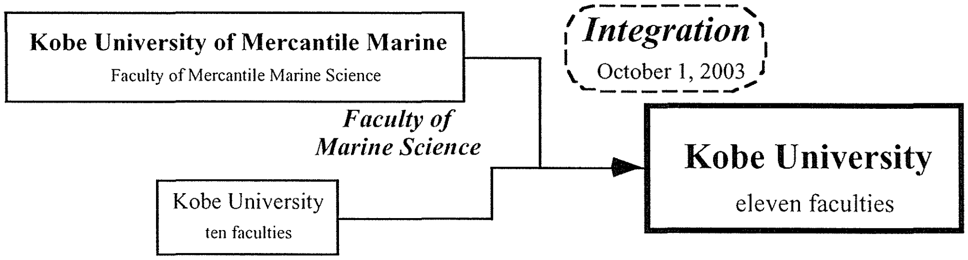

Fig.1 Integration of KUMM and Kobe University

2. Objectives and Ideology of the Integration

2.1 Why Integration?

All national universities in Japan have been put into severe situations since June in 2001. The Ministry of Education declared the future plans of the universities as follows.

1) *Integration Program*:

Integration should be promoted positively even between universities located in different prefectures.

2) *COE Program*:

For selected ten research fields, thirty divisions of graduate schools with Ph.D. course are to be selected according to their projects toward 21st century and the achievements so far. Governmental budgets are intensively supplied to those divisions.

3) *Introduction of Agency System*:

Each university should make efforts as an independent agency from the financial point of view.

The Ministry of Education intends to activate the research activities and enhance the education quality of ninety-nine national universities by the integration among them. The integration program is now fiercely being progressed. Before the end of this year, two sets of national universities are scheduled to be integrated.

2.2 What s the purpose of our Integration?

KUMM regards the integration as a great opportunity to incorporate the educational resource possessed by Kobe University (KU) into the fields of maritime science. That is, the integration has high possibility to open a new field for the conventional concepts of maritime science. By the integration, new Kobe University makes a fresh start as the first large-scaled university in Japan with maritime faculty in it and being open to the sea. It may exploit new research fields by combining the scientific principle of maritime science with those of engineering, science and social science.

2.3 Advantages and Disadvantages brought by the Integration

Advantages: From the education and research point of view, the integration brings KUMM a great deal of advantages. As for education, maritime science students are offered a opportunity to learn a variety of educational programs on cross-cultural studies in the first and second years. In addition, in the third and fourth years, the students can attend the lectures of the other faculties, i.e., science, engineering and social science. The discipline of maritime science is fundamentally supported by science and technology and is also closely related to social science. Figure 2 shows the subject exchange program between Faculty of Maritime Science and other faculties. It s a great opportunity for the students to understand maritime science more extensively and learn different approaches toward the goal. Research activities of Faculty of Maritime Science shall certainly be activated, e.g., in the form of joint research with the staffs working in the other faculties.

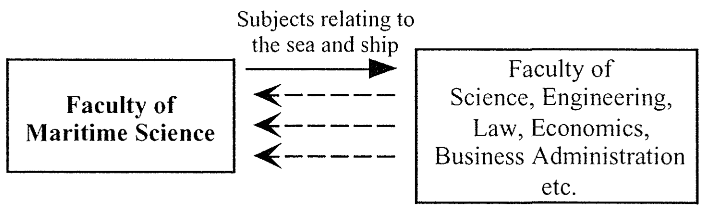

Figure 2 Subject exchange program among faculties

As already stated in the previous paper [1], many universities in Japan are facing a serious problem of decreasing applicants because the number of young people is continuously decreasing. However, it is expected that KUMM can acquire students constantly owing to the integration, since KU has high reputations as one of the representative national universities. In coming 2009, the number of applicants is to be equal to the total admission capacity of universities and other high education institutes, which means that every applicant apparently can enter a certain university. Actually, some universities have already been confronted with the severe situation. More and more universities will be troubled in acquiring students. That situation can hopefully be avoided in the case of KUMM by the integration.

Disadvantages: On the other hand, there are a couple of disadvantages brought by the integration. First of all, the decisions made by the maritime faculty on such problems concerning education, research an administration, might not be approved by the board members of Kobe University. For example, the distinctive educational system of KUMM seems disturbed, to some extent, especially on the introductory education for freshmen and sophomore concerning the sea and ship-training subjects. That is because of the rigid school calendar of KU to which every faculty has to follow. Budget problems may be more serious since the total budget supplied to KU is distributed to each faculty following the decision made by the board members.

As a whole, however, *KUMM predicts that the advantages by the integration will by far surpass the disadvantages* , and the integration will be the starting point of KUMM to be really the COE of maritime science.

3. Outline of a New Maritime Faculty

3.1 Outline of Kobe University

Kobe University (KU) is one of the representative large-scaled national universities in Japan and acquires a good reputation both in education and research. The total number of undergraduate students is approximately 12,000 which is more than ten times that of KUMM. KU has ten faculties as follows.

Faculties:

Letters, Cross-Cultural Studies, Human Development, Law, Economics, Business Administration, Science, School of Medicine, Engineering, Agriculture

As for graduate school, at the moment of the integration, Faculty of Maritime Science joins Graduate School of Science and Technology, which already exists and accepts many students graduated from three faculties of science, engineering and agriculture. These faculties are closely related to maritime science in many respects.

3.2 Organization and Outline of Undergraduate Course

Faculty of Maritime Science consists of three departments. Namely, four departments now composing KUMM is reorganized into three departments as shown in Table 1.

Table 1 Three departments of Faculty of Maritime Science

Kobe University, Faculty of Maritime Science

Department	***admission***
Maritime Technology Management	70
Maritime Transportation Systems	60
Marine Engineering	70
	Total 200

The total admission capacity is unchanged. Students who want to be seafarers or experience ship-training with large training ships are to choose Maritime Technology Management.

3.3 Organization of Graduate Course

Divisions of master and Ph.D. courses relevant to maritime science belong to Graduate School of Science and Technology. The graduate school consists of nineteen divisions for master program and ten divisions for Ph.D. program in all.

Master Program

Three divisions on maritime science are prepared for master program, which correspond to the three departments of the undergraduate program, respectively. Figures indicate the admission capacity of each division.

Divisions:

Maritime Technology Management (12), Maritime Transportation Systems (16), Marine Engineering (16)

Ph.D. Program

Division of Maritime Science is in charge of Ph.D. program concerned. The admission capacity is 11 students. Incidentally, it is predicted that some students graduated from Faculty of Maritime Science proceed to the other divisions of Graduate School of Science and Technology.

4. Education System of Faculty of Maritime Science

4.1 Admission

Two hundreds students are selected without their department being appointed at the enrollment. In one and half year later, each student chooses his or her department. The determination is made on the basis of the credits that the students acquire after the enrollment and the score of entrance examination. KUMM intention is to provide a chance for students to choose the department after they learn the fundamentals of maritime science. Currently in KUMM, students must determine the department prior to the enrollment. This system sometimes causes troubles such that some students feel, so to speak, a department mismatch. The system of designating the department in one and half year later might expectantly solve those kinds of problems. Consequently, students can learn what and in which they really want to learn.

4.2 Departmental Undergraduate Degree Programs

Each department prepares two or three groups of subjects in connection with its specialized field. They are tabulated in Table 2.

Table 2 Groups of special subjects for each department

Department	*Groups of Special Subjects*
Maritime Technology Management	1. Navigation 2. Ship Engineering 3. Maritime Safety & Technology Management
Maritime Transportation Systems	1. Logistics 2. Intelligent Transportation
Marine Engineering	1. Marine Mechatronics 2. Energy & Ecology

Ship-training with large ships is usually for Department of Maritime Technology Management. However, KUMM is making an effort so that it comes to be available for students studying in other departments.

4.3 Ship-Training & Maritime Officer s Certificate

Students who want to be seafarers or experience ship-training with large training ships are to learn in Department of Maritime Technology Management. Two groups of special subjects, Navigation and Ship Engineering shown in Table 2, are for seafarers certificate, respectively, each of which corresponds to the minimum value of 35 credits and exactly coincides with the minimum requirement specified in Japan law.

5. Strategies to be a New Center of Excellence of Maritime Science

KUMM has a couple of ambitions to be realized by the integration with Kobe University.

They are summarized as follows;

1) Establishment of "Technology Management" - New Concept in Maritime Science —

Beside the subjects relating to seafarers certificate, as explained in the previous section, a variety of subjects on technology management are prepared in order to bring up maritime engineers having the knowledge on management. They can cope with a new trend of maritime business appearing in the very near future.

2) Harmonization of Maritime Science with Science, Engineering and Social Science

By combining various disciplines in the different fields, a new concept could be produced in maritime science. Needless to say, maritime science has been greatly supported by the discipline of science and technology. After the integration, powerful support can be expected from social science, since Kobe University has faculties with high reputation in the fields of social science such as Law, Economics, Business Administration.

3) Maritime Engineers with Multi-background

It is predicted that some students graduated from Faculty of Maritime Science proceed to the master or Ph.D. courses of the other fields, e.g., engineering, science, law, economics and business administration. That means the advent of maritime engineers with multi-background. It is expected they will play an important role and create a new field in the maritime society.

6. Conclusions

Kobe University of Mercantile Marine now steps forward to the COE of maritime science. The integration with Kobe University is one of the concrete plans to achieve *VISION 21* projects and will be the threshold of the new types of education and research activities in maritime science. The results of *VISION 21* projects will be evaluated in the near future by the maritime society in Japan.

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Policy on the Reforms and Improvements of Maritime Education in China

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ABSTRACT

This paper provides an overview of the current status of maritime education in China and discusses the reforms and improvements of Chinese maritime education for the future. The author also discusses further possible reforms in the administration of MET in China; given the opportunity of administrative system changes in MET institutions, the Chinese maritime education system shall meet the demands of national economic development and international shipping. Some critical issues are here presented in depth, including the key role the Chinese government plays in maritime education, optimizing the utilization of resources in maritime education, the MET administrative system, funds and financing, the training of MET instructors, on board and simulator training for students, regimental management of students and enrollment and employment of students.

1. Introduction

Urgent necessity requires that the policy of reform and improvement of Chinese MET shall be undertaken and adopted. Our economic development needs the support of maritime transport. Statistics indicated that in 2000 85% of Chinese foreign trade was conducted through ocean shipping. Thus as one of the major means, maritime transportation continues to play an essential role in the process of China_s emerging into economic globalization.

The core of the shipping industry, as in other industries, is its qualified professionals, and the responsibility of training and educating maritime professionals rests with MET institutions. These have made great contributions to the shipping industry in the last 50 years or so. The Chinese MET has made great achievements through efforts over several generations, and has ensured the provision of qualified manpower to the maritime industry in China. With our entrance into the World Trade Organization (WTO) and the acceleration of economic globalization, Chinese MET will need, in order to be in a better competing position, to adjust and adapt to the trends of development in both the international shipping industry as a whole and in its manpower market in particular.

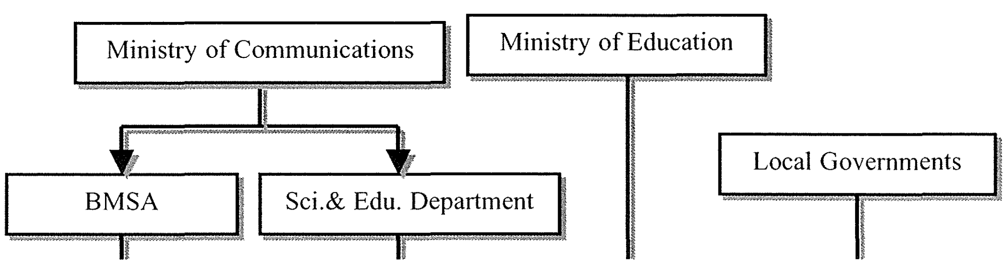
2. Maritime Education and Training in China

The overall regulatory control of the shipping industry in respect of safety and environment protection in China lies with the Ministry of Communications (MOC). The Ministry s responsibility for ensuring compliance with all the national and international maritime regulations is achieved through the Bureau of Maritime Safety Administration (BMSA). The regulatory functions pertaining to maritime education and training (MET) are controlled jointly by the MOC and the BMSA.

2.1 The Organization and Functioning of Chinese MET

The authority for implementation of international maritime conventions, including the provisions of STCW 95, rests with the BMSA. The organizational chart shows the relationship of the MET system and maritime administration.

Figure 1. Chart of MET Organization in China



2.2 MET Institutions in China

Chinese MET has a concrete foundation. China is one of the major MET countries, there being five maritime universities and colleges for the higher degree levels nationwide, 18 vocational/technical colleges and 43 maritime training centers. At present, about 4,000 academic staff are involved in conducting maritime education and training of which more than half are professors, associate professors and lecturers. Some of these academics hold COCs with practical sea experience. More and more investment is being made on the updating of training facilities, simulators and real equipment for hands-on training.

These higher level institutions are Dalian Maritime University (DMU), Shanghai Maritime University (SMU), Jimei University (Maritime College), Wuhan Polytechnic University (Marine and Inland Water College), Ningbo University (Marine College). Among the five MET universities, only Dalian Maritime University is directly under the Ministry of Communications; two others are subordinated to the Ministry of Education and the remainder, to local governments.

2.3 MET Systems in China

Two types of systems for MET exist: Higher Maritime Education and Vocational Maritime Education. The first is at university level, a four year course leading to a degree; the second is a vocational education type. The students educated and trained through either system can obtain the highest certificate of competence (COC) for officers, i.e. Master or Chief Engineer COC.

The entry to different levels is based on the grades obtained by students in the National College Entrance Examination (NCEE) governing university admissions. Students with higher grades are admitted to universities while the others pursue MET at vocational institutions.

In higher maritime education, the students enter after completing their 12 years of schooling ànd according to their results in the NCEE. During their subsequent four years at these MET institutions, seven months are dedicated to shipboard training. Upon graduation, the students have to pass the national seafarers examination for COCs and are required to complete one year of training on board ship. The national seafarers_ examination is controlled, administered and conducted by the BMSA.

In vocational maritime education, the vocational maritime institutions are divided into three levels: higher vocational colleges, intermediate vocational schools, and maritime technical schools.

3 Project on Policy of the Reforms and Improvements of Maritime Education in China

One of the tasks that Chinese MET faces is to make a study of the policy governing reforms and improvements in maritime education (PRIME) in China and to adopt such a policy. It contains objective requirements for sustainable development of the economy in general and of the shipping industry in particular, both°in China and abroad; it entails improvement of the quality of MET institutions and promotion and enhancement of maritime education.

China has a very comprehensive MET system to promote the value of its institutions. Through years of operation and with the increase of student enrollment, some drawbacks and difficulties have surfaced. It is therefore timely that research staff at Dalian Maritime University is undertaking the project of examining the policy on reforms and improvements of maritime education in China, which is sponsored and supported by the Ministry of Communications.

The project s purpose is to complete a thorough study on a policy of Chinese maritime education within a valid scientific framework: administrative system, funds and financing, training of instructors, onboard, simulator and workshop training, regimental management, enrollment and maximization of human

3.1 Chinese MET — its Characteristics and Appropriate Status

Chinese MET has celebrated 93 years of history since its foundation in 1909. Through years of growth and correction, China has built a very comprehensive MET system from higher maritime education and training to intermediate MET and from academic education to vocational training. Chinese MET displays several distinct characteristics concerning deployment of manpower, internationalization, national defense, and compliance with international conventions and national regulations.

MET in China is in the form of pre-sea courses, though seven months are dedicated to onboard training for students during their four years of university study. Most Chinese MET institutions have quality assurance systems in place; both internal and external audit schemes are followed in order to ascertain the standards of maritime education.

The goals and aims of MET in China need to be modified to meet the challenges and opportunities in the international shipping world. The BIMCO/ISF Manpower Update 2000 report predicts that°by the year 2010 the shortage of ship officers worldwide will be 46,000. The officers and seafarers from the OECD countries in the next decade will become advanced in years and a shortage will follow.

The requirements for Chinese MET consist of both quality and quantity considerations: quality means educating seafarers qualified to pass muster in international competition; quantity means educating and training a number of seafarers sufficient to meet the demand of domestic shipping companies.

3.2 The Administrative Scheme and System of Chinese MET

Chinese MET commenced in July 1909. Nowadays MET institutions are subordinated either to the central government or to local governments. In 1999 the Chinese Government effected an important reform decentralizing the control of educational institutions. Provincial governments therefore are more fully authorized to administer some universities and colleges that used to answer to the central government alone. Most MET universities have been placed under local governments; two MET institutions were merged with other universities under the administration of the Ministry of Education, viz. the former Wuhan Transportation University, for one; only one maritime university, i.e. Dalian Maritime University, retains the same status under direct administration of the MOC. To date, all MET institutions are state run and government owned, no private MET institutions existing at all in China.

Due to the fact that most MET institutions are now answerable to local governments, it is of the utmost necessity that follow up of this change in the MET administrative structure be tailored to cope with these MET reforms. The responsibilities, rights, functions and duties must be made clear to the central and local governments, MET institutions themselves, and other departments concerned. The adjustment to and clarification of these policies shall be undertaken as soon as possible.

The administrative development for Chinese MET in the 21st century shall be government dominated albeit with diversified infrastructure. The principal avenue is through a state run MET system, but MET diversity°is encouraged. MET is a costly education and training°undertaking and consequently needs considerably more investment than do other types of education.

MET institutions require external auditing, and it is the Maritime Safety Administration (MSA) which is accountable for this. For further enhancement of the Chinese MET, the legal framework will assure quality. Indeed, at the present the Quality Control Code of MET for Seafarers, issued by the MSA, sets out in detail the responsibilities of MET institutions, the MET mandate and any remaining fundamental requirements for MET institutions.

3.3 The Funds and Financing of Chinese MET

Educational funds in China come mainly from the government. The sources of funds for MET institutions in China are:

- the educational budget by the central or local government;
- donations by corporations or enterprises;
- revenue through enterprises that MET institutions run;
- students tuition fees;
- and some other sources.

With the unfolding of the last 20 years, the Chinese government has embarked on many efforts and reforms for MET institutions, including boosting education through ampler funding and bigger budgets. They continue, however, to face difficulties in funding and financing and struggle with shortfalls caused by the following:

lack of a policy for MET financing;
minimal corporate investment;
lack of individuals personal investment towards professional development;

The proposals for more funds to be directed to MET are as follows:
increased financing from government;
financing from banks;
investment from shipping companies;
creation of scholarships by shipping companies;
receipt of profits from certain investments as well as loans from banks;
tuition fees from students.

3.4 The Recruitment Reform to Attract More Students

The Ministry of Education (MOE) in China regulates national higher education. The MOE establishes and issues all regulations and requirements for the national college entrance examination and recruitment. To ensure a fair competition, all the candidates for each year must sit the same examination at the same time. The MOE decides on and prepares the examination papers, sets the same time for enrollment and then applies the same grading system.

The special policy of recruitment for MET students was formulated in 1990 by the MOE. The authority for selecting MET candidates is given to maritime universities and colleges. The criteria for entering MET institutions include successful examination results for entry (the minimum total score being set by provincial authorities) and candidates indication of MET institutions as their first post-secondary choice.

Some weaknesses in the recruiting policy also exist for potential MET students. First, there is lack of encouragement to continue professional development, which makes it difficult for seafarers to pursue further university education while on the job. Also, the physical criteria for Chinese MET institutions differ from the requirements of STCW 95 as far as the optical color-blindness test is concerned. Furthermore, the special system for recruiting MET students cannot be fully applied in certain provinces. Finally, but not least in importance, the current recruiting policy fails to vigorously attract more candidates of excellence for MET courses of study.

It is recommended that:
a policy be devised and adopted to enable MET graduates to continue their professional formation through on-the-job studies. A nationwide network shall be formed to provide continuing study options, customer oriented, by means of distance learning;
more authority should be accorded MET institutions in recruiting students;
other reforms in recruiting MET students are to be embarked upon;
MET students are to be exempted from any tuition fee and other general fees;
concerning eyesight standards, the national criterion must become compliant with the international one and the requirements of STCW 95.

3.5 Standards and Qualification Levels for MET Instructors and Assessors

Instructors and assessors qualifications are very important for quality in education. The Teachers Law of the People s Republic of China and the Higher Education Law of the People_s Republic of China have both prescribed and clarified teachers qualifications required for Chinese universities and colleges. A teacher at such an institution must possess a master_s or bachelor s degree. For maritime instructors, MSA requirements stipulate the instructor is to have at least five years of teaching experience and 12 months ocean-going experience in his or her area of instruction. Assessors for MET courses shall also have similar experience, both academically and at sea.

The establishment of a Chinese MET institution law is urgently required to ensure sound development of maritime education and training. In such an MET law, further specific qualification requirements for MET instructors should be particularized. For employment of instructors for MET institutions, competence-based qualifications and practical sea experience shall be taken into account. The ratio of staff holding COCs to those without COCs should be raised to a reasonable level. MET institutions should also make use of more part-time staff and visiting staff from the industry.

It is essential that:

- the concept of MET be changed;
- a scheme of MET instructors professional development be established;
- better conditions be offered to attract more excellent and qualified MET instructors;
- qualifications and practical skills for MET instructors be improved;
- exchange of instructors at different MET institutions be encouraged;
- MET instructors salary be increased.

3.6 Regimental Management to Improve the Safety and Security of Shipping

In October 1963, the Chinese State Council issued an order to approve a management regime for MET students at Dalian Maritime University (formerly Dalian Marine College). Shortly after this, the PRC Ministry of Defense officially informed the University that the Navy would be responsible for sending training officers and providing training textbooks, materials and uniforms, as well as equipment and facilities necessary for military training. In1988, the MOC decided to implement such regimented management in the rest of the MET institutions, i.e. Shanghai Maritime University, Jimei Institute of Navigation and Wuhan Transportation University. The other four MET colleges, of a vocational training type, also have implemented this system.

Thus all MET institutions in China have effectively established this regimented system as concerns management, teamwork, training and other aspects of its advantages.

In the twenty-first century, China has become a member of the World Trade Organization (WTO). Following the dreadful terrorist attacks in the United States, the regimented system needs to be adjusted to meet the new challenges. Future MET students shall have special training for tackling such emergency situations to ensure safety and security at sea. The students must be aware of the enormous uncertainty prevailing while international terrorists circulate. Wide-ranging comprehensive measures and strategies to combat them are allotted priority on the training program list.

As the IMO Secretary General, Mr. W. O_Neill, said in this context, shipping and maritime structures are clearly vulnerable. I therefore initiated steps to prepare a resolution on measures and procedures to avert acts of terrorism. The security of passengers and crews and the safety of ships must not be threatened. Such issues necessitated a prompt response from the IMO.

3.7 Better Facilities for Competence-Based Training

Practical training is an important part of MET. Recently more and more investment has been made in Chinese MET training facilities at our institutions, which still have been unable to cope with the increase in MET student numbers and the rapid development of modern technology. Only sufficient, state-of-the-art training facilities for MET students can ensure competence-based training.

In order to comply with the training requirements of STCW 95, Chinese MSA has published a series of regulations governing seafarers_ training, certification and watchkeeping. Specific practical training requirements are made in these regulations, including simulator and shipboard training.

Chinese MSA issued an MET Quality Control Code to furnish an external audit scheme for all MET institutions in China. The training facilities include real equipment in the laboratory, simulators, the survival training center and training vessels. Some Chinese MET institutions, as required by STCW 95 and national regulations, have purchased a certain number of training facilities and equipment. For financial reasons these facilities could not be kept updated. Other MET institutions, being short of funds, could not buy new equipment and simulators, resulting in inability of practical training in their own institutions. A general survey of MET institutions in China indicated that definite problems exist in terms of training facilities, including an insufficient number of and outmoded facilities, shortages of funds and lack of training vessels.

STCW 95 clarifies the standards of competence required and introduces qualification requirements for trainers and assessors. The competence-based training requires Chinese MET to place more emphasis on the following:

training students for creativity and practical skills;
investing more in MET training facilities of the latest technology;
improving MET quality by upgrading quality control standards;
providing regular training to keep abreast of the latest technology;
making the best use of the training vessels among MET institutions.

3.8 Employment of MET Graduates

Employment for MET graduates works by way of mutual selection . Before 1982, it used to be through a government controlled package, i.e. the companies and MET institutions reached an agreement on the number of graduates to be placed with each individual company. From 1983 to 1997, it was through _pre-employment_, i.e. MET graduates were engaged by shipping companies six months prior to their graduation. Since 1998, it has operated through _mutual selection_, i.e. shipping companies interview the MET graduating students and both can freely decide to offer or accept employment.

An employment encouragement policy for MET graduates shall be worked out to broaden their career opportunities. This employment policy shall take into account the following:

the actuality that China has joined the WTO;
meeting the demand of the new socialist marketing economy;
meeting the demand of the national shipping industry;
the mechanism of motivation;
encouragement of graduates to enter the international competitive market;

It is therefore recommended that a new employment system be used: graduates will be encouraged to work on board ship directly upon graduation, including with foreign shipping companies.

4 Conclusions and Recommendations

Chinese MET institutions need to improve their quality of education. It is time to completely revise the policy for Chinese MET. Although China is one of the major maritime countries, it is not a nation of maritime power. With a very long history, MET in China is well developed in its comprehensive infrastructure. Its administrative system and quality assurance are securely in place.

For most MET institutions in China, funding insufficiency is very common. Difficulties exist in recruiting top students for pursuing MET programs and in the lack of encouragement policies for graduates_ employment. The training facilities cannot be kept updated due to the financial difficulties. There needs to be a policy to motivate MET trainers and instructors to refresh and upgrade their knowledge.

Several changing factors must be taken into account when making a study of the policy on reforms and improvements of Chinese maritime education and training: regulations, society, technology and economics. Regulation changes are dictated by new international requirements of the STCW 95 Convention and the ISM Code. The changes in society are reflected in the attitude of young people to seafaring, which has the greatest impact on MET: decline of interest in seafaring can be clearly observed in most cities of China. As for technology, modernizing on ships and in maritime transport as a whole continues to develop; it has already led to a change in work conditions and content for shipboard staff; the social use of IT can also be extended to educational use by making distance learning programs available on board. In terms of economics, MET is considerably influenced by the globalization of shipping.

The PRIME project only serves to stimulate improvement of MET standards. Well qualified ship officers will make MET more competitive and its graduates will be able to contribute even further to a quality shipping industry. It will make the°seafaring career more attractive.

In summary:

maritime education and training in China functions significantly in providing qualified ship officers for the industry;
reforms in the administrative scheme and system for MET institutions in China shall be made to cope with the change of status of those institutions in relation to the MOC, local governments and MSA;

an improved recruitment policy shall be made to attract young people to seafaring;
a motivation policy for MET instructors/assessors shall be drawn up for MET institutions in order to attract and retain instructors of excellence;
the military management system shall be improved to adapt to new requirements, especially concerning the safety and security of shipping;
more investment shall be made in new equipment and upgrading of training facilities;
a motivation mechanism shall be inaugurated to encourage MET graduates to work on board ship at least several years for the industry before moving ashore;
a legal framework for MET in China shall be approved and established.

The best result of reforms and improvements of MET in China is to come to a comprehensive understanding, to get MET institutions involved in national activities and to make MET heard and known in meetings at national level.

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High-level management functions in MET

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ABSTRACT

Recent trends in MET in Croatia show a significant increase in the number of requests for courses dealing with high-level management functions and which are dedicated for the top-level onboard personnel. These requests, primarily from well-established shipping companies, are well defined in respect of the curricula and duration, with clear goals and, as a rule, exceeding the scope of the STCW 95 convention. Basically, they are intended to improve various management capabilities of the onboard personnel such as team management, resource management, handling of sophisticated units, units with unusual characteristics or in a particular environment, etc.

Such courses have been held at Faculty of Maritime Studies, University of Rijeka, over past two years. Based on the experience already gained in such courses, the paper discusses their general structure and main features as well as their advantages and drawbacks, as seen by teachers and lecturers. Particular attention is paid to feedback and comments from responsible persons in shipping companies. Also, the possibilities for inclusion of the content and experience into the regular education are discussed.

Finally, a proposal for the unification and standardization of such courses, particularly in respect of their syllabi, duration and main objectives is presented and offered for discussion to IAMU members.

1. Introduction

The main goal of shipping industry since its beginnings has been to produce as high a profit as possible under given (international) market conditions. The profit is the *raison d' tre* of shipping industry and, at the same time, the principal propulsive force demanding application of the technological advances.

The main restrictions come from two different sources: the first is inherent in any business activity, i.e. it is the consequence of business competition between shipping companies, while the second is the consequence of the influence exerted by the state to shipping, particularly in respect of the safety of life and maritime environment protection. Beside these two main sources, there are several other sources that influence maritime sector to a much lesser extent.

During the last decades, maritime transport has been under a constant and complex change, both in the organisational and technological sense. The main driving force for this change is, above all, a fierce competition among shipping companies and port operators on the global scale. In such circumstances, the winner is the one who is capable to offer the service on lower price. Consequently, it has forced large operators to exploit as much as possible the economy of scale — on one side it resulted in building larger and faster ships and on the other it resulted in the merger of shipping companies and the offer of common services wherever it was possible.

In order to make shipping more cost-effective it was necessary to introduce a sophisticated technology on board wherever it promises higher competitiveness and profitability. All these factors taken together exerted additional pressure on ships and their crews — the margins for deviation, both in time, space and expenses, become very narrow.

At the same time, the basic shipboard organisation and the supporting educational system did not follow these changes. They are mainly inherited from the 60's when the shore cargo technology as well as bulk of the world fleet was on a much lower technological level than the typical vessel of modern times. These differences have increased the operational workload, which in turn results in a decreased level of safety and a higher probability of maritime accidents and pollution. As a consequence, the number of accidents does not decrease to the extent it was once expected.

Obviously, negative consequences arising mainly because of increased workload of ship officers and ratings are already recognized by a number of shipping companies. The probable solution is sought out in additional education for their masters and officers, particularly for those with management responsibilities.

2. The influence of technological advances on shipboard organization

The new technological devices or systems could be introduced on board ships in two different ways depending on the purpose of such a device or system.
If the primary task is to improve the level of safety and/or pollution prevention it would be first recommended by IMO or, to a smaller degree, by national authority. If such device or system proves its efficiency, it will be formally standardized and confirmed mandatory on worldwide level by its inclusion in the appropriate international convention such as SOLAS or MARPOL. An example of such approach is the AIS system, recently made mandatory by amendments of the SOLAS 74 Convention.[1]
The devices or systems intended to improve commercial efficiency of the ship could be developed by independent ventures and offered to ship owners directly or through shipyards. Sometimes, they could be developed on ship owner s request in order to solve the particular problem. In any case if, after some time, their commercial efficiency is proved, the device or system becomes a standard part of ship s equipment. The same principles apply not only to the particular device but also to the new and more efficient construction features such as ship s hull design or new type of propulsion. In such case the organization acting on behalf of the government has to verify that the novelty does not interfere with the functionality of other safety systems as required by the international conventions.
Whatever development approach is used, the developer will try to make such a device or system as applicable to various ship types as possible. As a consequence, such devices or systems usually offer a wide variety of options and capabilities. Moreover, in order to operate correctly they more than often require thorough understanding of underlying principles, additional education and/or training of the crew. In the case of sophisticated equipment dedicated for the control of complex technical systems, the probability of undesired interferences among various components or with already installed equipment is also increased. A good example of such system is the cargo control system on large chemical tankers where numerous pumps, valves and other equipment have to be simultaneously operated and controlled by one person from one room, demanding prolonged periods of high mental concentration.
Probably the most important factor affecting shipboard organization is the increased number of sophisticated devices that have to be used concurrently. Thanks to modern technology there is usually clear distinction between actuators i.e. parts of a device that actually carry out intended function, such as pumps, generators, lifting devices and winches, and their control units that are usually centralized on several locations. The most probable locations where control units are concentrated and could or should be monitored and/or triggered simultaneously are the ship s bridge, the engine control room and, depending on a ship s type, the cargo control room.
From the operator s viewpoint, all these control units are sources of information about present and future status of the technological system he is trying to control and could be divided in three main groups:

- indicators, showing the current status of the particular process,
- controls, used for activating or deactivating different control functions,
- alarms, used to indicate that value of the monitored function has outreached predefined limits.

Each of them requires different mental and physical activities of operator controlling the process, and supplements information he can obtain directly by using his own senses — mainly by looking and hearing.
Indicators require a constant monitoring and comparison with value deemed to be correct. The supposedly correct value depends on knowledge about the controlled process and previous experience with the particular system or operation. If there exists a difference between actual and supposedly correct value the operator has to decide what action is appropriate to decrease the observed difference. Before any remedial action is taken the operator has to take into account other influences such as the reliability and accuracy of the indicator, the delay time, the extent of difference, the probable consequences on other components of the system and so on. Beside a technical device, a source of observed value could be even an experienced seafarer. The typical examples of indicators are the temperature of exhaust gases, the distance from the pier (for example observed by a mate during an approaching manoeuvre and reported to the master) or pressure created by a cargo pump during discharging operations.
Controls are used to change the status of a control device in order to change the rate of progress of a technological process. The most basic types of controls are on-off switches, multilevel controls or continual controls. As a rule each control will, if it is operational, change the status of the process after some time and in order to be used correctly the operator must be aware of this time delay. A number of controls require that some other conditions be fulfilled. The example of such control is the rudder. The delay before the course starts changing after rudder is put aside depends on ship speed — higher the ship s speed will cause decrease of response time. The example of conditional controls is a switch for hydraulically operated valves. The valve can be opened or closed if the pump is already operating and the pressure is high enough. Some shipboard controls do simple technological action(s) but others could change the way of operations of complex subsystems. The example of such system is the bridge

propulsion control. The simple pull or push of a control lever will produce changes in operational status of numerous technological units in the engine room.
Alarms are generally self-activated devices or a part of the control unit. They are activated when measured value exceeds the predefined limits indicating conditions that could jeopardize the proper operation of the whole system or its subsystems. They can be categorized as subclass of indicators that requires immediate corrective action and as such they are always equipped with more or less disturbing sound and/or light signals. In many cases the level of disturbing effect could be twofold or even threefold. The example of such approach is the fire alarm system — after an indicator detects fire-like conditions, the alarm system will signal it by sound and light; if after some time the operator does not accept this initial signal the general alarm will be raised. It has to be emphasized that in particular circumstances the effectiveness of built-in alarm functions could be significantly decreased. For example, in case of major malfunction when a number of alarms are activated simultaneously it is not easy to recognize what went wrong.
From the above examples it is clear that with increased number of control units on the spot the operator s workload is also increased. It has to be emphasized that it is not only the number of control units that counts. It is also their more or less ergonomic design, different operational conditions, a site layout and a relative position in respect to other units, information payload and significance, importance for the particular operation, a number of different options, etc.
And, as it can be concluded from recent trends in electronics, computer science and other related technologies, the number and complexity of sophisticated onboard equipment on a standard ship would probably increase. Consequently, it can be expected that in the years to come, even greater part of the time will be spent on controlling and regulating various instruments and devices, thus changing the way in which the ship is managed.

3. The analysis of the shipboard management functions

The complex operations that require a synchronized and coordinated work of several persons are not a novelty in shipping. Probably the first such operation was the berthing and unberthing manoeuvre of the ship. Other excellent example of such operation from the past is setting up and lowering down the sails on large sailing ships, particularly clippers.
But, there is a significant difference between those operations and complex operations on modern, much larger ships. On the ships from the past all activities are performed by the seafarers who can adapt to different circumstances. The person who controls the operation, usually the master, personally monitored the advance of each sub-activity and change the order of executions if necessary. The number of persons on board was for the most part sufficient. The number of operations in which the available time is a critical factor has been relatively small.
On modern ships the conditions are quite different. The majority of operations are activated and executed remotely from control stations. The knowledge on local circumstances is in many cases limited to what indicators are showing. The outcome of an activity is rarely observed immediately after its execution starts off. More than often the order of execution cannot be changed once it starts. The number of available replacement seafarers with necessary knowledge, skill and experience is very limited. And probably the most important difference, the number of time critical operations is much higher than in the past.
The direct consequence of an increased number of complex systems on board and conditions existing at the present time is that the majority of routine operations have to be carried out not by one person but as teamwork with clear division of duties and responsibilities.
Before any further examination it must be noticed that seafarers presently take on several different roles: they are acting as a part of the communication chain, sometimes they only collect information, in some cases they control some less demanding sub-process and sometimes manage overall progress of an complex operation.
The person on board is used as a part of communication chain in the cases when there is no direct link between measurement device and control post or it is not functional. It is usually a monotonic and time-consuming task. As communication device the simple VHF radio is usually employed. The necessary skill is a sufficient command of the working language.
Information collection by the human operator is used when adequate measuring devices are not available or does not exist. Depending on the complexity of an operation the necessary knowledge, skill and experience could be highly variable. Typical examples are estimating a distance between the ship s bow or stern and a pier during a berthing manoeuvre, measuring a distance and bearing from an object during navigation in narrow waters, draft measurement or provisory checking of cargo weight during loading/unloading of bulk-carriers. In many cases information collection assumes informing on current status of some parameter, usually to higher-ranking person, depending on their importance and previous standing orders.

Controlling sub-processes includes usually a number of different lower to middle level tasks that have to be executed during regular working time. Each of them taken separately does not produce significant workload but taken together they can, in certain circumstances, increase the operational workload above the acceptable level, thus endanger the safety of a ship. Typical examples include executing navigational or engine room watch during expected sailing conditions, monitoring the simple loading/unloading operations and regular maintenance duties. In many cases in order to carry out such tasks it is necessary to use more or less sophisticated equipment and several subordinates. The necessary knowledge, skill and experience highly depend on type of ship, equipment used, external conditions and complexity of particular task. In the STCW convention this group of tasks are identified as operational level tasks.

The traditional definition of management defines it as the effective use of resources to achieve the organization s objectives. Following this definition high-level management tasks on board should include all activities in which, in order to be successfully completed, it is necessary to simultaneously use the sophisticated equipment and a number of operators coordinated in space and time. In that respect it is to a certain degree a more restricted definition than traditional one since it as resources requires a number of different devices of witch at least some of them are sophisticated and a number of persons using that equipment. In addition, primary because of limited human resources on board, it is assumed that their knowledge, skill and experience are also at different levels.

High-level management tasks are characterized with multiple possible progress paths, each of them more or less equally successful. Which one will be followed, has to be decided well in advance. Furthermore, execution of the majority of these tasks follows the more or less formal plan. A good example of such approach is the cargo plan that in traditional way describes the final stage of cargo loading. Some other tasks, for example the berthing manoeuvre, are executed in accordance with personal preferences (style) of the person who executes them. And the last group of high-level tasks are externally formalized tasks. The good example of such approach is a repair and maintenance procedures that are, as a rule, prescribed by shipping company wishing to harmonize them across the fleet.

In reality, all the above characteristics of management functions are more than often mixed in various proportions as a result of national tradition, market conditions, the ships type, the prevailing service area and established practice and experience. However, basic high-level management functions are more or less clearly recognized and described in the STCW convention as obligatory functions or competences required for the highest duties on board in both deck and engine room department.

4. High-level management functions in MET

The very basic goal of any maritime education and training (MET) institution is to prepare a would-be seafarer to do his duties as skilful and competent seafarer. In order to achieve this goal any MET institution has to start with basic knowledge and primitive skills and then to upgrade this capabilities up to the target level. If future seafarer is not supposed to do the highest-ranked duties then high-level functions could be omitted. But, on the other side, if a future seafarer is supposed to assume the highest-ranking duties he has to be trained in the organization and management of the most complicated operations.

In order to be successful, such training can begin after some basic conditions are satisfied. First of all, it has to start after all traditional knowledge and skills regarding ship s construction and equipment are mastered. Second prerequisite is a thorough knowledge of basic working procedures that are assumed for target level of responsibilities, the most important being duties executed during navigational or engine watch or cargo handling. In other words the candidate must be proficient in all tasks that can be and usually are carried out as single-person tasks.

Being able to perform management functions assumes use of several important concepts. The first of them is resource management. The basic condition for successful resource management is a clear objective of what has to be accomplished (for example, to berth the ship alongside). The second condition is a clear idea about existing or potential restrictions regarding available technical facilities, equipment and human resources with particular attention to resources reusable under specified conditions. Examples of restrictions are the fuel available, the accuracy of the navigational equipment or the number of available seafarers with necessary knowledge and skills.

The second concept is time management. It is based upon particular restrictions such as the total available time for whole operation, time available for each task, time of availability for a particular resource, and conditional restrictions including as the most important the impact of the available resources to the available time for the particular task and vice versa. Examples of particular restrictions are time when tide is high enough to permit passage and time for tank cleaning with built-in equipment while examples of conditional restrictions include time for position fixing using different navigational aids or time needed for repair work using onboard or shore workforce.

The next concept is task management. It basically cover up the selection of the appropriate task order in cases in which several orders are equally possible as well as mutual impacts of various tasks that can or should be executed concurrently. For example, various strategies in respect of the task management could be easily noticed in loading/unloading sequences on large chemical tankers or container vessels.

The last concept is cost management. It covers costs of the overall operation and of the particular task. Usually, it is defined as achieving specific goals using the minimal financial resources. Examples of cost management are utilization of shore equipment or tugs in such way to create the minimal costs for ship owner.

In order to attain all the previously stated management capabilities it is necessary to apply a proper pedagogical methodology. It seems that the most appropriate learning methods are learning by example, as a first stage, and by experience, as the second and final stage.

Learning by example includes fictitious and/or real examples in which the student can clearly observe all or most of management capabilities. It could be done in several steps. The first one could be a complete cause — effect analysis of several selected cases. It has to be carried out by an instructor who should pinpoint particular learning objectives in each case, particularly identification of resources and their restrictions, time constrains, evaluation of tasks and other possible conclusions. The second step should be the same analyse carried out by students themselves. The outcomes should be verified by the instructor and discussed among students. And the last step should be analyses of cases presented uncompleted where students are required to complete the sequence.

Learning by experience could utilize several pedagogical methods such as games, role-playing and simulation. It any case, they have to promote a common spirit and clearly emphasize a need for close cooperation among group members (for examples see Klippert, 1998). Therefore, each of these methods should be limited to the group work while single-person involvement should be avoided. While games are well suited to encourage the spirit of teamwork, they treat each group member as equally important which is rarely the case in real situations. In that respect the role-playing could be treated as a good compensation since it resembles this aspect of real situations more closely. While scenarios for games do not need to be from maritime milieu, scenarios for role-playing should be selected from real-life situations as much as possible.

Learning by experience could be best exploited using simulators. In that respect the most typical and high-quality simulations could be easily created and carried out using full mission bridge and engine room simulators. However, the simulation should strictly follow the selected scenario until the final objective is reached while every person involved should stick to its role. Otherwise, the simulation lesson could diverge into exploration of visual capabilities or technical features of the equipment. Additionally, each lesson should start with brief introduction into the scenario and conclude with debriefing. If time permits it, the same scenario should be repeated with same group but in various roles and then followed by comparison of outcomes. However, the simulation as a learning method can be used not only for typical tasks such as navigation and engine room watch but also for other learning objectives when availability of dedicated simulators is not necessary required, for example for crisis management or commercial operations of the ship.

The high-value of additional training of ship officers to act as team members has already been recognized by a number of well-established shipping companies who recently start to send increased number of their officers to MET institutions with request to attend courses usually designated as Bridge Teamwork Management (BTM) or as Bridge Resource Management (BRM) course. The BTM course usually follows a curriculum broadly described in the book issued by the UK Nautical Institute and its primary target is to educate ships officers how to carry on their navigational duties as a team. The BRM course origins from human resource management principles as applied by SAS Flight Academy as part of their safety training.[2] It is a worthwhile to note that, since these courses are not required under revised STCW convention,[3] crew managers often prefer to modify a suggested curriculum in order to better customize the course in line with their need. Examples are a company requesting that all exercises during the BTM course have to be carried out using models of VLCCs and a company who requests instructors to simulate circumstances in which their ships already had a collision. Beside those two courses, there is also a third course with a very similar curriculum defined by the IMO as the Model Course 1.22 - Ship Simulator and Bridge Teamwork.[4] Various topics on bridge team management are also added to the revised Model Course 1.09 — Radar, ARPA, Bridge Teamwork and Search and Rescue.

It has to be emphasized again that higher-ranking officers apply the core management functions not only during safety related operations but also in various degrees during most other operations such as maintenance and repair, search and rescue and loading/unloading operations. Therefore, it would be reasonable to include management education and training in the regular curricula for all students enrolling in high-level MET institutions, particularly because a number of ex-seafarers continue their careers on the shore, often at management-level jobs. In order to be successful the subject should be harmonized and standardized at international level. Since it is not reasonable to expect that general management topics will be included in the STCW convention in next several years the most appropriate international forum for this task is the IAMU as the prominent international body committed to high-level maritime education and training. The subject should consist of the general management topics and after that the specific topics for deck and engine departments. For the present seafarers the management capabilities should be acquired in form of short courses whose duration, necessary equipment and curricula also have to be standardized.

5. Conclusions

Over the last two decades, a number of various sophisticated devices installed on board has significantly increased, resulting in the considerably increased operator s workload. Consequently, the number of operations that have to be executed by a coordinated group of officers and ratings has also increased. In order to successfully carry out such tasks and indirectly to maintain at least the present level of maritime safety, pollution prevention and commercial efficiency the higher-ranking personnel must be familiar with general and specific management skills, particularly in resource management, time management, task management and cost management. Probably the best way of acquiring required skills is by applying the learn by example and learn by experience approach based on pedagogical methods suitable for group work. For students in high-level MET institutions the core and specific topics should be delivered in accordance with harmonized and standardized curricula, preferably developed under the auspices of the IAMU, while for the present officers on board the necessary knowledge and skills should be acquired through standardized short courses.

Endnotes

[1] For example, the inauguration of the AIS system has been made as a proposed requirement for ADS system announced to be mandatory for ships sailing to Prince William Sound. See Fairplay, 1st October 1992

[2] The course started in cooperation with several maritime organizations back in 1994.

[3] The BTM course is already included in some voluntary inspection schemes, such as CDI and Shell.

[4] This model course is presently under revision.

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Problem Based Learning in Maritime Education

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ABSTRACT

Problem Based Learning (PBL) is a learning method based on the principle of using problems as a starting point for the acquisition and integration of new knowledge. PBL has been successfully applied at a number of disciplines and various academic institutions internationally. Objectives of PBL are to develop knowledge, skills and attitudes of the students through a "Student Centred" approach. PBL is believed to aim at creating a great deal of changes in the creativity of the learners.

Dokuz Eylul University School of Maritime Business and Management (SMBM) has decided to adopt this student centred education system. The school aims to provide education to those who will assume positions in the administrative, managerial and technical bodies of the domestic and international maritime institutions. The Deck Department's curriculum is in compliance with the IMO's STCW'95 conventions. Through utilizing the PBL approach, SMBM aims to provide the shipping industry with decently qualified and skilled personnel meeting all the requirements.

The overall results aimed through PBL seem to greatly comply with the expectations of the shipping industry for managers in general and the merchant fleet for deck officers in particular. The aim of this paper is to give basic principles of PBL, highlight the practices of SMBM and discuss the necessary steps to carry out this completely new system to the best possible extent.

1. Introduction

The overall aim of education is believed to provide the learners with certain proper knowledge, desired skills and profound attitudes. And the fundamental of education, in broad sense, has got to be structured in compliance with the targeted needs of the learners. This means that as the needs change, the relevant education system has to change so as to meet the new terms.

The recent rapid advances in technology have increasingly changed almost all aspects of human-life and thus accelerated the required changes in teaching and learning approaches. Particularly since the last quarter of the 20'th century, it has been clearly seen that a means of transferring knowledge from an instructor to the passive learner can never cope up with the outstanding changes in needs. Thus it has become inevitable for the learner to take an active role in and shoulder the greatest part of the responsibility in teaching learning activity. He / she has been placed at the center of the activity so that the whole activity can proceed under his / her control, based on his / her specific needs and preferences. Since the learner neither can nor does need to be loaded with all sorts of knowledge available, he/ she should himself / herself determine the limits of the knowledge needed. He / she should decide on the learning objectives and also on the way to access those objectives. Through practicing the mechanism of self-appraisal, he / she should be able to correct and improve himself/ herself. In other words, he / she should actively take part in learning activities and eventually become a life-long learner. The instructor's and/ or the education institution's role in this activity should be confined to act as an efficient facilitator rather than a knowledge-conveyor (Paker and Kalkan, 2002).

Maritime industry has been facing many developments in recent years. These developments have led the shipping companies to get involved in horizontal and vertical integrations with the other organizations. Container shipping has been characterized by the emergence of powerful alliances and other forms of co-operation such as mergers etc. (Heaver *et al*, 2001). In doing so, carriers believe they can fulfill their integrative promise by consolidating their operations and by sharing previously confidential assets (Sheppard and Seidman, 2001). Technological solutions including bigger container vessels and high performance Information Technology (IT) also have been introduced within the shipping industry. 7 to 8 percent of the ships deployed within the Asia-Europe trade were post - panamexes in 1995. However, this figure has increased up to 45 % by 2000 (Lloyd's List, 2002) Technological advances such as vessel automation and Global Positioning Systems(GPS) have made operation of these mega carriers less expensive than that of older vessels (Sheppard and Seidman, 2001). On the other hand, new services such as round-the-world, pendulum, and integrated global network have been introduced by the liner shipping companies, and transhipment concepts have gained popularity with respect to the major trunk lane concept. In addition to that, expectations of shippers have been changing and differentiating in terms of customer service level and costs. In order to meet the expectations of the shippers, transportation and logistics packages have been offered by the transport providers in terms of "one-stop shopping" and "total logistics providers" approaches (Tuna, 2002).

These changes in maritime industry and shipping have inevitably increased the need for qualified human resources. With regard to that fact, Dokuz Eylul University School of Maritime Business and Management (SMBM) has decided to transform its conventional curriculum to the "problem based learning" (PBL) curriculum in order the meet the expectations of the rapidly changing maritime industry in terms of both "maritime business managers" and "deck officers". This paper attempts to review the PBL steps in SBMM.

2. Problem Based Learning: Literature Review

Problem-based learning (PBL) has been among the curricular innovations most discussed in higher education over the last 30 years. Since it first came to prominence in the late 1970s, problem-based learning (PBL) has provided an increasingly important voice in the on-going debate on how we might organize teaching and learning in the universities (Harland, 2002). Several studies have shown that PBL is a successful approach compared with more traditional curricula with regard to intrinsic motivation and long-term retention of learned knowledge (Wiers *et al,* 2002). PBL restructures traditional teacher/student interaction to emphasize active, self-directed learning by the student, rather than didactic, teacher-directed instruction (Maxwell et al, 2002). It is characterized by problem-orientation, interdisciplinary work and self-directed learning and focuses on inter-personal and professional skills (Driessen and Vleuten, 2000).

As the term itself suggests PBL is a means of learning which is basically based on a problem. The problem stands for the stimulating aspect of the learning activity. In other words, it raises certain desire, wonder, and interest in the learner. The idea behind this philosophy must be that learning is inspired towards what is needed to be uncovered, what attracts interest and what creates certain desire and enthusiasm in the audience. It is commonly accepted that one is most likely to try to learn what he/she has questions in mind about, finds mysterious and interesting, threatening or useful, etc. (Paker and Kalkan, 2002). Therefore, in order for any learning activity to take place, there must be at the stage a motive, desire and interest, i.e. intrinsic motivation. These incentives are raised by the problem, which must be designed in accordance with the specific goal aimed. The problem also serves a challenge to students' reasoning or problem-solving skills as an organizer for their learning. The only way to discover what you already know, what you have really stored in your memory, is to work with a problem." (Dolmans and Schmidt, 1994) Another important function the problem serves is to encourage self-directed learning skills. "When students discuss a problem, they ask themselves whether or not their knowledge and skills are adequate to deal with this problem. This provides them with both a sense of direction and the depth of study that needs to be undertaken. Through problem discussion, students identify their own learning needs and formulate these as learning issues. These issues are listed and serve as guides for what they should learn during self-study. The main advantage of encouraging self-directed learning skills is that students learn how to deal with problems in the future, preparing them to become independent, life-long learners." (Dolmans and Schmidt, 1994)

As Dolmans and Schmidt (1996) make it clear, the problems which students tackle in small groups under the supervision of a tutor consist of description of a set of phenomena or events that can be perceived in reality and these phenomena have to be examined by the tutorial group in terms of their underlying principles, mechanisms or processes. " They rightfully also claim that this style of learning increases retention of knowledge, improves problem-solving skills, enhances integration of basic science concepts, develops self directed learning skills, and strengthens intrinsic motivation.

As far as the types of the problems are concerned, Barrows (1984) is right to have stated that these problems can be questions to be answered; observations, symptoms, signs or experimental results to be explained; even equations to be derived. Although the types vary however, certain principles should be kept in mind while designing a problem to be used in problem-based learning. They are, according to Dolmans; Balendong and Wolfhagen (1997) as follows:

the content of a case should adapt well to students prior knowledge; it should contain several cues that stimulate students to elaborate; the context should be relevant to the future profession; it should have relevant basic sciences concepts to encourage integration of knowledge; it should stimulate self-directed learning; it should enhance students interest in the subject matter, by sustaining discussion about possible solutions and facilitating students to explore alternatives; and it should match one or more of the faculty objectives.

The essence, or the fundamental base, of PBL lies on meeting the three basic conditions that facilitate learning. The three principles playing a major role in acquiring new information are activation of prior knowledge, encoding specificity, and elaboration of knowledge (Schmidt, 1983).The idea behind the first principle is exemplified in the mentioned article which compares the learning results of a first year student with that of fourth year student both of whom are assigned to read and interpret the same article. The results are found to be in favor of the fourth year students as their more elaborated prior knowledge will enable them to process the new information more easily, efficiently and fruitfully. The second principle, encoding specificity, is related with the resemblance between the situation in which something is learned and the situation in which it is applied. The closer the resemblance is the better the performance. The third principle, elaboration of knowledge, is fulfilled through various means such as answering questions about a text, taking notes, discussing subjects matter with others, writing summaries, teaching peers what has been learned, and formulating and criticizing hypotheses. All in all, the mentioned three principles ought to be complied with in optimizing learning. "Education should help students, in activating relevant prior knowledge, provide a context that resembles the future professional context as closely as possible, and stimulate students to elaborate on their knowledge (Schmidt, 1983).

3. Problem Based Learning Process in SMBM

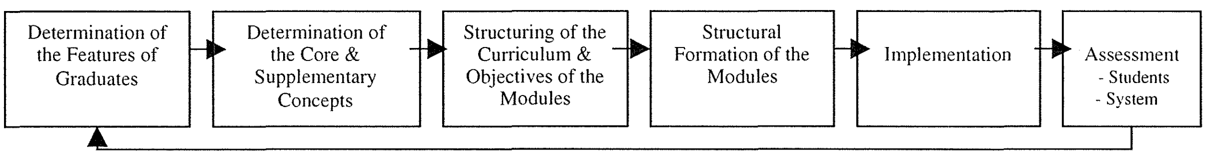
Dokuz Eylul University (DEU) was founded in 1982. DEU is a multicampus university dispersed throughout the city of Izmir at various locations offering undergraduate and graduate degree programs of study research in 10 faculties, 5 schools, 5 vocational schools, and 5 institutes, serving a total of 36,000 students.

School of Maritime Business and Management has two departments; Maritime Business Administration and Deck. Graduates of the Maritime Business Administration take part in the maritime industry effectively and have the opportunity to be employed internationally. Current curriculum of the department covers logistics, transport and maritime transport majors on business administration discipline. The aim of the Deck Department is to educate oceangoing masters. It is verified by the Turkish Prime Ministry Undersecretariat of Maritime Affairs that the department's curriculum is in compliance with International Maritime Organization's STCW'95 Convention. Graduates are granted the right of taking the "Oceangoing Chief Officer Exam".

Led by the Faculty of Medicine six years ago, Faculty of Law, Faculty of Arts and Sciences, Faculty of Theology have adopted PBL learning approach in Dokuz Eylul University. SMBM has decided to implement this new approach in its curriculum for both departments starting from the academic year of 2002-2003. PBL approach will be implemented after a two year of preparation period. This section summarizes the major steps taken during this process.

Major steps of the PBL process in SMBM can be summarized as follows; (1) Determination of the features of the graduates, (2) Determination of the core and supplementary concepts, (3) Structuring of the four year curriculum and determination of the objectives of the modules, (4) Structural formation of the modules, (5) Implementation, and (6) Assessment of the students and the system.

Figure 1. Major Steps in PBL



3.1. Determination of the Features of the Graduates

The first step of the "Problem Based Learning Process in SMBM" was to determine the features of the graduates. Features have been determined in terms of **"knowledge"**, **"skills"**, and **"attitudes"** with the participation of the lecturers of SMBM, representatives of the shipping and logistics industry, and former graduates of the School. Separate brainstorming sessions have been organized for both "Maritime Business Administration "and "Deck" departments. All contributions proposed by the participants have been recorded and classified in order to determine the features of a "maritime business manager" and "deck officer". Needless to say, this stage has helped to develop the objectives of the departments.

3.2. Development of the Core & Supplementary Concepts

Having determined the features of the graduates, core and supplementary concepts in terms of **"knowledge"** have been developed for both departments. Core concepts of a department refer to the vital subjects that a graduate ***has to know*** in his/her business life. Supplementary concepts, on the other hand, can be defined as the subjects that help the implementation of the core concepts. Lecturers of both departments have determined core and supplementary concepts after a series of meetings (See **Table 1**).

3. 3 Structuring of the Four Year Curriculum and Determination of the Objectives of the Modules

Conventional four year curriculum has been changed in accordance with the objectives of the School in terms of "knowledge", "skills", and "attitude". Lectures within the conventional curriculum have been eliminated and 14 modules have been constituted for the first year in order to achieve vertical and horizontal integration among the core and supplementary concepts. The objectives of the modules have been determined in terms of knowledge, practical skills, professional implementation skills, field study, professional values and ethics, communication, social, maritime English (See **Table 2**).

Table 1. Core and Supplementary Concepts for the Departments

MARITIME BUSINESS ADMINISTRATION DEPARTMENT		DECK DEPARTMENT	
CORE CONCEPTS	**SUPPLEMENTARY CONCEPTS**	**CORE CONCEPTS**	**SUPPLEMENTARY CONCEPTS**
§ Multimodal Transport § Ship and Fleet Management § Third Party Warehousing and Inventory Management § Cargo Transportation Management § Passenger Transportation Management	§ Business Administration § Marketing § Finance and Accounting § Operations § Organization and Management § Economics § Law § Information Technology § Transportation § Logistics § Sea Transport § Public Finance § Geography § Marine Sciences and Technology § Tourism § Calculus § Maritime English § Statistics § Seamanship	§ Navigation § Maritime Safety § Prevention of Marine Pollution from Ships. § Cargo Handling and Stowage § Ship Structure and Stability § Ship Management	§ Calculus & Statistics § Physics § Medical First Aid § Meteorology § Maritime Business § Seamanship § Ship Maneuvering § Information Technology § Naval Shipping Control § Communication § Ship Engines § Law § Technical Drawing § Electric and Electrotecnics § Behavioral Sciences § Maritime History § Geography § Chemistry § Oceanography § Maritime English § Survey § Shipbuilding § Search & Rescue

Table 2. Objectives of the Modules

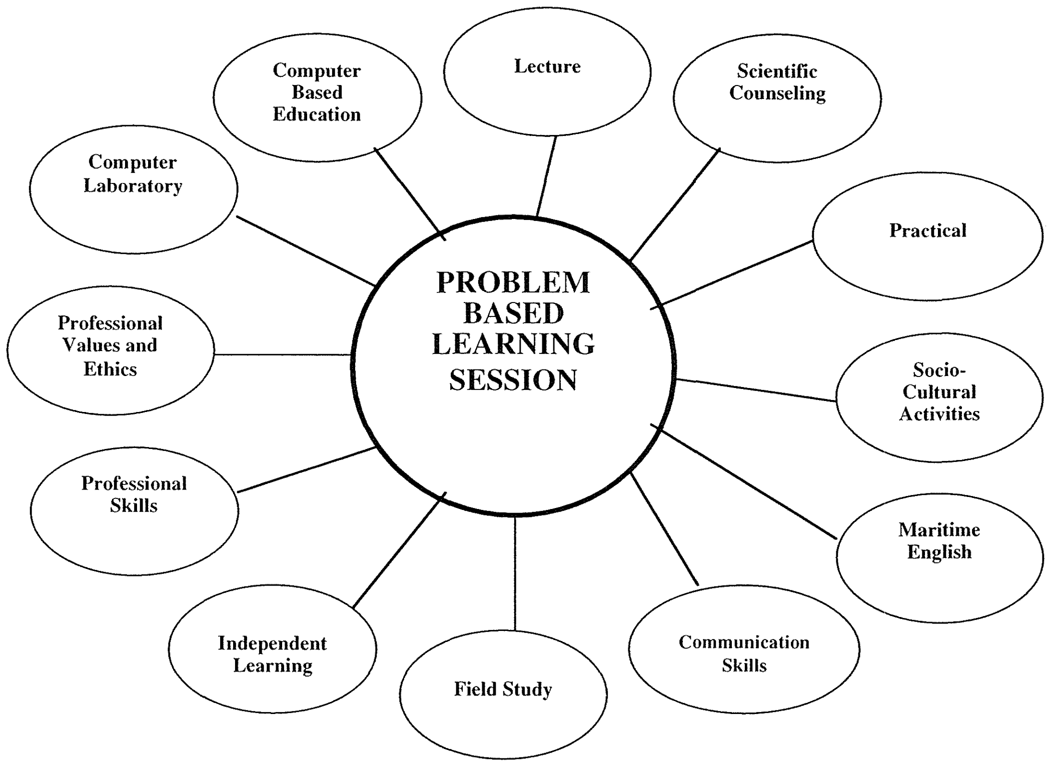
MARITIME BUSINESS ADMINISTRATION DEPARTMENT **Year 1 Module 1**	**DECK DEPARTMENT** **Year 1 Module 1**
A. KNOWLEDGE • **Maritime Trade:** Introduction to trade, Cargoes traded, World merchant trade, Ship types and characteristics • **Business Administration**:	A. KNOWLEDGE • **Seamanship:** Definition of the ships, Classification of the ships Types of the ships, Structural parts and elements of ships, Cargo Types

Business and business management, Business environment, Global dimensions of business, Ethics and social responsibility • **Economics:** Definition of economics, Scarcity and choice, Supply and demand • **Calculus:** Sets, Functions • **Law:** The concept of law, Relations with other fields B. PRACTICAL • Practice related with ship and cargo C. PROFESSIONAL SKILLS • Acquiring basic skills related with ship and cargo • Acquiring integration of mathematics skills with knowledge about ship and cargo • Acquiring basic skills on earth geography • Keep in touch with and interpreting sources of knowledge related with world trade • Acquiring skills related with basic law concepts • Acquiring basic skills related with general mathematics D. FIELD STUDY • Visiting the fields related with ships and cargo E. PROFESSIONAL VALUES AND ETHICS • Introduction to ethics in general and business ethics F. COMMUNICATION SKILLS • Basic communication skills G. INFORMATION TECHNOLOGY • Introduction to Information Technology • Information Era and Information Society H. SOCIAL • Acquiring social aspects of trade and business • Acquiring desired aspects of being a good model as individual as well as citizen I. MARITIME ENGLISH • Getting introduced individually • Practicing free conversation (commenting on the sessions) • Recalling, brain storming and briefing (the topics, based on the contents of the module, are to be itemized and discussed)	• **Maritime Law:** Definition of ship, Sea worthiness • **Basic Navigation:** Definition of navigation, Universe, solar system and Earth, Shapes of the earth, Equator, latitude and Longitude, Differences of latitude and longitude • **Physic :** The law of Archimedes, Mass, weight, volume and force Circular motion and rotation, Density, Fluency • **Geography:** Geographic positions of major canals, Trade routes • **Maritime History:** Maritime history B. PRACTICAL • Chart Practice • Life Boat Practice • Latitude and Longitude Differences C. PROFESSIONAL SKILLS • Life Boat structure and parts • Sailing Boat • Mass, Weight, Volume and Force • Trade Routes • Ship Parts D. FIELD STUDY • Visiting the fields related with ships and cargo E. PROFESSIONAL VALUES AND ETHICS • Introduction to ethics in general and maritime ethics F. COMMUNICATION SKILLS • Basic communication skills G. INFORMATION TECHNOLOGY • Introduction to Information Technology • Information Era and Information Society H. SOCIAL • Acquiring social aspects of trade and business • Acquiring desired aspects of being a good model as individual as well as citizen I. MARITIME ENGLISH • Getting introduced individually • Practicing free conversation (commenting on the sessions) • Recalling, brain storming and briefing (the topics, based on the contents of the module, are to be itemized and discussed)

3.4. Structural Formation of Modules

The core of the module structure in SMBM is **"Problem Based Learning Session".** Other activities; lecture, scientific counseling, computer based education, practical, professional skills, socio-cultural activities, professional values and ethics, independent learning, field study, communication skills, and maritime English have been designed in order to meet the learning objectives of the modules (**Figure 2**)

Figure 2. Structural Formation of a Module



The nature of the student based learning in PBL is to a large extent dependent on the quality of cases presented to students (Dolmans *et al*, 1997). Two basic elements in PBL session are: (1) the analysis of authentic problems in a professional context as a starting point for learning; and (2) communication among peers (Ronteltap and Eurelings, 2002). As far as the SMBM is considered, the process of a typical PBL session consists of three group meetings.

The PBL process is tightly structured and contains a number of key steps; (1) case presentation, (2) identifying key information, (3) generating and ranking hypotheses, (4) generating an enquiry strategy, (5) defining learning objectives, (6) reporting back, (7) integrating new knowledge (Johnson and Finucane, 2000). The starting point for enquiry is a problem or challenge that is presented to a group of students as a 'real life' scenario. Groups are encouraged to be self-directed as they tackle the problem and tutors take on a facilitative role that allows students the freedom to learn independently (Harland, 2002).

The tutorial begins with the introduction of a problem to the group. The group then brainstorms to generate hypotheses about what underlies the presenting problem. The aim of giving such a problem is to allow the students to develop their hypotheses related with the problem. The first and the second meetings are devoted mainly to brainstorming and analysis of the problem presented in the beginning of the case and ends with a joint definition of learning issues (What do I need to know?) that will be studied in the coming period, usually 3 or 4 days. In the next group meeting, after the individual study, students report on what they found in the literature or other information sources (Ronteltap and Eurelings, 2002) . The third meeting allows the students to solve the problem and to draw the mechanism including the cause and effects within the given problem. Students work in small tutorial groups (8 students) under the guidance of a member of staff, who serves as the tutor. They discuss the problem, activate and discuss their prior knowledge, identify points that need clarification and formulate learning objectives. The sample problems that are created for the "Deck" and "Maritime Business Administration" departments are given below:

Problem 1: Deck Department

"M/V Bayraktar commenced her voyage at 02:30. At 02:45 after passing the Yenikale Narrow and leaving the watch to the 2nd. Mate the master left the bridge. At 03:00 second mate realized that the vibration increased and the vessel was not moving".

Problem 2: Maritime Business Administration Department

"Mete Erkan, the owner of Turkmar Shipping Co. which serving between Turkey and the Mediterranean countries, called his daughter Sema, who is a graduate of School of Maritime Business and Management and has been working for Turkmar for the last six months, and Hidayet Milli, who is the manager of Turkmar, for a meeting on January 2nd. At the meeting, Mr. Erkan stated that the company's profits are decreasing considerably".

3.5. Implementation

All the elements given in **Figure 2** are designed and timetabled so as to complement PBL in SMBM (See **Appendix I**). Module starts with the first PBL session and the students determine their learning objectives at the end of the session. Before coming to the next PBL session, students attend various activities such as laboratories, lectures etc. Independent learning and scientific counseling allow students to study the learning objectives.

3.6. Assessment

Assessment can be analyzed in two major groups; assessment of the students and assessment of the PBL system by the students. Assessment of the students is achieved at the end of every module and at the end of each academic year. In addition to that, tutors evaluate all students at the end of PBL session with respect to their contributions to the problem solving session. On the other hand, students give feedback both in oral and written forms in terms of the quality of the PBL sessions and the overall system including self-appraisal and evaluating the overall contribution and progress.

4. Conclusion

Rapid changes in the maritime industry have inevitably increased the need for qualified human resources. On the other hand, educational paradigms are rapidly changing and it is therefore critical for the success and development of maritime education and training that these changes are fully understood so that the decisions on how best to meet these changes are made in an informed way (Lewarn, 2002). Considering this fact, Dokuz Eylul University School of Maritime Business and Management (SMBM) has decided to transform its conventional curriculum to the problem based learning (PBL) curriculum in order the meet the expectations of rapidly changing maritime industry in terms of both "maritime business managers" and "deck officers".

It can be stated that students from PBL curricula regard the learning environment as more nurturing; they find the subject matter more relevant and challenging, and they enjoy the active learning process involved. Students in PBL curricula have also demonstrated greater psychosocial knowledge, better relational skills, and more humanistic attitudes when compared with non-PBL curricula students (Kaufman and Mann, 1999).

As far as the nature of maritime education is considered, PBL curriculum seems to contribute a lot to the quality of educational system. For example, simulation based education in maritime transport is considered as the best example of active learning (Teel, 1998; Teel 1999).

The overall results aimed through PBL seem to greatly comply with the expectations of the shipping industry for managers in general and the merchant fleet for deck officers in particular. The developments achieved through the problem based learning practices of the maritime education will not only help the improvements in the outcomes of the education systems in the industry, but this will also be a great contribution to educational practices in general due to the dynamic characteristics of the maritime industry.

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Appendix 1 - Dokuz Eylul University School of Maritime Business and Management, Module Sample Schedule

Week I

Time	Monday	Tuesday	Wednesday	Wednesday	Thursday	Thursday	Friday
0830 — 0915	PBL Session — 1	Lecture	Lecture		Lecture		PBL Session — 2
0930 — 1015		Lecture	Independent Learning		Professional Values and Ethics		
1030 — 1115		Professional Skills					
1130 — 1215		Communication Skills	Scientific Counseling		Computer Laboratory		
1215 — 1330							
1330 — 1515	Turkish Literacy Maritime English	Professional Skills Practical	Socio Cultural Activity 1230 -1400		Professional Skills	Computer Lab	Practical 1 Practical 2 Practical 3 Independent Learning
			1415 - 1545	Field Study Independent Learning Computer Laboratory Field Study	Independent Learning Practical	Computer Lab	
1530 — 1715	Turkish Literacy Maritime English	Professional Skills Practical Independent Learning	1600 - 1730	Field Study Independent Learning Computer Laboratory Field Study	Professional Skills Independent Learning	Computer Lab	Practical 1 Practical 2 Practical 3 Independent Learning
						Computer Lab	

Dokuz Eylul University School of Maritime Business and Management, Module Sample Schedule

Week I

<table>
<tr><th>Saat</th><th>Pazartesi</th><th>Salı</th><th colspan="2">ar_amba</th><th colspan="2">Per_embe</th><th>Cuma</th></tr>
<tr><td>0830 — 0915</td><td>Lecture</td><td>Lecture</td><td colspan="2" rowspan="4">PBL Session - 3</td><td colspan="2">Lecture</td><td rowspan="4">Assessment</td></tr>
<tr><td>0930 — 1015</td><td>Independent Learning</td><td>Lecture</td><td colspan="2" rowspan="2">Lecture Discussion Session</td></tr>
<tr><td>1030 — 1115</td><td>Physical Education</td><td>Professional Skills</td></tr>
<tr><td>1130 — 1215</td><td>Fine Arts</td><td>Communication Skills</td><td colspan="2">Computer Lab</td></tr>
<tr><td>1215 — 1330</td><td colspan="7"></td></tr>
<tr><td rowspan="2">1330 — 1515</td><td rowspan="2">Turkish Literacy
Maritime English</td><td rowspan="2">Professional Skills
Practical</td><td colspan="2">Socio Cultural Activity
1230 -1400</td><td rowspan="2">Computer Based Education</td><td>Computer Demonst.</td><td rowspan="4">Principles of Ataturk</td></tr>
<tr><td>1415 - 1545</td><td>Computer Based Education</td><td>Computer Demonst.</td></tr>
<tr><td rowspan="2">1530 — 1715</td><td rowspan="2">Turkish Literacy
Maritime English</td><td rowspan="2">Professional Skills
Practical</td><td rowspan="2">1600 - 1730</td><td rowspan="2">Computer Based Education</td><td rowspan="2">Computer Based Education</td><td>Computer Demonst.</td></tr>
<tr><td>Computer Demonst.</td></tr>
</table>

Session IIA — WG 2

Chair: Prof. Dr. G. de Melo Rodriguez

The Importance and Contributions of VTS Towards the Establishment of the Global Safety Management System for the Safety of Maritime Transportation
B. Sitki Ustaoglu, ITU Maritime Faculty
Masao Furusho, KUMM

A Ship-Based Approach to Determine the Effectiveness of VTS Systems in Reducing Vessel Accidents in Congested Waters
Ender Asyali
Dokuz Eylul University, School of Maritime Business and Management

The Ways of Enhancing the Safety of Navigation
A.S. Maltsev
Odessa State Maritime Academy (OSMA)

Development of Port State Control Officers Training Using Marine Simulators and Real Vessels (Entering Odessa Sea Port)
Capt. Dmytro Zhukov, Ph.D, Asst. Prof.
OSMA

THE IMPORTANCE and CONTRIBUTIONS of THE VTS TOWARDS THE ESTABLISHMENT of THE GLOBAL SAFETY MANAGEMENT SYSTEM for THE SAFETY of THE MARITIME TRANSPORTATION

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ABSTRACT

Although maritime transportation has a much longer history comparing to the air transportation because of the advantages induced various reasons of the air transportation recent technological and applicable developments are imported to the maritime transportation industry from the air transportation.

Shore based traffic control applied to the maritime transportation units —*inter alia* — is one of those despite the fact that there are certain differences on the application, legal bases etc. However the control of the maritime traffic from shore tends to increase world wide although there are considerable variations on the legal, technical and form of application bases from one authority to another unlikely to those observed in the air transportation industry.
The authors argue that the VTS applications are invaluable aids for the safe navigation and consequently for the safety of the maritime transportation if they are properly manned and operated without doubt. However to enhance safety traffic conditions at sea and consequently minimize the risks threaten the maritime transportation some advanced applications can be carried out on the shore based maritime traffic control.

1. Introduction

Despite considerable developments on technology and safety measures, in parallel to the safety and effectiveness of marine transport are still a matter of serious concern on the global basis. Particularly by pressure of economic imperatives the increase of size and speed of the commercial ships has been observed as one of the most efficacious factors. Some of the other factors such as decrease of quality of the seafarers, increase of the total world merchant fleet and consequently the increase of marine traffic density, etc. In addition to these process in commercial maritime transportation sector recent decades have been the period of important diversification of marine activities as well. With the new innovation on the underwater technology, exploration of petroleum products and other mining of mineral resources from the sea bed, installation and maintenance of pipelines, underwater cabling activities and similar construction work have been carried out in an inclining tendency (Degre, 1995). All of these are important factors that are increasing the casualty risk in all navigable waters and apparently in confined waterways or port approaches in particular.

On the other hand, since the size of the cargo vessels have extremely enlarged in particularly those that are carrying dangerous or hazardous cargo in bulk or other forms of transport the threat for the marine environment has become at an unacceptable level. Therefore besides some serious measures taken by international or regional basis in multilateral or unilateral norms in the form of international conventions or amendments to the existing conventions, agreements, memorandum of understandings or acts; control and monitoring of marine traffic techniques were developed and founded in areas where the traffic concentration is higher such as port approaches, natural channels, straits or other places where the deep see and local traffic are met.

1970s are the years that Vessel Traffic Services (VTS) had become a common element in major ports or waterways throughout the world. However although some countries stop running some of the systems due to budget problems later on it is observed that afterwards the severe oil pollution incidents as a consequence of the recent casualties these countries established more sophisticated VTS around their coasts. New York VTS and New Orleans VTS can be given as a sample of this case. New York VTS was commissioned in 1978, became fully operational in 1985 and closed in 1988 due to budget constraints however reopened in 1990. Similarly, New Orleans VTS was commissioned in 1977 and closed in 1988 due to same grounds (Babu and Ketkar, 1996). New Orleans VTS was also decided to be reopened in late 90s and was under construction when one of the co-authors of this paper had visited it in 1999.

1.1. Overview of the VTS Developments

Although it is known that some form of traffic control has existed since sixth century in Grand Canal in China, first radar set installed in the Port of Liverpool especially to assist pilot cutters in restricted visibility in 1948 which is admitted as the pioneer of the modern VTS. This was followed by Long Beach, California after one year with installation of VHF radio set in 1951 (Satow, 1990). In same period Halifax and Le Havre were the other ports carried out similar trials (Hughes, 2000) followed by Rotterdam in 1956. Then shore based radar chains became a common tool in most other major European and North American ports and harbors in 1960s followed by Japan in early 1970s.

Nowadays one form of VTS is all around the globe despite the fact that there is no determined standards. These services can be seen in all continents and most of the littoral countries. Some of these are China, Egypt, Hong Kong, South Africa, all European countries including those of Baltic Sea, Atlantic and Mediterranean littorals, most of Mediterranean countries, countries around the Arab Peninsula, some of the Black Sea littorals such as Romania, Ukraine. Only In the United States of America there are as many as 23 operational VTS areas (Babu and Ketkar, 1996). 12 in Canada (Martin and Bushell, 2000) and 20 in China (Gonchen and others, 2000).

1.2. Functions of the VTS

VTS is defined in the IMO guidelines[1] as ... is a service implemented by a Competent Authority, designed to improve the safety and efficiency of vessel traffic and to protect the environment. The service should have the capability to interact with the traffic and to respond to traffic situations developing in the VTS area . As it is mentioned in the definition, VTS is a service rather than a system. However the service may be given through a well organized system.

Having considered the definition it is clearly deduced that a VTS service should comprise at least an information service. Nevertheless it may also include other functions such as navigational assistance or traffic organization or a combination of both. In other words; it may range from the provision of simple information messages to extensive management of traffic within a port or waterway.

One of the services provided by a VTS is information service. Information service is the case that VTS is enabling essential or necessary information provided to the users i.e. those on-board subject to make navigational decision. Second service provided by a VTS is navigational assistance. Navigational assistance is a higher level service comparing the previous one and it is the case that VTS is involving decision making process regarding the ship s navigation and providing navigational advice to those on-board and consequently monitor its effects. Other service provided by VTS is traffic organization service. Traffic organization is a service to prevent the development of dangerous maritime traffic situations of an early stage and in fact it regulates the traffic within the VTS area.

One might think that these all three functions are resembling and in practice very much similar. Certainly it is not the case. There are serious differences on the legal and liability basis and the competent authorities as well VTS authorities must be very careful when planning a new VTS or carrying out the service.

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[1] Resolution A. 857(20) Adopted on 27 November 1997.

However regardless of the type of service provided the common achievements of a successful VTS in general terms can be summarized as follows:

- Improvement of Safety of Traffic; by foresighted prevention of situations of likely to be endangering either the vessel concerned or any other encounters in the vicinity or the environment. This capability very much depends on the quality of the service provided which has direct link with the quality of all of the components of the VTS. The VTS components or the basic elements of the system can be categorized as four; hardware, staff, training and procedures(Kop, 1990) or in another categorization was made considering the training and staff in one category and hence; people, hardware and procedures(Wiersma and others, 2000). Thereby safer traffic flow can be achieved through the service provided either as an information service, traffic organization service or navigational assistance service or combination of them. In addition to that VTS can supply a supporting service to all allied services and other interested parties by exchanging information, using common databases and making action agreements.[2] On the other hand, in case of an unexpected emergency situation such as a casualty (e.g. collision or stranding) by organizing the other traffic in a confined waterway the an exacerbated situation can be avoided.
- Improvement of Efficiency of Traffic; by achieving an appropriate planning and execution delays can be avoided and optimum traffic flow can be obtained. This capability also depends on the quality of the VTS elements as well as VTS objectives. Similarly through the service provided this benefit can be shared by the service providers, allied services and the users.
- Improvement of Safety of Environment; by achieving safer navigable waters VTS does serve to reduce the environmental risks simultaneously in fact. Nevertheless, there are some other facilities provided by the VTS for the environmental protection in the following areas:

§ Optimized traffic flow and additional navigational assistance (if provided) for ships carrying dangerous and/or noxious cargo can decrease the possibility of casualties involved these type of vessels,

§ Providing prompt information to the competent authorities about movements of ships carrying hazardous/dangerous/noxious cargo onboard hence enabling them check the further planning i.e. port control or others if necessary,

§ In case of emergency of a pollution incident early detection can be performed and co-operation can be done with the emergency clean-up services and other official bodies. Consequently by regulating the traffic further problems can be prevented in advance.

§ By continuous monitoring illegal and deliberate spills and other source of pollution events can be prevented.

2. Various Types of Vessel Traffic Services and Their Comparisons: What s In A Name?

Definition of the VTS was given above as quoted from IMO VTS Guidelines. However, there are dozens of Vessel Traffic Services around globe and almost as many names as the number of the services one observes. In the previous paragraph common benefits of the Vessel Traffic Services were discussed. Then, what would be the difference of the VTS and VTIS or VTMIS?

Before going into details of above mentioned technical words regarding the services provided by the VTS authority, VTS as a base, fundamental wording embracing all types of these services should be categorized in terms of geographical location of where it is based. This categorization can be named as main type which is divided into three; coastal, estuarial and Harbor (Hughes, 2000). As a matter of fact these main categories are one of the most effective specifying factors for a competent authority to decide what type of VTS that the authority should establish. For instance, coastal type VTS is usually used for surveillance purposes established in sensitive areas to make sure the vessels passing through are complying with the traffic separation schemes. English Channel VTS, Morocco (Strait of Gibraltar) VTS and Turkish Straits VTS (still under construction) can be given as sample of coastal VTS. Great Belt VTS, two different VTSs one of which run by Swedish Administration where the other by Danish Administration in the Flint Channel area are other examples of coastal surveillance. It can be stated that major objective of the coastal VTS is safety of maritime traffic and protection of the marine environment. Traffic efficiency may or may not be of major concern.

Estuarial type VTS is usually found in rivers or estuaries and carry out its duties to ensure safe transit of marine traffic in the area concerned. Since these areas are usually on the approaches of ports performing the optimum and efficient traffic organization to achieve maximum possible traffic flow provided that the safety conditions observed

[2] IALA VTS Manual, 1993 Edition.

are among the objectives of the VTS as well as providing safer navigational conditions and better environmental protection.

Harbor type VTS is for vessels entering or leaving the port. Main concern is usually traffic efficiency despite other important factors are also aimed. Port of Dover or Portsmouth are examples for harbor type VTS (Hughes, 2000).

It can be stated that despite the relatively long history, VTS has come upon maritime sector in a rather *ad hoc* way. Since the VTS developed step by step rather in a scattered way all over depending on the individual trials in a number of different ports or out of traffic separation scheme neither training standards nor legal framework could have been set up. However it is on the contrary, in air transportation sector Air Traffic Control (ATC) was formulated as part of the overall development of a specific transportation and then easily set up necessary legal terms in a widely accepted international convention[3](Gold, 1990). In other words, maritime transportation is always under influence of long historical and traditional background therefore implementation of changes — no matter how good they are — takes considerable time. VTS is a typical case ofhis phenomena.

Apart from early applications despite the fact that Vessel Traffic Services have been existing quite a number of different regions and/or different countries since early 1960 first action by the IMO was carried out in 1968 when Resolution A.158(ESIV) was adopted (Kop, 1990). This was followed by 1985 IMO VTS Guidelines[4] and an updated version Guidelines in 1997[5]. However there are still no common standards on many aspects on VTS applications. Today, one can observe different names for various VTS applications around the world which some of them giving the same service. Vessel Traffic Service (VTS) is the only acronym that has been officially defined by the IMO. However one can see various acronyms such as Vessel Traffic Information Services/System (VTIS), Vessel Traffic Management Services/System (VTMS), Vessel Traffic Management and Information Services/System (VTMIS), Vessel Traffic Control (VTC), Marine Traffic Control (MTC). Although there are some functional differences between these services, these are mainly due to the political regime of the VTS area or capability of VTS elements, aims and objectives of the Competent Authority etc. For instance; There are 12 high level VTS centers in operation covering 14 zones (Vancouver, Tofino, Prince Rupert, Sarnia, Montreal, Quebec, Les Escoumins, Saint John, Halifax, Placentia Bay, Port-aux-Basques and St. John s) and the major impetus for the creation of Canadian VTS systems is declared as Oil spills and the threat of oil spills (Martin and Bushell, 2000). On the other hand another example is Hong Kong VTS, which was installed in 1989 and the main objective was handling the busy vessel traffic in an efficient way. The other major functions are facilitate the safe and expeditious execution of port calls of commercial vessels, maintenance of port call records, automation of related invoicing procedures and supply of information to pilots, government agencies, port users and the general public (Fan and Pang 2000).

It may be observed that despite the fact that the first generation of Vessel Traffic Services were rather found for optimizing the traffic flow or in other words economy dominated where the recent VTS types were established rather for environmental protection. And this is natural considering the recent environmental campaigns and increase of public concern for the environment.

3. Expectations From VTS Towards the Future

Although there are some scanty applications in particular on legal basis there is no doubt that Vessel Traffic Services will play more pro-active role on the maritime transportation in near future. Automatic Identification System(AIS) as a VTS tool will significantly increase the VTS capability. It can obviously be stated that the AIS implementation will open a new era on the VTS history. One might even question whether shore based pilotage would be possible through VTS by having the AIS facilities. However since this debate is completely out of the coverage of this paper therefore it would be better to leave this question for a further discussion.

IAS will provide (transmit) three message types which will be transmitted over VHF/FM maritime radio bands. These message types are (Harre, 2000):

§ Static Messages; IMO number, call sign and name, length and beam, type, location of the position fixing antenna on the ship.

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[3] Chicago Convention on International Civil Aviation, 1944 and relevant protocols.

[4] Resolution A.578(14).

[5] Resolution A.857(20).

- § Dynamic Messages; ship s position with accuracy indication and integrity status, time course over ground, speed over ground, heading, rate of turn, navigational status, angels of heel, pitch and roll (optional),
- § Voyage related messages; ship s draught, hazardous cargo type, destination and estimated time of arrival (at master s discretion) and route plan in form of way points.

The authors of this paper support the general concept on shore based surveillance services and pilotage services. Pilotage and shore based surveillance services are two main real time information and assistance to the shipmaster nowadays combining each other can not be considered as an alternative to one another. Having long historical background and tradition pilotage is still the first priority navigational assistance to the shipmaster having considered the special circumstances of the ship maneuvering characteristics. And this is a commonly admitted principle of ultimate decision regarding the ship maneuvering should remain with those on board i.e. master or pilot . In fact VTS is mainly a support service to provide information (or sometimes advice/assistance) for those on board who are not able to have the overall picture and an additional watch-eyes to ensure that everything is going on well in a sensitive area.

VTS will play more important role for the overall safety measures not only in a regional geographical area but also in the globe by sharing data obtained by each regional/local VTS between the regional systems. This concept has been considering throughout some international (particularly European) projects since as early as late 1980s[6]. Over the past decade much research work has been carried out by the European Commission with respect to vessel traffic services. Throughout these projects it became evident that information available to VTS could be used for further application. This could be shipping agents, Port State Control bodies, security units, other official bodies or commercial enterprises or basically all parties concerned with maritime transport management. This concept was Regional Vessel Traffic Services (RVTS). In 1995 a number of projects were initiated relating with the VTS including two large projects. One of them named COMFORTABLE concerned with the development of new tools for VTS use to help operators recognize and assess traffic situations. The other was POSEIDON concerned with integrated VTS, monitoring of sea environment and inter-active data on-line networks. The latter one has significant importance and is subject to play serious pro-active role for the global safety measures in case it is enlarged to embrace more global geography.

Within the EU Maritime Safety Policies recently in particularly afterwards of the Erika casualty in the North Brittany Costs of France in 1999 EP was decided to strength the safety measures for both own flag vessels as well as for foreign flag vessels. Among others the issues on telematics applications for transport in Europe. A part of a global telematics system for trans-European transport networks; some important maritime issues were included and traffic control/management and information centers were emphasized.

When these new policies realized it will obviously be a new era on the global safety measures with the support of AIS in shipping. AIS is being considered not only for short range data transfer but also for long range data transfer. Therefore it can be used as a tool for not only data transfer to the vessels in the vicinity (VHF range) as well as to the VTS. It is a tool which can be used for global ship monitoring as a long range transciever either will be work on Inmarsat-C or MF/HF DSC radio[7].

4. Conclusion

As it was deduced from the recent projects carried out in the European Community and the new technologies just integrated to the communication systems of the mobile units in the International Maritime Transportation VTS concept is fronting completely a new era. However, the idea of Traffic Control, Management and Information Network should amplified in such that it will embrace all compatible Vessel Traffic Services. This is will be a Global VTS network which can possibly facilitate all functions listed below:

- § There will be a united memorandum of understanding (MOU) combining all regional MOUs and enabling them act in a concordant manner. And by doing so, all Ports State Control activities will be able to standardized, supportive to each other,
- § A global oil pollution monitoring system will be established. Thereby not only regional protection but also a global marine environment protection will be enabled,

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[6] Cost-301 Project; European Concerted Action on Shore-based Maritime Navigation Aids Sytems.

[7] Guidelines for installation of shipborne AIS.

- This process will improve the security measures which became a major concern for some of the countries afterwards the inauspicious event of September 11th of last year,
- It will enable a global monitoring facility for observing the rogue vessels those who do not comply with the COLREG not only in areas under a specific VTS coverage but also in wider navigable area.
- Support Search and Rescue organizations and SAR activities,
- Support maritime Security Guards against illegal activities such as smuggling, piracy etc.
- Enabling advanced planning for port managers,
- Enabling advanced planning for traffic controllers/managers (VTS) etc.,

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A Ship Based Approach to Determine the Effectiveness of VTS Systems in Reducing Vessel Accidents in Congested Waters

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ABSTRACT

Safety has become a major issue in maritime community as the adverse effects of increased marine transportation have become a serious problem especially at congested waters like narrow straits, ports and port approaches. As a precaution, shore-based centers called VTS, have been used widely in these water bodies for monitoring, controlling, and directing the vessel traffic and also collecting and disseminating information about the traffic situation and navigational hazards. In this study the author explains the effectiveness of VTS systems in reducing vessel accidents by using the experiences and the perceptions of the mariners who had direct experiences on these systems as user. The maximum benefit to be obtained through the introduction of a VTS system was estimated by using the causal factors of accidents as a starting point on collisions and groundings. Also the results of this study have been compared with the studies that were done on this subject by different institutions and at different levels.

1- Introduction

In March 1967 the tanker Torrey Canyon ran aground off the South—West coast of England spilling 120.000 tons of oil into the sea. This disaster and clean-up costs along the coast totaled 2 million pound. For the first time general public were made aware of the danger that the maritime traffic posed to the environment and this accident promoted investigations into how such damage could be avoided in the future.

Before the 60 s the marine casualties affect a limited group of people such as ship and cargo owners, insurance companies and the crew but as result of technological developments in ship building sector, the demand for large ships and explosive and noxious cargoes which are carried, vessel casualties began to affect great communities, large areas and long periods.

The adverse effect of marine transportation becomes a serious problem especially at congested waters like narrow straits, ports and port approaches where the limited water bodies are used by great number of users for different purposes. Beside conventional waterway management tools, shore-based navigation support systems have been used widely in these water bodies for monitoring, controlling and directing the vessel traffic in these water bodies for more than 2 decades.

William O'Neil, Secretary-General, IMO stated in one of his speech that the principle of control had been accepted in all other modes of transport and there is no need for not extending it to shipping when safety would be enhanced . This statement is of great importance for the changing future of marine navigation. Masters and the officers may share their commanding authority with the shore-based centers for enhancing safety of navigation especially on coastal waters, ports and ports approaches, as it is at aviation. So the effectiveness limits of VTS systems and the factors effecting the VTS effectiveness must be identified and the mechanisms which will enhance the co-operation between ship and VTC must be developed.

2. VTS Definition and Legislative Background

Vessel Traffic Services (VTS) are the assortment of personnel, procedures, equipment, and regulations assembled for the purpose of traffic management in a given body of water. A VTS includes some means of area surveillance, traffic separation, vessel movement reporting, a traffic center, and enforcement capability. These functions are not dissimilar to the advanced air traffic control and management systems.

Although it was first introduced in 1948 at the port of Liverpool, the value of VTS in navigational safety was first recognized by IMO in Resolution A.158 (ES.IV), Recommendation on Port Advisory Systems adopted in 1968, but as technology advanced and the equipment to track and monitor shipping traffic became more sophisticated, new guidelines were needed on standardizing procedures in setting up VTS. As a result in 1985 IMO, adopted Resolution A.578 (14), Guidelines for Vessel Traffic Services which said that VTS was particularly appropriate in the approaches and access channels of a port and in areas having high traffic density, movement of noxious or dangerous cargoes, navigation difficulties, narrow channels or environmental sensitivity.

Revised Guidelines for Vessel Traffic Services, including Guidelines on Recruitment, Qualification and Training of VTS Operators , were adopted as Assembly resolution A.857 (20) in November 1997.These guidelines are associated with SOLAS Regulation V/8-2. In June 1997 IMO Maritime Safety Committee adopted a new regulation 8-2 to Chapter V — Safety of Navigation- which sets out when VTS can be implemented.The regulation states that VTS contribute to the safety of life at sea, safety and efficiency of navigation and the protection of the marine environment, adjacent shore areas, worksites and offshore installations from possible adverse effects of maritime traffic. Governments may establish VTS when, in their opinion, the volume of traffic or the degree of risk justifies such services . The new SOLAS regulation also states that; contracting governments planning and implementing VTS shall, wherever possible, follow the guidelines developed by the organization. The use of a VTS may only be mandatory in sea areas within the territorial seas of a coastal states.

According to official definition of VTS at IMO Resolution A.857(20), Vessel Traffic Service (VTS) is a service implemented by a competent authority, designed to improve the safety and efficiency of vessel traffic and to protect the environment. The service should have the capability to interact with the traffic and to respond to traffic situations developing in the VTS area[1] . interaction with the traffic and to respond to traffic situation are the goals of VTS that make it different from all other vessel traffic management tools. The term competent authority used in the definition is; the authority made responsible, in whole or in part, by the government for safety, including environment safety and efficiency of vessel traffic and the protection of the environment [2]. It is very important to mention the difference between the terms VTS authority and competent authority VTS authority is the authority with responsibility for the management, operation and coordination of the VTS, interaction with participating vessels and the safe and effective provision of the service [3]. Service area of the VTS should be delineated and formally declared and this VTS area may be subdivided in sub-areas or sectors.

The surface picture of vessels and their movements in a VTS area -VTS Traffic image-, is created at the center where VTS is operated -VTS center- by appropriately qualified persons performing one or more tasks contributing to the services of the VTS -VTS operator-.

The approach to VTS operations differ from country to country and also from authority to authority that is responsible for management, operation and coordination of the VTS. For instance in Europe, primary purpose for VTS operations is to increase the throughput of port facilities. Maritime safety and environmental protection are secondary benefits. The driving force of these systems has been the need to improve efficiency in order to compete with other national ports and, ultimately more important, with those in the country or countries next door. In the USA and Canada installation of VTS is motivated primarily by safety objectives as the majority of them are managed by coast guard and other public utilities (Moore,1997).

2.1 VTS Services

As a service provider, VTS should comprise at least an information service and may also include a navigational assistance or traffic organization service or any other coordination with allied services,

The Information Service; is provided by broadcasting information at fixed times and intervals or when deemed necessary by the VTS or at the request of a vessel by predetermined declared VHF channels and may include for example reports on the position, identity and intentions of other traffic; waterway conditions; weather; hazards; or any other factors that may influence the vessel's transit.

The Navigational Assistance Service is especially important in difficult navigational and or meteorological circumstances or in case of defects or deficiencies. This service is normally rendered at the request of a vessel or by the VTS when deemed necessary [4].

The traffic organization service concerns the operational management of traffic and the forward planning of vessel movements to prevent congestion and dangerous situations, and is particularly relevant in times of high traffic density or when the movement of special transports may affect the flow of other traffic. The service may also include establishing and operating a system of traffic clearances or VTS sailing plans or both in relation to priority of movements, allocation of space, mandatory reporting of movements in the VTS area, routes to be followed, speed limits to be observed or other appropriate measures which are considered necessary by the VTS authority 5. Also VTS makes cooperations with the allied services which are actively involved in the safe, secure and efficient passage of the vessels through the VTS area. An overall summary of basic and co-operatve VTS services are shown in table 1.

Table 1: Basic and Co-Operative VTS Services

Basic VTS services				**Co-operative services**		
Information	**Navigational assistance**	**Traffic organization**	**Regulatory**	**Emergency**	**Transport-oriented**	**Support**
Traffic information	Position and movement info on own vessel	Establishment and operation of a scheme of routes	Law enforcement	Search & Rescue	Port operations	Pilot management
Meteo. Information	Identities and movement info on other vessels	Establishment and operation of a reporting system	HAZMAT	Environment monitoring	Terminal management	Tug management
Fairway conditions	Warnings to individual vessels	Allocation of maneuvering space	Port state control	Pollution fighting	Intermodal transport chain	
Hydrographic Information	Shore-based pilotage	Forward planning of movements	Customs	Fire Fighting	Ship operators	
NAVTEX		Assignment of sailing plans to individual vessels	Marine police	Civil Protection		
		Enforcement of traffic rules	Immigration			
			Port and coast security			
			Health control			

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3. VTS Effectiveness

VTS systems have been variously defined and existed in a number of configurations. Their basic objective is to provide information and advice on other traffic and navigational hazards for ships. It is a system designed to decrease uncertainty and to increase the situational awareness of the bridge team. The expected effectiveness that VTS systems could have in reducing vessel casualties and associated dangers are determined in this study. The weight average effectiveness level for major causal factors of groundings and collisions were defined which reflected the estimated reduction in vessel casualties that could be expected to occur with the introduction of VTS systems. An acceptable analytical method has yet to be developed for fully measuring the effectiveness of VTS systems relative to all the factors that affect operational risk. Further more VTS performance data from which effectiveness might be assessed are limited. Nevertheless major port needs and VTS studies, accident investigations and limited near-miss documentation demonstrate that substantial benefits can be achieved through VTS operations (NRC,1994).There are 3 potential alternative techniques for estimation of the VTS effectiveness. These are,

1- Statistical analysis of casualties in situations with and without a VTS.

In this method the effects on casualties before and after a change to VTS are examined. It can have limitations, particularly if the traffic demand characteristics change during the period (Fabre et al,1988) and this method can be possible only if a significant number of casualties occur before and after, and if no other factors change in the meantime (NRC,1994). So this method needs long period of statistical casualty observations. Also statistics must be accurate and well prepared to reach reliable results.

2- Simulation of a VTS system.
Simulation is creation of an analogy or likeness of a real—world phenomenon and is widely used in maritime education and training but its effectiveness for defining the VTS systems is not accurate. This method includes the use of full mission bridge simulators coupled with a simulation of a VTS center as well as various forms of a mathematical simulation. (Maio et al,1991)

3- Synthesis of expert opinions.
This is a widely used method to develop VTS effectiveness estimates. The opinions of experienced mariners and/or VTS operators are collected and then analyzed (Fabre et al,1988).Focus groups and/or questionnaire techniques are generally used for data collection.

3.1 Literature Related to VTS Effectiveness

There is a large VTS related literature concerning its history, organization and functions, authority in which control of VTS is vested, VTS legislation, equipment and capital projects, staffing, training and qualification for personnel, advanced technologies and the future of VTS but the literature is very limited for the effectiveness of VTS systems. Major studies related to this subject are mentioned below.

1- COST 301:The COST 301 project was a program established by the European Community (European Union) in the early 1980 s to asses the risk to marine traffic in European waters and to promote safety through shore-based navigation aids including VTS systems. Opinions of experienced mariners and VTS operators were collected by a questionnaire. The maximum benefit to be obtained through the introduction of a VTS system is 60 percent on collisions and the maximum benefit which is likely to be obtained through the introduction of any VTS system is estimated to be 55 percent on groundings.

2- National Vessel Traffic Service Study, Canadian Coast Guard, 1984: This study, performed to asses the benefits and costs of the Canadian VTS, is one of the primary documents specifically addressing the effectiveness of VTS. The study focused on developing effectiveness measures for four different waterway configurations and a number of alternative VTS systems configurations. VTS effectiveness was estimated to range from 15 to 70 percent. The study found that the casualty rate reduction factor for a radar surveillance VTS with automatic track analysis would be expected to range between 0.50 and 0.70 depending on the type of waters. The average VTS effectiveness was estimated to be 43.3 percent. Estimates of VTS effectiveness were developed using the knowledge and experience of a team of personnel with marine related background. These persons included former mariners, VTS regulators and consultants, as well as Canadian Coast Guard management.

3- Vessel Traffic Systems, Analysis of Port Needs, USCG,1973: The purpose of this study was to rank 23 ports of U.S. in order of their VTS needs using a cost—benefit algorithm. The estimated reduction in vessel accidents was found 30 to 32 percent for a mix of collisions, rammings and groundings and collisions alone 60 to 65 percent.

4- Dover Strait Research, 1978: In this study the annual rate of collisions was used to measure variations in the level of safety. After the introduction of Channel Navigation Information Service there was a 54.7 percent reduction in the number of collisions.

5- Safety Assessment of Waterway Network in Tokyo Bay Area,1990: The time trend of the number of traffic accidents in the Tokyo Bay was studied to evaluate the effectiveness of the Tokyo Bay Traffic Advisory Center. The percentage reduction in accidents due to the VTS was found to be 52 percent.

6- Port Needs Study, USCG, 1991:This study was performed by USCG to determine the benefits and costs of potential U.S.C.G. vessel traffic services in selected U.S. deep water ports on the Atlantic, Gulf and Pacific

Coasts. Casualty rate reduction factor for collisions was found to range between 0.52 and 0.68 and for grounding between 0.25 and 0.46

4. Methodology

In this study Synthesis of expert opinion method was used to estimate VTS effectiveness at congested waters. Questionnaire technique was used for collecting data about the perceptions of officers and masters who have direct experience on these systems as users. A non-probability convenience sampling method was used during the sampling process. The questionnaire was applied to respondents at a terminal on the south coast of Turkey, Pilot Associations in Izmir and Istanbul and maritime education institutions. It was aimed to reach respondents from different nations having oceangoing licenses. 150 questionnaire were prepared and total 61 replies were received in two months period. The questionnaire was designed within two stage and these stages will be discussed at next section.

5. Findings

Respondents were from 9 different nations including Turkey, India, Pakistan, Greece, France, U.S.A., Norway, Romania; 48 % of the respondents have ocean going master, 19.7 % of them have oceangiong chief officer license; 87 % of them have sea experience more than 6 years; 70 % of them are at an age of 30 and above; 70 % of them were active on board, 15 % of them were maritime lecturer with sea experience and 13 % of them were pilot.

The study was performed at the two stages. At the first stage, ten major casual factors of two major accident types at sea were chosen. In general more than 80 percent of major vessel accidents are collisions and grounding (including stranding). Collision involve physical contact between two or more vessels, where there is an interactive decision making process for the vessels concerned and groundings involve the crossing of the boundaries of navigable space by the ship concerned, therefore, the decision process only for that ship, were chosen as accident types. Respondents were asked to rank the role of casual factors of casualties with regard to their experiences and perceptions from 1 (min) to 5 (max). And results were shown as Casualty Effect Level (C.E.L) in the table 1and 2.

Casual factors of groundigs and collisions

1- Hydrographique features : current, tide etc.
2- Meteorological features: fog, wind, rain etc.
3- Geographic conditions: narrow, shallow etc.
4- Traffic intensity
5- Crew conditions: motivation, training etc.
6- Non-compliance with COLREG
7- Defective ship
8- Commercial pressure on the crew
9- Beyond human control
10- Insufficient infrastructure of the waterway

At the second stage, respondents were asked to rank from 1 (min) to 3 (max) the role of Vessel Traffic Services (VTS) on preventing the marine accidents which are caused by the factors listed above. These values were called VTS Effect Level (VTSEL). And these two sources of data were analyzed together and the weighted average of VTS Effectiveness Factor (WEF) was found for both collisions and groundings for each casual factor (see table 1 and 2). At the end of the analysis the maximum benefit which is likely to be obtained through the introduction of any VTS system is estimated to be 51.7 percent on collisions and 52.7 percent on groundings. The results were found to be parallel with the studies that were done by different institutions and at different levels. Term VTS Addressable Casualties and factors effecting the VTS effectiveness are described according to the results of this study at the next sections. The results of the researches related to VTS effectiveness are also shown in table 4.

Table 2. VTS Effectiveness on Collisions

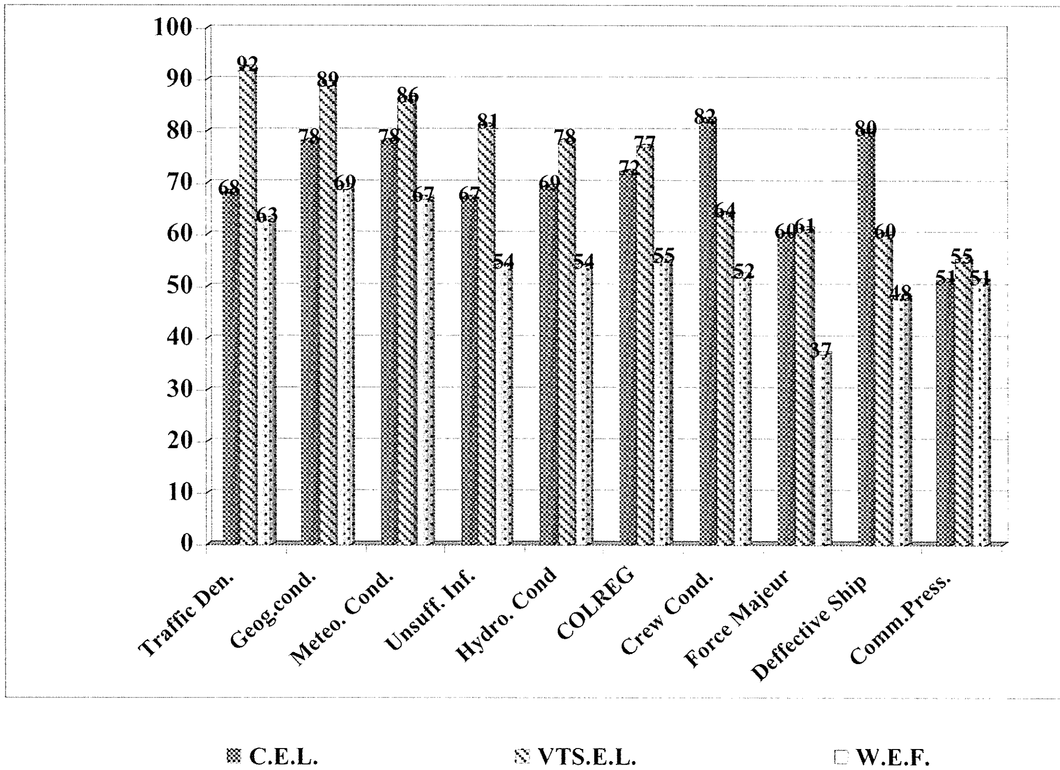
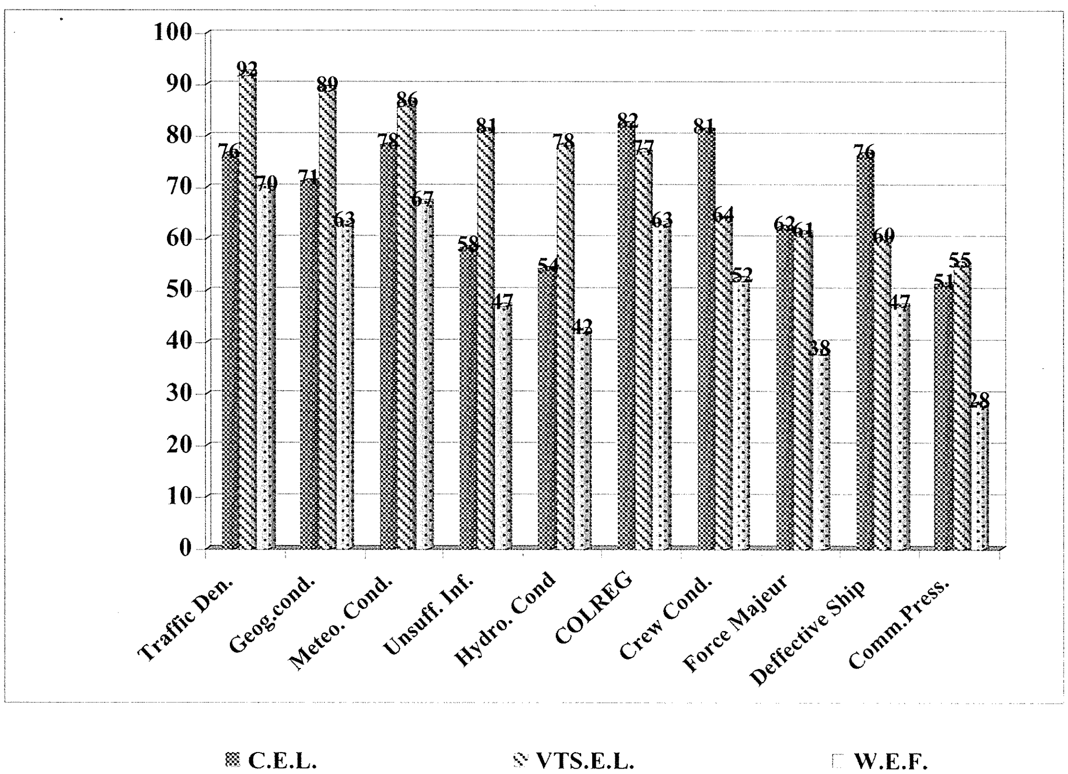


Table 3.VTS Effectiveness on Groundings



5.1 VTS Addressable Casualties

VTS addressable casualties are the ones that may be prevented directly or indirectly by a VTS system. For instance; open water collisions between two vessels caused by surprise, poor visibility, severe weather, or simple miscalculation on the bridge; certain overtaking situations; casualties at dredging operations or at similar work activities in a waterway; some casualties involving vessels at anchorage; casualties caused by traffic density, geographic (narrow, shallow etc) and meteorological conditions (fog, wind, rain etc), hydrographic features (current, tide etc), and insufficient infrastructure.

Also there are some incidents where effectiveness of VTS systems are limited. Incidents which are not addressable by VTS include mechanical and technical failures, fire or explosion, non-participating vessels (i.e., fishing vessels or other vessels less than 20 meters in length), casualties outside of the VTS range of surveillance, groundings or collisions in close quarter situations such as docking, undocking, maneuvering in crowded anchorage, incidents which occur with insufficient warning or lead time. Also it was found that VTS systems have limited effectiveness in reducing the accidents caused by human error and commercial pressure.

5.2 Factors Effecting the VTS Effectiveness

During the research and the literature survey it was found that effectiveness of VTS systems depends on many factors. These factors can be classified as follow;

1- Type of encounter: Meeting, crossing, overtaking
2- Technological level of VTS system
3- Waterway types: Open sea, open approach, convergence area, open harbor or bay, enclosed harbor constricted waterway, river, or open waters and confined waters
4- Traffic pattern: Simple ,complex
5- Dynamic changes in VTS area: Varying port volume, types of cargo, regulatory actions, improvements in the harbor, improvement accident reporting accuracy
6- Accident types: Collision, grounding, ramming
7- Types of services to be provided : Information, navigational assistance, traffic organization
8- Density and the character of the traffic: Local, transit traffic
9- Participation type and level : Voluntary, mandatory
10- Competency of VTS operators

Table 4. Results of the Researches Related to VTS Effectiveness

Related Studies	Methodology		Results (VTS Effectiveness Factor) (%)		
	With and without VTS analysis	Synthesis of expert opinions	Collision	Grounding	General
COST 301 Project		X	60	55	**55-60**
Canadian Coast Guard Research		X	-	-	**50-70** [1]
USCG (1973) Study		X	60-65		**30-32** [2]
Dover Strait Research	X		54.7	-	**54.7** [3]
USCG (1991) Study		X	52-68	25-46	**36-60**
Safety Assessment of Waterway Network in Tokyo Bay Area	X		-	-	**52**[1]
Ender Asyali (2001)		X	52	53	**52-53**

Note: Values are for advanced VTS systems active at congested waters
(1) Casualty types were not examined
(2) Total factor for collisions, groundings and rammings
(3) Only collisions were examined

6. Conclusions and Recommendations

VTS systems will play a more active role for enhancing navigational safety in the close future. The level of cooperation between the bridge team and the VTS operators will determine the effectiveness of these systems. Both the quality of ship s crews and that of VTS operators limit the effectiveness of VTS operations.VTS authorities should be aware that well-trained VTS operators may have a positive effect on the quality of participation by ship in VTS. VTS systems have limited effect in reducing the accidents caused by mechanical and technical failures on board, human factors, non-complience to COLREG, and also commercial pressure on the crew.Also when we consider the related VTS studies, the effectiveness varies in large ranges depending on many factors related to waterway types, traffic pattern, participation conditions and technological level.But in general overall accident reduction rate expected to range between 0.50 and 0.60 depending on the factors mentioned above. The effectiveness of shore based systems in offsetting human errors such as those found in collisions and groundings is limited. The results of this study give an overall idea about the VTS effectiveness in general and can be used to evaluate the effectiveness of an existing VTS and a planned VTS and to make a cost and benefit analysis for VTS projects. But to gain precious results for a special VTS area, an on-field study must be performed. Such information can be useful in determining how VTS could be improved for existing systems.

Endnotes

1 VTS Guidelines A.857(20) (article.1.1.1)
2 VTS Guidelines A.857(20) (article 1.1.2)
3 VTS Guidelines A.857(20) (article 1.1.3)
4 VTS Guidelines A.857(20) (article 2.3.2)
5 VTS Guidelines A.857(20) (article 2.3.3)

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The ways of enhancing the safety of navigation.

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ABSTRACT

The shift of priorities in fitting out the bridge is the most characteristic feature of modern navigation. Ship's position determination by means of satellite systems is prevailing nowadays. The current developments negatively influenced the navigator. He stopped using the classical methods of navigation. Besides some problems have arisen finding no solutions by now. The following problems are worthy of special attention: pilotage, sharing the responsibility between the master and the pilot; manoeuvring characteristics of the vessel and taking them into account when planning a manoeuvre.

Pilotage diminishes the risk of navigating accidents. It is evident that the desirable solution of the problem is the division of responsibilities between the pilot and master, and giving their relations a legislative form of a pilotage contract where the obligations and responsibilities of both parties are to be clearly defined. The conflict between the master and the pilot arise on the ground of absence of the clear division of their roles, functions in the ship advancement control system.

The existing nowadays situation in the issue of ship's manoeuvring characteristic data provision does not comply with the modern requirements to the safety of navigation warrants. The necessity of the manoeuvre preliminary planning is declared theoretically to be essential but it is impossible to put it into effect due to the absence of the necessary data. The way of solving the problems is the creation of the full structural scheme of a ship's movement control system and working out the methods of manoeuvre planning taking into account the ship's characteristics.

1. The information for the captain about manoeuvring properties of the vessel.

The principal peculiarity of modern condition of the science of handling the vessel is the aspiratic to automate process of handling the initial data, display of the situation, acceptance of the decision and fulfilment of manoeuvring without intervention of the navigator. However before automating any process of handling, it is necessary to learn to carry it out manually, and then to have it formalised. Fast change of conditions and unpredictability of influence of the external factors result in the necessity of taking decisions on ship s handling in circumstances of uncertainty and shortage of time and that is always risky. Production-economic risk and high price of an eventual error result in the fact that the handling of a vessel in difficult conditions is carried out by the captain of a vessel. The safety of navigation thus is determined by master s skill of handling the vessel. Such skill can be obtained only by repeated fulfilment of operations of handling vessels on simulators and on the bridge during her exploitation. The attempt of a rigid regulation of actions of the navigator while handling the vessel by the edition of manuals and instructions does not give positive effect, as the majority of documents order, what it is necessary to carry out, but do not enjoin how to make it. Three ways of formation of steady skill of accomplishment of elements navigator's works are shown on fig1.

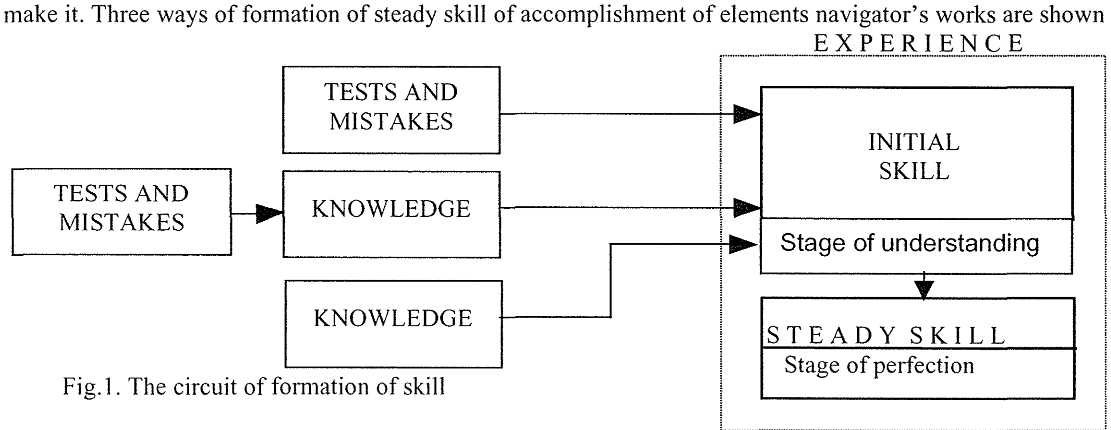

Fig.1. The circuit of formation of skill

The analysis of navigation incidents shows, that they have taken place in most cases not because of malfun c-tion of means of navigation and handling or late detection of danger, but owing to the readiness of navigators to accept the decisions on steering control adequate to a developing situation. It occurs the reason, that the navigator has not enough sufficient experience. The personal know-how of the navigators on handling the vessel consists of the sum of skills of fulfilment of definite elements of navigator s work (turns, navigation in fairways and in constrained waters, mooring in port and sea etc.). It is acquired in result of long work at sea, mainly by a method of tests and errors. However there is a number of kinds of activity of the navigator at handling a vessel, when he is compelled to work without the right for an error.

The absence of proper skill handling a vessel is especially displayed with navigators who are allowed to work independently on the bridge as the chief mate, captain or pilot for the first time. Therefore for development of proper skill proficiency we use a system of training and work on the bridge at sea with an extra master, which requires significant expenses. It is more preferable to form the initial skill on the simulator.

For the description of a vessel as of the object of handling manoeuvring characteristics are used. They can be divided into two groups: stopability and turnability (fig.2). In conformity with the offered classification the stopping characteristics are: dispersal, substopping, passive braking and active braking. The characteristics of circulation include: constant time of delay of turn $T(\delta)$; course keeping ability, criterion Q; a zone of instability $\pm\varpi_o$,$\pm\delta_{po}$; of meeting the turn, time $t_m(\delta)$,angle $\Theta_m(\delta)$;advance $l_1(\delta)$; transfer $l_2(\delta)$;a tactical diameter of circulation $D_t(\delta)$; a final diameter of circulation $D_f(\delta)$. About most of them navigators have no information (according to IMO recommendations 20% only).

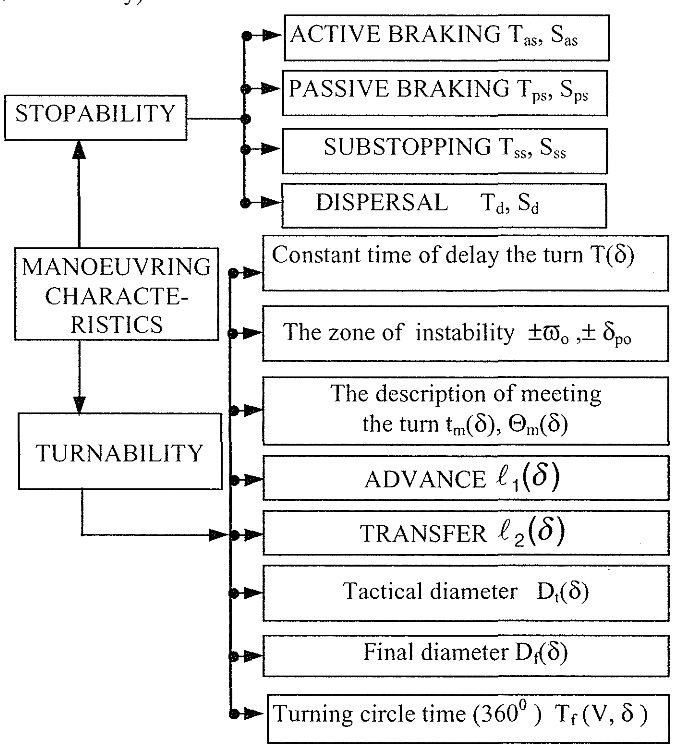

Fig.2. Classification of the ship s manoeuvring characteristics

For uniform interpretation of each of the specified characteristics we shall give their definition. Dispersal -process of increase of speed from a smaller step to greater. Substopping- process of reduction of speed from a greater step to smaller. Passive braking - process of reduction of speed of a movement at the stopped main engine on account of water resistance. Active braking is process of reduction of movement speed at the expense of a thrust of the propeller, working astern.

In order to consider each element of circ u-lation, it is necessary to consider the turn of a vessel in detail. With the beginning of turning a rudder at a movement of a vessel ahead a lateral force occurs and the vessel begins to move in the direction, opposite to turning of the rudder, there is a turning drift angle. However the specified turn occurs in a slowed-up way, and the shifting in the opposite side for the majority of vessels is insignificant and consistent with the width of the ship and accuracy of the trace measurement. With the occurrence of a drift angle of the hull there is a hydrodynamic force, which essentially accelerates all processes, and at turn of about 180 degrees there is the movement at a constant turn rate.

As the analysis of results of sea keeping trial on more than 35 vessels shows, a dependence close to linear exists between the rate and the time of turn. In practice while manoeuvring it becomes apparent that after turning of the rudder to the given angle the vessel is as if standing. This time in navigation is named as "preliminary period of turning", and the way covered during this time is a preliminary way of circulation. The value of that time depends on the displacement of a vessel. For example for m/v The Captain Temkin in loaded condition it is within limits 42s at $\delta=5^o$,and 10s at $\delta=35^o$. For m/v " Khariton Greku" in loaded condition it is within limits 52s at $\delta=5^o$ and 5s at $\delta=35^o$.The behaviour of a vessel at handling on a steady course is determined by a kind of an initial site of the diagram of handling, which is characterised by limiting angles of negative turnability ($\pm\delta_{po}$) and turn rate of spontaneous circulation at a rudder in zero position ($\pm\omega_o$).

For the estimation of course keeping ability generalized criterion Q is applied:

$$Q= (0.5+6\omega_o)\cdot \overline{\Delta\Theta}/\overline{\Delta\delta} = n_p \cdot L \cdot \overline{\Delta\Theta}/\overline{\Delta\delta}/t/V ,$$

where n_p is the number of turns of a rudder during observation t; L is the length of the vessel between perpendic u-lars; V is the speed of the course; $\overline{\Delta\Theta}$ - average amplitude of yawing; $\overline{\Delta\delta}$ - average amplitude of an angle turning of a rudder. For the description of the process of the termination of circulation we apply the operational characteristics - angle (δ_m) and time (t_m) of meeting the turn, received from the manoeuvre "an asymmetrical zigzag". Advance(l_1), transfer (l_2), tactical diameter (D_t) and final diameter of circulation (D_f) are geometrical characteristics of a trajectory at circulation.

The stopability characteristics. At the existing calibration of forward (AHF, AHFm, AHH, AHS, AHDS) and back (ASF, ASH, ASS, ASDS) rotation of the engine number of all possible combinations will be 50, and in view of two conditions (in load and in ballast) - 100. Thus completely the braking properties of a vessel characterise 200 values of time and brake way. Such a big quantity of data, necessary not only to be known, but also used intelligently, presents significant difficulties for navigators. Therefore it is important to determine in which kind they should be given, for navigator to be able to take them easily into account at manoeuvring.

The basic issue, determining the value of knowledge of the stopping characteristics, is accuracy and form, in which they are submitted. Experimental-calculation method allows to get accuracy higher than 10%. The tabulated form is the most compact, which contains final values of the way and time of braking (tab. 1-3). By use of PC on the bridge for determination of the brake characteristics the specified gradation of speed loses sense, as PC calculates a brake way and time for the existing condition and speed.

Table 1 Stopping characteristics m/v Chariton Grecu

Engine ahead	AHF		AHFm		AHH		AHS		AHDS	
Engine astern	$t_{,min}$	$S_{,cbt}$	$t_{,min}$	$S_{,cbt}$	$t_{,min}$	$S_{,cbt}$	$t_{,min}$	$S_{,cbt}$	$t_{,min}$	$S_{,cbt}$
	In ballast condition Draft =8.05 m, Disp. = 41770 tons.									
Stop	34.7	27.02	34.0	25.45	33.8	24.92	31.7	20.98	28.7	16.85
ASF	8.2	10.27	7.6	8.7	7.4	8.17	6.3	5.72	5.6	4.06
ASH	10.7	11.95	10.1	10.38	9.8	9.85	8.7	7.24	7.8	5.25
ASS	15.4	14.63	14.7	13.06	14.5	12.54	13.3	9.71	12.1	7.27
ASDS	22.7	17.97	22.1	16.41	21.8	15/88	20.5	12.84	19.0	9.95
In loaded condition Draft=12.33m, Disp. = 66000 tons.										
Stop	55.0	42.35	53.5	38.98	53.5	38.98	49.6	32.1	43.9	24.81
ASF	10.9	14.22	9.5	10.85	9.5	10.85	7.8	6.99	6.7	4.66
ASH	14.2	16.62	12.7	13.25	12.7	13.25	10.9	9.04	9.5	6.17
ASS	20.4	20.54	18.9	17.16	18.9	17.16	16.9	12.48	15.1	8.82
ASDS	30.2	25.51	28.7	22.14	28.7	22.14	26.4	16.98	24.0	12.48

Table 2. Dispersal characteristics m|v Mikola Bajan in ballast

Existing rotation of the engine	New calibration of the engine									
	AHDS		AHS		AHH		AHFm		AHF	
	$t_{,s}$	$S_{,cbt}$	$t_{,s}$	$S_{,cbs}$	$t_{,s}$	$S_{,cbs}$	$t_{,s}$	$S_{,cbs}$	$t_{,s}$	$S_{,cbs}$
Stop	1253	15.5	924	15.5	691	15.5	655	15.5	593	15.5
AHDS	---	---	448	10.3	457	13.1	448	13.4	427	13.8
AHS	---	---	---	---	326	10.0	338	10.8	346	12.0
AHH	---	---	---	---	---	---	8	0.3	177	6.6
AHFm	---	---	---	---	---	---	---	---	107	4.1

Table 3 Substopping characteristics m|v Mikola Bajan in ballast

Existing rotation of the engine	New calibration of the engine							
	AHDS		AHS		AHH		AHFm	
	$t_{,s}$	$S_{,cbs}$	$t_{,s}$	$S_{,cbs}$	$t_{,s}$	$S_{,cbs}$	$t_{,s}$	$S_{,cbs}$
AHF	919	23,4	552	17.5	215	8.3	127	5.1
AHFm	874	21.7	490	15.1	18	0.7	---	---
AHH	846	20.6	448	13.6	---	---	---	---
AHS	695	14.0	---	---	---	---	---	---

On the basis of the analysis, generalization of existing methods of definition, account and presentation of the stopping characteristic classification of methods of determination of the stopping characteristics (fig. 3) was offered.

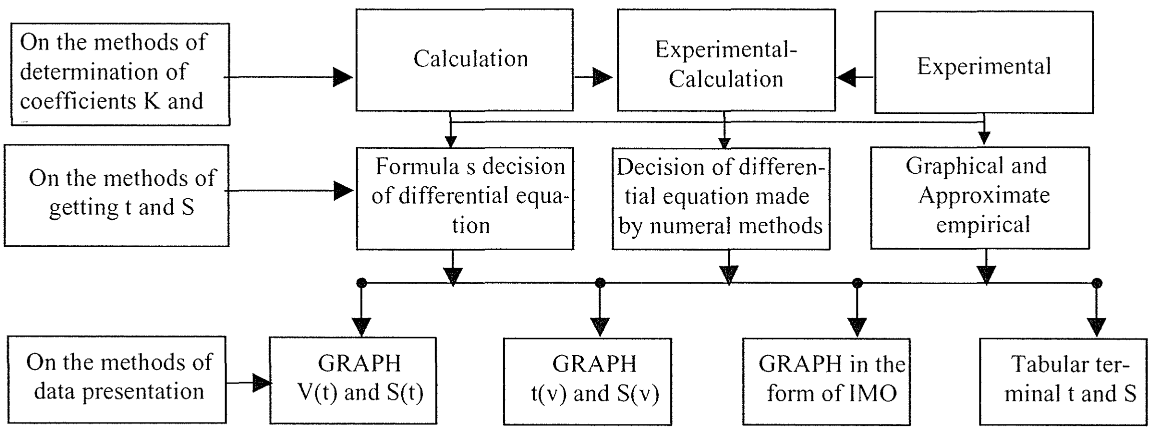

Fig. 3. Classification of the methods of the stopping characteristics determination.

The characteristics of turnability. For the representation of the characteristics through 5 degrees interval of a rudder to the right and to the left for a condition in load and in ballast total of the data, describing process of turn will make about 180. On the basis of the analysis and systematisation of existing methods of determination, account and representation classification of methods of determination of the turnability characteristics (fig. 4) was offered. For the account of the data about turnability at planning of the manoeuvre ways of pieces, perpendiculars and ellipse were developed.

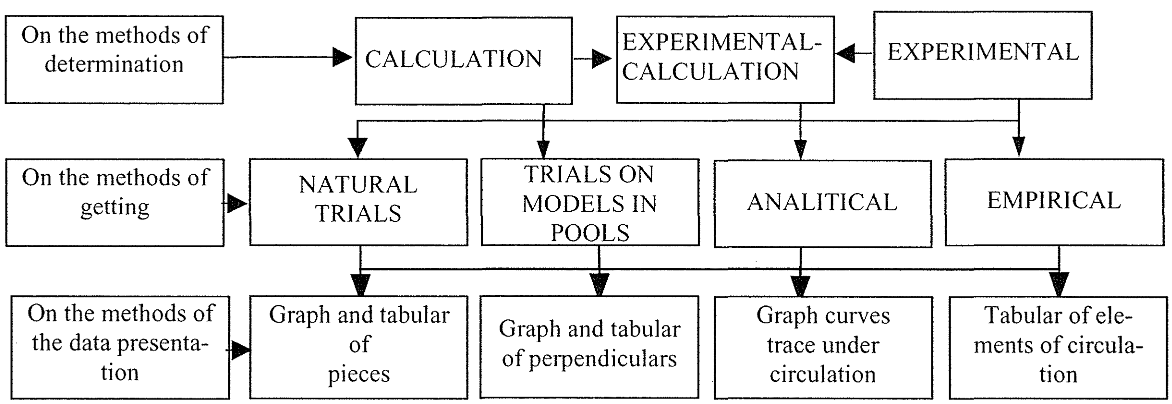

Fig. 4. Classification of the methods of the determination of turnability characteristics.

The most compact is the tabulated form of representation of the circulation given above elements. At hand-operated planning of turn it is reasonable to use the data on the characteristics as pieces, from a point of crossing of ways before and after turn (M), up to points of beginning (MB), current and ending (ME) of turn.

At automated or automatic planning of points of turn it is recommended to use way of an ellipse and perpendiculars. The essence of the way of an ellipse is in the fact that on meanings of elements of circulation l_1,l_2, D_t, D_f a trajectory of circulation with the sites of an ellipse of variable curvature. The points of the beginning of turn and intermediate ones are calculated and represented through the given by navigator interval of course as perpendiculars from the point of the ending of the turn up to the line of the initial way and from the beginning of the turn to the point crossing of the mentioned perpendicular and the line of the initial way. Having carried out binding of the specified points to geographical position of the point of crossing of ways M, we shall receive both latitude and longitude of points of the beginning and ending of the turn and intermediate points.

2. Motion controlling system of ship

From the very beginning the navigation skill was acquired solely in practice, through trial and error. With all that the process of acquisition of the specific navigation skills, as well as of knowledge, either concerning them, or the whole manoeuvring process, was too long. Many generations of captains, shipbuilders and scientists contributed to the development of the science of ship manoeuvring control. The results of theory as well as practice of ship manoeuvring control are contained in the works by many authors [1-7].

However, the process of cognition of the ship as an object of control as well as its manoeuvring cannot be considered complete. The reason for this is the great number of new types of ships, variety of tasks ships carry out at sea, and also the absence of universal systematised conception of the theory of construction of the system of ship movement control during manoeuvring.

While the collection, accumulation and generalisation of experience on manoeuvre control for various ship types is going on through trial and error, the acquisition of adequate knowledge will last long. To accelerate the process of cognition and to form necessary skills on manoeuvre control different training equipment is used, including simulators with visualisation of situation at sea. Nevertheless, accidents at sea often happen because of wrong man s actions when manoeuvring. It turns out, that he isn t prepared for operation in non-standard and extreme situations, though the equipment works well. When dealing with problems of shiphandling the questions of practical manoeuvring are usually distinguished and discussed, mainly it is the account of personal experience on carrying out one or another sea operation — mooring, towing, anchoring, storming etc. Less attention is given to ways of securing safe navigation by forming composition and structure of ship controlling system, through the knowledge of physical processes, taking place when manoeuvring. For the process of navigation, the following wording of the term ship controlling system can be suggested: totality of ship devices and elements, providing ship control when carrying out industrial tasks or manoeuvring.

The main quality of ship controlling system is its extremity. It has double nature. Firstly it means that the task of controlling is achieving of extremes of a function, which describes the condition of a controlled object (for instance, sailing from one port to another by the shortest way, in the shortest period of time and so on). Secondly the question on controlling extremity raises, through the necessity of achieving the aim of control with minimum expenditures, that is using it with maximum effectiveness (for instance, controlling by course with minimum number of helm orders, with minimum deflection from the given track). In the first case the extremity of controlling is defined by the extremity of the aims of control. In the latter one it is connected with the extremity of the controlling process itself. It means, that it must be optimal in certain sense. In such a way the controlling has some hierarchical levels, which are schematically presented on fig.5.

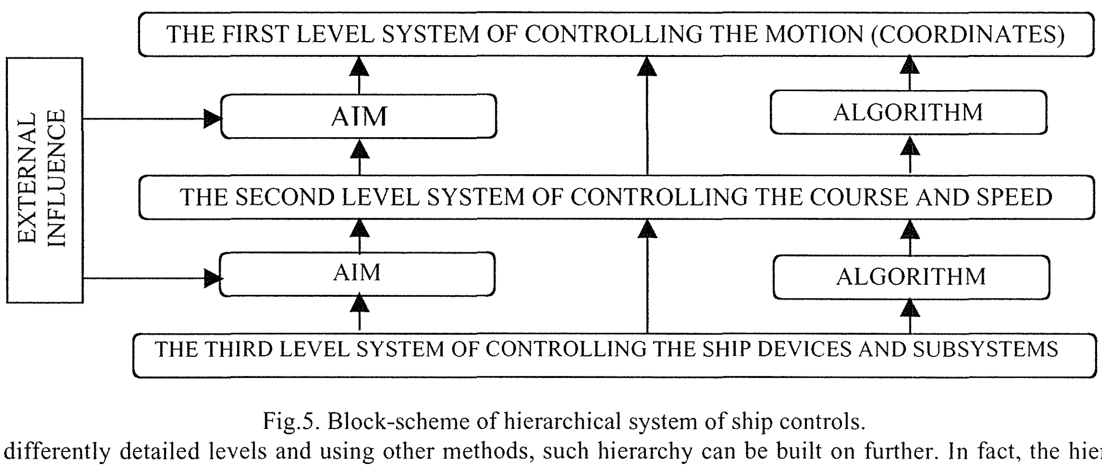

Fig.5. Block-scheme of hierarchical system of ship controls.

On differently detailed levels and using other methods, such hierarchy can be built on further. In fact, the hierarchy of ship controlling is not large and exists up to 2-nd, 3-rd level. On fig.5 we can see that controls under the influence of the 2-nd level are first of all the aim and algorithm of the 1-st level. Besides, the 2-nd level can have direct influence over the 1-st level, in order to increase its functional effectiveness. Rastrigin L.A. considers that the extreme controlling is universal and all other methods are generalised by it. As applied to the process of ship control, the system has its functional and space restraint. On one side there is a ship and its devices, on the other — environment. Two types of constituent objects can be distinguished in the system: a number of devices, elements and a number of relations. The process of dividing the system into devices and relations is called structurally [8].

In dependence on the number of devices and elements the systems can be divided into two types: simple and complex. If the system includes a large number of interrelated devices and elements of various physical nature, including man, and these elements correlate with each other in order to attain the general aim, then such system is called complex. As the contour of controlling includes man, such systems are called man-machine (MM). Thus, ship-controlling system can be defined as complex structurally MM system. It has the quality of adaptability, as it allows resolving the main problem under changing navigational conditions. For the study of the behaviour of a complex system under different working conditions, it is necessary to create its model. It should be mentioned here that despite the complexity of ship controlling system, its aim is quite clear and is described with a small number of criteria.

The complex system can be divided into sub-systems that possess certain independence but are subordinate to a single aim of the system functioning as a whole. The process of subdivision of the system into sub-systems is intended for the analyses of its functioning algorithm and the optimisation of its construction. To define the importance of a sub-system and its place in the controlling system, the consideration of two types of sub-systems— main and subordinate — is suggested. The system structur represents a fixed totality of devices and elements, as well as the order of interaction between them.

For the description of the system s functioning, graphs, structure- and block-schemes are used. For the understanding of principles of interaction between devices and elements, it is necessary to place them in order according to the existing relations and given functional task. The organisation of a ship controlling system consists of the construction of a well justified ordered distribution of ship devices and elements, together with the indication of the algorithm of their interaction, and of their order of functioning under controlling to attain the given aim.

There are structural and functional organisations. The structural organisation defines the totality and purpose of certain devices and elements. The functional organisation defines the way of subdivision of duties and interaction between devices and elements. The system s condition is characterised by the parameters describing its original state as well as the ongoing controlling process. The system is affected by the various factors usually called input values that are numerically characterised by input parameters. They can be subdivided into inner and outer ones. If the source of influence lies outside the ship, they are called outer. If the influence comes from ship devices, they are called inner. For a ship as an object of control the output values are the forces of the influence from the wind, current, waves, contact with berth, the tugs, interaction with other ships and so on. The inner values such as forces from the rudder, propeller or thrust, can be further subdivided into controllable — those, that are fixed by a navigator, and uncontrollable — those whose time and value of influence are arbitrary.

The system s reaction to these influences is described by parameters called the output. For a ship as an object of control the output parameters are kinematics parameters of the ship s motion and its position on the Earth surface. The output parameters, whose change or preservation is the aim of controlling, are called the controlled. If the controlled parameters, characterising direction and speed of a ship motion don t change, we can say that the ship is moving in an established regime. If its course and / or speed are deliberately changed, it means that the ship is manoeuvring.

System controlling consists of collection and processing of the information, and determination of the controlling influence for changing the output parameters in order to put the system in the given condition. The basis for functioning of any system, either simple or complex, is the given algorithm of its work (functioning). Without the working out of the given algorithm of system functioning , the latter s work is impossible, because the goal and purpose of the given system or sub-system is defined precisely by this algorithm. Besides, it is necessary to stress that external disturbances are disregarded when synthesising the algorithm, defined only by configuration of the area for the manoeuvring.

System s complexity is determined by the quantity of devices and elements it contains, and a number of tasks it performs. According to the number of tasks, the systems can be single-purpose and multi-purpose. The quantity of devices and elements determines the number of controlling contours flows the information flows through. The number of tasks is still more important for this determination. For instance, the sub-system of the anchor device controlling has but one aim — letting go or heaving up the anchor, and one controlling contour. Thus it is logical to call it simple.

Depending on the location of a source of influence or information, inner and outer contours are distinguished. The outer contour designates the way of passage of information whose source lies outside the ship. The inner contour stands for the way of passage of information whose source is on the ship itself.

Controlling the ship represents a multi-purpose task. Within this the aims of controlling can be of different nature and aim. They can be aimed at providing navigational safety or effective fulfilment of production tasks. Presence of man in controlling contour, during the breakdowns in the functioning system allows speaking about the influence of the human factor on the safety of navigation and working effectiveness.

On the basis of numerous ship moorings at sea (1645) and in ports (980) carried out by the author, the analysis of manoeuvre controlling system functioning was made. In accordance with the aforesaid and the results of investigation, the structure scheme of ship controlling system is suggested at fig.6.

In accordance with the given scheme, one can distinguish three main sub-systems within the system, namely Ship motion controlling , Ship technical exploitation controlling and Ship crew controlling . With a view for providing safety of navigation, the sub-system Ship motion controlling is of considerable importance. Because the consideration of all aspects of ship controlling represents a many-sided problem, later we will deal only with the sub-systems of providing navigational safety.

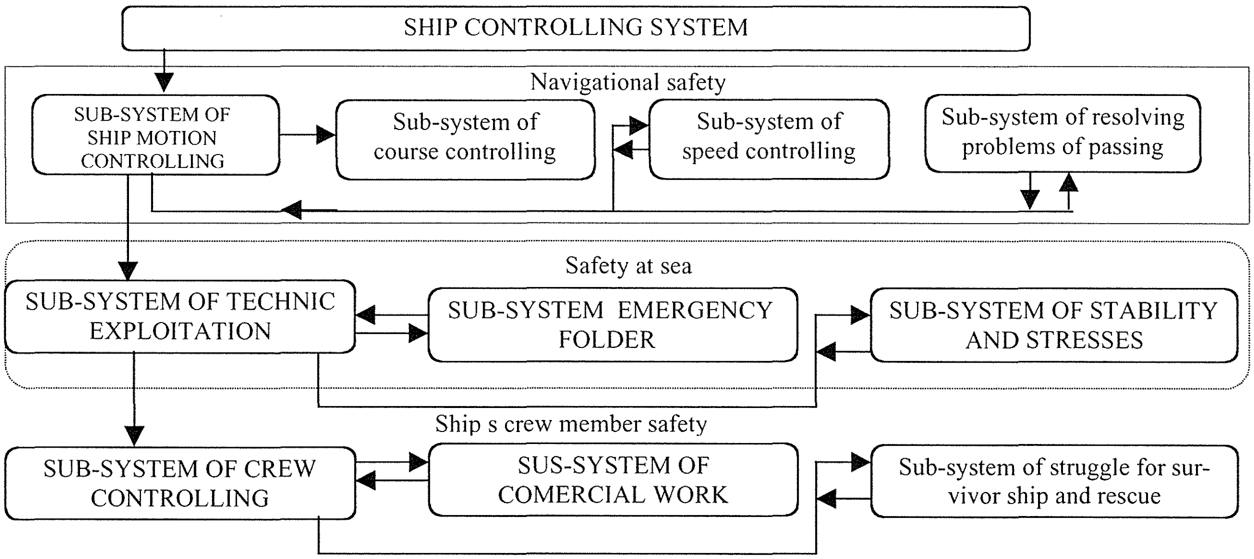

Fig.6 Structural scheme of the system Ship controlling

In a very general aspect the aim (task) of the ship motion controlling is guiding the ship along the given line of safe way defined by points on the chart, with minimum divergence. t that the way line is defined by totality of rectilinear and curved sections. The motion-controlling task can be divided into several levels namely sub-systems and contours of controlling (either outer or inner). This sub-system has subordinate sub-systems of course and speed controlling as well as of resolving problems of passing. The system of ship motion controlling can be represented by a structural scheme as it is in fig.7.*The object of controlling* is the hull of the ship, which will be represented as trajectory of a

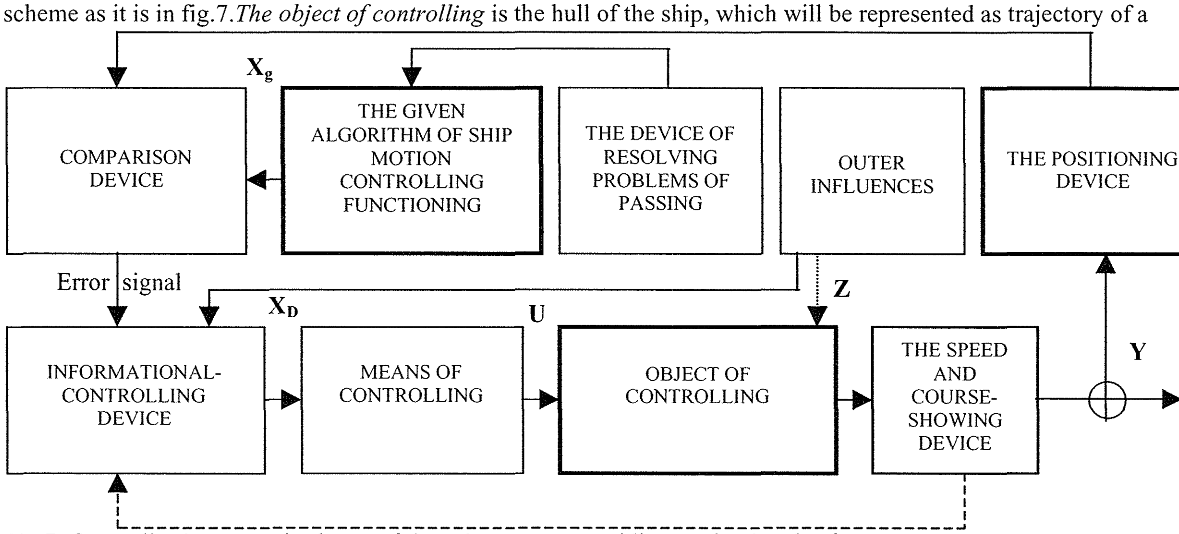

Fig.7. Generalised structural scheme of the sub-systems providing navigational safety.

point situated in the gravity centre G, when examining the manoeuvring process. *The informational-controlling device*, receiving the information of the course, speed of the ship, sea depth, values of outer influences and the error signal, works out the command on means of controlling, in order to bring the system in the given condition. Man-operator (MO) represents an element of this device.

By *means of controlling* (steering gear, propeller, steering propeller, anchor device, braking device and tugs), the controlling effect U is worked out, which brings the system into the given condition. The navigator, who is responsible for the manoeuvring process, sets the value and duration of controlling effect.

Outer influences Z — the wind (drift angle α), current (leeway from wind-induced, tidal and constant current β_t), waves (slamming, flooding), interactions (with ships during overtaking and passing in short distance, with moorage s, channel and fairway walls, with sea bottom) affect the ship and cause its displacement concerning the given line of way. There are two approaches: either the corrections for taking these perturbations into account are brought in when working out of the controlling effect; or the corrections are not calculated during the working out of the leading influence, but their effect is taken into account in the value of the error signal. In the latter case the error signal value may be so high that the controlling effect would not be sufficient to bring the system into the given condition. As a result, grounds for an accident appear. If the ship s position goes out of the admissible limits, then the accident occurs.

The given algorithm of the motion controlling system functioning is technologically defined by configuration of navigational area for manoeuvring and is represented as geographical position of the points on the chart, through which the ship should and can go when moving and manoeuvring. Usually the navigator elaborates this algorithm according to the information of the planned passage contained in the charts, pilot books and other sources. The rectilinear sections of the way are chosen, the position of the crossing points of the way line before and after a turn are plotted on the chart or entered into PC memory, the true courses between consecutive way points are plotted or calculated. To draw the curvilinear trajectories it is necessary to have the knowledge of turnability characteristics as well as of methods of plotting or calculating intermediate points position according to these values. It is necessary to mention that the algorithm does not depend on the outer influences. Secondly, the algorithm can be subject to a correction only when the navigational conditions change, which do not let to pass along the given way.

If navigator elaborates the given algorithm orally and controls the actual situation only visually, without using any technical devices, then the reliability of controlling system is essentially reduced. Usually the conflict between the captain and the pilot takes place for that reason. The pilot, on the basis of his knowledge of local conditions, elaborates the given algorithm of controlling system functioning; he actually controls the ship, while the responsibility for realisation of the algorithm lies upon the captain.

Besides, the conception of such algorithm allows explaining the reason of navigational accidents. Such definition can be suggested — The ship accident had occurred, when the controlling effect was not sufficient for bringing the ship into the given condition .

The device of resolving problems of passing works out the source data for the forming of the given algorithm of motion controlling system functioning, taking into account the presence of dangerous ships, and for its correction according to changes in situation of closing.

The comparison device evaluates the actual and given admissible position and works out the error signal X_d, in accordance with which the informational-controlling device elaborates the command for means of controlling.

If there is no comparison device and X_d signal is not worked out, then the ship will never be able to fulfil the given aim of controlling and to get to the point of destination. It is necessary to particularly stress that the motion controlling system cannot function without information of actual ship position. The sub-system of course controlling can function without information of position.

The positioning device functions on the basis of using different ways of receiving the information about the position — astronomical navigational, visual, radar, radio-navigational, satellite and others.

The speed and course-showing device determines the direction of the ship motion by gyrocompass or magnetic compass and the ship s speed by log or propeller revolutions.

The sub-system of ship motion controlling works in accordance with the following algorithm. The given algorithm of the motion controlling system functioning produces the position of points along the given way. The information of the actual position, coming from the positioning device, together with the given position go to the comparison device where the error signal X_d is worked out, the value of which comes to the informational-controlling device. The information of the previous given course, actual position, and the information of the value of outer influences also come here. On the basis of the received information the course corrections for the outer influences and devices errors are calculated, and new value of the course is determined, which brings the controlling object to the given way. Let us call the represented algorithm of the ship motion controlling system functioning as working by outer contour. The main system includes subordinate sub-systems working by the inner contour and providing the controlling of certain devices and elements. The sub-system of motion controlling and the subordinate sub-systems constitute the system of navigational safety controlling.

Process of the motion controlling sub-system functioning uses the main fundamental principles defined by methods of taking outer influences into account and using the course controlling sub-system. The consideration of the four main principles is suggested: course, course by disturbance, course by deviation and combined course.

The course principle. The structural scheme of the ship motion controlling sub-system using the course principle of controlling is characterised by absence of some elements namely the positioning device, the device of value finding and taking into account outer influences and the comparison device. During the system s operating only the course controlling system by inner contour is working. The given algorithm of functioning is worked out manually or automatically, by graphical defining or manual or automatic calculation of the ship s way; is corrected for compass errors; and then goes to the informational-controlling system, which automatically or manually conserves its value. Taking into account the influence of outer condition by means of entering corrections for their influence on the ship is not effected. It does not mean that they are absent at all, but merely their influence is not taken into account during working out of the controlling effect U of the system.

The course by disturbance principle, the course by deviation principle and the combined course principle is characterised by the absence of some elements, which are given on fig. 7.

The suggested system approach to the ship motion controlling allows to plan well reasonably the organisation of ship motion process, taking into account the manoeuvring characteristics, navigational situation and traffic density. The considered principles of controlling and their structural schemes, allow to create different models of ship motion controlling, analyse their functioning, synthesise the system and define its optimal structure for providing safety of navigation under different navigational conditions. Besides, such an approach allows to produce an adequate mathematical description of the process of ship motion controlling formalise and automates it [9].

3. Distribution of Responsibility

Pilot is one of the actions allowing to raise safety of ship s manoeuvring especially in congested water and dangerous areas. In International marine practice compulsory pilotage inward / outward the port is generally adopted. The only exception is small ships with local knowledge, which are liners in these areas, and ferries. Everywhere the tendency is the same — on embarking a pilot takes control of ship s navigation without submitting his actions and intentions to master s approval. Afterwards, while working together, a master can receive information of navigation conditions, arrange mooring order, the required number of tugs, traffic schedule, etc.

In case if an accident takes place with a pilot aboard the ship, he bears practically no responsibility. The deficiencies of ship s navigation operations and quick change of navigation conditions reduce the possibilities to check up pilot s actions, to clear out a mistake in his commands without local knowledge. This information is not always received in time through corresponding channels, port authorities do not inform of it when arranging ship s communication with a pilot s assistance

Analysing the present conditions of world pilot service, we can come to the following conclusions. World powers, providing for shipping safety in their territorial waters, declared pilotage compulsory everywhere. Pilotage costs have been greatly increased, they share considerable sums in ship s working expenses and are the source of port income. Meanwhile, in the case of an accident pilot is not ever guilty in general practice. Even if he accused to be guilty, he is not to hold liability for financial compensation of the accident consequences. So, his professional actions are irresponsible. If his pilotage is successful, he is evaluated as highly qualified. In case of an accident master bears his individual responsibility

Meanwhile, the procedure of ship s navigation in the congested waters causes some productive and economical risk, a master has no right for an error, but a pilot has such a right. At the same time, we don t think that pilotage is an extra service. In connection with this we d like to stress the following. It is necessary in heavy traffic areas and when entering and leaving the port. But the pressing demand is to stipulate more distinctly ships and pilot s rights duties and responsibility. The present state of facts gives evidence that a ship bears the entire responsibility and duties for the navigation, but it is not ever mentioned for ship s right and pilot s responsibility.

4. ***Conclusions and Proposals***.

Taking into account the changed condition of shipping, we propose to revise the clauses concerning pilotage. It is necessary to stipulate more precisely pilot s right, duties and responsibility, meaning that under all the circumstances he has to protect ship s interests.

Our next proposal is to carry out the distribution of Ship and pilot s responsibility in the following way. Master is to be in charge of the main engine, manoeuvring device (if any), and steering gear and for his mates and helmsman s qualification. At the same time, pilot is to bear responsibility for ship s safe navigation, with all that this implies.

With the distributed responsibility it is necessary to stipulate more precisely the moment of taking over by pilot himself the ship s navigation, with entering the date down in ship s and pilot s papers. The Pilot's contract may be as below.

PILOT'S CONTRACT

We, the undersigned pilot of port **Lattakia Nachle Intable** and Master of the m/v " "**Maria" Andrew Chircov** concluded the present contract for the first one, mentioned above, provides ship's safe navigation from/to the entrance buoy to/from port berth _10 and her mooring. Pilot bears responsibility for safe manoeuvring from agreed time moment of starting pilotage 25 January 2000 5^{35} GMT.

Master bears responsibility for right work of ship's gear and other systems, qualification of ship's personnel The second one provides proper work and qualified service of anchor, steering gear, the main engine and also strict giving of commands on ship's navigating.

All disputes on the given contract are settled upon agreement of both the parties, otherwise juridical.

The contract is composed in two copies, one of which for the Pilot, the second for the Master.

Pilot .. Nachle Intable Master Andrew Chircov

(signature) (signature)

Pilotage must be conducted for ship s interests, that s why it is necessary to think over master s opportunities who call at ports frequently and express their wish, the right of ship s navigation without a pilot. A competent master can operate his ship not worse than a pilot can. When a master is not sure, he will take advantage of pilotage compulsory. The information about manoeuvring characteristics with which vessels are supplied today according to the IMO recommendations is insufficient, as it does not cover those modes of operations of the main engine and using angles of a rudder which are used in daily operation. There are only 40 meanings of way and time of braking out of 200; for dispersal and substopping characteristics don t exist at all. And for the characteristics of turnability the data are available only as curves to the right for angles of turning the rudder of 15 and 35 degrees. The form of representation of the existing data about the braking characteristics as the IMO linear diagrams and about turnability is inconvenient for practical use on the bridge.

It is offered to reconsider the program of tests of the vessels after construction, by providing as minimum quantity obligatory manoeuvres: asymmetrical zigzag (characteristics of meeting the turn, zone of instability, diagram of handling); passive and active braking (the definition of the maximum force of a thrust of the screw for modes ASF,ASH,ASS,ASDS and is desirable no less than three times each); circulation to the right and to the left for angles of turn of the rudder on 5,10, 15,20 and 35 degrees at the speed of complete forward manoeuvring and AHH; dispersal from a motionless condition up to AHDS, AHS, AHH, AHFm, AHF; circulation to the right and to the left for an angle of turn the rudder on 15 degrees at an astern movement; passive, active braking and circulation on the shallow water; asymmetrical zigzag on the shallow water. All data about manoeuvring characteristic should be represented as a separate folder " The Information to the captains about the manoeuvring characteristics ".

Account of a way and time of braking, dispersal and substopping should be made by an experimental - settlement way, and results to be represented as the tables for the bridge and in any other kind, required by the normative documents. To present the offers to IMO about realisation of an international conference on providing vessels with the data about the manoeuvring characteristics in view of the last achievements of science and engineering.

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Development Of Port State Control Officers Training Using Marine Simulators And Real Vessels

ABSTRACT

This course provides training for officers to be authorized by their Government to execute Port State Control in accordance with:

- STCW — 78-95, Code STCW —95
- SOLAS 1974 as amended, chapter I, regulation 19;
- Load Lines 1966, article 21;
- MARPOL 73/78, article 5 and regulations 1/4 and 11/10;
- ILO Convention 147, articles 2 and 4 and appendix.
- IMO Resolutions 740(18), 741(18), 787(19)

One of the most important points, that is highlighted during the course is implementation and influence of the ISM Code by PSC Officers as a tool of communication between shore and ship s Safety Management Systems, vital for efficient work and pollution prevention.

The analysis of the delivery approaches of the PSCO training program discovered the following basic aspects of the given approaches:

1. Normative basis studies
2. Practical skills development onboard the ships, entering the port, where the there training is going
3. Skills development with the help of the appropriate simulators
4. Skills development onboard the ship located at the port area waters, given to the disposal for training needs.

Aspects 1 & 2 are mandatory. The easiest way of the course delivery is the first variant, which includes normative basis studies and practical skills development onboard any vessel, located at the port at the time of course running. In order to carry out the training program successfully, Aspect #4 (ship permanently located at port area waters, given to the disposal for training needs) or # 3 (appropriate simulators), which are variants # 2 and 3 accordingly, may be used effectively.

The ideal variant to our opinion is the combination of all Aspects, listed above, which will form the Variant #4. The basis for our PSC Course is the IMO Model Course No 3.09 and European Port State Control Officers Training Program (EPSCOT). The Course was designed with the help of the Secretary of the Black Sea Memorandum of Understanding.

1. INTRODUCTION

As you know, starting from July 1 2002, ISM Code is mandatory for all types of vessels. The ISM Code was adopted by the International Maritime Organization (IMO) by resolution A.741(18). The objectives of the ISM Code are to ensure safety at sea, prevention of human injury or loss of life, and avoidance of damage to the environment, in particular, to the marine environment, and to property. The Code requires companies to establish safety objectives as described in section 1.2 of the ISM Code. In addition companies must develop, implement and maintain a Safety Management System (SMS) which includes functional requirements as listed in section 1.4 of the ISM Code.

That is why the given report is organized in a way, that the Safety Management System (SMS) is structured.
In order to provide proper and sufficient work of the SMS, it should contain answers on the following questions, available for all personnel, involved in the system:

What?
Why?
When?
How?
Where?
Who?

2. Port State Control Officers Training
2.1 What?
PSC Officers training is carried out in OMTC from March 2001. Course development consisted of the following phases:

§ Planning, development and preparation phase. Here IMO Model Course 3.09 (Port State Control) was thoroughly analyzed together with the feedback and previous experience from our colleagues and our training institutions. Necessary human and technical resources were finalized.
§ Operational phase, that includes 60 hours course
§ Result phase, that includes the analysis of the pilot course, held in OMTC .

After the test course was done and when it was reported to the 2nd Committee Meeting of the BSMOU, our Center was accredited for carrying out PSC training in this region.

2.2 Why?
So, why such training is necessary?
Fist of all, as Mr. O Neil, IMO General Secretary told at the time of ISM Code Adoption, the joint responsibility for safety at sea and pollution prevention should lie between IMO, Flag State And Port State as follows:

- IMO mainly bears the responsibility for developing international standards in the form of conventions, codes, recommendations and guidelines
- Flag state — is responsible for issuing certificates and guarantees that the vessel fully complies with the requirements of IMO Conventions
- Port state- responsible for continuous vessels inspection for their compliance with IMO requirements and provide deficiencies elimination.

At that, as you might have noticed, Port States bear the responsibility of **continuous** vessels inspections, as far as they enter ports of the states, who signed the Convention.
Then, in April 2002, Ukrainian Government has ratified the BSMOU and, as a result, this should lead to the improvement of such training.
That is why the importance and necessity of carrying out PSC courses in our area cannot be denied.

2.3 When?
When and in what case should such training take place?
Such training is mandatory for PSC Officers prior to work start and should be refreshed periodically not less than once in two years. Safety Management and Pollution Prevention standards are changing worldwide quite often- that is why the two years term is minimum sufficient for refreshing.

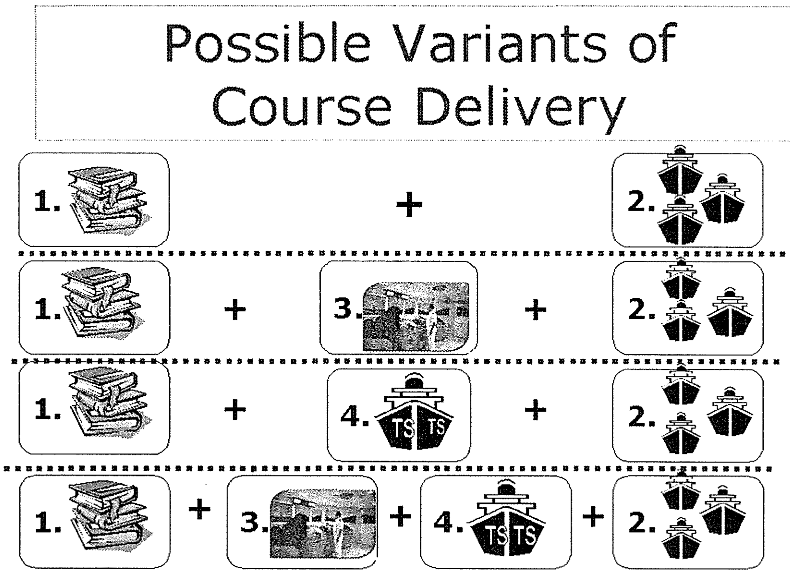
2.4 How?
How the training should be delivered?
As it was mentioned before, the basis for the Course is the IMO Model Course 3.09. Following the 2nd BSMOU Committee Meeting and with the active help of BSMOU Secretary Mr. H seyin Y ce, we have got the full set of EPSCOT (European Port State Control Officers Training) Program with all support materials (i.e. manuals, CD s, overheads, etc.), which were included into OMTC PSCO Course s syllabus.

The course duration is 2 weeks, the theoretical material is fixed by means of simulation training followed by practical skills development by participating in real inspections onboard either the training ship (a sub- contracted vessel, which might be used for training needs) or a real vessel entering the port.

The analysis of the delivery approaches of the PSCO training program discovered the following basic aspects of the given approaches:

1. Normative basis studies
2. Practical skills development onboard the ships, entering the port, where the there training is going
3. Skills development with the help of the appropriate simulators
4. Skills development onboard the ship located at the port area waters, given to the disposal for training needs.

From all listed above, it is possible to derive 4 different variants of the aspects interaction, determining the approach of achievement the PSCO training program.



As it can be seen from the scheme, Aspects 1 & 2 are mandatory. The easiest way of the course delivery is the first variant, which includes normative basis studies and practical skills development onboard any vessel, located at the port at the time of course running. But as you understand, this variant possesses considerable deficiencies due to the accidental and chance character of the 2nd Aspect, which interferes with distinctness/determinacy of the course delivery.

Thus, in order to carry out the training program successfully, Aspect #4 (ship permanently located at port area waters, given to the disposal for training needs) or # 3 (appropriate simulators), which are variants # 2 and 3 accordingly, may be used effectively.

The ideal variant to our opinion is the combination of all Aspects, listed above, which will form the Variant #4. The given variant is used in particular in OMTC during PSC Officers Training . 6 additional hours for English Language review were added to the program, which open the training.

Bearing in mind, that EPSCOT structure has modular form, it could be easily adopted into our local course.

As an example, let s have a brief look on several sections of the PSC officers course program.

English Language Review is taken from the part of English Language Studies, and includes brief grammar overview, necessary terms and definitions review, summing up, followed by Marlins computer-based test.

Safety & Quality Management System — is a simulator, that contains Company s SMS documents circulation database of different types of the vessel in electronic format and contains drafts and samples of mandatory documentation stored onboard various types of the ships.

Load Control System is a simulator, which allows understanding and clarifying main principles of safe loading and correct cargo stowage; it as well contains samples of various ships typical stability calculations and all appropriate documentation.

Tankers Simulator reflects peculiarities and specific features of cargo handling onboard tankers, gas and chemical carriers and all appropriate documentation.

GMDSS Simulator — simulator imitating communication GMDSS equipment in real time frames, all needed equipment checks and controls in accordance with SOLAS Convention, appropriate documentation keeping.

FMSS — Full Mission Ship s Simulator allows to perform an equipment and documentation of a modern navigation bridge and peculiar features of its operation and

Control as well as charts usage, proof and control.

Turbo Diesel, AMOS, Engine Team Simulator, which help to show main operation principles and technical maintenance of various equipment and documentation onboard.

Besides the theoretical part, combined with standard means of training, such as blackboard, PC Light Pro projector, Audio and Video equipment, standard set of handouts (in accordance with EPSCOT materials), PC- based simulators are widely used during the Course.

The importance of EPSCOT Program — that it is one of the examples of Maritime Training globalization world wide.

Unfortunately, continuous changes of the managing personnel in the Maritime Administration of Ukraine put obstacles in the way of proper course delivery.

2.5 Where?

The course is carried out in OMTC in close cooperation with OSMA and Odessa Port. Odessa Maritime Training Center (OMTC) was established in 1998 in order to conduct training and further training of seafarers and shore-based personnel.

In 1999 OMTC QMS was certified in accordance DNV Rules for Maritime Training Centers. At that, 37 courses were approved, both conventional and non-conventional, which are carried out in accordance with DNV requirements.

Please note, that the certification was carried out no in accordance with ISO 9000 Standards, but with the rules, especially developed for training institutions.

In year 2000 various Maritime Administrations all around the world have approved OMTC QMS.

2.6 Who?

This question might be subdivided into two areas:

a) who is a trainer
b) who is a trainee

The training is carried out by lecturers and instructors from Odessa State Maritime Academy and Maritime Administration. Thus, among the lecturing staff on the given course there are 2 professors, 3 assistant professors, 2 Maritime Administration representatives and Odessa Sea Port Harbor Master.

The training is delivered for shore personnel, mainly assigned by Harbor Masters so they will be able to carry out vessels inspections in the ports of Ukraine.

3. Conclusion

The vessel s inspection is its assessment as a part of the Company s Safety Management System. At that, not only the technical condition of the vessel, its documents and crews certificates should be checked, but also its compliance to the ISM Code requirements. That is, the crew s competency and training level are subject to the PSC check. At this point, the crewmembers assessment in its own way reflects the quality level of the maritime training institution, where the seafarer was trained. Thus, only a proper trained and competent PSC officer is able to verify and inspect not only the ship itself or the crew as it is, but their unity as an integral part of the System, the formation of which is fundamentally new approach in shipping culture.

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Session IIB - Simulation

Chair: Prof. S. Walk

Simulation and Modeling: A Tool for Public Policy Research
Capt. Anthony Patterson and Mr. Leslie G. O Reilly
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Johnson O. Olaiya
World Maritime University (WMU)

Simulation and Modeling: A Tool for Public Policy Research

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ABSTRACT

Within Canada, the Federal Government has initiated a discussion on the application of the precautionary approach in a number of high risk areas, including marine transportation. The authors believe that the application of the precautionary approach in the maritime sector implies a more rigorous risk assessment for policy initiatives than is currently required. Given the fundamental changes occurring in the Canadian maritime regulatory system; the rapid proliferation of new technology, and the desire to expand shipping activities into remote and pristine areas, the scientific and academic communities can play a vital role in guiding policy-makers in their application of the precautionary approach to shipping.

Over the past 30 years there has been a shift in the public perception on the importance of safety, environmental protection, and - more recently - security to society. As regulators and shipping interests attempt to create a safer, more environmentally friendly and secure maritime transportation sector, they have been confronted with the fact that human error is the main cause of shipping incidents. If it is accepted that there is a desire to improve the maritime transportation system, and that human factors represent one of the key weaknesses in the system, then there is a need to improve the capabilities to deal with human factor issues. Simulation is a method to identify, quantify, and modify risky behaviors in transportation systems, and represents a critical tool in the evolution of public policy in the maritime sector.

The authors propose that the academic, scientific, regulatory, and corporate communities begin a collaborative effort to address human factors issues using the existing maritime simulation capabilities in Canada. The authors further propose that a modest investment be made to develop modeling and simulation capabilities that will permit more advanced studies to be conducted in the future.

1. Introduction

In September 2001, the Government of Canada published a discussion document entitled *A Canadian Perspective on the Precautionary Approach/Principle*[i]. The intent of the document is to stimulate discussion on the application of the precautionary approach[*] in the development of public policy initiatives.

The Government of Canada has developed their concept of the precautionary approach from Principle 15 of the *1992 Rio Declaration on Environment and Development*:

> *In order to protect the environment, the precautionary approach shall be widely applied by States according to their capability. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.*

Within Canada, the Federal government suggests that Principle 15 of the Rio Declaration be expanded to include science-based programs of health and safety, the environment and natural resources conservation, both domestically and internationally . While the Federal Government has not specifically identified the Programs to which the precautionary approach would apply, the list of Departments contributing to the development of the discussion document includes Transport Canada, which acts as the Maritime Administration for Canada.

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[*] The Canadian discussion document equates the terms precautionary approach and precautionary principle . In this document we will use only use the term precautionary approach for simplicity.

The discussion paper circulated by the Federal Government contains a comprehensive overview of the precautionary approach of which we will outline 2 aspects. The first aspect will be the rationale for extending the application of the precautionary approach to non-environmental areas. The second will be the guiding principles for the application of the precautionary approach.

The government discussion document indicates that the fundamental reasons for a broad application of the precautionary approach are legal, political, and economic. Legally, the government believes that the application of the precautionary approach will help to help demonstrate due diligence related to decisions that it makes, especially in the areas of human health, safety, and the environment. From the political dimension, the public is growing increasing cynical about the decision making process employed by governments. The precautionary approach opens avenues for public input and scrutiny of sensitive decisions. From an economic perspective, the proper application of the precautionary approach is seen to be an element in ensuring that cautious public policy becomes neither a barrier to innovation nor as a trade restriction.

The Canadian Government has proposed that the precautionary approach be implemented in accordance with 11 guiding principles. The first 6 principles, entitled General principles of application , provide guidance on whether on not a particular policy problem justifies the application of the precautionary approach. The final 5 principles, entitled Principles for precautionary measures , provide implementation advice to policy makers once they have decided to apply the precautionary approach.

The core considerations for the implementation of the precautionary principles are: 1) is there scientific evidence of a credible threat to human health, safety, the environment or resource conservation; 2) will the threat exceed society s risk tolerance threshold; and, 3) who is responsible for generating the scientific data? Once it is decided to use apply the precautionary principle in a given situation, there is a recognition that the perception and quantification of risk changes over time, and that any decisions are subject to review. There are also the requirements that risk mitigation measures are to be applied in a consistent, fair and reasonable manner, and that the overall impact of risk mitigation is to be cost-effective.

2. Risk Assessment and Perception

At its core, the precautionary approach is a risk management tool. In order to interpret how the precautionary approach could be used in the maritime context, it is important to have an understanding of the methods of assessing and perceiving risk.

From a quantitative point of view, risk can be described as the likelihood that an unwanted event will occur and the cost incurred when the event occurs. In this sense, risk can be expressed as the total expected loss taking into consideration the probability of all possible events and the costs associated with each event. Mathematically, risk would be derived using the general equation for calculating an expected value.

$$E(X) = n \cdot \sum_{i}^{n} x_i \cdot p(x_i)$$

where $p(x_i)$ is the probability that the i^{th} scenario will occur°; x_i is the loss that would be incurred if the i^{th} scenario occurs°; $\sum_{i}^{n} x_i \cdot p(x_i)$ is the sum of losses for all scenarios for a given system (it is also the mean loss for a given system); n is the number of independent and identical systems in operation°; and $E(X)$ is the total expected loss for all systems in operation.

To use this method, the analyst would need, for a given system, to 1) list all possible scenarios that could lead to a loss; 2) for each scenario, determine the cost associated with the loss; 3) for each scenario, determine the probability that the scenario will occur; and 4) identify the number of independent and identical systems that are also in operation to which the analysis can also apply.

The method of calculating an expected value is used in a number of circumstances. At the macro-level, it is used as a sensitivity-mapping tool to prioritize a list of loss producing scenarios. The Canadian Office of Critical Infrastructure Protection and Emergency Preparedness (formerly Emergency Preparedness Canada) advocates this approach when building contingency plans[ii]. At a micro-level, the expected loss method is used to quantify the risk of well-defined systems or sub-systems. Again, the method helps to identify particularly sensitive risk elements, and can help to estimate the cost-benefit of implementing certain loss reducing actions.

The expected value method, however, has difficulties in dealing with low probability — high cost scenarios[iii]. By their very nature, low probability scenarios are very difficult to define in advance through analytic reasoning. The chain of events leading to real-life maritime accidents are usually so convoluted that no reasonable person could foresee its occurrence. The old adage that a mariner s life is 99% boredom and 1% excitement underlines the fact that most voyages are uneventful and routine. Indeed, accidents seem to have a random nature, striking where and when least expected. When faced with this situation, the analysis shifts from cause-and-effect to determine the likelihood of an event occurring, and switches to observations of past trends.

From a statistics point of view, the occurrence of shipping casualties is analogous with binomial distributions. In other words, incidents at sea are like with a random sample from a jar containing a large number of balls labeled safe , and a small number which are labeled accident . For each voyage of each vessel, a sample is drawn from the jar. If a safe ball is drawn, nothing happens. If an accident ball is drawn, the ship suffers a casualty (e.g.: grounding, fire, collision, etc.)*. Increased marine activity increases the number of samples. Technology and regulatory controls, or lack thereof, can increase or decrease the number of balls labeled accident . As long as the number of voyages is large and the number of safe balls is very much larger than the number of accident balls, the system will <u>appear</u> to be random. Mathematically, binomial distributions with these characteristics are best approximated by a Poisson (random) distribution.

$$p(x) \cong \frac{e^{-\mu} \cdot \mu^{x}}{x!} \text{ and } \mu = n \cdot p$$
$$\text{if } n \to \infty \text{ and } p \to 0$$

So much for theory. In practice, maritime administrations, shipping companies, and maritime underwriters face a daunting task. The number of risk scenarios, as well as the estimated likelihood that a scenario will occur are based on observations of past incidents or near-misses. There are a number of implications of the observation that risk is estimated from historical data. The first is that some low probability — high cost scenarios will be missed because they haven t happened yet. The second is that observational studies do not reveal cause-and-effect relationships, and cannot be used to accurately predict the results of changes to the system. The third is that the perception of risk will lag the actual risk due to the time taken for a statistically significant trend to emerge in the data. The result is that, in the absence of research, the impact of new technology or new policy on risk can only be measured after the fact, that is, through a trial-and-error process.

Is the trial-and-error method a reasonable means of managing risk in the maritime industry? According to the precautionary principles, the answer partially lies in society s chosen level of risk. For society, risk analysis does not involve any statistical methods, but is rooted in perception. For the general public, the primary source of information from which to form a perception of risk in shipping comes from media reporting of casualty reports; information produced by government bodies; and the rare political debate on issues related to shipping. The public perception of the risk of maritime activities is difficult to gauge. The only real methods available are the political processes and the public consultation process - both of which are fraught with misleading signals.

If it is accepted that no system can be made entirely risk free (i.e.: the expected loss will always be greater than 0), it must also be accepted that there is a certain threshold of acceptable risk. The term acceptable must be interpreted with caution. It should not be viewed that the consequences associated with risk are desired, but rather that the principle of diminishing returns indicates that further measures to reduce risk are not cost-effective. The

* The Canadian Transportation Safety Board 2001 annual report indicates that for every 1000 trips of commercial vessels in Canada, there are 3.60 shipping accidents.

concept of acceptable risk becomes even more complicated when one considers that society appears to adjust its behavior to be either more or less risky so that the acceptable risk threshold is achieved.

Gerald J.S. Wilde[iv] contends that there is a risk homeostasis or target risk that individuals attempt to achieve. For example, if the individual feels more secure by wearing a seatbelt, then the same individual should drive a bit more recklessly (by increasing speed for instance) until the security of the seatbelt is offset by the risky driving. In this simple example, the individual is striving to achieve a target risk. The shipping industry also seems to follow this pattern of assuming a target risk. The introduction of technology that reduces risk (RADAR for example) induces more risky behavior (higher speeds in poor visibility). One of the key roles of Maritime Administrations is to promulgate and enforce public policy that ensures that the target risk accepted by society is achieved by the maritime industry under its jurisdiction.

An important implication of risk homeostasis is that equilibrium is maintained until there is a change in either risk aversion or the perceived expected loss. While risk aversion is a relatively stable characteristic, expected loss can change relatively quickly. Recalling the equation for expected values, expected loss can increase with increases in the accident rate, the value of loss, the number of loss producing scenarios, or the activity level. A detailed examination of these factors is beyond the scope of this paper, however there are clear signals that the overall expected loss rate is increasing in Canada.

The clearest signal that overall expected loss is increasing comes from the maritime insurance industry. The role of maritime insurance is to protect business interests against loss producing shipping accidents through the provision of coverage in exchange for a premium. The insurance industry can only survive if the premiums collected exceed the value of claims paid, and are thus very sensitive to both the expected (upon which premiums are based) and actual loss rate (upon which claims are paid). In 1999, the global loss in marine insurance was estimated to be $3 Billion (US), and the Central Union of Marine Underwriters in Norway stated that with loss ratios of 160 — 170%, marine underwriters need a premium increase in the order of 100% [v]. The December 2001 issue of The Log (published by the Canadian Board of Marine Underwriters), indicated that there were significant losses in Canada in 2001, and that there was likely to be an increase in premiums as well as an overall reduction in available coverage in order to keep the industry afloat[vi].

It is also fairly clear that the public perception of the "costs" of maritime activities is moving away from the accountant's view of book cost and towards the economists view of opportunity cost. In the environmental field, the perception of costs of damage to the environment have increased over time. The current debate over the impact of ballast water discharge, and the substantial increases in oil spill liabilities in the aftermath of *Exxon Valdes* are evidence of this shift in perception. Through the introduction of the International Safety Management (ISM) Code, liability for a casualty has expanded beyond the Master to include the managers of the shipping company itself. In the Canadian offshore oil and gas sector, safety of offshore workers became a significant point of public interest in the aftermath of the *Ocean Ranger* disaster[vii].

With the increase in the value assigned to a maritime loss, it is important to look at the trends in the accident rate. In order to maintain risk homeostasis, the accident rates should be dropping. Data from reports issued by the Transportation Safety Board of Canada[viii] and the Canadian Coast Guard s Search and Rescue Program[ix] indicates that there has not been any change in the frequency of serious, loss producing, accidents in Canada. Indeed, in portions of the fishing sector, the accident appears to be increasing[x].

For the purpose of the analysis, the authors attempted to identify data sets that are not subject to changes in reporting criteria, and represented a loss. Data from the Canadian Coast Guard Search and Rescue Program and from the Canadian Transportation Safety Board were selected.

From the search and rescue data, the data associated with the number of incidents reaching the distress phase were chosen. The criteria for the declaration of distress are less subjective than the criteria used to declare the alert or uncertainty phases.

Number of Distress Incidents Reported in Canada				
1995	1996	1997	1998	1999
771	665	684	681	697

Within the Transportation Safety Board data, the normalized accident rate for Canadian registered commercial vessels, the numbers of commercial vessels lost, and the fatality rates were used.

Canadian Commercial Vessel Accident Rate (shipping accidents per 1000 trips)									
1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
4.83	4.01	4.11	4.09	4.27	2.92	3.45	3.80	3.24	3.60

Commercial Vessel Loss Rate — Canadian Waters									
1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
5	9	9	7	7	7	8	5	3	7

Fatality Rate — Canadian Waters									
1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
15	10	12	11	13	12	10	15	15	17

Regression tests on the above data sets does not support the hypothesis that there has been any change in the loss producing accident rate in Canada.

The net result is that the maritime transportation system is moving in a direction that will likely require the application of the precautionary principle (i.e.: scientific uncertainty and an increase in the overall expected loss). The next question then becomes one of identifying the key issues that require investigation that have a high likelihood in reducing the accident rate in shipping. From previous studies, it would appear that investigations directed towards human performance would be the fruitful area of research.

3. Human Performance and the Risk of Maritime Incidents

Human error is present in 80% to 90% of all shipping accidents[xi]. Det Norske Veritas has recently concluded that human error still continues to be a serious challenge, accounting for 58% of major [insurance] claims [xii].

In 1996, the European Commission, as part of its 4th framework research program, commissioned a study entitled Maritime Standardised Simulator Training Exercises Register (MASSTER). The objective of the MASSTER study was to investigate the standardization of simulation exercises within Europe as part of the implementation strategy of STCW 95. One of the tasks of the MASSTER program was to investigate human error, and a working paper entitled Improving Human Error Control in Maritime Simulator-based Training (WP 3) was produced[xiii].

The general model for human error in the MASSTER report was described as a five stage process leading to an accident. The first stage consisted of latent errors, or general failure types. The general failure types are the triggers that set the entire human error chain in motion. The latent failures are related to the environment in which the human operates and includes diverse elements such as equipment design, work processes, training, and error trapping methods. The MASSTER report noted that these latent failures are usually the result of decisions made by the upper level in systems, such as decision-makers, legislators, designers, managers, [and] inspectors .

An example of a general failure type in action would be the potential for a communications error caused by an inaccurate or incomplete Maritime Mobile Service Identity (MMSI) database. MMSI numbers are analogous to a telephone number issued to a ship, and are used as a ship identifier in distress messages. An inaccurate or incomplete database has the potential to hamper communications in a crisis, and represents a latent error. Whether or not the latent communications error will ultimately lead to an accident depends on a number of factors, outlined below.

The second stage of human error was identified as psychological precursors that aggravate the latent error. The main psycological precursors were identified as slips, lapses, and mistakes. Slips were defined as an error in the execution of an otherwise perfect plan ; lapses are losses of memory; and, mistakes are the perfect execution of a wrong plan . There are various sub-categories of psychological precursors, and different precursors occur under different conditions.

The third stage of human error is the commission of a substandard act. It is important to note that the commission of a substandard act is the first observable event in the human error chain. Of itself, a substandard act (e.g.: incorrect helm order) does not cause an accident, but causes an operational disturbance (e.g.: ship turning in wrong direction) that can ultimately lead to an accident. Substandard acts caused by slips can be detected and corrected relatively easily because the deviation in performance is different from the expected outcome. Mistakes, on the other hand, are difficult to detect except in hindsight because the substandard act cannot be recognized as a deviation until the scenario has progressed to its final conclusion.

The fourth stage consists of the barriers between an operational disturbance and an accident. In some cases, the barrier is situational in nature, that is, the conditions are not right for an accident to occur. In the example above, a ship turning the wrong direction has different implications in the open sea as opposed to confined waters. In other cases, the barrier consists of error trapping methods designed to detect and prevent accidents. For example, procedures that promote bridge team members to monitor and challenge each other would detect the incorrect turn before it progressed to an accident.

Operational disturbances that breach the barrier defence results in the fifth, and final stage, which is the occurrence on an accident. As can be appreciated from the above description of the process of human error, the accident represents the final stage after of a long sequence of events that has as its roots factors that pre-existed a particular situation got the ball rolling. Within the chain, however, there are four dominating factors that justify closer scrutiny.

The first factor is the limits of human cognitive capacity. The MASSTER report indicated that the overall category of cognitive problems accounted for 70% of the errors, and was present in 93% of the accidents . Within the MASSTER report, cognitive problems were defined as 1) false hypothesis 2) habits 3) personality and training . While improvements to training are undeniably a good strategy for reducing cognitive problems, training cannot be the only strategy. For instance, the MASSTER report indicates that there is a high correlation between information processing and high environmental stress. This finding confirms the Yerkes-Dodson law that predicts a serious degradation of human performance beyond a certain optimal arousal[xiv]. Overloading of the cognitive faculties of an operator is not a problem that can be solved exclusively through training, but needs investigation into ergonomics and work processes as well in order to engineer the overloading conditions out of the system.

The second factor is the influence of organizations on human error. A 1995 paper entitled *Human and Organization Factors (HOF) in Design, Construction, and Operation of Offshore Platforms* described the impacts of human error on the quality assurance and quality control processes in the offshore industry[xv]. The paper indicates that the single most pervasive HOF influence on quality in marine systems is organizational. Organizations in one way or another are largely responsible for creating the situations that either lead to or prevent major accidents . Human error induced by organizations has far reaching implications at both the corporate and legislative levels. Corporate culture is as important as policies and procedures for the introduction of latent errors due to organizational factors.

The third factor is the error trapping abilities of human. It has been observed that humans are much better at error trapping than error avoidance if they are given adequate opportunity. In other words, it is easier to recognize an error than anticipate one. In this sense, while organizational risks need to be engineered out of the system to the extent possible, the individuals within the organizations need to be prepared for crisis management. In terms of the MASSTER report, preparation in crisis management is equivalent to bolstering the defenses that prevent operational disturbances from becoming accidents. Such defence mechanisms were outlined as improved equipment and information design, development of emergency strategies, and training in crisis situations (especially simulator training).

A final point to consider is the impact of change on the creation of latent errors. Bea and Roberts observed that the rapid pace at which significant industrial and technical developments have taken place, there is a tendency to make design guidelines, construction specifications, and operating manuals more and more complex . The increasing complexity of modern systems is promoting the growth of latent human factor errors. While Bea and Roberts were specifically referring to improper documentation and procedures, the observation can be applied to the other elements of latent errors including regulatory regimes that lag technological innovation.

Within Canada, the potential for the proliferation of latent errors is significant. The Canadian maritime industry is in the midst of large and fundamental changes. Firstly, the entire regulatory framework surrounding shipping is in a state of flux. The Canada Shipping Act has been completely rewritten, and its associated Regulations are currently under-going extensive revision and consolidation[xvi]. This initiative is being undertaken by a Federal civil service that has been decimated by staff reductions. Secondly, the Federal Government is attempting to stimulate productivity through innovation[xvii]. With an expressed goal of doubling investment in R&D over the next 10 years, the already fast pace of introduction of technology into the workplace will further accelerate. Thirdly, the maritime industry is expanding into new areas and activities. The offshore oil and gas industry is accelerating on the Canadian East Coast and is expected to open on the West Coast and in the Arctic. Shipping activities are moving towards remote areas such as the Labrador coast where bulk carriers will be shipping nickel from Voisey s Bay and cruise vessels will be exploring remote fjords. Fourthly, maritime activities are being conducted in harsh environments, especially environments associated with ice. Iceberg towing, for example, is a necessity to permit drilling operations on the Grand Banks.

With the magnitude of the changes happening in the Canadian maritime industry, and without a clear understanding of the cause-and-effect relationships in maritime accidents, there is no assurance that there will be any reduction in the maritime accident rate in Canada. In fact, the opposite may be true. Rapid innovation without a clear understanding on the impacts on human performance may very well stimulate the creation of latent errors that lead to accidents, and ultimately increase the overall expected loss attributed to maritime operations.

4. Simulation and Modeling as a Risk Management Tool

Human error is not a new concept in maritime transportation. Until the advent of advanced simulation technology, there were few tools available to identify human factor problems other than operational analysis by experts. In the past, testing of new systems was done by deploying a few systems in the field, and observing the impacts on performance through sea trials.

Sea trials, while satisfactory for proving engineering concepts, are a poor method of investigating human performance issues. Firstly, crisis situations cannot be replicated safely in live systems. Secondly, only a limited number of people can participate in a sea trial making the observed results difficult to extrapolate to the entire marine community. Thirdly, it is difficult to control for variables in sea trials making it very difficult for investigators to identify cause-and-effect relationships. As a result of these three shortcomings, new technology and work processes are often introduced with little knowledge of its impact on human performance. The impact of Digital Selective Calling upon communications at sea is an example[xviii].

In the early 1990 s, military planners in the Unites States Department of Defense were facing a similar situation where there was a requirement to rapidly innovate, maintain operational performance, and remain cost effective. The traditional innovation method used by the military was judged to be too expensive and ineffective. After some analysis, the military turned to modeling and simulation as a means to provide readily available, operationally valid environments [xix].

Before commencing a discussion on how simulation and modeling is used as a risk management tool, it is important to present the US DoD definitions of the terms modeling and simulation . Modeling is the application of a standard, rigorous, structured methodology to create and validate a physical, mathematical, or otherwise logical representation of a system, entity, phenomenon, or process (DoD Publication 8320.1-M, (reference (j)). Simulation is a method for implementing a model over time (DoD Directive 5000.59 and DoD Publication 5000.59-P, (references (f) and (g)).

From the US DoD perspective, modeling and simulation are expected to have benefits in four key areas, namely: readiness, modernization, force structure, and sustainability. The benefits in readiness include training and assessment; development of doctrine and tactics; and mission rehearsal. For modernization, the benefits include improved efficiency in the acquisition process and improvements in the quality of systems. For force structure, modeling and simulation is expected to assist in the optimal deployment and tasking of resources, while under sustainability, life cycle cost management is expected to improve. Within the United States, the Defense Modeling and Simulation Office (DMSO) oversees the US military s simulation and modeling efforts.

In order to achieve the expected benefits, the US DoD has defined an implementation strategy consisting of 6 theme areas. Of particular interest to the civilian community is the substantial investment being made to improve simulation technology, and the desire to engage the broader community in simulation and modeling through joint technology development and technology transfer. The work being done to improve simulation technology has resulted in the growth of open systems that are modular and recyclable. The efforts to define High Level Architecture (HLA) and the development of readily available Run Time Infrastructure (RTI) are examples of development in simulation technology. The authors believe that such developments will ultimately reduce the costs associated with simulation projects in the civilian sector making simulation and modeling more accessible for commercial applications.

In Canada, the Department of National Defence has initiated its own simulation program called Simulation and Modeling for Acquisition, Research and Training (SMART)[xx]. Recognizing the importance of human performance on system effectiveness, the SMART program is being implemented through the Canadian Military s human factors researchers at Defence R&D Canada — Toronto (DRDC Toronto and formerly the Defence and Civil Institute of Environmental Medicine). Within the maritime sector, DRDC Toronto has conducted a variety of projects including distributed simulations of warship formation maneuvering; helicopter deck landing simulation; and human performance issues related to the use of electronic charts. The electronic chart research, in particular, has a direct relation to regulatory initiatives within Canada for the civilian sector, and has involved the use of simulation facilities at the Centre for Marine Simulation.

The lesson to be learned from the military is that simulation has a much wider application than training in the reduction of human error. Simulation is aggressively being pursued as a tool to address latent human factor issues that are present in the general failure types outlined in the MASSTER report. The civilian (maritime) community has not picked up on simulation to the same extent as the military. Although simulation is now a mandatory component in mariner training (but only for the operation of radar), the use of simulation to address the human factors in marine operations is sporadic and haphazard. As far as human performance is concerned, the maritime industry continues to rely upon trial-and-error when implementing new technology or work processes.

5. Using Simulation and Modeling in Public Policy Research

At its core, public policy research is concerned with goodness and utility. That is, what are the right things to do, and what are the best ways of doing them? The answer to the first question is a philosophical question, while the second is economic. While there are few who would argue that safety at sea and protection of maritime environment are not good objectives of society, there is certainly debate on the extent to which these objectives can be achieved. One of the goals of the public consultation process in Canada is achieve a balance between the costs of protective measures and the costs of expected loss.

The public consultation process relies upon evidence presented either through scientific studies, observation of trends, or professional judgement in order to determine if an appropriate balance is being struck between protection and loss. The authors participate in the primary maritime consultative forum in Canada, the Canadian Marine Advisory Council (CMAC), and have observed that the evidence to support or refute maritime related policy initiatives usually has very little scientific backing.

Application of the precautionary approach in the maritime sector implies that an increased level of scientific evidence will be required to support policy initiatives. The scientific evidence demanded by the precautionary approach does not demand conclusive proof, but rather sufficiently sound scientific information . Expert opinion and data from observational studies can continued to be accepted, but the need for experimental evidence will increase. With human performance as a key determinant of safety and environmental protection, simulation and modeling will become a critical tool in future public policy research.

An example of how simulation and modeling could produce experimental evidence to support the implementation of public policy would be mission rehearsal. The mission rehearsal process could be used to develop and validate operational and contingency plans; determine the need for, and effectiveness of, publicly funded infrastructure; and, evaluate the effectiveness of new technology. To use mission rehearsal, the operating conditions would need to be modeled, and then professionals would participate in a series of simulations to determine. Simulation and modeling, in this sense, represents a tool to generate artificial experience that would significantly improve professional judgement in the consultation process, especially with respect to human performance.

In general there are two objectives for simulation and modeling in the maritime sector. The first is to address the existing problems related to human performance and the second is to ensure that additional latent human errors are not introduced into the marine transportation system. In order to achieve these two objectives, the existing simulation capability in Canada must be mobilized to undertake human performance research; advanced simulation and modeling capabilities must be established; and funding to cover the costs of simulation and modeling must be identified.

To date the Federal and Provincial Governments have invested well over $30M to establish a maritime simulation capability in Canada[xxi]. At the present time, the Canadian capability is primarily used for training, and its capabilities to conduct human performance research has been largely untapped. Aggressive utilization of existing simulation capabilities will help to address operational issues such as process/procedure validation, crisis management methods, and new equipment prototyping.

Even though the existing simulation infrastructure is useful to investigate general human performance issues, they are somewhat limited to deal with specialized issues, such as performance in harsh environments. An initiative to create advanced simulation and modeling capabilities (both in terms of physical infrastructure and expertise) for researchers to investigate the broad spectrum of human performance issues related to marine transportation is essential. Investment into improved numerical models, improved simulation technology, and improved evaluation methods using simulators will provide the necessary tools to address the introduction of latent human error through the process of innovation.

Transport Canada supports research of maritime issues through its Montreal based Transportation Development Centre (TDC). According to TDC s 2001 annual report, Transport Canada s contribution to maritime research was approximately $1 million (CAD), a fraction of which was spent on human factor s studies[xxii]. This level of investment by Transport Canada seems woefully inadequate to support its sweeping regulatory changes in the marine sector and must be increased.

The Federal government, however is not the only stakeholder with an interest in reducing human error in the maritime sector. The private sector also has a role to play through sponsoring and participating in human performance research. A collaborative funding and priority setting effort on the parts of the public and private sector will permit the academic and scientific communities to produce the necessary scientific evidence required by the precautionary approach.

Industrial clusters have demonstrated their worth in focussing the efforts of the academic, scientific, industrial, government, and capital communities to accrue maximum benefits. Within Canada, an Ocean Technology Cluster has been created[xxiii], and should include simulation and modeling as part of its core capabilities. The authors believe that innovation can only result in productivity improvements if human performance elements are factored into the creation of new technology or work processes. When considering innovation in the maritime sector, a portion of any increased R&D investment must be directed towards human performance, especially the mitigation of latent errors induced by rapid change.

6. Conclusion

With the rewriting of the Canada Shipping Act and its associated Regulations, the regulatory structure surrounding marine transportation is undergoing a fundamental change for the current system that has its roots in the mid-1800 s. At the same time, new technology is proliferating all aspects of marine transportation with the potential to revolutionize and optimize work processes.

Without addressing the chronic issue of human error, however, the maritime transportation system in Canada, already feeling the effects of spiraling costs associated with accidents, will have difficulty in absorbing the sweeping changes currently underway. Without mitigating the impacts of human error, innovation in the maritime sector may introduce more cost than benefit and not be sustainable in the long run.

Increases in the expected cost of loss activates the public interest, and leads to the implementation of the precautionary approach in the maritime sector. Simulation and modeling provides a capability to address human performance issues, and to contribute to the increased requirement for scientific information demanded by the precautionary approach. Utilizing existing simulators, as well as investment in specialized simulation and modeling capabilities, should lead not only to reductions in the accident rate, but also to improved productivity.

Memorial University of Newfoundland already possesses many of the elements required to host a comprehensive simulation and modeling program directed at the Canadian maritime sector. Through the Marine Institute, Memorial University is in the process of mobilizing its capabilities, as well as those of the Canadian Ocean technology community, to establish the necessary simulation and modeling capabilities to support public policy research in Canada.

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COMPUTER SIMULATOR TEACHING SYSTEMS FOR PROFESSIONAL TRAINING OF SEAFARERS

2002

Contemporary processes in economics and social life have given rise to a revolutionary situation in education. It is seen in bringing down a level of knowledge at both secondary and higher school. One reason for this is an outstripping development of engineering and new technologies as compared with educational dvancement. Efforts to improve educational process including a broad-gauge action to introduce computers and simulators in it do not pay because such things as old contents of education, methods of educational process organization, and purposes of the existent pedagogical system remain.

A lag of educational system behind the requirements of the industry is acutely showing in marine transport. For instance, a state of safety problems makes international maritime organizations (IMO, BIMCO, ISO etc.) pay much attention to a professional training of seafarers in matters of safe ships operation and environmental management.

To understand what we should do to improve maritime education it is necessary to analyze existing contradictions between modern requirements of the industry and possibilities of the present-day training system.

Existing educational system is an explanatory-illustrative type of training. It means that the teacher gives a theory, then demonstrates examples of its practical use in the form of problems, and then offers methods of solving them. The student is only to study ready-made opinions and to train himself in solving problems following teacher's patterns. The student cannot motivate his actions and formulate questions himself, and nobody teaches him about it.

Thus, student's attention and memory are mainly burdened. Thinking becomes unnecessary since a scientist, an author of a textbook, and a teacher have been thinking for the student. The student is a taught one, i.e. a controlled link in the system of education. This, of course, does not mean that students do not think but the teacher cannot evaluate the process of thinking because he spends all his time to manage to give ever-increasing information to his students.

This situation gives rise to the following contradictions:

1. A contradiction between an abstract subject of a cognitive activity (texts, tasks, computer and simulator programs, etc.) and the real subject of a professional activity where the knowledge is realized in the context of a workflow and under working conditions.
2. At higher school the student acquires knowledge dissimilarly (assorted disciplines, different departments, "independent" simulators) but under working conditions this knowledge is used as a whole, as a system.
3. Individual training principle contradicts the real use of knowledge while working in a group. Skills and inclinations developing under such a training could cause some strain in a team and emergencies on board.
4. The main thing in professional activity is a creative thinking while in traditional studying process it is attention, perception and memory. But the memory reflects the past. One can extract from the memory only what has been stored there before which could not necessarily correspond to the real situation and changed conditions.
5. Considerable inertia of the modern form of maritime education makes substantially difficult the adjustment of curricula taking into consideration ever-appearing new knowledge. This inevitably leads to an extensive enlargement of the volume of theoretical studying materials and forms among cadets a formal attitude towards the knowledge (unnecessary from the point of view of the student) and, therefore, their unwillingness to study. The same leads to some contraction of hours for some practical, laboratory, and simulator training.

The above-mentioned disadvantages of the traditional form of training result in a long period of adaptation (3 – 5 years) of fresh specialists on board. This has been proved by the results of a 20 year research program made by the Makarov State Maritime Academy in cooperation with the Baltic Shipping Company. The research has shown that the adaptation of 80-90% of maritime higher schools graduates ends by the third year of their career. It is necessary to say here that about 7 – 8% of the graduates would never be able to adapt to the working conditions on board.

With regard to the above-said, an advancement of the student's thinking ability, his ability to analyze any situations quickly and make adequate decisions must become a basis for improving of the maritime educational system.

It seems it would be to the point here to pay attention to the role of simulators in improving of professional maritime training. Some 20 years ago in maritime schools of the USSR a large-scale action was organized to introduce technical means of training (TMT) into the studying process. However, the lack of training technology with the use of TMT as well as the introduction of the simulators into an unprepared studying process did not allow to change the situation for the better. The whole chapter regulating the use of simulators in a professional training of seafarers has appeared in STCW 78/95 Convention. In this document, however, requirements to the simulators have been formulated from the point of the traditional approach to training (part A-1/12 of the STCW). Criteria of evaluating of the student's competence are uncertain with unclear limits of evaluation, for example: "The conduct, handover and relief of the watch conforms with accepted principles and procedures" (table A-111/1). Unclear wording prevents from single-valued understanding of requirements, makes difficult to work out certifiable requirements to marine simulators of the new generation.

Analyses of the existing simulators show that the main goal of the training, - advancement of the professional intellect of the student – is evaluated indirectly, by estimating the operational quality of a simulator and there is no evaluation of the real level of training (abilities to make decisions, first of all). A student can guess the right answer adding nothing to his intellect. Moreover, the knowledge obtained earlier is not used in such a training as well as the fruits of self-learning.

Thus, in order to improve the quality of the simulator training it is necessary to reconsider the training technology itself. At the Makarov State Maritime Academy a certain work has begun to form a new conception for the simulator training. It must become an undivided part of the studying process during the whole period of forming the professional intellect.

Simulators as they are now can not solve the problem because of the following:

1. Modern marine simulators are built copying real articles, most exactly reproducing all their functions, where the student has to be a subordinate and passively perform the tasks set into simulators' programs.
2. The complexity and the cost of the simulators are constantly growing while they are merely 30-50% employed.
3. Present-day simulator training has not got reliable methods to control a skills level of the student in making operational decisions (especially when working in a group). Evaluation of the quality of the training process is done through evaluating some changes in simulator parameters. This lowers the student to the level of a mechanical slave unit of the system that has no motives, no ambitions, no mentality.
4. Nowadays, when using simulator training, the leading element of the higher school, the teacher, who is to estimate the final level of professional skills, is excluded. His place is taken by the instructor who, in addition to the task of the estimation of the students level, must work the simulator, have practical skills to work the real unit, and have good enough level in psychology and professional disciplines. To train such an instructor is an unreal business. It is necessary to add here that, when using such a scheme of training, to

check the level of the accumulation of expertise is rather difficult (if not impossible at all without special tests)

Thus, an absence of indissoluble bonds between the studying process and the simulator training, an excessive complexity of simulators, a limited number of tasks performed by a simulator, and almost unreal business to train super-qualified instructors, - they are the obstacles to having desirable results when using present-day simulators.

It is necessary to create a new computer simulator system (CSS) organically integrated into the studying process beginning from the first year of study and to make a technology of its application based on an active training. Of course, the student should not be made but motivated to be active. The teacher is sure to become more active too to achieve the goal.

The control of the studying process must be active as well. It is not a level of the mastered information but the way and results of student's actions based on the information mastered and the level of student's motivation that should be controlled.

There should be considerable innovations in functions of computer simulator systems. The student should be given a dominant position. The instructor should be replaced by the Advisor who would not interfere in the studying process but would help to get rid of mistakes, formulate targets of activity, make an algorithm to achieve the goal.

As a result of some researches done at the Makarov State Maritime Academy, a new Computer Simulator Teaching System (CSTS) has been proposed. It differs from the existing simulators and works like the following. First, the Advisor (teacher, guru) gives the student necessary information on a particular topic. Next, an instructor of the CSTS forms a task. Then the student without any assistance, using the task, works with the CSTS acquiring and polishing practical skills based on the previously learnt information. If necessary, he goes for consultation to the Advisor. Having independently completed a number of tasks the student acquires certain skills to practically use his knowledge of the material of the topic, in other words, there is an increase of a professional intellect of the student. Finally, the Advisor evaluates student's knowledge and skills using specially designed expert system.

The main functions of the new Computer Simulator Teaching System must be:

1. Consolidation and securing of theoretical knowledge in the course of the self-control with the assistance of the CSTS and the Advisor; forming of motivation and targets and their correction. This function could be called a teaching-methodical.
2. Forming of sensory-motor skills in making decisions on concrete questions of studying and training.
3. Forming skills of both personal and collective control over individual systems, the ship power plant, and the ship as a whole.

The above functions have to be effectively used during the whole period of training, divided into four phases:

Phase 1 - forming of the general intellect while studying academic subjects;

Phase 2 - forming of the general-technical intellect while studying fundamental technical and professional subjects;

Phase 3 - forming of the professional intellect while studying special professional subjects;

Phase 4 - advancing of the professional intellect while attending special extension course for seafarers.

During the phase of forming of the general-technical intellect some sensory skills are worked up to get and handle information received from informational devices (gauges, indicating lamps, digital boards, computer displays, etc.). Laboratories and practicals are used for that as well as special training programs.

During the phase of forming of the professional intellect the sensory-motor skills and skills in making decisions are developed and advanced but at a higher level: as indivisible (complex) management skills for controlling both pieces of equipment and systems under different conditions (emergencies included).

At the end of the course of study the management skills for controlling complicated systems when working in a group are trained.

The simulator training must be transformed from the instrument for drills and practising in solving standard problems into an instrument for developing a professional thinking allowing to make correct decisions under any circumstances on board.

It is necessary to remember, as well, that one of the features of the marine transport nowadays is its extensive and ever-increasing internationalization. First of all it affects a personnel sphere of maritime business. That is why I believe that most actual and important nowadays is to join forces and achievements of teaching institutions and systems of maritime education of the countries all over the world in order to succeed in what is to be done in the field of maritime education.

At the very end I would like to say that there is no hope in improving the situation in the field of professional education until we, the teachers, grasp the full significance of a Protagoras' dictum "Man is the measure of all things."

The Development of Performance Assessment and Comparison Model for Mariners Utilizing a Ship Bridge Simulator

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ABSTRACT

This paper describes the establishment of an analytical criteria for the assessment of marine cadet and experienced officer competencies through simulation. The study involves the application of Analytic Hierarchy Process (AHP) to develop an evaluation system including job task analysis and implementation of simulation scenarios. The main goal of this study is design a powerful and flexible assessment process to assist simulator instructors to set up priorities and make the reliable performance-based evaluation when both qualitative and quantitative aspects of a performance measure need to be considered.

1. Introduction

National administrations, shipping companies and international organizations have always been concerned with navigational safety within their own fleets. However, even on well found ships operated by trained crew, it has not been possible to eliminate navigation casualties. Investigation into casualties indicate that the major factor in their cause is a weakness in bridge organization and management. Thus, the involved parties seek some evidence to ensure the competency of bridge team members. Though, the traditionally mariners assessment has been knowledge based using writing examination, the 1995 amendments to STCW Convention mandate performance base competency assessment for members of bridge team [1]. Sections A/II-1 and II/-2 of the STCW code list the accepted methods for demonstrating competence knowledge, understanding and proficiencies. The assessment of evidence obtained from a reliable simulator test is one of the methods listed.

It is not always an easy process for a simulator instructor to evaluate his trainee s performance. The simulator instructors at ITUMF assessing both marine cadets and experienced officers as part of the bridge team management course over the past two years have been experiencing the same problem. The tangible lessons learnt from the difficulties of assessment of the trainees during ITUMF simulator courses donated the importance of developing a quantitative assessment and comparison method. Although there were some guidelines both in STCW Convention and related IMO Model Courses, they were found not to be analytically sufficient.

2. Literature Survey

The literature survey was carried out by the Author prior to the analytical approach it was observed that three prior studies were presented as research papers. One of these papers involved research on comparing task ratings of Alaskan Marine Pilots. The main emphasis given to the methodology, Content Validity of Ratio [2]. The majority of the other documents concluded that developing a curriculum under the supervision of the simulator instructor method proved to be more efficient in comparison to the analytical methods.

3. Task Analysis

The main critical objective of this study was to determine the task in the officers and masters job performance. The essential task on bridge would then be the basis of development of the intended performance evaluation system. In order to clarify the objective techniques for reliable assessment, the author had used the method of an iterative process of review and discussion until a consensus is reached by experienced master mariners and maritime simulator instructors. Capt. Carl F. Wass who has recently completed a variety of research projects on bridge operation in Chevron Texaco Shipping contributed vastly to the contents of this research works supporting the author by transferring the industry s vision at the different phases of the study involved. The analysts have suggested that the job task analysis essential to be conducted for one particular simulation exercise. Therefore, the author has developed two visual simulation scenarios of a typical passing fairway and approaching the pilot station in Europort/Rotterdam and Solent/UK regions Some new tasks were identified during the trials in simulation environment. When the study group is satisfied that they have collectively identified the critical tasks on the bridge, alternatives and criteria involved in the performance evaluation system, author has decided to configure the criteria into a tree-like hierarchy. The assessment criteria (task list) is shown in Table 1.

Table 1. The assessment criteria

Code of Criteria	Asssesment criteria
M1	Turning rate for altering course
M2	Wheel over positions
M3	Designated ship speed at the pilot station
M4	ETA s maintained at the pilot station
N1	Deviation from the planned track
N2	Frequency of position fixing
N3	To carry out the Parallel Indexing
N4	Rules of Road in TSS
W1	Visual look-out
W2	Compliance of CPA
W3	Early action for avoiding collision
C1	Internal Communication between bridge members
C2	Communication with VTS using SMCP
C3	Pilot /Master exchange of information
M: Maneuvering **N :** Navigation **W:** Watch keeping **C :** Communication	

3.1. Evaluation Process

Dr. Ahmet Paksoy from Istanbul University provided AHP procedures. The Analytic Hierarchy Process is analytical tool, supported by simple mathematics, that enables people to explicitly rank tangible and intangible factors against each other for the purpose of setting priorities. The process has been formalized by Saaty and used in a wide variety of problem areas. The process involves structuring a problem from a primary criteria to secondary levels of criteria. Once these hierarchies have been established, a pairwise comparison matrix of each element within each level is constructed. Participants can weigh each element against each other element within each level. Each level is related to the levels above and below it, and the entire scheme is tied together mathematically. The result is a clear priority statement of an individual or group.

To determine the importance of the task listed in Table 1, the author created a descriptive questionnaire. This survey was sent to 40 masters and mates. A Sample of the questionnaire survey is denoted in Table 2. A total of 29 masters and mates responded to the questionnaire. The objective of the questionnaire survey was to engage participants in breaking down their decisions into smaller parts, proceeding from the goal to criteria down to subcriteria, eventually reaching to simple pairwise comparison judgments throughout the hierarchy arriving at overall priorities for the tasks on the ship bridge.

Table 2 Sample of the questionnaire

Code Of Criteria	Equal Importance	Which is more Important?	How Much Important?		
			Minor Importance	Important	Highly Important
M1 -M2	a				
- M3		M3			a
.					
N2 —W1		N2	a		
.					
W2 —C3	a				

The Author provided a AHP table of priority based on the result of this survey. The tasks importance hierarchy is shown in Table 3 and Table 3a. Table 3 indicates that main criteria maneuvering was agreed to be most important.
The second phase of this study consists of quantitative components beyond this point. Tasks were graded using the importance scale. However it should be taken into account that there will be some differences in the task list between the simulated sea region.

Table 3. The task importance hierarchy between the main criteria

	M	N	W	C	Weight
M	1	1,07	1,33	2,73	**0,328**
N		1	1,27	2,87	**0,319**
W			1	1,20	**0,217**
C				1	**0,135**
					CR=0,016

Main Criteria	
M	**Maneuvering**
N	**Navigation**
W	**Watch keeping**
C	**Communication**

Table 3 a. The task importance hierarchy between the sub criteria

M	**M1**	**M2**	**M3**	**M4**	**Weight**
M1	1	1/1,33	1/1,87	1,07	**0,197**
M2		1	1/2,07	1/1,13	**0,211**
M3			1	1,20	**0,356**
M4				1	**0,236**
					CR=0,019
N	**N1**	**N2**	**N2**	**N4**	**Weight**
N1	1	1/2,27	2,33	1/2,40	**0,175**
N2		1	3,07	1/1,73	**0,306**
N3			1	1/3,67	**0,095**
N4				1	**0,425**
					CR=0,020
W	**W1**	**W2**	**W3**	**Weight**	
W1	1	3,47	1,20	**0,470**	
W2		1	1/3,00	**0,134**	
W3			1	**0,396**	
				CR=0,0	
C	**C1**	**C2**	**C3**	**w**	
C1	1	1/1,07	1/2,07	**0,245**	
C2		1	1/1,60	**0,279**	
C3			1	**0,476**	
				CR=0,003	

3.2. Scoring Scheme and Performance Measures

A grading sheet was designed for the exercise consisting of fourteen tasks that the assessor is asked grade. A five point rating was given for the assessment of each task. This is an integrated component of the training and provides more useful feedback to the survey than a simple pass-fail scoring system. This scoring method is developed on the tasks which were rated by participants of the questionnaire surveys. Table.4 indicates the grading sheet and subcontent of the assessment [3]. Performance measures in the scoring system ranged from parameters like value rated to the achieved or not achieved and parametric . It was thought to be extremely important for an assessor to observe all tasks in the passage plan which was conducted by the bridge team during the briefing stage of simulation. The deviations from the sailing plan resulted in deficiency and a loss of points.

Table 4. The grading sheet

Code	Description of Criteria	Loosing point ← → Loosing point Scoring				
	...	.				
M3	Designated ship speed at the pilot station	Speed<3kt	3-5 kt	6 kt	6-8 kt	8 kt<speed
	...	.				
N1	Deviation from the planned track	Dev >0.5 nm to port	0.5-0.1mil to port	0 nm	0.5-0.1 nm to stb.	0.5nm<Dev. to stb.
		→ Loosing Point →				
C2	Communication with VTS using SMCP	SMCP & Speaking & Understanding	Speaking & Understanding	Understanding	Speaking	Can not Communicate
	..				.	.
W2	Compliance of CPA	CPA >1 nm	1- 0.5 nm	0.5 nm	0.5-0.3 nm	0.2-0 nm
	..	.				

4. Implementation on the Ship Bridge Simulator

The author invited the four cadets and the four ship mates intending to be promoted to chief mate license and another four master mariners for simulation trails to the ITUMF. The mariners were then separated into three balanced bridge teams, each of four participants, namely master, chief officer, 3rd mate, and observer. A helmsman was provided by ITUMF Staff.

4.1. Scenario

The author created two scenarios. Events were planned in the scenarios to ensure all of the various tasks that were identified by Subject Matter Experts.

In the first scenario, the vessel approaches the pilot station for Europort/Rotterdam. Due to rough sea condition the vessel were requested to proceed further inshore to pick up the pilot. Strong currents and conflicted crossing traffic were encountered in the pilot embarkation area. While still in the buoyed channel the vessel was advised by VTS to reduce speed and hold in the channel until a loaded VLCC clears the turning basin and enters the inbound lane. Once the pilot was aboard the vessel and had the con, a rudder command was carried out incorrectly which could put the vessel in danger if not corrected.

The second scenario the vessel was developed in the East Solent region. The vessel picked up the anchor in the East Solent and proceeded to Southampton. During the turn into the Thorne Channel, the pilot became incapacited and the Bridge team had to decide if to abort the transit and anchor or proceed using shore base pilotage. Events were planned in the scenarios to ensure all of the various tasks that were identified by the experts.

4.2. Briefing

Prior to conducting the scenario a full briefing was given to participants, and all charts and publications, such as tide tables and ship s routing information were supplied. Authors introduced the initial exercise setting in relation to the voyage situation, and allocated roles to the team. The suitable time was allocated for the master in order to organize the ships navigational plan in cooperation with his mates.

4.3. Simulation

The first part of the simulation, three sessions with the same scenario was followed, but played by three different groups. After studying the information collected the second scenario was executed with the same group. A separate observer from each team and an assessor evaluating the participants were utilized during the simulation process. The Assessor observed the executions through the TV cameras on the bridge and slave radar monitors in the control station. Three data sheet have been developed to track task against group performance. There were no major failures such as collision or grounding at the end of the simulation.

5. Assessment and Comparison

Descriptive data was generated for each group during the simulation. One weakness of the process was the marginal number of the focus groups and scenarios. Ideally more data must be accumulated for assessing and comparing the groups, but these data could be the subject of an additional analysis. Table 5 shows the performance comparison values of three focus groups. Table 6 summarizes the final scores of the performance comparison after the second scenario.

Table 5. The Final Performance Comparison Values of Three Focus Groups at the end of the First Scenario

	0,197	0,211	0,356	0,256	
	M1	**M2**	**M3**	**M4**	w_M
Masters	0,637	0,455	0,637	0,333	**0,534**
C/Off.	0,258	0,455	0,258	0,333	**0,324**
W/O	0,105	0,091	0,105	0,333	**0,163**
	0,175	0,306	0,095	0,425	
	N1	**N2**	**N3**	**N4**	w_N
Masters	0,714	0,714	0,600	0,091	**0,439**
C/Off.	0,143	0,143	0,200	0,455	**0,281**
W/O	0,143	0,143	0,200	0,455	**0,281**
	0,470	0,134	0,396		
	W1	**W2**	**W3**	w_W	
Masters	0,429	0,429	0,600	**0,497**	
C/Off.	0,429	0,429	0,200	**0,338**	
W/O	0,143	0,143	0,200	**0,166**	
	0,245	0,279	0,476		
	C1	**C2**	**C3**	w_C	
Masters	0,778	0,429	0,600	**0,596**	
C/Off.	0,111	0,429	0,200	**0,242**	
W/O	0,111	0,143	0,200	**0,162**	

	0,328	0,319	0,217	0,135	
	M	**N**	**W**	**C**	**Result**
Masters	0,534	0,439	0,497	0,596	**0,503**
C/Off.	0,324	0,281	0,338	0,242	**0,278**
W/O	0,163	0,281	0,166	0,162	**0,199**

Table 6. The Final Performance Comparison Values of Three Focus Groups at the end of The Second Scenario

	0,328	0,319	0,217	0,135	
	M	**N**	**W**	**C**	**Result**
Masters	0,414	0,395	0,505	0,389	**0,424**
C/Off.	0,331	0,303	0,314	0,219	**0,274**
W/O	0,275	0,303	0,181	0,392	**0,325**

From the assessment and comparison, following result were obtained.

There was a tendency by the experienced officers to handle all the work themselves. They could establish the priority among the different tasks. As a result many low priority items were not taken care of. In addition to look out and collision avoidance, adjustment of course by parallel indexing, estimation of leeway, and reducing speed at pilot point became most important tasks for the experienced masters. The frequency of the position fixing and using SMCP with message markers were found to be relatively poor [4].

The cadets taking the test in the simulation had very limited sea experience. They have had 5 months at sea as a cadet but their experience had been in the role of an observer. The weight of Criterias N4, W2 and W3 were very good evidence for the cadets who had very good knowledge of rule of the road in TSS, but recognition of danger and early action for avoiding collision were found to be relatively poor. They waited too long for action. The weight of Criterias W1 and C2 showed that the cadets had some difficulties establishing priority. They respected to check off lists and Standard Maritime Communication Praises, but the secondary tasks overloaded them and these tasks took the priority over immediate navigation concern. Ship s deviation from planned track was relatively high and ship speed at the pilot station was too much during the scenario. The criteria M3 and N1 indicate that the cadets were in lack of consideration on margin of safety and ship speed. The deviation between scheduled position of reducing speed and maneuvering results were bigger than master s result.

6. Conclusions

Author has developed an assessment and comparison system based on rank ordering of the tasks by criticality factor. standards and performance measures depended on the condition of the assessment. This problem was minimized by using simulator and AHP method - Subject Matter Experts ideas. The model provided a quantitative method of grading and comparing seafarer s skill during bridge simulation. By utilizing the performance assessment and comparison values the effective training curriculum can be constructed. Therefore insufficient degree of abilities can be trained intensively.

Abbreviations

AHP: Analytic Hierarchy Process
ITUMF: Istanbul Technical University Maritime Faculty
CPA: Closest Point of Approach
ETA: Estimated Time of Arrival
VTS: Vessel Traffic Services
TSS: Traffic Separation Scheme
SMCP: Standard Maritime Communication Phrases

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Marine Simulators: Technical And Performance Specifications - A Paradoxical Parallelism?

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ABSTRACT

The need for safety of life at sea and the protection of life and the marine environment resulted in the harmonization of training for navigation in the form of the Standards of Training, Certification and Watch keeping for seafarers (STCW 95). The Use of simulator for training is also something that has come to stay, in view of the advantages accruable from this, and Performance Standards for simulator use in training seafarers are contained in A-I/12 (training) of the STCW Code.

This paper briefly examines the interesting development in simulator use where performance standards have since been developed with relative ease, but the expected resulting technical specifications seem to be taking much longer in coming, if they do finally come. The framework in the form of the STCW document was developed by the Maritime Safety Committee (MSC), giving performance standards while the International Marine Simulators Forum (IMSF) was assigned the task of developing the technical specifications.

It is revealed that the reasons for the delay lie as much with the opinions of instructors as with the manufacturers and economic concerns. However, safety of navigation which must remain paramount in the minds of all players demands that the technical specifications be developed, and as a matter of urgency.

The International Maritime Organization, non-regional interests and of course those associations representing the interests of the lecturers and instructors will do well to come together to agree on the technical specifications based on the STCW performance standards in the interest of the objectives of the international maritime community.

The works of several scholars and active persons in simulator training come into good use, and their presentations have been considered.

Key terms: performance standards, simulator training, technical specifications.

1. Introduction

Maritime Education and Training is a vital part of the marine affairs, given that incompetent crew translate to damage to or loss of property and life, and indeed damage to the environment. Furthermore more competent crew will assure or at least contribute to the economic viability of the particular sea trade. For these and more, the Standards of Training, Certification and Watch keeping for seafarers, 1978 as amended in 1995 dealt extensively with the issues of education and training of the merchant navy personnel.

The emphasis on hands on experience cannot be better justified in any vocation than the maritime field, and training on board ship is a natural necessity. Over the years however, with the strides in technology, the development of simulation tools has made it possible to reproduce real life situations at sea, in the school. This means that some sea experience is obtainable on land, and some uncommon experiences are also easily experienced . Several other advantages do exist especially where the simulator-training tool is properly utilized.

The interesting scenario in the use of simulator for training presents itself as an intriguing paradox of parallelisms, where performance standards have since been developed with relative ease, but the expected resulting technical specifications seem to be taking much longer in coming, if they do finally come. The attempt is to approach the subject(s) the way they have been considered; as pseudo-separate issues. This is more especially as the International Maritime Organization (IMO) for some reason deals with one and leaves the other for the International Marine Simulators Forum (IMSF) which for some reason has been unable to bell the cat.

2. Performance Standards:

The Standards of Training Certification and Watch keeping for Seafarers (STCW) Convention 95 has since resulted in performance specifications being developed for marine simulators

2.1 The STCW Input

The establishment of performance specifications for marine simulators was seen as a necessity, especially in view of Cross and Veenstra (1996) who stated inter-alia In the case of simulators training there are no recognized standards of performance furthermore, little research has been done into showing of ship-handling simulators to be an efficient training tool. While the research remains unavoidable, the onus of this presentation lies with the former. The 1995 amendments to the Standards of Training Certification for seafarers 1978 had of course taken cognizance of this lapse, in the interest of the objectives of the convention. It is to be noted that this alarm was actually raised before the standards were born.

2.2 The Requirements: Basic requirements.

A remarkable difference between training and assessment specifications is in A-I/12.1.5(training) of the STCW Code, which states provide an interface through which a trainee can interact with the equipment, the simulated environment and, as appropriate, the instructor and that in A-I/12.2.4 (assessment) which states the same thing with the exception of the underlined above which is grossly irrelevant in assessment. This is the only difference in the two addresses quoted above, each of which contained five sentences, which were exact in every detail besides the highlighted difference. This only difference draws the line between training and assessment, and is a pointer to two vital facts: the STCW did not intend to leave any stone unturned in giving the specifications that were considered important, and the STCW was not going to give specifications which were not necessary. A basic understanding is therefore evident. The establishment of performance standards was indeed a vital matter.

2.3 Additional performance standards.

This includes standards for Radar Simulation and Automatic Radar Plotting Aid (ARPA) simulation. In addition to this, STCW.7/Circ.10 (ANNEX) offers Interim Guidance on Training and Assessment in the Operational use of the Electronic Chart Display and Information System (ECDIS) simulators

2.4 Their Purpose

Generally speaking, the requirements are basically to ensure that the selected objectives and training tasks are achieved. They are also concerned with the operational capabilities of shipboard equipment and the errors and limitations so obtainable, behavioral realism, provision of a controlled environment, instructor control and monitoring, trainee interface with the simulator, instructor (where applicable) and simulated environment. These performance standards are simply a harmonization of performance and quality standards. Miurhead (1996) stated performance and quality standards of simulators and instructor are many and varied.

In the first instance, given that simulator use is diversified, and the use of 3D moving graphics means that a great demand for programming and memory space is connoted, each type of simulator will therefore perform a group of tasks. For this reason, there are several simulator types for varying group tasks , all of which add up to marine simulation. This would pose no problem was it not that maritime education and training is globally harmonized (thanks to IMO) and the training standards must then have some degree of parity. It therefore becomes necessary to harmonize the performance standards of the training equipment, major of which is the marine simulator. In order words, this harmonization will aid in ensuring harmonized training.

Again, owing to the capital-intensive nature of simulator production, the tendency is to cut corners with a view to cutting cost, hence producing substandard equipment that may be attractive in certain quarters. The domino effect on the industry will stem from poor training. The fact is that simulators cannot be done away with Navigation education is vocational in nature with prominent attention paid to technical ability the only way out lies in training through simulators whereby the student can obtain corresponding technical ability (Wang 1996). The stipulation of performance specifications will put paid to this.

2.5 Expected Use

The performance of specifications stipulated for simulator training should be so used: compliance to specifications while employing simulators in training. For obvious reasons, the use of simulators in training covers a vital area of ensuring the competence of seafarers, a function which is all-encompassing and hence performance standards must be complied with in all simulator training for marine purposes. There is no justification for exemption, unless such training, assessment and / or certification will not require the recognition of the IMO or its member states.

3 Technical Specifications:

But Efforts to establish internationally recognized technical specifications for marine simulators have failed to date.

According to Muirhead (1996), it is noticeable that not only is there a surprisingly high level of acceptance of simulators in the maritime community, but that the range and type of marine simulators is expanding quickly . Given the prevailing scenario - technological advancement vertically (improvement) and horizontally (broadening of scope), the existence of simulation in practically all physical fields of human endeavor does not come as a surprise, neither does the fact that the community in entirety has been unable to come up with internationally recognized specifications, technically speaking, for the repertoire of simulators, in spite of the fact that performance specifications have existed for quite some time.

3.1 The Underlying factors

While the current quagmire is to be decried, one cannot but appreciate the underlying factors to this precarious yet sturdy situation. Precarious in that the needs and continuous diversifications and generalizations — the simulator industry is moving into new terrains while at the same time simulators are increasingly able to combine more functions than they previously could — portend an imminent collapse or its applicability becoming limited owing to reduced acceptability, dragging the user industry back in time. Sturdy, in that precipitous as the situation may be, the factors (and interests) behind it appear desperate to keep it in such a state.

For one, the ambient view offered by bridge simulators is a major bone of contention. Certain persons feel very strongly that views should be limited to 180° — 240, others cannot agree with anything less than a full 360°. Bole etal (2000) referred to simulators offering less than 360° view as blind simulators. The question arises as to whether or not the bridge of the usual vessel actually offers this. The author attended a lecture in October 2001, delivered by Capt. J. Cross, Director of the Willem Barentsz Maritime Institute, Terschelling, Netherlands He suggested a situation in which the simulator may offer 240°-280° while the remaining of (rear view) is displayed on a monitor (computer screen) on the bridge. This appears to be a convenient meeting point. It is to be seen however if the players on the two sides of this center will agree to be drawn to it.

It is argued by some that simulator based training should be abandoned altogether while certain others are of the opinion that it should totally replace on board training. S. Murata and H Kobayashi (2000) however concluded that a combination of the two approaches would give optimal results. Another center with two poles.

Muirhead (1996) estimated that a total of 810 simulators are in use in maritime training institutions. Different firms in different countries produce these simulators, and the capabilities and functions of the products vary. For economic reasons however, each producing nation argues in favor of its products. In view of this, it is unlikely that there will be internationally accepted technical specifications for some time to come, as such an agreement will be seen by nations as jeopardizing their interests. It is common knowledge that there are numerous firms involved in the manufacture of marine simulators, each with its own different approach to its product, and the use and familiarity procedures as well as training patterns applicable to each machine are varied. There are simply no standards.

The case with assessment by simulator is also worth mentioning. While Endo et al (2000), Hooper et al (2000), Stiles and Jacobs (2000) are strong proponents, Smith (2000) even expresses that instructors should be less involved and let the simulators do more of the work. Conservatives are of the opinion that simulators can simply not replace humans in assessment. The general belief however is that while thought processes cannot be measured by simulators, these simulators remain objective assessors of the indices of these thought processes.

The Users in the quagmire

The author has obtained instructor training in simulator use, and has been in some simulator facilities in various locations, including ISSUS in Hamburg, STN Atlas and the GAUSS Institute both in Bremen, all in Germany, the Arab Academy in Egypt, the Willem Barentsz Maritime Institute, Terschelling, Netherlands, and had familiarity programs with others including Poseidon, . The observation is that each software and hardware manufacturer approaches simulation in a different way, and sets principles and priorities as it deems fit. In some cases, certain features that are considered basic in some programs are entirely missing or underdeveloped in others. After all there is no person or agency empowered to enforce standards, more especially in the absence of standards. Worse still, the arguments are always in favor of these inadequacies. The particular is either unimportant or is of minor importance, or scenarios demanding it do not occur. In another argument, the feature is of utmost important because a single occurrence of such scenario can be fatal. There are a lot of other issues, and the instructor and student are at the receiving end. Familiarity of an instructor with a particular simulation equipment does not mean an ease in familiarity with another. Rather, it almost certainly means a need for reorientation, since it is rare if not impossible to find two simulators which perform the same functions having similar operational features. Errors of scenario generation can therefore not be avoided, and more importantly, the same goes for assessment by simulator.

At a briefing on a particular simulator, a student who is used to another one finds that instructor expectation are very different for the same operation, so are those of the training tool and its assessment parameters. Some of these parameters have already been mentioned, and others may include dynamic visual and acoustic realism, system-instructor-student interactivity, amongst others. Of course the final end result of inconsistence in training is clear, and is not desired.

The IMSF Initiative

The International Marine Simulators Forum (IMSF) at the 1993 Marsim decided to develop an international standard for ship operation training simulators. The FIRST stage was the development of a simulator classification, for which a classification working group was established. At the IMSF meeting in Norway in August 1994, a draft recommendation on simulator classification was submitted.

The recommendations for simulator training, assessment and refreshment were to be dealt with by the SECOND stage, but these were overtaken by .the development of the new STCW Code. An opportunity still exists however, for IMSF members to develop practical training and assessment guidelines given their experience, by making contributions to the STCW sub-committee to complete development of Part B of the Code. A scheduled 30 month European Union project (Task 46) entitled Maritime Standardized Simulator Training Exercises Register (MASSTER), coordinated by ISSUS, Hamburg, commenced in 1996 with the participation of IMSF members. The overall objective being the inventory of existing scenarios and the development and documentation of new ones, based on the assessment of gaps and shortcomings in the currently existing scenarios. The resulting final catalogue of scenarios serves as a basis for the harmonisation of maritime education and training for existing simulation facilities, at least in the EU.°

The THIRD stage intended to develop performance standards aimed at the description of technical characteristics and capability of various classifications, including instructor stations given the functional training requirements they are designed to meet. Given that IMSF is best suited for this, especially with the STCW mandate, this has been too long in coming.

The FOURTH stage was to be a development of a classification system in which evaluation of a simulator would lead to class approval. The Quality Standards requirements of Regulation I/8 and the Codes may be seen to obviate this, while indeed they do demand for it. Section B-I/8 (Guidance regarding duality standards) states In applying quality standards under the provisions of regulation I/8 and section A-I/8 to the administration of its certification system, each party should take account of existing national or international models The intention also included the examination of the sea service equivalence of simulator training.

The amendment of the FIRST stage and subsequent approval was done in 1994, but that was where it ended, and even the other stages have not been so lucky.

Conclusion

Generally speaking, for reasons of experience, background, technological advantages and otherwise, local marine industry focus, tradition and many other considerations, there are simply too many opinions, each differing about too many details, for there to be a consensus. This was easily reflected by Muirhead (1996), where he indicated that owing to diversified opinions on specifications for different types of simulation, the International Maritime Organisation (IMO), which incidentally is the parent of the STCW sub-committee concluded that codes do not include detailed technical specifications of simulators. Hence, the line was drawn, and the role of the Maritime Safety Committee (MSC) was therefore to come up with performance standards while the onerous task of developing technical specifications would lie upon the International Marine Simulators Forum (IMSF) which is composed of the users, manufacturers etc. Expectedly, of course the grouse is greater within IMSF than anywhere else. Here lies the imbroglio.

Proposal

Cross (2000) indicated that new initiatives were being made in IMSF to restart the of coming to a new classification, which was scheduled to be ready for the Marsim 2000 and he further stressed that

> It should be noted that in a limited body such as IMSF, it has taken more than 10 years to reach an acceptable draft, due to the great diversification of members, all wanting to be heard and have influence on this classification. No doubt that such a decision for acceptance by a body as diversified as IMO will probably cause even greater discussions and deliberations.

Having therefore concluded as above, it can be argued that the grouse need not be so great, for the technical specifications, if they are to objectively meet the goals of the international maritime community — of promoting safety of life, property and the environment by improving standards of navigation - can not be borne from anything outside the performance standards clearly itemized in Section A-I/12 of the STCW (95) Code.

It therefore behooves the IMSF with the necessary support of the International Maritime Lecturer s Association (IMLA), the International Association of Maritime Universities (IAMU), and other well meaning recognized but non-regional maritime bodies to convoke for the purpose of designing achievable technical specifications from the IMO document. A working group may be assigned the preliminary task before such a general convocation. Again the IMO must be aware of the fact that it can not adopt the position of an observer in this matter, as, delicate as the prospects may seem, it is entirely necessary if the efforts it (IMO) has so far made regarding simulation training are not to be trounced.

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Session IIIA — WG 3

Chair: Dr. D. Grewal

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Evaluation of Maritime Universities/Faculties Based on the Qualifications of the Academic Staff

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ABSTRACT

Globalization of Maritime Education and Training has been accelerated since the international maritime community adopted the revised STCW95 convention and Codes. Several maritime institutions including universities have keenly been searching for the best solution to meet the requirements of STCW95 and demands for their graduates from shipping industry. Since the demands from shipping industry, however, varies in the economic states from country to country, it becomes difficult to obtain the only consensus to harmonize the level of education and training, especially in the community of maritime universities in the world. In such a current situation, the author has recently realized that evaluation of the academic curriculum and academic staff at the maritime universities should be definitely needed before obtaining the consensus.

The purpose of this paper is to propose an evaluation method for maritime universities based on the academic staff. Considering the current situation of the international MET system, the four criteria that are Academic Degree, Teaching Experience, Certificate of Competency and Seagoing Experience will be selected for the evaluation. Furthermore, Geometric analysis will be introduced for fair and objective evaluation. And usefulness and issues on this method will also be discussed in this paper.

1. Introduction

In general, effective education is achieved with having a well-organized curriculum for teaching objectives, well-planned teaching methodology in the classroom and high competence of academic staff for subjects concerned. The issues of teaching curricula and methodology for a field of education have been developed with the agreements between related educational institutions and industry. Consequently, accreditation of teaching curriculum at educational institutions for engineering education by regulating bodies, such as Accreditation Board for Engineering and Technology (ABET), Japan Accreditation Board for Engineering Education (JABEE), has recently attracted a great deal of attention [LATORRE, (1997)]. Moreover, the program of accreditation of which the philosophy is based on the quality assurance has been regarded as one of the approved methods for external evaluation of highly educational institutions.

Reflecting these trends in the field of Maritime Education and Training (MET), STCW95 and the Code, especially in the tables of sections A-II/1, 2 for Deck officers and A-III/1, 2 for Engineer officers, clearly define the requirements on the competence for being a license holder. The IMO Model courses provide the administrators of maritime institutions with a well-constructed template for syllabi of maritime subjects concerned even though they are just guidelines and not strict criteria such like the accreditation programs mentioned above. However, STCW95 that also adopts the concept of the quality assurance mentions not only the teaching curriculum at maritime institutions but also the qualifications and experience of instructors and assessors at the maritime institutions, as provided in the sections A-I/6 and A-I/8. With the progress of implementation of STCW95, a target of evaluation will shift from the MET and certification systems for the whole of a country to individual maritime institutions that have undertaken education and training aiming at the Certificate of Competency approved by STCW95 and the Code.

It can be acceptable for experienced lecturers at educational institutions that the contents of a subject provided by several lecturers will not exactly be the same even if they refer to the same syllabus as well as the same textbook. This suggests that the contents which the students have learned from the lecturers depend entirely upon the lecturers competence and methodology in teaching. Therefore, comprehensive evaluation of a maritime institution cannot appropriately be achieved without evaluating the qualifications and experience of the academic staff at the maritime institution.

Considering the current situation of MET at maritime universities, the qualifications and experience of the academic staff are discussed in this paper. Additionally, an analytical evaluation method for the maritime universities based on the qualifications of the academic staff is proposed and applied to an example. Furthermore, usefulness and issues of the proposed method are also pointed out and discussed in this paper.

2. The current situation of MET and the target of evaluation

What is the main purpose of Maritime Education and Training for the undergraduate course at an advanced Maritime university? The answer to this question has long been discussed with educationalists at maritime universities in the world. However, it seems to be difficult to find the only consensus which all of the maritime universities in the world can accept. In this section, the target of evaluation will be examined after discussing the current situation of MET at maritime universities.

2.1 The current situation of MET for the undergraduate course at a maritime university

There is a traditional perspective that the purpose of MET is to educate people for ships officers, that is to say, to obtain the Certificate of Competency issued by authorized organizations. To achieve this purpose, most of the maritime universities have keenly made great efforts to find out their educational level suitable for being a university —not a training center. However, after the preparation of revising the STCW convention, inconsistency in the level of MET at the maritime universities has been emerged. Because the level required by the revised convention was the minimum, which was just the opposite of the direction they had done so far. Consequently, most of the maritime universities have arguably lost sight of the direction.

In addition to this current situation, the author have realized from his experience to attend several discussions about this matter that the reason for making this issue more complicated may lie in the following two facts;

MET systems in several countries have their own historic background.

Having developed over a period of hundred years, the MET system in each country varies in its philosophy and methodology. To take an example, it is known that there were two major approaches to establish the relationship between the academic degree program and the license program at maritime universities during 1960 s/1970 s [LEWARN, (2002)]. Such different perspectives based on the historic background in each country have often delayed finding a mutual consensus of the issues on developing the international MET system.

MET has an aspect of vocational education.

The target of vocational education is generally to educate people for qualified experts on an industrial activity. Taking this fact into account, MET as one of vocational education has always been affected by the demands of shipping industry, which vary according to the economic situation of each country. Consequently, the following facts have been found in the world; a maritime university in Seafarers Supply Countries has to emphasize the necessity of the educational program leading the students to be the qualified marine officers onboard ship in compliance with STCW95 or higher regulations, while another maritime university in Seafarers Demand Countries has certainly to emphasize the necessity of the additional educational program leading the students to be the managers and administrators of maritime industry in the country.

Under such complicated situations, it might be impossible to find the only consensus on the issues of MET among maritime universities in the world. The author would therefore like to suggest that maritime universities should have high potential for both academic education leading the students to be those who can contribute their knowledge to maritime industry and practical training leading them to be qualified ships officers, in order to cope with the demands from maritime industry which always vary according to the economic state of the country. The key point to meet this requirement must be the qualifications and experience of academic staff.

2.2 The target of evaluation

Although the main purpose of a maritime university is to educate the students either for officers on ships or managers of maritime industry on shore, the contents of the curriculum have to be sufficiently high. By this reason, academic staff is required to have sufficient knowledge and experience for the subjects they are providing. For such an avaricious requirement, another consideration will be needed, that is to say, it is difficult for an academic staff to have high knowledge and enough experience for both academic education and practical training if each of the levels to be achieved becomes higher and more sophisticated.

Generally speaking, education is accomplished by some instructors each of whom has specialized field. In other words, education is supported by a team of instructors which consists of several specialists. Therefore, the solution to this consideration can be obtained by shifting the target of evaluation from an instructor to an entire team of instructors. This can also give us expectation that the result of evaluation shows potential of a maritime university because competence of academic staff as a team of instructors dominates the implementation of the curriculum for MET.

3. Evaluation of a maritime university based on the qualifications of the academic staff

To prevent difficulty in evaluating a human and meaningless criticism for ranking the academic staff, items for evaluation should carefully be selected and the evaluation has to be done by a logical method. In subsequent sections, the proposed evaluation method will be explained with taking an example.

3.1 The four criteria for evaluating the academic staff

The fields of academic education and practical training are selected as the focus of evaluation since it is quite obvious from its name that MET consists of these two fields. Regarding the selection of appropriate criteria for evaluating the academic staff, paragraph 7 of the section A-I/6 gives us a great hint, which is Each Party , shall ensure that the qualifications and experience of instructors and assessors are . . W ith referring to this sentence, the academic degree and teaching experience may be appropriate as the qualifications and experience for academic education. In the same way, the certificate of competency and seagoing experience may also be appropriate as those for practical training. Then, the four criteria for evaluating the academic staff have been selected as follows;

For academic education

- Academic Degree
- Teaching Experience in year

For practical training

- Certificate of Competency
- Seagoing Experience in year

To make the evaluation logical, a grading system using numerical calculation should be introduced. After collecting data from each of the academic staff, the data should be converted in accordance with the table 1. Then a fundamental data table for a maritime university is obtained with calculating the average number of each criterion, as shown in table 2.

Table 1. Conversion table for the grading system

	Criterion	Grading number				
		0	1	2	3	4
AE	Academic Degree	Non	Dip.	BSc	MSc	Ph.D
	Teaching Experience	0y	_1y	_3y	_7y	15y_
PT	Certificate of Competency	Non	Dom.	3O/4E	CO/2E	MM/CE
	Seagoing Experience	0y	_1y	_5y	_10y	15y_

Abbreviations:

AE: Academic Education, PT: Practical Training, Dip.: Diploma, Dom.: License for Domestic voyage

Table 2. Fundamental data table for a maritime university as an example

No	Position	AD		TE		CC		SE	
1	Professor	BSc	2	18y	4	MM	4	10y	3
2	Ass. Professor	MSc	3	5y	3	2E	3	5y	2
3	Research Assist.	Ph.D	4	2y	2	Non	0	0y	0
:	:	:	:	:	:	:	:	:	:
:	:	:	:	:	:	:	:	:	:
Average		-	2.2	-	2.2	-	2.8	-	3.4

3.2 Geometric method to evaluate a maritime university

Potential of a maritime university based on the qualifications of the academic staff is geometrically analyzed by plotting each of the averaged numbers of the four criteria explained in the section 3.1 on the *X-Y* coordinates as shown in fig. 1, of which the average numbers are A=2.2, T=2.2, C=2.8 and S=3.4, respectively. A set of index numbers are defined in order to make it clear that the relations between the geometric characteristics and their meanings on the evaluation.

The area of the square _*CSAT* may be indicate the comprehensive potential of the academic staff. An index number P is introduced for easy comparison with other data, which is shown as the ratio of the area enclosed by solid lines A, to that enclosed by the dotted lines A_{max},

$$P = \frac{A}{A_{max}} = \frac{1}{64}(S+T)(C+A)\ (\%). \quad (1)$$

The location of the center of gravity, G (x_G, y_G), of the square _$CSAT$ may indicate the balanced point of the comprehensive potential of the academic staff. The coordinates at G are respectively obtained as;

$$x_G = \frac{1}{3}(S-T) \text{ and} \quad (2)$$

$$y_G = \frac{1}{3}(C-A) \cdot \quad (3)$$

In addition, the length between the origin O and the center of gravity G may indicate the deviation from the even point at where the four criteria are completely balanced. Another index number D is also introduced in accordance with the previous way, which is shown as the ratio of the length between the center of gravity and the origin OG to the maximum length OD at the angle θ,

$$D = \frac{\overline{OG}}{\overline{OD}} = \frac{\sqrt{2}}{4}\cos(\theta - \frac{\pi}{4})\sqrt{x_G^{\ 2} + y_G^{\ 2}}\ (\%), \quad (4)$$

where the angle θ is given as;

$$\theta = \tan^{-1}\left(\frac{y_G}{x_G}\right). \quad (5)$$

The relation between the location of G and the characteristics of the academic staff, namely those of the maritime university is illustrated with fig.2. In the case of this example, the location G has the coordinates (0.4, 0.2), P=43.8, D=15.0 and θ=26.6¡. The results of evaluation are briefly listed as follows;

- There is even more possibility to improve comprehensive potential.
- The field of MET emphasized in teaching has a tendency to practical training and the deviation is 15%.
- The method of teaching students has a tendency toward experience based.

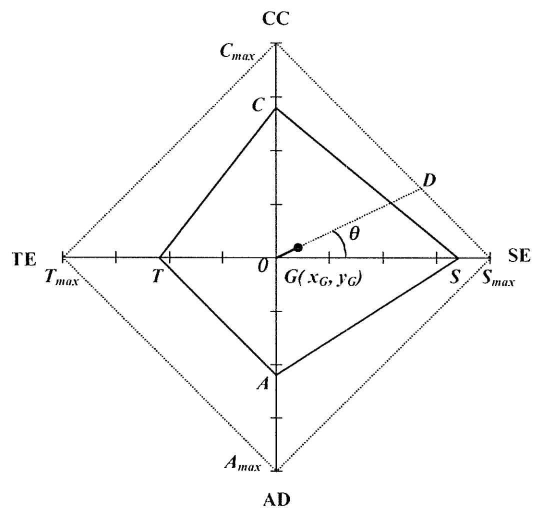

Fig. 1 Geometric analysis for the maritime university as an example

4. Discussion and conclusion

The purpose of the proposed evaluation method is not to rank maritime universities in the world, but to identify their comprehensive potential according to the qualifications of the academic staff. Hence, this method may be suitable for self-evaluation or internal evaluation to identify strengths and weaknesses of a maritime university, faculties or departments. The index number P shows comprehensive potential for MET as mentioned before. The index number D of the advanced maritime university should be close to zero, however, a little deviation to the first quadrant could be allowed if there is a great demand for marine officers, but the angle θ have to be close to 45 degree because the balance of education between knowledge base and experience base should be even.

Following an idea that potential of an educational

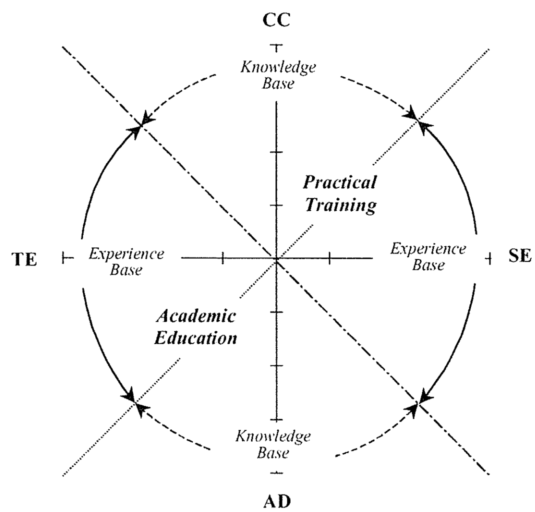

Fig. 2 The relation between the location of G and the characteristics of the maritime university

institution has to be dominated by the qualifications of the teaching staff, this method for maritime universities has been proposed in this paper. Evaluating a human is, needless to say, difficult and sensitive. However, fair and objective evaluation for educational institutions is never achieved without evaluating both academic curriculum and the staff.

Since the author has always attempted to be fair and objective in the consideration of this method, some issues of this method may appear as follows;

- The four criteria are inadequate to evaluate the academic staff. Other criteria should be added.
- Teaching experience in year is not directly in proportion to capability in teaching. If so, the older, the better.
- The relation between the academic degree and teaching experience is not directly connected, while that between the certificate of competency and seagoing experience is closely connected.
- Justification of the grading numbers in table 2 should be discussed.

These issues should be considered in comparison with ease of investigation. Complicated investigation may give us sophisticated results but it will cause difficulty in collecting complete data from the majority of maritime universities in the world. However, even more discussions should be needed to modify this method.

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Aspects of decision-making in a multicultural shipping environment

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ABSTRACT

Little research has been done into the influence of differences in cultural backgrounds of maritime personnel on working in groups and arriving at agreements and decisions. Such an internationalisation of working groups can be expected to intensify with the increasing globalisation in the maritime field.
There is a growing conviction among seafarers and persons working in the land-based sector of the maritime industry (including ex-seafarers) that staff on board and on shore should be prepared to work with crews and groups, whose members come from different countries and cultures and speak different languages. There is also growing concern that preparation for this should be offered at MET institutions, either in a separate professional development course to ship officers or as part of a regular syllabus to students.
It is an obvious part of such an approach to use a common language - almost always English - to ensure communication. There are, however, nearly no research findings yet on what a programme should comprise that aims at facilitating comprehension and appreciation of influences from differences in cultural backgrounds on group performance and decisions.
This paper is a report on research done at World Maritime University (WMU) on how post-graduate students holding unlimited certificates of competency, as well as holders of university degrees with experience in the maritime industry or administration, can make a consensus decision.
The multicultural issue will be seen from an angle different to the normal onboard ship view. This paper will specify the need for further research and discuss the methodology. A short remark on a few observations will be discussed. Perhaps cultural differences can be developed from an assumed hindrance into a catalyst for stimulating national appreciation and cooperation that works very well at World Maritime University.

1. Introduction

This paper addresses a fundamental challenge, new or old, in the shipping industry. Do we have an understandable communication system between various operators in the industry? Are we au fait with each other? It has evidently become important to be able to communicate and be quickly understood both ashore and onboard. It becomes even more important in emergency situations (crisis- and crowd management). One should not forget the multicultural and multilingual presence in the boardrooms of shipping companies and in the lecture halls of MET institutions. The language problem and the cultural problem suddenly have become hot issues in different maritime scenarios.
Within a year, three major studies have been presented on mixed crewing with its advantages and disadvantages. Findings vary.

One could ask oneself if the above really is a problem or if it is a self-made problem to find reasons and excuses for accidents and incidents at sea. Has the discussion become a cover-up for technology and other aids introduced onboard ship - aids that have made the work situation on the bridge and in control rooms almost impossible to grasp for normal human beings. To change the already far-gone introduction of high technology innovations in shipping is probably more controversial and expensive than to blame the human being that is working in an ever-inhuman environment. Perhaps it would be wiser to attack the hardware (machines) instead of the software (human brain) in order to remedy the reason of accidents where the so-called human factor is to be blamed. Perhaps the explanation for many accidents at sea is to be found in the pure lack of communication and lack of understanding behaviourism. If this is so, then of course we must put an emphasis on this in MET. A better/new program should be introduced on; understanding people, leadership, English language and cultural differences. Recent reports indicate both the advantages and disadvantages with multilingual and multicultural crew combinations. Young people travel abroad more now than before. At a young age foreign cultures are visited. This would argue that people, in general, know how to handle cultural challenges before going to sea. In reality this argument might not be totally correct.
The subject was debated in IAMU 2. In an IMLA context the subject has also been dealt with but only one time in it s over 20-year history. That paper was given a few years ago. Recently at IMLA s Workshop on Maritime

English (WOME) the issue has though been debated. This must be an indication that this is a rather new phenomenon in the industry. Or is it? The problem, or better the challenge, has always been there. It becomes clear through the studies by Moreby. Today, with the minimum number of crew and because of this, peoples low stress threshold, we cannot afford to have any misunderstandings in our different ways of communication. It has become a real challenge, both for ratings and officers, to master cultural differences and human behaviour.

1.1 Terminology; an explanation of a few keywords

For the sake of good order the reader should understand words used in this context. In the following shortened definitions of a few keywords concerning group dynamics are given:

What is the meaning of a decision?

A decision is a step in a process comprising initiative, preparation, *decisions*, implementation and follow up. A number of considerations and actions lead to a decision. Implementation is mentioned as a step in the process because not until the content has been formulated, and this usually happens during the implementation, can a decision be taken. In other words it can be described as a choice between alternatives that will have an impact on a future situation (Ring, 1983).

What is a group?

Most organisational decisions are group decisions. Ring (1983) states that all members should have full individual capacity as decisionmakers in their own areas of specialisation.

Why group-decisions?

We have group-decisions because the possibilities for better decisions are increased. A synergy effect is achieved. The whole is usually more than the sum of each individual s general input. The effect of the outcome from a group decision reaches its apex with about 8 persons participating in the group. Arfwedson (1992) says that if the group is bigger than 5 persons (during a learning activity) it will not work efficiently.

Classical studies of decisionmaking suggest that group discussion contributes something over and above the statistical pooling of individual contribution (Ring, 1993, p.17).

Ring (1983) also notes that a study of group behaviour usually identifies weaknesses like:

- Why do some persons turn passive?
- Why do some persons become governed by an extreme belief in authority?
- Why do some group constellations tend to come to a hasty decision?
- Why do some persons avoid giving alternative suggestions with a clear effort not to challenge and thereby prolonging a decision?
- Why do some people think they are better than they are when appearing in a group?
- *When is a group sensitive to friction disturbing the work*?

To the last question, one could add, as a follow up, the following two questions:

- How does the *language* influence a homogenous decision?
- Do *cultural differences* influence the achievement of a good decision?

What are social loafing and groupthink?

Social loafing effects is understood to be the human being s tendency to reduce its work assistance in the group when it is not clear who is contributing to what for the benefit of the group — a motivation loss. This phenomenon is often the result of cultural differences. Cultures with a high level of individualism show social loafing most. If social loafing strikes the group the cohesiveness in the group might be lost and a consensus decision difficult to achieve.

Groupthink is understood to be a phenomenon where people are not able to think critically. Group members are sometimes afraid of questioning an alternative. This is a very bad occurrence in group decisionmaking because a collective decision is best formed under conflict and individual s effort in seeking his/her own way. In the process the consensus-seeking attempt could lead to what is called *groupthink*. Conflicts are frequent when different cultures are merged. Companies can grow faster and develop more with some domestic conflicts than if the staff is totally homogenous. This means that in the shipping industry we should *be able to have* many sub cultural conflicts. If this is correct it should be an advantage to the industry and the industry, should carefully take advantage of this.

What is triangulation?

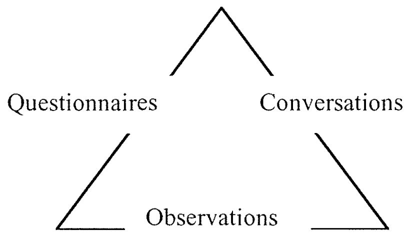
A combination of research-methodologies clearly strengthens its validity and reliability. Some researchers feel that a mixture of qualitative and quantitative methodologies should be used more frequently.

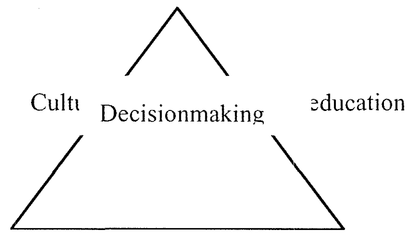
Patton (1990) identifies four basic types of triangulation:

1. Data — the use of a variety of data sources
2. Investigator — using several researchers
3. Theory — interpretation of data from many perspectives
4. Methodological — using several methods for the same problem

This means that a variety of mixes and sampling strategies are possible. At the same time it is a recognition that the researcher is open to look at things in more than one way. The crosschecking of data also strengthens the conclusion.
In the WMU study questionnaires, observations and conversations are used. The conclusion is based on different perspectives. The interpretation is based on culture (the culture of the students), the WMU method and the condition to pass on knowledge (because decisions are based on acquired knowledge) and decision-making (how group-decisions are made in a multicultural multilingual environment).

What is phenomenography?
Phenomenography is a fairly new research specialisation describing conceptions of the world around us. The





empirical study- method describes how people experience, conceptualise, understand, perceive and apprehend various phenomena. The different ways in which people see a phenomenon using words, as those just mentioned, depends on how they describe them. This we can say because it is impossible to deal with an object without experiencing or conceptualising it in some way. When a person with these words experience/understand a phenomenon it also tells us a lot about how the subject, that has been subject for this description, is conceptualised. This research method is the complementary to other kinds of research. The method is directed towards experiential description aiming at description, analysis and understanding of experiences. We cannot separate what a person has experienced from the experience per se. Psychologists would aim at learning about how people experience things, how people perceive and conceptualize the world. In phenomenography thinking is described in terms of what is perceived and thought about. Psychological models are not particularly helpful in solving practical pedagogical problems. On the contrary, phenomenography is interested in the content of thinking. Descriptions of perception and experience have to be made in terms of their content. Between the common and idiosyncratic there seems to exist a level of modes of experience worthwhile of study (Marton, 1981). This means that this method is non-inferential in the sense that there are no hypotheses to be tested.
According to Wittgensteins philosophy a line should be drawn between what we can speak of and what we must be silent about. What really matters is that we cannot speak of. However what we cannot speak of we can still show — we can point out in the way we live and the way we act when talking about a phenomenon. In these situations a domain like phenomenography would give light to our research efforts.

2. Objectives

It would be of interest to find a method or system on how decisions in culturally mixed group-compositions are carried out. Such findings would make it easier for decisionmakers to make a rational and quicker decision. Rational in the meaning based upon reason rather than emotion. This is even more important when realising that too many decisions are a result of coincidence. Knowledge, experience and engagement play a key role when taking a good decision. With knowledge is meant not only the knowledge in the related subject but also knowledge on how people react and behave. The objective therefore has to be formed from many different available resources.
This issue is a case for the top management in any company playing in the international market where contacts have to be taken with multicultural partners/customers.
Another challenge is that during debates and lectures on how the management/operation of a port/shipping company can be improved the students, from some countries, almost always see the suggested improvements as impossible to implement; the reason is that they often believe that it is their cultural background that shackles their efforts to become capable operators. Everyone should realise that it does not matter from where on earth you come or what historical, cultural, ethnic or religious background you have in order to improve. It is always possible to change procedures if you have the right *attitude* and understanding of the value of a certain improvement. To understand your colleagues, your international colleagues, and be able to play on an even playing field and discuss, with the

knowledge that differences exist between people, then your decisions in this environment will be of benefit to all — a win-win situation. To change a student s attitude, knowledge and practices is a key attempt and mission in all learning processes.

The pedagogues will equally benefit from such knowledge. The world is getting smaller and education will more and more be carried out within a multicultural student body. The pedagogues working in MET should take a closer look at the shipping environment and become more international in their thinking. Decisions in the classroom can then more easily be defended and explained. A fairer assessment can be made.

This research will help to fill a miserable research-gap within the shipping industry.

2.1 Purpose of the research

The objective of the research is to be able to get answers to the following questions:

A Are people with a shipping background less influenced by multicultural differences when making group decisions in a multicultural environment than people with no seagoing background at all?

B How do seafarers and people working in the shipping sphere take group decisions when doing so in a multicultural setting, assuming all groupmembers have a managerial background?

C Is senior shipping staff persistent, or less inclined to negotiate, when taking decisions in a multicultural and multilingual environment?

D Have teachers in MET institutions anything to contribute to students in group work where consensus decisions need to be taken?

E How should cultural awareness be passed on to future officers practising teamwork on i.e. the bridge?

In shipping circles where people have been to sea for a number of years on international voyages, the problem of co-operation and working in multicultural and multilingual settings *should* not be a major problem. MET teachers should be trained and educated in cultural awareness as well. In the near future shipping shore personnel also have to get ready to work with mixed nationalities in their own playground.

Teachers should be encouraged to have students work in groups. The reason is that it has been indicated that learning in certain areas of the education is increased, the social contact between students is enhanced and often the students themselves find this method of learning very rewarding. It is fostering the human in many ways.

Group work, which is carried out in a multicultural environment, needs other methods than group work in a hetero-cultural setting. Working with adults, already in decisionmaking positions requires additional considerations.

A teacher assessing a mixed group composition has to consider the cultural impact. Fair should be fair and non-technical matters should not have an impact on students marks.

Being part of a management team made up of members from different cultures is becoming more common (beside at maritime institutes and onboard ships) at shore establishments of shipping companies. Swedes and others do not see the work onboard ships as a future career anymore (unless reputation and conditions change). The consequence might be that a Swedish owned shipping company, that has its headquarter in Sweden, has to employ non-Swedes to work ashore in its headquarters. This might not sound attractive to start with, but might be a necessity because seafarers are normally needed in headquarters.

The composition of group members should never be ad hoc. The reason is that intercultural differences could then be negative to the group result. Possible differences must be known to the teacher in order for him/her to make up groups with a fair chance to achieve the highest possible output. If there are goals to reach, among groups working on the same challenge, then a group with a poor composition has an inherent difficulty in being successful. Contrary random group member composition would apparently be of minor importance if the group-work also seeks to teach people how to work together.

Every society consists of diverse cultural groups. Cultures are also linked to identities by the meaning differences, which means that *all relations, within all societies, are intercultural* (Coulby, 1997).

From theories and models an interesting target also is to get verification on the *dominance* and psychological (*inter-cultural*) processes. Therefore, it is important to get a concentration on the actual decision process more than pre- and pro- decision-making processes.

The theoretical aim is to test the influence that language- and cultural differences have in this process. S*ocial loafing* is studied with the object to see if students with a seafaring background, compared to students with an academic background, have a negative/positive impact on the group s efforts to make a consensus decision. It might be that one of the two categories dominate the group and then the *groupthink* phenomena would be studied. The *social cognition* theory will be used to find out if group members treat information differently depending on what culture they come from. The *cognitive dissonance* theory will show if there is social interaction between the two categories.

3. Theoretical starting-points

What have researchers published in decisionmaking and cultural behaviour and what theories have been developed from such research.

3.1 Literature

Several researchers have studied how decisions are made but they have mainly discussed what, how and by whom decisions have been taken and carried out (Ring, 1993). Little research has been done on the pedagogic influence of decisions taken in groups in both multi-cultural and multi-lingual environments.

Decisions are mainly discussed when taken by one *lonely* decisionmaker, for instance the managing director of a company. The rationality in the decision would then be limited. In contrast, many decisions are taken in a *group* where the groupmembers are required to come to a consensus decision. The goal and the resources are then tackled at the same time. Psychologists have studied this category of decisions but rarely pedagogues (Ring, 1993). In a modern company decision-participation is often called for by a greater number of employees. Staff who will be engaged in the implementation of the decision should be required to participate in the decision process also.

Lane (2000, p.4) wrote in The Sea on mixed nationality crews: Not only have we found no evidence whatever that nationality is a barrier to forming a cohesive shipboard society, but we have also found many seafarers who actually prefer mixed nationality crews . In the year 2000 working culture elements in shipping have been assessed in a EU research report which found that differences in national culture are likely to be related to differences in work culture (Workport, 2000). The Seafarers International Research Centre (SIRC) released, last year, a report Transnational Seafarer Communities . The researchers have testimonies that there are only benefits with mixed crew (Kahveci, 2001). A team with a Swedish ethnologist has made a voyage on a Wallenius PCC and has reported on life onboard with a mixed crew (du Rietz, 2001). Generally they encountered doubts with a mixed crew. The Philippine National Polythechnic (PNMP, 2002) has published a report Mixed National Crews: The Filipino Seafarers Experience . This report lists a few minor problems; language, communication, work cultures, behaviour, racial stereotyping etc. Evidently there are different opinions on the effectiveness issue of exotic crewing.

When studying decisionmaking, and include social psychological aspects, one has to study decisionmaking from a single individual level. When giving others the possibility to take part in a decision the phenomenon of *diffusion of responsibility, social loafing* and *persuasion* has to be discussed.

Distinction between normative and informal social influence is one of the most approved postulates in social psychology (Eisele, 1999, p.24). In this theory it is also noted that members have an excessive tendency to seek consensus. By admitting this members are led to suppress their own dissent in the interests of group consensus. Eisele also discusses a theory where we can measure a possible change of attitude and where one s cognitive response is more important than understanding the content of a message. The theory is called *Attitudes and Persuasion*. How are we being convinced? What kind of involvement inhibits persuasion? Other types of involvement are outcome-relevant and impression-relevant. Eisele also pictures that many suggestions of involvement exist: ego/personal, issues, vested interest, task and response involvement; just to mention a few. It is important to note that these differences affect also how group-members behave in a decision undertaking.

4. Framing of the problems

The discussion of mixed crews has taken form mainly for two reasons:

1 The frequent occurrences of shipping casualties

2 A future problem of scarcity of nationals going to sea and thus possible negative impact of having to recruit foreigners to work in the head office of shipping companies. If realised that non-nationals occupy decision-making positions in a company, these decisions have to be taken in a multicultural environment. The challenge is already a fact with the increasing number of shipping alliances. Certain pooling constellations had to be broken because of the adverse impact of not being able to come to quick decisions and the psychological fact that many people have problems in accepting company protocols. Misunderstandings could be a serious risk in achieving a quality operation/management. This plays a vital role in achieving what is defined as quality shipping. We cannot have quality shipping without a quality crew that is able to work together and communicate without hindrance. In the past the alternatives for such shipping companies have been either to close their sheer shipping activities or, if financially strong purchase (take-over) the other shipping company and keep the hegemony by building a new corporate culture. An example of a broken pooling arrangement is the famous *take-over* that the Danish container giant *Maersk Line* did when buying another major shipping company *Sealand.*

The second statement perhaps looks a bit paradoxical, but in Greek shipping the management normally is strengthened by a *majority* of ex Greek seafarers. If there were only a few Greek seafarers to recruit to office-positions a catastrophic situation could develop. In such a situation the challenge would be profound because a cultural hindrance would certainly come into being when decisions have to be made.

4.1 Need for research

Are decisions taken in boardrooms, onboard ships and in MET institutions the very best, remembering that decisions can easily be given a negative impact when people from different cultures and languages have to coordinate their opinions? Are cultural differences a detectable hindrance in taking qualified decisions?

There is a serious need to talk about this subject before we get provoked. We need to update ourselves on how to master multicultural decisionmaking in high-level management and training. Knowledge on how to master this challenge is needed.

5. Method

In order to try to answer the last question a study of students studying at World Maritime University (WMU) has been made. Observations of students solving problems in small groups, questionnaires on the work carried out in these groups and relaxed conversations with students, is the basis for the research. Some group-work has also been videotaped making it possible to analyse each group member s social interaction style. The reason for the conversations is also to find out if the education delivered at WMU is fostering future decisionmakers.

6. Some research findings

It has been well attested that a group of seafarers with multicultural backgrounds can discuss and take decisions together without making too much trouble. Perhaps this could have been expected. Master Mariners normally (as leaders in their right environment) insist on having their opinions/orders carried out. They are apparently ready to compromise but for the good sake of keeping harmony in the group and to show that the group can agree. Their ego and pride would be hurt if this could not be achieved. Teachers and captains usually are individualists.

The Asians, in this sample, like to take notes and also assure that what has been agreed also is taken to the protocol. The Americans, being outspoken, take the lead. The context of the exercise was very serious so the students did not use much time for laughter.

Table 1 is an example of two groups during an exercise to solve a certain problem linked to a serious maritime activity (Horck, 2001). A few remarks on the table:

A major contributor to ideas cannot be clearly selected from the two groups. One can find representatives from all continents in this. The Americans seem a bit more willing than others to contribute with ideas. To ask others for ideas has not been a characteristic for any of the participants. Evidently there has been no need for such an activity. The Asians have, a little more than the others, showed a need to remind the others of the task. Otherwise this seems not to be necessary either. The Africans[1] both support and disagree and at the same time suggest ideas. The Africans also wish to be confirmed in the decisions taken. They want proof and in this way they express a wish to learn.

In another study the following could be noted:

A. Conflicts: were concluded as happening sometimes.

B. There are generally no joyful moments in these groups. It is a conclusion with slight modification for the groups with only seafarers where a slightly greater animation prevailed.

C. The seafarers did not naturally take the lead in the groups in which they were represented.

D. Misunderstandings often happened.

E. With some difficulties these groups have been able to come to a consensus decision.

The seafarers did not directly take command of the groups but might have had an indirect command. Seldom a clear group leader was appointed. A tendency is that the person who possesses better knowledge in the subject takes the lead in the group. It is not the person with better-spoken English or the captains who leads the group. Students emphasise that the result comes from joint efforts. Some difficulties were shown in these groups because the seafarers probably had different opinions than the members with academic backgrounds. The technical language used by the seafarers and also their different way of pronouncing words in the English language could explain some of the misunderstandings. The academics are not used to such kind of talking . Many seafarers are naturally serious because of their high work responsibilities. In this exercise all students took the situation equally seriously and therefore not much room was given to joyful moments.

Table 1. Behaviour observations

Behaviour	Group 1 and 2		
	America	Africa	Asia
Contributes to ideas	40	31	22
Asks others for their ideas	5	2	5
Reminds group of the task	5	4	9
Summarizes ideas	15	11	10
Asks others for facts, proof, reasons	2	21	13
Offers support for other positions	8	13	6
Disagrees with other ideas	6	14	10
Suggests alternatives	5	12	9
Points out differences among ideas	4	6	4
Points out similarities / relations among ideas	2	2	2
Adds humor	3	2	1
Acknowledges others feelings	0	2	1
Interferes in others talking	18	10	8

Remarks: Format adapted by A. Soucy from Johnson & Johnson, 1987.

The following has been noted from a 3rd group exercise:

A No distinct conclusion can be made that seafarers more easily adapt to work in multicultural settings. Seafarers, like everybody else, apparently need education in intercultural understanding.

B Contrary to groups with only women or groups with no seafarers the groups with a mixture of seafarers and landlubbers had more difficulties to come to a smooth consensus decision. The seafarers did not take the command in these groups either. Perhaps they realised that there are others who have greater competence and skill to lead the discussion.

C The cooperation between senior shore staff clearly shows that conflicts in group decisionmakings are not a serious problem. Is this because of the generally high intellectual level of the students?

There is a growing need to exchange ideas between people. The various ideas should be fertilising and not blockading. This behaviour of exchange appears to be different in different cultures. Swedes, for example, are known for avoiding discussions with people with different opinions. Ethnographers mean that, e.g. Swedes prefer to discuss with people with similar views to their own (Arfwedson, 1992).

The group members positioning around the tables could have an important impact on the possibilities to convince during discussions. The decision quality depends on the possibilities to have your voice heard. It is known that persons sitting opposite each other talk more to each other than people sitting side by side.

According to Arfwedson (1992) individual relations increase faster than the number of individuals in the group. It is important to realise this when deciding how big a group should be. It is crucial how fast the group can produce something with quality.

Groups have a tendency to focus on shared information and neglect information that is unique to a single group member. Group members often do not consolidate the decision made by the group. With this follows that respect fo[illegible] principles of a multicultural society. The observations in the various groups clearly indicate that the students show respect for each other. No harsh words were uttered and nobody raised their voices. Students seriously met the ideas and honestly tried to come to a unanimous decision.

The element of divergent thinking is one of the most difficult aspects of group decisionmaking (Kaner, 1996). Different cultural values make people disagree rather than agree. This becomes more evident when the person comes from a culture that is a lot different from the rest in the group. In these circumstances intercultural co-operation has become a prime condition for the survival of mankind (Hofstede, 1991).

1 Africans are North Africans excluded

A very important observation is that students respect each other very much and realise that they can learn from each other, though all come from peripheral countries. A major problem might be that very seldom a 100% understandable sentence is formulated. Ce que l on con oit bien, s nounce clairement et les mots pour le dire arrivent ais ment. However students are normally given time to talk without being interrupted. Another observation is that the values of words vary. These two observations must be serious in crises situations or in board-meetings where quick solutions and decisions have to be taken. In a normal classroom obscure words are equal to dim thinking, and then it is interpreted as lack of knowledge.

4. Future research

In the future similar studies should be performed on a bigger sample. There are obvious differences that need to be better understood in MET institutions and in boardrooms.

It is also important to explain why seafarers differ (if they really differ) from people who have no seafaring experience in their contact with cultural differences. Little knowledge only increases misunderstandings. We cannot expect to be all-alike but we can be more cosmopolitan in our thinking.

Group discussion is characterised by a unique information exchange that is different from any information flow that goes on in the individual s head (Eisele, 1999). Group learning is not much used in MET institutions and should therefore be introduced. A study is then needed to figure out if this is feasible or not.

The only IMO model course that has a lecture on cultural awareness (one hour) is the Ship Simulator and Team Work (1.22). In MSC 75/15/2 on the human element it is noted that a working group is set to identify necessary *mandatory* training on cultures, decisionmaking and group work principals in the industry.

The impact of women in the shipping industry should also be studied. IMO is promoting this, but what are the consequences and how can the industry take maximum advantage of women in the industry? Do women in multi-cultural decisionmaking groups participate and contribute in such a way that the group decision would be of higher quality? Can perhaps women contribute in making groupmembers play a more active role in the group? Do they have a positive impact on ex-seafarers in board meetings?

More research should be done to find out how seafarers mixed with non-seafarers take decisions in a multicultural environment. I am not fully in agreement with Sampson who says that the Cultural differences appear to have no impact on teamwork (Lloyds List, 2001, July 3). I think they have.

5. Discussion

To survive in a multicultural world one does *not* need to think, feel and act in the same way in order to agree and co-operate (Hofstede, 1991). Understand your own cultural values and the cultural values of others with whom one has to cooperate and the basic skill of survival will be achieved.

The involvement or active participation in groups has more generally been steered by the effort to be able to show that the group has been able to formulate a viable and technically correct answer to a given problem. Due to the task-oriented group members in this study the involvement could be categorised as value-relevant. In this way the members are led to suppress their own dissent in the interests of group consensus.

Groups inhibit natural criticism (Eisele, 1999). This came out quite well in this study. No inconsiderate words between the members in any groups could be noticed. This is a result of the statement but could also be a result of the fact that group participants of this category are not inclined to argue because of the nature of their work and their intellectual level. The consensus-seeking tendency had taken over and had become more important. People from different cultures seem keen on coming to a consensus decision.

Social loafing had been a tendency but mostly by the experts on an expert subject. Nothing extreme, because all students have realised that they are at WMU to learn and there is no natural competition element between students. Students not being subject to loafing (if one can for sure conclude there is no element of this) are the students from America. None of the other nationalities can be assumed to have stopped the Americans for doing their share of the workload and contributing to good results.

Social influence tends to be stronger in groups that discuss until participants agree, so called consensus groups (Eisele, 1999). The discussions in the groups in this research were fairly quick and therefore did not contribute in creating any deep social bonds. According to Eisele the level of involvement can be defined as: Personal relevance, personal importance, future consequences and responsibility. The psychologist Janis (1984) says in his work Groupthink that a major challenge exists if there is a relation between the decision process and the decision content and if there are special risks when the decision is taken in a small group. In a small group the group thinking can be too mechanical. Then again it is important that the composition of the members in the group has been considered.

As a logical consequence of this an important power will be vested in the person recruiting staff-members in the company because it will have consequences on how the decision process will be structured in the decision groups. A group has to have a minimum of collegiality in order to function. The group should also be properly mixed to give a better balance between ideas and interests. Here our challenge will be manifested. If members come from different cultural societies it is a fact that some are more immune than others to group thinking. Although newcomers in the group usually adapt rather quickly, maybe too easily, it still gives reason to discuss the group composition. If all becomes equal, conforms, we will have an obstacle to development. Tuchman (1984) shows in her book The March to Folly that too many yes-speakers are a real threat to wise decisionmaking.

Intercultural education is a relatively new field. Education is needed both in order to understand how people react in a group in general and how it is done in multicultural and multilingual group-settings. Future officers at sea should be given time in the curricula to discuss these phenomena. In addition they should be trained to be aware of their own stress reactions and the handling of these to manage decisions in a group and to make better group decisions. To know the theories in group-decision-making under stress should be included in the education of all decisionmakers.

Misunderstandings are a great threat to safety in the shipping industry. This is a hazard that today should be considered with greater efforts. *Too many seafarers do not master the English language*. Accidents have met in-proportional consequences because of language difficulties. More emphasis should be put on pronunciation in the English language courses. *Exercises on how to be distinct in pronunciation are evidently needed.* Sadly, there are no statistics where we can see if an accident is really caused by cultural behaviour and/or lack of communication. It is not backwards to say that merchant mariners in general should take lessons from the navy on how to behave on the bridge. A clear order/*repeat* policy perhaps has got lost on the modern merchant bridge with the introduction of high tech instruments. The vocabulary has now been adopted with IMO s SMCP[2]. We still need verbal communication. Both IMO and ILO are shifting the emphasis onto people. Then communication should be underlined as well. Breaking cultural barriers in giving respect, realising the benefits and teamwork in mixed groups would give flexibility, pleasure and profit.

Some institutions have already realized the need to educate people working in a multicultural and multilingual mixture. In an article in the Financial Times (2002, March 29) MBA for Europe s managers it is reported that three European Universities have made joint efforts on crossculturalisation and are convinced that MBA-graduates need an advanced understanding of European business contexts, language skills and practical international experience. The future business leaders must understand Europe, both culturally and commercially, and must also be able to realise the needs of such knowledge. MET institutions should also aim at this. Many seafarers later might join the office of a shipping company and be involved in the business on a more academic and intercultural level than they have been during port visits and onboard. The industry needs cosmopolitan managers who can both negotiate and manage people from different cultures. Crosscultural understanding is needed to avoid getting stereotypes. The stereotypes that we see in others are usually wrong and are highly dangerous to good communication. To get this perception proper education is needed.

The Ecole Nationales de la Marine Marchande (ENMM) in Marseilles has taken a new, innovative approach to maritime training. New programmes to accommodate the industry and the legislators have been introduced. In addition, the doors are now open for foreign students also. They have considered it high time to enhance its specialisations in terms of maritime training at an international level. If they have not thought about it then it is high time also to give professors, lecturers and instructors a few lectures in cultural awareness.

The Numast newsletter (2002, June). explained that the UK Department of Trade and Industry (DTI) is encouraging the dissemination of a *partnership culture* throughout the shipping industry. The idea is to move away from traditional confrontational relationships to a new way of working together.

Future managers need to know the terminology and understand activities in the operational department of their co the company leaders they impossibly could have a short, quick and correct understanding of how the people, who are the bona fide contributors to the companies earnings, tackle their challenges. If the message from the floor is not passed on correctly the managers don t have a sound base for their decisions. This is what was discovered in the WMU study where the seafarers and the non-seafarers misunderstand each other because of terminology and technical jargon. Universities who wish to serve the industry therefore must not forget, in the programme, to pass on knowledge in non-managerial subjects. Managers need a lot more than economy, law, finance, management principles etc. Besides operational subjects should therefore not be left to something like an introductory course and in the worst position perhaps not even assessed. The issue is too important to be left as an encumbrance. Today most managers get their good insight in what is happening in the operational department of their company but that knowledge has been achieved by their own

2. SMCP: Standard Marine Communication Phrases, adopted in 2001

initiatives and many times at the cost of the company. We joke about accountants being managers but it would be accepted if they had also achieved proper knowledge on what is happening on the floor so to say. Today a fast expanding CEO is more risky when the expansion (as we can read in the papers) is built upon buying assets instead of looking after the welfare of his operational department and be able to listen and understand (communicate) what constrains that exist in his company. An investment in the human being includes communication.

We have to find another way to break these deadlocks at board meetings

Source: S.A. Beebe (1989), *Communicating in small groups*, p.216

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Implementation of quality management systems in Romanian maritime education and training

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ABSTRACT

The paper presents the most important quality related concepts such as: quality control, quality assurance and total quality management displayed in a hierarchy and shows how they can be applied in education. For better understanding, the work answers two essential questions: which the product is and who the clients for education are. Finally, the actors of the Romanain MET community are presented, showing how they developed and implemented quality management systems in their organizations.

1. Quality as a dynamic concept

Being a highly fashionable subject **quality** has received different definitions, however all related to the client satisfaction. Since the main idea had been the same from a long period of time, the practical application of the concept was different and proved that the quality is a dynamic concept.
The oldest application of the concept is related to the detection and elimination of components or final products which are not up to standard. The expresion used is **quality control**. The process, albeit an after-the-event one, proved to be a good method of ensuring quality even if that involved a considerable amount of waste, scrap or reworking. The quality control was the task of professionals and not a common subject. Along this line, the final assessment of students« knowledge and skills is an expresion of quality control in education and training.
The next important step in quality concept application was the **quality assurance**. Even if it is a continuation of the same idea there are considerable differences. The quality assurance is no longer related to the end of the process but to the entire development of the process and however some of the actions are taken even before of the process. Its concern is to prevent faults occuring in all phases of the process. That means to ªdo things right first time, every time . The result of quality assurance is ªzero deffects . The quality assurance impose responsibilities on each and every personnel. Quality assurance systems are related not only to the technical aspects of the products or services, but also to methodologies, management etc.. Quality standards are maintained by following the procedures laid down in the QA system. The references made by STCW Convention to quality standards are related to quality assurance. Some of the phases of process are specifically expressed:

- all training;
- assessment of competence;
- certification;
- endorsment;
- revalidation activities.

All the above have to be continuously monitored through **a quality standards system** to ensure the achievement of defined objectives, including those concerning the qualifications and experience of instructors and assessors.
The other quality related items included into STCW Convention impose the application of the same concept. These are the following:

- ensure that all the related actors performing the above mentioned activities are following a quality standards system;
- the MET objectives and related standards of competence to be achieved the education and training objectives to be achieved are clearly defined and identify the levels of knowledge, understanding and skills appropriate to the examinations and assessments The objectives and related quality standards may be specified separately for different courses and training programmes and shall cover the administration of the certification system.

To be more specific the Convention includes the fields of application of the quality standards:

- administration of the certification systems;
- all training courses and programmes;

- examinations and assessments;
- qualifications and experience required of instructors and assessors.

The quality concept application continued with **total quality management**. This incorporates quality assurance, and extends and developed it. TQM means to create a quality culture where the structure of the organization *allows to do so*. Even if the present application of the quality concept impose to consider the TQM main characteristics, most of the conservative organizations avoid to use this expresion. It might be the way to avoid the structural changes of the organization needed to apply this concept.

This paper will not try to answer to the question ªhow to apply the quality concept but to remind that this is a dynamic one. We should not forget that a large number of organizations started to develop and implement a quality standards system based on the ISO 9002 standard and during this process found out that the standard disappeared.

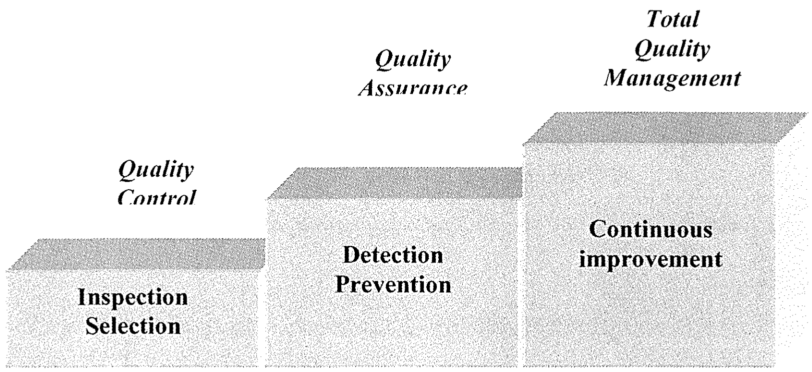

Figure 1 Evolution of Quality Concepts

2. Quality in Education

Nowadays, everyone recognizes the importance of quality for any public or private organization.So, the education and training organizations came into situation to develope and implement own quality standards system. Due to specific characteristics of the topic, first questions appeared were related to ***product*** and ***clients*** identification.

A first apparently corect answer is that the product is the student or the graduate, but that means we should consider the maritime university as ***an officers factory***. Product of the universities are the competencies of their graduates, which incorporate the knowledge and skills they aquired during the time between admission and graduation.

For clients identification the situation is more complicate, because we can not delimitate a clear target, but a number of different categories being in the same time clients for the same product. These can be considered: students, parents, Government, employers, society, and as internal customers teachers and support staff. One of the important quality related chalanges of a higher education institution is to reconciliate the different clients needs and to avoid conflicts of intertests among the different categories of clients.

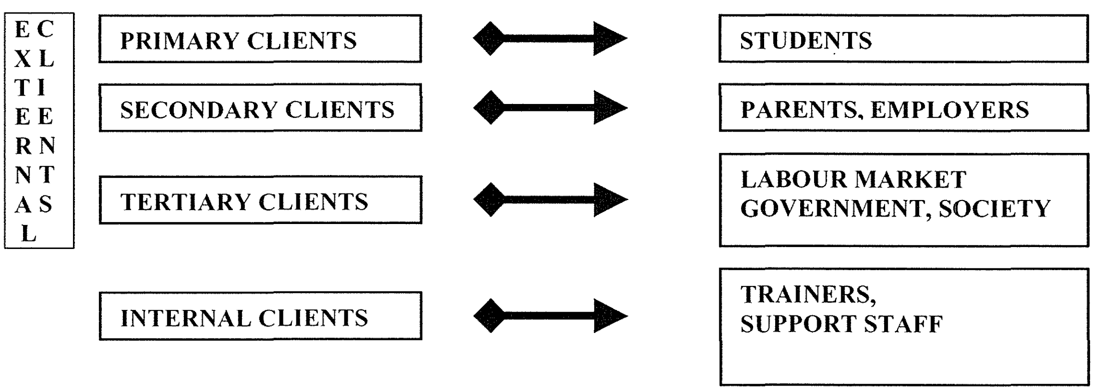

Figure 2 Categories of clients for education

The difficulties generated to answer the above questions conducted to another one, now regarding which quality system to be applied in education, or how should be such a system. More than that, due to the very specific characteristics, the question is quite important for the maritime education and training organizations.

3. Quality standards in maritime education and training organizations

The decision of the quality standards system applied by MET organizations is based on comparative analisys made on ISO 9000 standards, ISM, STCW «95, but also having in view the national regulations.

In observance of the above mentioned issues and the need to have common standards, Professor Sag prepared a proposal for MET accreditation called METAS. The standard model contains as main ingredients:

- IMO Conventions, Port State Control, Statutory certification of ships and insurance requirements
- ISO 9001-2000 Quality Management System Standards, ISO 14001 environmental Management System Standards
- National accreditation standards like those developed by Canadian Engineering Accreditation Board, Accreditation Board for Engineering and Technology, Council for Higher Education Accreditation.

METAS includes items such as: mission and purposes, planning and evaluation, organization and governance, programs and instruction, student services, physical and financial resouces.

Since there is no a specific quality standards system for MET organizations, they have developed and applied different systems. There are organizations using a national quality management system specific to education organizations, but also ISO 9000 certified universities, that also meet the relevant national requirements.

An example of specific academic system is the one used in UK. The approach to managing and enhancing academic quality and safeguarding academic standards is based on four working priciples:

1. *academic quality control involves processes by which quality is secured at the point of delivery by those directly involved in teaching and learning*
2. *academic quality assurance involves processes intended to enduse the existence, and monitor the operation, of procedures used to secure quality at the point of delivery*
3. *academic quality audits monitors the effectiveness of the arrangements at faculty and couse level for maintaining and enhancing the quality of the students learning experience, and their contribution to safeguarding academic standards*
4. *academic quality enhancement is an integral part of the management of quality responsibility for which is shared by staff and students at course, faculty and institution level.*

The specific of the MET organizations led, in some countries, to the need to comply with regulations of different Governmental bodies, having as a result the implementation of a broader quality standard, such as ISO 9000. Under these circumstances the specific procedures are kept as operational procedures, being completed by system procedures.

4. Quality management systems in Romanian maritime education and training

The Romanian maritime education and training organizations started to develop and implement quality management systems as a strategic policy, in order to meet to market requirements. Nowadays this is no longer a mater of organization policy, but also a requirement of the existing regulations. The academic institutions (Constanta Maritime Univesity and Naval Academy) had to comply with the regulations imposed both by Ministry of Education and Research and by Maritime Authority. Each of the above authorities required the academic instittutions to be accredited and certified by an independent organization in relation with quality and academic standards.

The Romanian maritime education, training and certification regulations have been continuously improved. The last changes introduced by the Maritime Authority requires:

- quality management system certification for the institutions delivering IMO model courses
- training and certification of the assessors angaged in maritime examinations for certification
- training and certification of the trainers delivering IMO model courses

The teaching staff of the academic institutions have to comply, at the same, time with the regulations established for the national education. The new education law which will come in full force in the next year introduced higher standards for the entire academic process. For example, as from the next year the PhD degree will become compulsory as from the lecturer level and not just for assistant professors and professors as it is now. Periodical assessment of all academic institutions, performed by an independent organization, became also compulsory.

At present, the main actors of the Romanian maritime education and training community are: the Maritime Authority, two academic institutions and training centers. The main tasks and relationships between the above actors are shown in the figure 3.

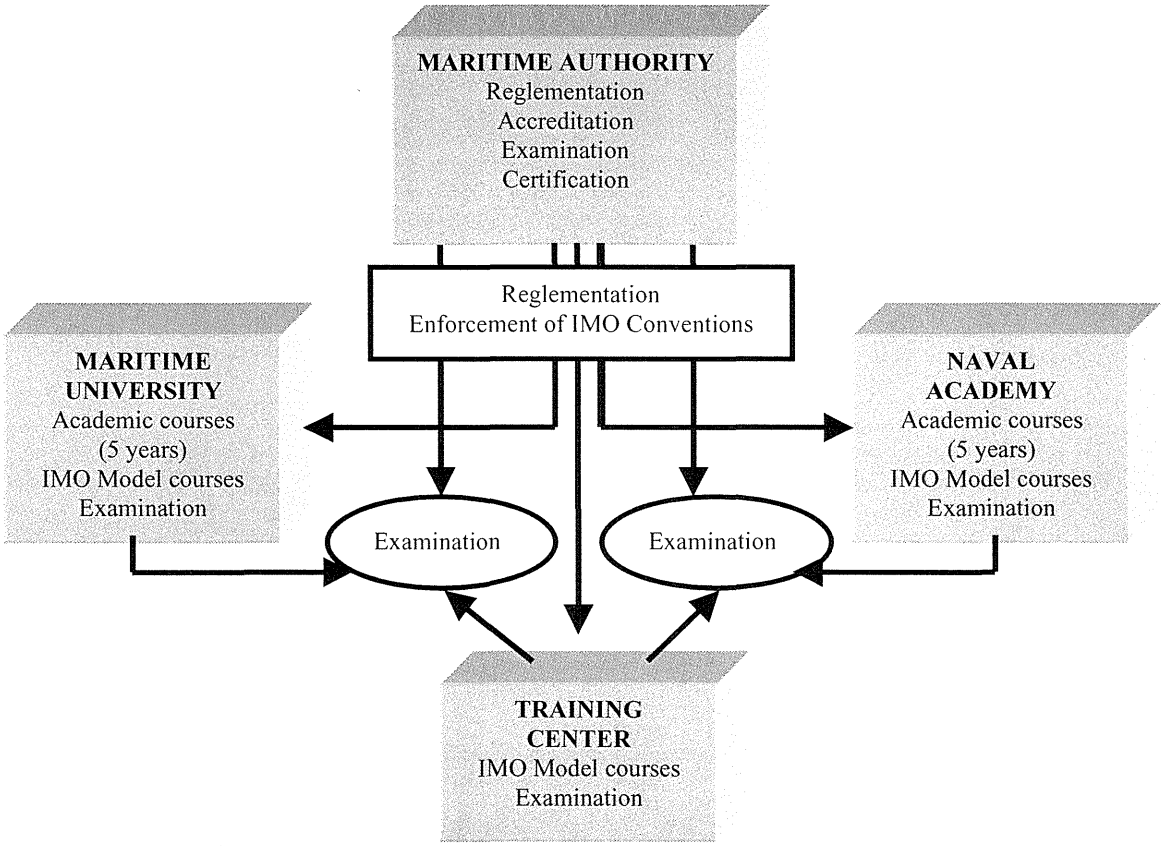

Figure 3 Relationship between Romanian maritime education, training and certification organizations

The high importance given by the Maritime Authority to the implementation of a quality management system was shown by decision to certificate this public organization in accordance with ISO 9001 standard. This step was succesfully passed this year, Maritime Authority being certified by a worldwide recognized certification society.
The Romanian Maritime Training Center was the first MET institution certified in accordance with the above mentioned standard (by another worldwide certification society), and this year RoMTC was recertified.
The two academic institutions both passed periodical audit performed by an independent organization. Maritime University passed the last one this year.
Having in view the importance to apply common standards not only in training but in quality management systems as well, Constanta Maritime University decided to implement and certify an ISO 9000 based management quality system. The certification is planned to be taken at the end of this year.

5. Conclusions

There are many reasons which are leading Romanian MET institutions to develop, implement and certificate quality management systems based on ISO 9000 standards. Among these resons could be:

- achieve a higher and recognized level of the quality of their products
- better cooperation among institutions involved in MET activities
- assure a high common standard to be met by the MET institutions which could be developed in the future
- better perception by the international market which is addressed
- avoid non-conformities related to national or international regulations
- possibility to be certified by a worldwide certification society
- better position on the national education market.

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Session IIIB - Simulation

Chair: Capt. L. Wade

Painted Ship Upon a Painted Ocean: Facilitation and Practical Competency Assessment of Shiphandling Skills
Capt. Cynthia Smith
United States Merchant Marine Academy

Managing Abnormal Situations caused by A Failure in the Automatic Navigation and Steering System
Sauli Ahvenjarvi
Satakunta Polytechnic Sector for Technology and Maritime Management

Fault Simulation of Main Engine System for Engine Room Simulator
Hu Yihuai, Wang Xihuai, Hu Xianfu
Shanghai Maritime University

Establishing A Simulation, Training and Research Center: Achieving the Vision
Philip B. Arms, Jr. Ph.D
California Maritime Academy

PAINTED SHIP UPON A PAINTED OCEAN:

Facilitation and Practical Competency Assessment of Shiphandling Skills

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I hear, I forget. I see, I remember.
I do, and I understand.
--- *Ancient Chinese Proverb*

Abstract

This paper will provide an overview of the three types of simulators employed during the Shiphandling / Seamanship course offered at the United States Merchant Marine Academy, discuss the virtues and limitations of each in the facilitation process, and provide techniques for competency assessment. Examples of the course practical training exercises and critique of each methodology will be presented. The paper will offer observations between the employment of simulation and the use of training vessels for the dissemination of practical shiphandling skills. In conclusion, the paper will confer the relevance of the use of simulators as an integral part of experiential learning and reinforce the importance of the facilitation and practical competency assessment of shiphandling using a painted ship upon a painted ocean .

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1. Introduction

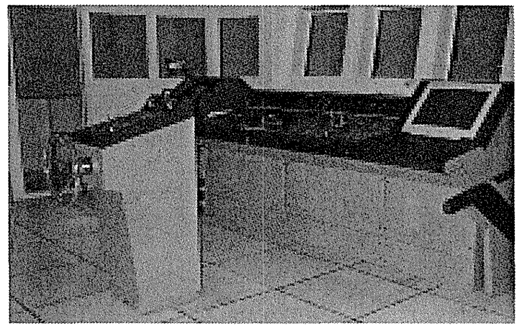
Marine simulation, when used in conjunction with other training methodologies, provides an effective mechanism for dissemination of the physics of shiphandling theory. The mariner s ability to apply the abstract concepts in real time scenarios transcends vector analysis to become the art of shiphandling. IMO/STCW addresses specific competency assessments with respect to ship officer certification. Historically, the Shiphandling/Seamanship course offered at the United States Merchant Marine Academy did not provide for evaluation of midshipmen through practical competency assessment of these mariner skills. Moreover, simulation was not traditionally used in the facilitation process to demonstrate ship behavior.

With the advent of IMO model courses and implementation of STCW competency assessment, the Shiphandling/Seamanship course offered to midshipmen at the United States Merchant Marine Academy has been redesigned to employ practical demonstration, performance evaluation, and assessment. Part-task simulators, full mission simulators, small vessels, and the training ship are used to facilitate the understanding of ship manoeuvring concepts. Because shiphandling training is fundamentally task oriented, marine simulation or actual shipboard training is requisite to the facilitation process. Practical mariner assessment of shiphandling skills, to be successfully objective and quantitative, should be executed in a controlled environment such as the simulator provides.

2. USMMA Simulators

One full mission simulator (CAORF) and two part task simulators (RADAR NMS-90 and PortSim) are currently employed at the United States Merchant Marine Academy (USMMA) for the facilitation of practical shiphandling skills.

2.1 CAORF



CAORF (Computer Aided Operations Research Facility) was installed at the USMMA in 1975. Since that time of room-sized mainframe computers, the CAORF simulator has evolved to the state of the art full mission simulator it remains today. In the summer of 2000, the simulator underwent another upgrade to the Polaris system of Norcontrol. Modern navigation units and realistic ship interactions are a part of this new system.

2.1.1 CAORF Advantages

Any full mission simulator, such as CAORF, offers a number of advantages over a part task simulator or a training vessel for the facilitation of practical shiphandling skills. By removing the instructor from the bridge of the ship, the midshipmen are afforded complete immersion in the scenario. The perceived safety net is removed and the students are allowed to carry the exercise to its ultimate outcome, whether their commands result in collision, allision, or grounding. The midshipmen are directly accountable for their bridge team decisions and are able to observe the final outcome of their actions. The process lends validity to the lesson. A statement from an instructor, such as, If we had not altered course at this point, we would have had a collision with the crossing vessel, becomes unnecessary as the team is able to observe the consequences of their choices. Newest versions of full mission simulator provide for a playback of the scenario so that a chain of error may be easily identified and followed during a debrief. Essentially, the full mission simulator allows the bridge team to fail an operation, or, stated in the positive sense, the simulator provides for maximum learning opportunity as the ship experiences a grounding or collision.

Generally, the use of the simulator is reserved for upperclassmen at the USMMA -- those having had some experience at sea aboard real ships. Having stood on the bridge of a ship, these midshipmen are less likely to perceive the simulator as a video game and so bestow upon it serious respect. Anyone doubting the validity of the aforementioned has not witnessed the deflated egos, shaky hands and voices, and almost tears as a watch team is debriefed following a less than stellar performance. Ship officers will remember the first time they made a solo decision, albeit minor, such as altering course for traffic. How carefully did he or she check the grease pencil rendition of the other ship s resultant RM line, check the trial maneuver on the ARPA, or replot the vessel s position? Midshipmen, and freshly minted officers, share a fear of having the conn. Simulators assuage this anxiety. Each ship master clearly remembers their first command — first maneuvering, first time they were called to the bridge at 0300, etc. This feeling of command is perhaps the most important element imparted to the marginally experienced midshipman, albeit intangible and nonquantifiable. All prior experience has probably been that of an observer — a requisite stage in the learning process. The next stage is necessarily learning by doing — the experiential environment that the simulator provides.

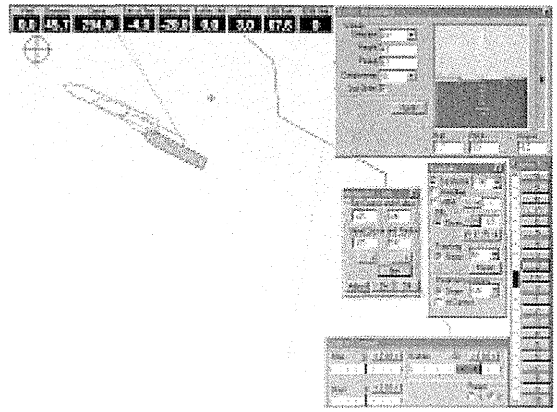
CAORF provides a number of clear advantages with respect to both qualitative and quantitative assessment of mariner skills requisite to successful shiphandling. Once developed, the same exercise may be utilized for multiple assessments. Conversely, the instructor is easily able to alter a scenario efficiently before or during a run. Traffic may be changed or other elements altered according to bridge team responses. Especially relevant to shiphandling training and assessment, the own ship model may be changed for comparison purposes. After initial scenario development, preparation time is relatively short. Shjphandling elements such as ship interaction, squat, bank cushion, suction and the resulting sheer will be easily demonstrable. Each run may be recorded and played back during a class debrief.

2.1.2 CAORF Disadvantages

Operation of the CAORF simulator is both time and labor intensive. The capstone course, Bridge Team Management, offered at the USMMA, is taught exclusively with the use of the simulator. The course is well planned with respect to both time and student to teacher ratio. One instructor and one computer operator work in tandem to operate the simulator for each bridge team of four midshipmen. Each scenario runs for approximately one hour and is followed by an extensive debrief, facilitated by same the instructor. As this course was designed for the simulator, its rendition is consistently excellent.

Conversely, the Shiphandling / Seamanship course offered at the USMMA is assigned thirty midshipmen to one instructor and one assistant. During the laboratory, a two-hour period, five midshipmen are in the simulator during a twenty to thirty minute scenario while the twenty-five others in the section stand by to rotate through the simulator. The assistant handles these twenty-five midshipmen. There is neither time nor instructor available for the debrief, which should, for optimum corroboration, be given immediately following the simulation. A brief discussion on how these challenges were allayed will be provided later in this paper.

2.2 PORTSIM®



The Marine Transportation Department of the USMMA also employs a part task simulator, PortSim, developed by SSPA Maritime Consulting of Gr teborg, Sweden. The PC based simulator presentation is bird s eye view and may be displayed in true motion, relative motion, head or north up. The ship models are based on mathematical modeling, tank model testing, and full-scale correlation; and therefore accurately describe the many vessel hydrodynamic behaviors in four degrees of freedom. A few of the features include: current and shallow water effects, bank, quay and squat effects, wind effects including lees from buildings, escort towing, eight winches for mooring, accurate underwater topography, dynamic position predictor, replay function, result file for storing of parameters.

2.2.1 PORTSIM Advantages

Part task, PC based simulation systems, such as PortSim, offer a number of advantages to full mission simulators. A first quality, interactive, multistation PC based simulator may be acquired for under $100,000.00 (USD), whereas installation of a first quality full mission simulator may easily cost $2,000,000.00 (USD). Often these simulators require major architectural alterations to existing classrooms or offices, a new wing, or dedicated building. Beyond the obvious monetary and space considerations, part task simulators offer a number of advantages to the full mission alternative.

PortSim 4.0 includes fifteen student stations and one instructor station. The system permits a section of thirty midshipmen to work in pairs during a two-hour laboratory. Alternatively, half of the class, fifteen midshipmen, may work solo. The low student to simulator ratio affords increased training time for each individual. The student necessarily makes his or her own maneuvering decision and views the direct outcome of that action. Recorded observations, outcome analysis and assessment are also individual. With respect to shiphandling facilitation, this is also important when training differing personality and learning types.

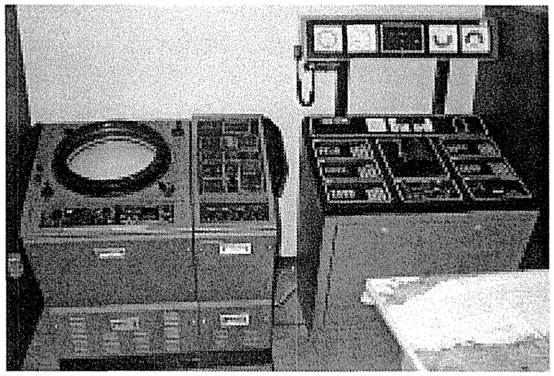
Part task simulators allow the instructor to easily develop a lesson isolating a single competency or shiphandling factor for study. Outputs such as drift angle, turning rate, set and drift provide the data for quantitative analysis during report and debrief. The bird s eye view divulges outcomes not as readily apparent from the bridge perspective of the full mission simulator. Definition and relevancy of factors such as drift angle are clearly apparent. Although a student may be able to memorize a textbook definition of terminology such as advance, transfer, tactical diameter, final diameter, the lexis is often without the marked significance revealed by a dynamic rendition. Real time maneuvers, such as the shallow water turning circle of a VLCC, are extremely time consuming. Observations of isolated tasks, such as turning circles, were challenging to the patience of even the most attentive students. The part task simulator provides for observation of maneuvers in a compressed time mode, relieving the tediousness of the real time renditions. Additionally, if adjacent monitors are programmed to execute similar tasks, those with one factor altered, the result is readily apparent. For example, while one station is programmed to have a VLCC execute a turning circle in deep water, and the adjacent station is set up to have the same VLCC execute the turning circle in shallow water. Part task simulators, such as PortSim, generally provide a wider variety of own ships, thereby increasing the potential for comparison study. For example, the same turning circle described above yields quite different results when executed with a container ship.

In the shiphandling course at the USMMA, midshipmen are asked to present results to the class as a part of the facilitation process. The part task simulator permits the midshipmen to save and play back their shiphandling experiments. The dissemination of the individuals results to the group reinforces basic concepts studied by reinforcing the individuals outcomes. Part task simulators such as PortSim provide the best venue for several practical competency assessments, as are compulsory with the recent implementation of STCW requirements. A midshipman s ability to successfully complete a shiphandling task is not dependent upon the performance of others on the bridge team or on another ship, as is the case with the current assessment methodology. Further, the assessment may be completed on a singular basis, without requirement of a watch team to execute the task. A further comparison of test beds for competency assessments is discussed in the section *Assessment of Shiphandling Skills,* later in this paper.

2.2.2 PORTSIM Disadvantages

By definition, part task simulators do not provide the immersion experience of the full mission simulator. Although PortSim is extremely effective in the isolation and dissemination of the physics of shiphandling theory, the system does not provide the command experience of the bridge. Danger of a video game mentality approach to PC based simulators is a risk when midshipmen have little bridge experience. Proper introduction of the simulator as a serious teaching tool and presentation of its utility for competency assessment should preclude this attitude. For this reason, use of the simulator should be reserved for those with some shipboard experience, such as upperclassmen, as this familiarity will lend validity to the own ship responses.

2.3 NavSim NMS-90 Norcontrol Simulator



The NavSim NMS-90 MK III Simulator is a Norcontrol part task simulation system that provides radar input in the form of several port databases. It has applicability as a shiphandling simulator through the blind bridge maneuvering of up to twelve own ships in the radar laboratory. Accurate ship model behavior is included in the system to afford students experience in ship maneuvering. The instrumentation on the own ship bridges is modeled after ship equipment to give trainees the best possible illusion of operating an actual ship. The system is interactive, i.e., each of six stations (own ships) tracks five other vessels on the screen and may maneuver as requisite to avoidance of collision.

2.3.1 NavSim NMS-90 Simulator Advantages

The radar simulator is state of the art for instruction of radar plotting, navigation, and ARPA training. It has limited but valuable use in the promulgation of shiphandling theory and practical competency assessment. Currently, it is the only simulator at the USMMA with which bank effects and ship interaction may be demonstrated. For this reason, it is used as the assessment method for the ship interaction competency required by STCW. Details of the evaluation procedure will be reviewed in the section, Assessment of Shiphandling Skills. A feature unique to the NMS-90 simulator, as compared to other simulators in use at the USMMA, is in the fact that there are essentially twelve own ships. Each of the student stations is interactive with five others, permitting realistic meeting, crossing and overtaking situations between the vessels.

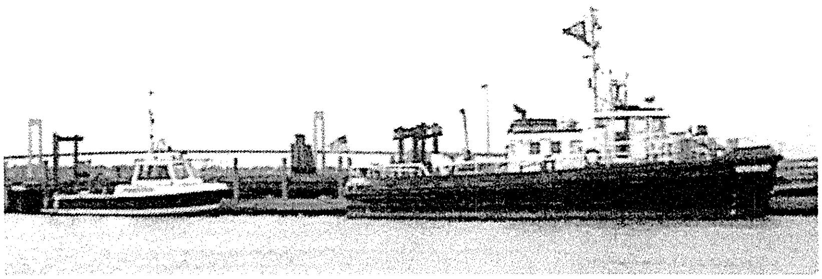
2.3.2 NavSim NMS-90 Simulator Disadvantages

The radar simulator stations are essentially blind bridges, with electronic equipment including an echo sounder, helm, bow thruster, engine controls, and VHF radio. During the exercise, the midshipmen determine the ship s position by radar and plot same. Given that there is no visual output excepting the radar screen, the midshipmen do not gain the benefit of visual orientation. Much of effective shiphandling is executed in response to visual orientation; consequently, the sense of immersion is deficient. Although the shiphandling exercise developed specifies that the ship is in dense fog, the midshipmen do not maintain the sense that they are conning a real vessel as with a full mission simulator such as CAORF.

3. USMMA Training Vessels

The USMMA Department of Waterfront Activities maintains several vessels for midshipman training. The vessels utilized specifically for shiphandling practice are described in the following subsections.

3.1 Small Boats: POSEIDON and GROWLER



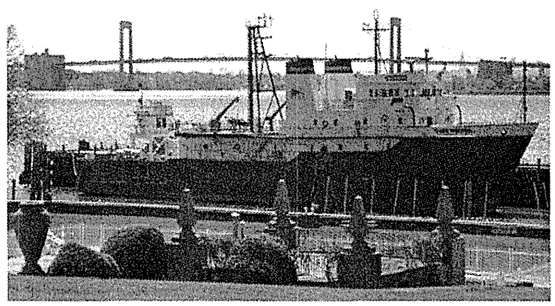
3.1.1 POSEIDON

The *Poseidon* is a thirty-two foot former U.S. Coast Guard fireboat. The vessel has twin Caterpillar 3208 high speed diesel engines, 200 SHP each. She has two small unbalanced spade rudders. She has a wheel and throttle control of the engines in a small wheelhouse. The open deck can accommodate ten midshipmen for training purposes. The *Poseidon* is easily maneuverable and is best for demonstration of twin-screw shiphandling techniques. Her rudders are fairly ineffective at slow speeds and when going astern.

3.1.2 GROWLER

The *Growler* is a sixty-five foot former U.S. Coast Guard ice breaking yard tug — 5 _ foot draft and 74 ton displacement. She is single screw (60 inch diameter, 39 inch pitch), with a maximum speed of 10.5 knots. Her main engine is Caterpillar D375, 400 SHP at 1250 RPM. The control of the engine is from the pilot house. She has a single large balanced rudder. Although her pilot house is small for instructional purposes, she can accommodate forty passengers or sleep seven on short voyages. The bow is unconventional in that it possesses a sharp break and dead rise in the keel line for ice breaking purposes. The hull is fitted with rub rails and a resilient bumper at the sides, useful to student drivers. The *Growler* is very responsive to both rudder and screw, and is the best vessel in the USMMA fleet for demonstrating single screw maneuvering.

3.2 Training Ship: T/V KINGS POINTER



The *T/V Kings Pointer* (ex *USNS Contender*) is a former U.S. Naval TAGOS class ocean surveillance vessel. She has a 224 foot length overall, 43 foot beam, 15 foot design draft, and has a displacement of 1,914 tons. She is diesel electric; the four main engines are Caterpillar D398TA, 970 HP, the four main generators are Kato 600 Kw, 600 VAC, 3 phase, and the two main propulsion motors are General Electric 800 HP. Her twin screws are inboard turning, 4 bladed, 8 foot diameter, 8_ foot pitch. The two rudders are semi balanced spade with a deflection of 0°°— 45°. She also has a bow thruster: 4 bladed, fixed pitch, 48 inch tunnel, 550 HP Harbormaster. The *Kings Pointer* requires a Master, a Chief Engineer, and an Able Seaman for crew on short voyages (under 12 hours), and a Master, three Mates, three A.Bs, a Chief Engineer, and an Assistant Engineer and thee QMEDs for longer voyages. She may carry a maximum of 115 persons on short voyages and 30 total aboard on extended voyages. She is limited by her draft to sailing on the high tides, which occur diurnally at Kings Point, where she is berthed. The *Kings Pointer* makes three extended voyages each year, during the fall, spring, and summer holidays. In addition, she frequently makes short weekend voyages to nearby ports and overnight cruises to nowhere for plebe orientation on Long Island Sound. The *Kings Pointer* is the best training platform for practical watchstanding and shiphandling at the USMMA, but time, cost, weather, manning, and berthing limitations somewhat restrict her use. A very short training voyage, one commencing two hours before high tide and returning two hours after high tide, burns about 280 gallons of fuel. Even a short voyage is disruptive to the daily class schedule, especially when it must be organized around the tidal cycle rather than the academic day. During a recent term, a single planned four hour voyage for shiphandling and navigation practice had to be rescheduled four times owing to weather considerations. Longer voyages, those spanning one full tidal cycle, are often executed overnight. These trips consume about 840 gallons of fuel, require meals, and usually require additional officers and crew. One twelve-hour trip costs roughly $2500.00 (USD). The ten-day voyages, taken three times yearly, cost roughly $25,000.00 (USD) per voyage.

3.3 Advantages of Using Vessels for Shiphandling Training and Assessment

When a person learns to ride a bicycle, the process is first by observation then by emulation. Rarely is the neophyte cyclist cognizant of the physics of gyroscopic inertia required to successfully balance on two wheels. Some of the best ship handlers in the world have little formal education. These fishermen and supply boat captains cannot explain transverse thrust or Bernoulli s Principle, yet all can handle a vessel adeptly. They have mastered the art of shiphandling.

Experiential learning is the process of learning through doing initially, then studying the theory subsequently. As an example of experiential learning, this Master Mariner handled vessels beginning with small boats at the age of six. The physics and theory of shiphandling were not conveyed until years later during academy advanced seamanship courses. Small craft training aboard boats most directly emulates the experiential learning process. On the small boats, the midshipman must handle the vessel and can directly see and feel her responses to each maneuver. He or she learns empirically — through direct observation followed by trial and error. Most significantly, the student experiences the responsibility of a real conn, with all of the feelings of fear and accomplishment that ensue. On the larger vessel, the *T/V Kings Pointer*, ship characteristics such as advance, slow response time of engine, continued swing after the command amidships, and heel of the vessel after she is put hard over lend validity to instruction. As the midshipmen learn by doing, the validation through class briefings becomes exponential.

3.4 Disadvantages of Using Vessels for Shiphandling Training and Assessment

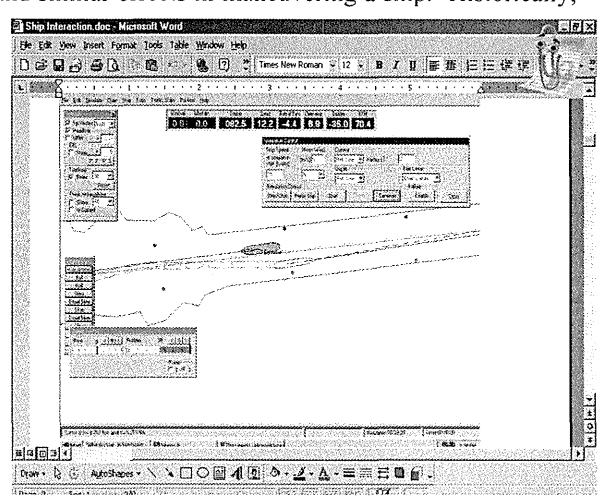
Ultimately, the objective of a practical shiphandling course is mastery of those skills aboard a real craft. Using a simulator for dissemination of shiphandling skills, however, has a number of marked advantages over the use of small boats for the same purpose. The cost analysis of deploying the training vessel *Kings Pointer* has already been reviewed. Although she is the most expensive, the smaller vessels have fuel and maintenance considerations as well. Operation of all of the vessels is weather dependent, with wind, tide, precipitation, ice, and temperature of significance. All of the vessels are time and labor intensive with respect to the hands on training opportunities. In the case of the *Kings Pointer*, often the midshipmen necessarily miss other classes to sail aboard. In a recent term, over one hundred midshipmen were registered for the shiphandling course at the USMMA. Provision of quality time for each student at the conn of the ship would have been time prohibitive. Moreover, use of the vessels for assessment is not only time prohibitive but possibly dangerous. The midshipmen are tested for shiphandling competency. For example, would a prudent mariner place a possibly incompetent student at the conn of a vessel to determine skill in compensating for narrow channel interaction an assessment required by required by STCW? Further, there are numerous uncontrollable factors, such as weather or oncoming traffic. Such major factors not under control of the examiner might also serve to undermine the validity and reliability of the assessment mechanism.

4. Assessment of Shiphandling Skills

The 1995 Amendments to the Standards of Training and Competency of Watchkeepers (STCW 95) mandate performance based competency assessment. Performance measures are observable actions or consequences of those actions that can be recorded or quantified. Performance based testing may be successfully accomplished through simulation or ship operations. The 1997 report, *Mariner Qualifications and Training — Performance Based Test Development*, affirms that simulators provide a convenient, cost effective, and consistent means of controlling the operational conditions under which competencies may be demonstrated (McCallum, et. al., 1997). The report emphasizes that successful assessment testing must be both reliable and valid. Reliable tests are defined as those that yield consistent results when repeated — the environment which a simulator provides. Please refer to the example Portsim Turning Circles Laboratory and corresponding competency assessment in the Appendix of this paper.

With respect to shiphandling competency, STCW 1995 (STCW TABLE A-II/1, Specification of minimum standard of competence for officers in charge of a navigational watch on ships of 500 gross tons or more.) specifies that a mariner demonstrate a knowledge of squat, shallow water and similar effects in maneuvering a ship. Historically, Testing for this competency assessment was accomplished using the NMS-90 simulator in the radar laboratory. The midshipmen were assigned to ships meeting in a narrow channel. To accomplish the assessment objective, the two ships were required to successfully meet in the channel. To demonstrate proficiency, the midshipmen were required to score a grade of 70 or higher according to the following quantitative assessment criteria:

retake	grounding
retake	collision
- 10 points	on wrong side of channel.



- 20 points hit buoy
- 20 points sheer

A testing limitation was revealed upon actual execution of these procedures in the NMS-90 simulator: if one team made an error, such as sheering into the oncoming vessel, both teams consequently failed the test according to the grading criteria set forth in that initial outline. A more reliable testing methodology was developed using the PortSim part task simulator: the instructor preconfigures the meeting vessels, thereby yielding more consistent testing results. The PortSim simulator was also used to generate shallow water, bank effects, wind and current in laboratory. The midshipmen are tested for competencies involving compensation for these additional externalities as is also required by STCW 95.

The second criteria outlined by the 1997 report states that a test must also be valid, i.e., related to performance in the real world. In theory, the optimum means of real world assessment would be aboard a vessel. However, as previously stated, any prudent mariner would not put their vessel in harm s way — such as meeting in a narrow channel with a cadet at the conn might exemplify. In addition, real world testing such as a vessel provides is not easily repeatable or consistent with respect to testing conditions.

4. Conclusions

. . . using the language of knowledge is no proof that they possess it. --- Aristotle, 4th Century, B.C.

The importance of experience, i.e., learning by doing, has been valued through the millennia. Aristotle believed that theory was not truly understood until a person had the ability to apply it. Lecturers of shiphandling may expound upon the physics of shiphandling theory, but the lessons will remain unlearned until reinforced by practical demonstration and emulation. Practice with real vessels would appear to be the logical solution. The actual use of vessels for shiphandling training and assessment, however, fosters a number of limitations as outlined in this paper. Moreover, the prudent mariner would not place an actual vessel in an adverse situation for the purpose of assessing cadets.

Both the part task and the full mission simulators provide a controlled learning environment for practical shiphandling training. Lesson objectives, such as turning circle comparison or shallow water interaction, may be isolated and studied without adverse effects of weather or current. As stated above, successful assessment testing must be both reliable and valid. Reliable tests are defined as those that yield consistent results when repeated — the environment which a simulator provides. The environment of a simulator is also valid, i.e., related to performance in the real world.

Shiphandling facilitation at the USMMA adheres to the model of the learning theorist David Kolb, a proponent of experiential learning. He advocates the learning is a multidimensional process, beginning from concrete experience, to observation and reflection, then to the formation of abstract concepts and generalizations, to testing implications of new concepts in new situations (Kolb, 2000) Kolb s model for experiential learning is exemplified in shiphandling methodology at the USMMA: *Concrete experience*: before the shiphandling course, the midshipmen spend several months at sea as cadets aboard merchant ships. *Observation and reflection:* the midshipmen are required to submit a comprehensive sea project with respect to their individual observations. *Formation of abstract concepts and generalizations*: shiphandling class discussions combine individual observations to shiphandling theory. *Testing of implications of new concepts in new situations*: validation of theories through practical applications using a simulator and during debrief. In closing, the ancient Chinese proverb quoted at the inception of this paper serves to reinforce the importance of the facilitation of practical shiphandling using a painted ship upon a painted ocean :

I do, and I understand.

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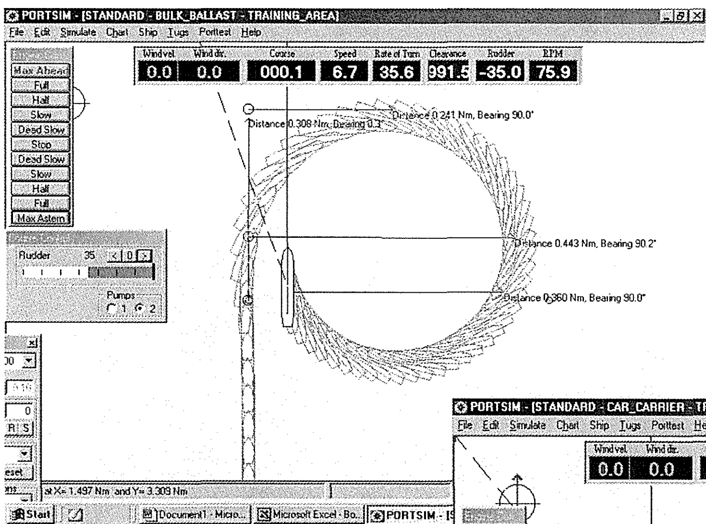
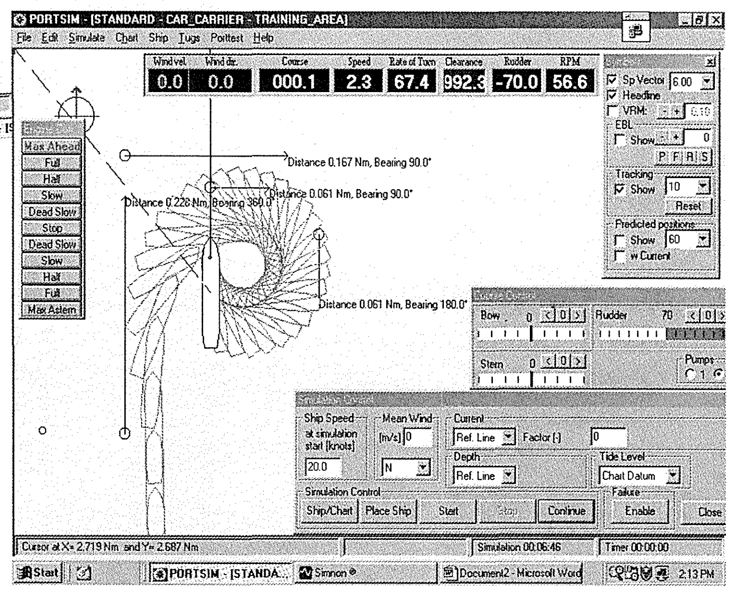
Diagramsbelow correspond to TURNING CIRCLE LABORATORY (Appendix)



TURNING CIRCLE EXPERIMENT

3A. Shallow water



TURNING CIRCLE EXPERIMENT

3B. Deep water

APPENDIX: Example Part task Simulation Laboratory and Corresponding Competency Assessment

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PortSim Laboratory: TURNING CIRCLES

OBJECTIVE: Practical application of turning circle shiphandling theory.

ASSIGNMENT: Each team will write a report about observations made during each experiment and turn in the work by the assigned date. Each team may be required to present the results of their experiment to the class during class debrief and discussion.

INSTRUCTIONS: Utilizing the PortSim part task simulator, conduct the following experiments with given conditions: using the assigned vessels, on the grid, no wind or current, track recorder on.

Teams having laboratory the 1st week make right turns; midshipmen having laboratory the 2nd week make left turns.

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1. **Effect of Ship s Speed on Turning Circles**

   A. **High Speed**
   Using the assigned ship, steady the vessel on a course of 000° at full ahead [max ahead or 100% CPP]. Set the SPEED AT START in the SIMULATION CONTROLS to the maximum design speed for assigned ship. After running on a steady course for 5 cables (1/2 NM), put the rudder hard left and observe one complete turn. When heading is 000°, stop the run, measure turning circle parameters and save all data to own disc as required.

   B. **Slow Speed**
   Place own ship on a starting grid point two rows up from the bottom center of the chart. Determine slow ahead for own ship by setting an initial speed of 30% of full (max) ahead on the SPEED AT START. Steady the vessel on a course of 000° at slow ahead [30% CPP] on the EOT. Observe the speed of the vessel for 5 cables (1/2 NM) and check that she is not accelerating or slowing speed. If yes, adjust the initial speed accordingly. Once own ship is on course at slow ahead, bring the rudder hard left and observe one full turn on the grid with the track recorder on. When heading is 000°, stop the run, measure turning circle parameters and save all data to own disc as required.

2. **Effect of Engine RPM on Rudder**
   Using the assigned ship in deep water, place the vessel as above and steady on a course of 000° at full ahead [100%CPP]. Set the SPEED AT START to the max ahead speed of own ship. After a run of 5 cables, give the ship hard left rudder. When the heading is 270°, stop the engines [0% pitch]. Observe the change in turning circle diameter. Measure and record all data to own disc.

3. **Effect of Water Depth on Drift Angle**

   A. **Shallow water**
   Using the assigned ship, steady the vessel on a course of 000°°at full ahead with initial speed corresponding to RPM. Set the simulation in the shallow water: determine shallow water by adding 2-3 meters to design draft. Water depth is set by clicking on fixed under depth in the simulation controls window. After a run of 5 cables, put the helm hard left and observe the complete turning circle.

   B. **Deep Water**
   Repeat the above exercise given the same parameters with the simulation in deep water: 100M.

4. **Effect of Acceleration on Turning Circle**
   Using the assigned ship, begin the exercise with the vessel stopped on a heading of 000° in deep water. Put the ship on full ahead, helm hard left. Compare results to those found in 3B above.

5. **Create Own Maneuver**
   Given the examples in the film, texts, and class discussion, create your own experiment to substantiate shiphandling theory. The experiment should be short and simple. Consider that the maneuver may be presented in class for discussion. DO NOT USE TUGS OR BOW THRUSTERS.

<u>IMO/STCW Assessment Control Sheet DN460-12C</u>

STCW Requirement	STCW TABLE A-II/1 (Specification of minimum standard of competence for officers in charge of a navigational watch on ships of 500 gross tons or more.)
STCW Function	Navigation at the operational level.
STCW Competence	Maneuver the ship.
STCW Knowledge, Understanding and Proficiency	Knowledge of the effects of deadweight, draught, trim, speed and under-keel clearance on turning circles and stopping distances.

Assessment Method	Graded practical exam in CAORF simulator or part task simulator
TRB Cross-Ref. (if applicable)	Ship maneuvering 10.1.10.1

Course/Designated Examiners	Bridge Watchstanding (DN460) / Meurn, Sandberg, Hagedorn, C. Smith

EACH OBJECTIVE MUST BE SUCCESSFULLY DEMONSTRATED

		Standard Met		
Assessment Objective	**Performance Measure/Standard**	**Pass**	**Fail**	**Date**
1. Candidate is able to recognize the effects of varying draught, trim, speed, and under-keel clearance on turning circles and stopping distances.	Test candidate shall pass a graded practical exercise using a navigation simulator under varying conditions as specified in the assessment objective and criteria. Minimum passing score: 70%			

Comments

ASSESSMENT CRITERIA:

1. Demonstrate the effects of varying water depth on turning circle diameter.
2. Demonstrate the effects of speed on turning circle diameter.
3. Demonstrate the effects of acceleration/deacceleration on turning circle characteristics.
4. Demonstrate the change in draught and UKC during a turn.
5. Demonstrate the effects of turning on speed.
6. Demonstrate the effects of varying parameters on vessel stopping distances.

A midshipman who fails the practical exercise will be allowed a retake exercise at a later time. The retake has no bearing on the midshipman s academic grade. The retake must be passed to satisfy STCW requirements.

A midshipman who fails a retake shall be referred to the Academy s Professional Review Board for further action.

Managing Abnormal Situations Caused by a Failure in the Automatic Navigation and Steering System

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ABSTRACT

The extensive use of computer technology onboard ships has influenced navigation work. The introduction of automation has been motivated by promises of better safety and increased efficiency. The new technology contains potential safety risks and creates new challenges. Recent accidents have shown that the user s ability to manage abnormal situations is critical for safety. The management of abnormal situations should receive special attention in the design of new systems and in the training of deck officers. In the case of a failure in the steering system, the user must activate the back-up steering mode. This should be done as early as possible, since the time margin for preventing an accident can be very short. Maintaining situation awareness by monitoring the system is crucial. The proposed use of audible feedback for enhancing the monitoring of critical signals is presented. Type specific navigation simulators for abnormal situation training are used by some shipping companies. Since practically every ship is unique, more extensive use of type specific navigation simulators is problematic. The use of ordinary navigation simulators and the need for systematic knowledge assessment is discussed.

1. Introduction

On the bridge of a modern ship, electro-mechanical, manually operated navigation and steering instruments have been replaced by an integrated navigation system. The system consists of computer-based devices communicating with each other through digital interfaces. Many of the tasks that were earlier performed manually by the officer of the watch have been automated. The role of the user in passage execution is to supervise the navigation system, monitor the feedback information on the displays and give orders to the system.

However, the work of the officer of the watch has not become easier. Automation sets new demands on the user and has created new possibilities for making mistakes. The user has to be master of the automation system, knowing what it is doing, why it is doing it, and what it will do in the future. The user is responsible. He must be ready to take the decision and take over the controls whenever the system does not perform as expected.

Faults in a critical component in a navigation and steering system have resulted in accidents (NTSB, 1997), (OTK, 1995, 1998 and 2000). The safety of the navigation and steering systems on ships is of particular interest in Finland, since the south-west coast of Finland is surrounded by an extensive archipelago area. The fairways are narrow compared to the size of the vessels sailing in this area. When the distance to the nearest island is only a hundred meters, the time to the point-of-no-return after a critical failure can be only a few seconds. A gyro compass failure caused the grounding of the ro-ro passenger ship *M/S Finnfellow* near the Finnish coast in April 2000. The grounding took place only 85 seconds after the compass failure. Even though the deck officers noticed that the ship was turning abnormally 30 seconds after the failure, it was too late to avoid the grounding (OTK, 2000).

The user must be able to cope with abnormal situations, such as a missing or erroneous function due to a component failure or software error. The user should also be aware of how the system behaves under extreme environmental conditions. The lack of this knowledge and these skills is a safety risk. Ways to enhance the monitoring of the automatic steering system, training for managing abnormal situations, and assessing the users' knowledge are discussed in the following chapters.

2. The user's role

Reason (1990) states: "The main reasons why humans are retained in systems that are primarily controlled by intelligent computers is to handle 'non-design' emergencies. In short, operators are there because system designers cannot foresee all possible scenarios of failure and hence are not able to provide automatic safety devices for every contingency". The user is not the only human element involved in the safety of a navigation and steering system and in managing failure situations. The human factor is present throughout the life-time of the system: in the design phase, in the assembly, testing and commissioning phases, in the maintenance phase, in the user training phase and finally in the actual operating phase.

The primary task of the officer of the watch is to navigate the ship safely along the planned track by using his/her knowledge, experience and the technical aids available. In relation to the bridge equipment, the officer of the watch has the role of supervisor of the automation system. The user has to perform the monitoring task, when the ship is sailing in the automatic steering mode. The present design principles of such systems give the user a decisive role in a failure situation. In the event of a failure in the steering system, the user should manually activate a back-up steering mode (Ahvenj rvi, 2000). As stated above, the switch-over should be performed as early as possible, since the available time margin to prevent an accident can sometimes be very short.

Maintaining situation awareness by monitoring the operation of the equipment is crucial. This is a demanding task, since users cannot maintain effective vigilance for more than rather short operating periods (Donald, 2001). In order to aid the user in detecting abnormalities, the system contains self-diagnostics and automatic alarm functions. Unfortunately, the self-diagnostics in the integrated navigation system are only able to give an alarm for faults and failures that they can recognize, i.e. for known failure modes. All the intelligence of the self-diagnostics has been coded into the software. A failure mode that was not anticipated by the software engineer will not be recognized by the self-diagnostics - and there will be no direct alarm for it. A missing alarm is a typical cause of a delayed or wrong operator action. Is this an operating error or a design fault? Several accidents have proved the statement that many operating errors are just the delayed consequences of design errors (Reason, 1990).

In consequence, the poor user must stay alert and use his intelligence and experience to compensate for the missing or incomplete parts of the fault diagnostics. Leveson (1995) addresses the monitoring problem by saying: "Unfortunately there is usually no way for a human to check in real time if the computer is operating correctly or not. As a result, humans must monitor the automatic control system at some metalevel, deciding whether the computer's decisions are acceptable." The user should monitor whether the system is operating correctly by persistently reading the feedback signals from the equipment.

2.1 Which data should be monitored?

As there are so many displays and indicators on the bridge, the monitoring task needs to be rationalized in a sensible way. The first thing is to decide which data should be monitored at shorter reading intervals and which at longer intervals.

A simplified structure for the feedback control loop in the automatic steering is shown in figure 1. The navigator s primary tasks on the bridge are to keep the ship on the planned safe track and to avoid collisions with other crafts. For this reason monitoring the status of the process, i.e. the course of the ship and its position relative to the track and to obstacles, must have highest priority.

We can define a dangerous failure of the navigation and steering system to be one that causes an unwanted deviation in the course or position of the ship. From this it could be assumed that monitoring the course and position of the ship is enough to deal with possible dangerous failures. Recent accidents have shown that this does not guarantee safety, if time margins are short (OTK, 1995, 1998 and 2000). Any dangerous failure in the navigation and steering system leads to an abnormal or unwanted performance by the propellers or rudders, since they are used to control the angular and translational movements of the ship. Therefore continuous monitoring of the operation of the rudders and the main propulsion is extremely important when the ship is sailing under automatic steering.

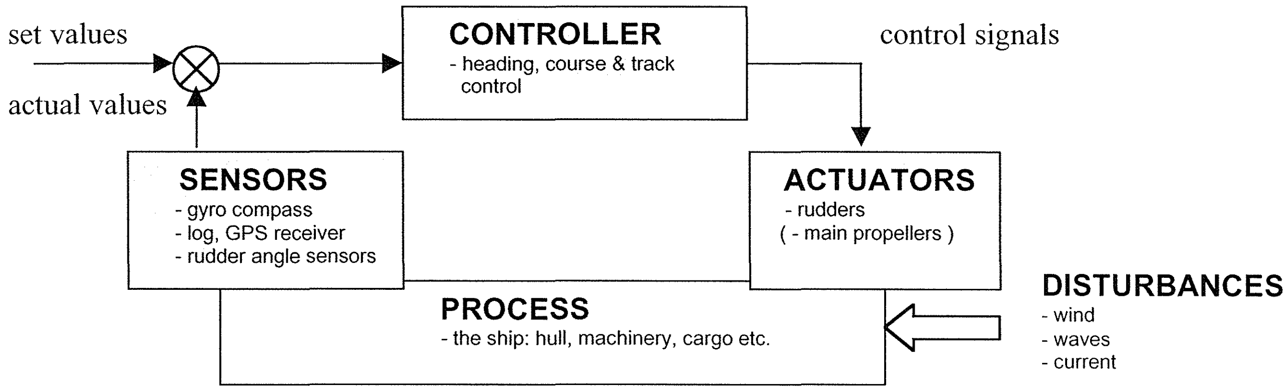

Figure 1. The feedback control loop in the automatic steering system

The movements of a large ship are difficult to monitor - and also difficult to control - because of the great mass of the moving structure. The large mass results in long time constants for translational and rotational movements. A so-called predictor display helps to monitor the ship s movements. The predicted track of the ship for a given time period is displayed assuming that the speed and rate of turn of the ship remain constant. The predictor speeds up the detection of unwanted developments in the position and course by visualizing the derivate of the position and the heading of the ship. The speed and the rate of turn are, on the other hand, integrals of the forces acting on the ship. The forces used for controlling the movements of the ship are the steering force of the rudder(s) and the translational force caused by the main propellers. Changes in the actual rudder angle and the actual propeller RPM and pitch represent an even earlier indication of the future movements of the ship than the predictor. This also confirms the importance of continuously monitoring the propeller and rudder feedback signals.

This can also be seen from some recent cases: In two groundings near the Finnish coast in the 1990's (OTK, 1995 and 1998), a zero propeller pitch due to a technical fault caused the loss of the rudder effect. In both cases, there was an early indication of the abnormal propeller pitch on the bridge, but the users did not look at the indicators. The possibilities of avoiding a grounding would have been dramatically improved if the deck officers had immediately noticed the abnormal propeller pitch. The time between the zero pitch condition and the grounding was over three minutes in the first case (OTK, 1995), and over ten minutes in the second case (OTK, 1998).

2.2 Enhancing the monitoring of critical signals by using audible feedback

The large amount of information makes monitoring a very difficult task. A single conning display can contain over 20 values related to navigation and steering. Apart from this data, the user has the radar display, the chart display, the wind sensor display, the echo sounder display, the communication equipment and many status lamps, meters and indicators related to other systems on the ship in front of him/her. And above all, the user must make direct visual observations about the situation through the windows. It is no surprise that in some accidents the user did not notice quickly enough a critical change in a value on a display or indicator (OTK, 1995), (NTSB, 1997) and (OTK, 1998).

When the bridge is located at the front, no sound from the engines, main propellers or rudders can be heard on the bridge. Information about the operation of this equipment is available only in visual form. Monitoring must be done by continuously scanning the displays and meters. The operator should read the values at short intervals in order to keep the necessary time margin for action if something goes wrong. Obviously these values are not always monitored actively enough. This is quite understandable. Continuous visual monitoring is difficult because information can be received only if it is close to the primary attention focus of the user (Rauterberg and Cachin, 1993). The operator has to deliberately look at the readings on the display or indicator. Again, for most of the time nothing abnormal can be seen on the displays, which is a strong demotivating factor.

Our hypothesis is that monitoring safety-critical signals on the bridge could be improved by using audible feedback. i.e. by producing a continuous background sound for the operational status of the rudders and the main propellers. Critical faults in the navigation and steering system would then be detected earlier, which would improve the safety of automatic steering.

The idea of audible monitoring can be demonstrated by a simple example: we have all learned to recognize the sound of our own car when the motor is started or when the gear is changed. We are immediately alarmed if the sound is different. Similarly, bridge officers would learn how the propellers and the rudders sound at different points of the route under normal weather conditions. The detection of abnormalities would then become automatic.

The potential of multimodal interfaces has been studied by many researchers. A well-known experiment using auditory cues in monitoring a complex system is the ARKola bottling plant simulation reported by Gaver *et al.* (1991). The effect of sound feedback on the work of a plant operator has also been studied by Rauterberg *et al.* (1994). Rauterberg states that the most important advantage of sound feedback is its attention-demanding ; it breaks in on the attention of the user. The detection of changes in the background sound happens automatically, without the need to pay special attention to it. The sense of hearing is an all-round sense. This is a very important difference compared to visual perception, which is a directional sense.

Questions to be examined in further research on the subject are listed in the table below.

Table 1. Main topics for further research on the use of audible feedback in monitoring.

The topic to be examined	Explanation
What requirements are set for the additional feedback sound by the existing sounds on the bridge of a typical passenger ferry?	Real sounds onboard a passenger ferry in different weather conditions will be measured. An identical background sound will be created for the navigation simulator. The frequencies, tone and volume of the audible feedback should be selected so that the sound can be heard under all conditions and, on the other hand, so that the feedback sound does not obscure speech or any other important sound on the bridge.
What kind of sounds would be acceptable to users?	Adding the background feedback sound must be accomplished in such a way that it does not disturb or irritate the users or cause additional mental stress. In the experiment of Gaver, a natural sampled engine sound was used (Gaver *et al.*, 1991) whereas Conversy (Conversy, 1998) used a real-time filtering technique to create wave- and wind-like sounds.
What kind of changes in the background sound attract the user's attention?	The user should immediately notice any abnormality in the feedback sound. Many parameters can be varied: the pitch, volume, timbre, tone, direction or repetition frequency of the sampled sound patterns etc. The effect of different ways of varying the sound must be examined.
Does sound feedback improve operator performance in fault situations?	Introducing audible feedback should speed up the detection of critical faults in the automatic navigation and steering system. A navigation simulator will be used to measure the efficiency of the sound feedback. The result for fault detection with additional sound feedback will be compared with the results without sound feedback.
What is the effect of learning?	The users should learn how the healthy system sounds. Learning the healthy feedback sound is the key to detecting abnormalities. This shall be studied using simulator exercises.
Does audible feedback have a similar effect on the performance of all users?	There may be differences between individuals in reacting to the sound feedback. The navigation simulator shall be used to study this matter.

3. Training of users

It may be difficult to see any difference between the performance of an experienced user of an automatic steering system and that of a novice under normal operating conditions. But the difference becomes apparent when an abnormality occurs in the operation of the system or in the conditions where it is being used. A novice might act in the wrong way or take no action at all, whereas the skilled operator would be able to manage the situation without problems. Managing abnormal situations is the most demanding area in operating an automation system and therefore should receive much attention in the training of users.

Properly arranged, continuous user training is an important means for reducing the safety risk in automation systems. It can even reduce the safety risk due to design errors. Operator training should contain not only exercises in using the system under normal operation conditions but also a large, carefully designed set of exercises in managing the system under abnormal situations, for the following reasons:

- An abnormal situation such as a failure situation or extreme operating conditions means a higher safety risk. The risk of an accident is greater and therefore any error made by the user could have more severe consequences than in normal operating conditions.

- Redundancy in existing navigation and steering systems is usually realized in such a way that in the event of a failure the user has an active role in selecting the stand-by device or back-up function. The threshold for activating the manual control mode after a fault could be kept lower by giving training for various situations in a simulator.

- The skills for managing different kinds of abnormal situations cannot be learned or maintained during normal operation onboard.

- There is always the risk that users become over-confident if in their experience the automation system is always very reliable. Demonstrating potential failure cases could provide motivation for users to continuously cross-check and monitor the system properly.

- Training in different failure cases gives the users the chance to correct their mental model about how the system will behave in different conditions.

- Becoming familiar with an abnormal situation reduces the mental stress when a similar situation occurs in reality, which reduces the risk of an operator error.

- Simulating critical situations can give information about the individual's ability to act under stress.

Reason (1990) says: "One of the consequences of automation is that operators become de-skilled in precisely those activities that justify their marginalized existence. When manual takeover is necessary, something has usually gone wrong; this means that operators should be more rather than less skilled in order to cope with these atypical conditions".

3.1 The need for type specific training simulators

It is quite obvious that learning to manage abnormal situations cannot be achieved by reading books or manuals. The more rapid the reaction needed, the more important it is to train in the correct procedures in advance, hands-on. The training also needs to be repeated at reasonable intervals. High-quality simulators have been used for more than twenty years in training nuclear power plant operators and aircraft pilots to handle abnormal situations. A realistic and well tuned type specific simulator is an ideal tool for operator training. In the simulator trainees can make their own, direct observations and obtain their own experience of how the system behaves in abnormal situations. All training cases and scenarios can be repeated as many times as needed. The procedures taught can be directly applied in operating the real system. Trainees can also compare their own mental model with the behavior of the system and make corrections if needed.

The realism of the simulator is crucial. The Human-Machine-Interface of the simulator equipment, the operating logic and the behavior of the process should be as close to reality as possible. Trainees should experience the simulated situation and the behavior of the system as it happens in real life. Otherwise they are not learning the right thing. The reality of the simulation may also have an effect on the motivation and attitude of the trainees. If the simulator equipment or its behavior does not match reality, this may make it impossible to reach the stress level that exists in a distress situation. This would lessen the effectiveness of the training, since mental stress is an essential factor when managing abnormal situations.

However, high-quality simulator facilities do not automatically mean good training results. Training sessions must be carefully planned and the exercises performed in a professional way, taking into consideration the laws of human learning. All training scenarios should be realistic. Documented incidents and accidents are an excellent source of realistic training scenarios.

3.2 The problem of standardization

A type specific simulator, i.e. a simulator that is identical to the actual bridge on a ship, is not common in the training of navigators. The reason is simple: the level of standardization for complete bridge systems is still very low, and so a navigation simulator with a type specific bridge equipment and simulation model would be compatible with very few ships.

There are thousands of different ships in the world and almost every ship type has a unique bridge layout. There have been some brave efforts to create integrated bridge standards, but with poor results.

Since competition, the shipbuilders and the regulating authorities do not give sufficient support for the strict standardization of integrated bridges, the leadership in the work of standardization should be taken by the shipowners. Some of the most important benefits from using a standard bridge concept on a whole fleet are:

- *Training costs*: the costs of high quality training are much lower when the same written material, CBT programs and type specific simulation equipment can be used for training all deck officers

- C*osts and quality of maintenance*: spare part costs, overall maintenance of equipment, training of electricians etc. can be optimized when there is a company bridge standard.

- S*afety*: the special technical, operational and training expertise derived from a company bridge concept will promote safety. The opportunity of using high-quality type specific simulator equipment for crisis management — not only for training operators but also for testing purposes - is also essential. Another important factor is the possibility of moving deck officers from one ship to another without the risk of having users with too little knowledge of the system.

The development of computer electronics has been very rapid during the past twenty years, which means short product lifetimes. From the system manufacturer's point of view, the product development cycle should be as short as possible and a new product generation should be introduced ahead of competitors. But if manufacturers are introducing new product generations every third year, it becomes practically impossible for a shipowner to create a company bridge standard. Very few shipowners can afford to replace the integrated bridge of the whole fleet every five or seven years. Compared with the typical lifetime of a ship, even ten years is short for the lifetime of equipment.

3.3 The use of ordinary navigation simulators

It is difficult to see any other method that would be superior to using a type specific navigation simulator in training deck officers to manage abnormal situations. However, without major developments in the standardization of bridge concepts, few new type specific navigation training simulators are likely to be introduced. Most deck officers will have to continue their work without proper simulator training in managing abnormal situations.

One possible solution to the lack of type-specific training opportunities would be to make special use of existing simulator facilities to demonstrate real incidents and accidents, examine potential failure modes in navigation and steering equipment, and train in generic crisis management procedures, that would apply to a particular ship with small modifications.

The behavior of a human being when performing a control task can be described with the well-known three-level model proposed by Jens Rasmussen (1987): the skill-based, rule-based and knowledge-based levels. At the skill-based level, performance is governed by stored patterns of preprogrammed instructions. At the rule-based level, solutions are governed by stored rules. At the knowledge-based level, actions are planned using conscious analytical processes and stored knowledge.

A type specific simulator is obviously needed to provide efficient training at the skill-based level. But a well designed, realistic general-purpose full-mission navigation simulator - which would have the necessary features for demonstrating various equipment failure modes on different ship types - could be used to train for operations at the rule-based and knowledge-based levels. This kind of training would teach the right attitude and raise the level of awareness of the potential risks in using automated systems. It would also emphasize the importance of continuous monitoring and cross-checking during the use of an automated system and the user s role in managing abnormal situations.

The use of general simulators in crisis management training as described above should of course also be applied in the training of deck officer students at maritime education and training institutes.

3.4 Knowledge assessment

An assessment of the users' competence should be included in all training. No training course should be completed without an evaluation of its effects. This information is necessary for the ongoing development of the training. Ineffective training practices and scenarios can then be eliminated and better ones developed.

A test is also a good motivator. This fact is well known by everyone working in the field of education. When trainees know that they have to pass a test, they are better motivated to learn. Competence assessment of deck officers is also a requirement of the STCW 95 and should be carried out on a regular basis. The methods for demonstrating competence defined by STCW 95 include the use of simulators. The aviation industry has long experience of using simulator tests for this purpose.

The skill-based and rule-based behavior of the operator could be tested by running suitable tests on a simulator. For testing the mental models and knowledge of the operators, a traditional written exam, in the form of open questions or multiple-choice questions, would be a good choice. A computer-based tool, based on a large set of multiple-choice questions, could be used for this purpose.

4. Conclusion

The user s readiness to successfully manage abnormal situations is crucial for the safety of automatic navigation and steering systems. Continuous monitoring of critical feedback data is important, since the built-in self-diagnostics of the integrated systems do not necessarily cover all failure modes. On restricted waters, the operation of the rudders and the propellers should be actively monitored when the ship is sailing under the control of an automatic steering system. Monitoring could be enhanced by using audible feedback.

The management of abnormal situations should also have a high priority in operator training. The operator is the critical resource that should be able to find the way out of a hazardous situation after a failure in the automation system. The need for simulator training for specific navigation systems is obvious. Training in the exact procedures for handling different kinds of failure situations can only be effective when using a simulator that is a copy of the real system. The problem in establishing type specific training simulators is the lack of bridge standards. Almost every new ship type has its own unique bridge layout. Companies would gain many other benefits from building company standard bridge concepts.

Because of the obvious problems in establishing type specific navigation simulators, the potential of general-purpose simulators in crisis management training should be utilized as much as possible. The performance of the operator can be described with a three-level model consisting of the skill-based, rule-based and knowledge-based levels. A general-purpose full-mission simulator could be used to train users in managing abnormal situations at the rule-based and knowledge-based levels.

Training activities should be supported by a systematic assessment of the skills and knowledge of the operators. A simulator trial is a convenient method for testing skill-based and rule-based level performance. For testing knowledge-level performance, a testing method based on an extensive multimedia question database could be used.

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Fault Simulation of Main Engine System for Engine Room Simulator

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ABSTRACT

An engine room simulator has recently been developed to simulate the behaviors of a 2700 TEU container ship under different performance faults and different running conditions. This paper introduces the mathematical models of the main diesel engine including chamber combustion model, variable injection timing model and hull-propeller-engine model. A real time simulation algorithm is described to meet the demands of rapid response, long running duration and little error accumulation of the simulator. Typical performance failures, structural faults and boundary conditions of main engine were simulated and their simulation models are briefly mentioned in this paper. Seafarers operation to the simulated faults can be assessed and operation-assessing algorithm is also introduced in this paper.

1. Introduction

The demands of modern ship operations require that deck and engineering officers should be taught more than the standard technical skills of their craft. Statistical data from the United States National Transportation Safety Board as well as several international organizations site human factors as the cause of 75% ~ 80% of all investigated commercial marine casualties. In 1995 the International Maritime Organization (abbreviated to IMO) amended the implementation of the international convention on Standards of Training, Certification Convention and Watch-keeping (abbreviated to STCW) for seafarers (1978) and formed the STCW 78/95 convention. This convention stressed the importance and the necessity of simulator training in examination and assessment for certification of competency.

To satisfy the requirement responsible for the training, examination and assessment of competency certification of seafarers in eastern China, a marine engine room simulator has been accomplished which includes main engine system, power plant station and auxiliary machinery system and alarm system. The simulated ship is a 2700 TEU container carrier of Shanghai ocean shipping company, which is 236 meters long and 32.2 meters wide .The main engine is MAN B&W 6L80MC two stroke diesel engine, whose bore is 0.8 meter and stroke is 2.592 meters. Fitted with two VTR-564-32 exhaust gas turbochargers its rated speed is 88 r/min and rated power is 16668 kW.

2. Mathematical Models

2.1 Engine Models

The engine model referred to in this paper is a general-purpose engine thermodynamic simulation code. The model is control volume type, which treats a multi-cylinder engine as a series of thermodynamic control volumes interconnected through valves and ports. Several modifications have been made to meet the demand for fault simulation within full running range briefly described below.

To take into account the influence of performance faults to combustion procedure, a term called combustion efficiency was inducted into the heat release. The term is defined as the ratio of completely burned fuel to injected fuel, which is the function of excess air factor_defined as

$$\eta_u = \begin{cases} 3\alpha / 5 & (\alpha < 1.25) \\ (\alpha + 1)/3 & (1.25 \le \alpha \le 2) \\ 1 & (\alpha > 2) \end{cases} \tag{1}$$

Then the rate of heat release can be defined as

$$\frac{dQ_f}{d\varphi} = \begin{cases} \eta_u \cdot \frac{M_{x0}}{0.35\Delta\varphi}(\varphi - \varphi_{VB}) & \varphi < 0.35\Delta\varphi \\ -\eta_u \cdot \frac{0.85 M_{x0}}{0.35\Delta\varphi}(\varphi - \varphi_{VB} - 0.35\Delta\varphi) + \eta_u \cdot M_{x0} & 0.35 \le \varphi \le 0.65\Delta\varphi \\ -\eta_u \cdot \frac{0.15 M_{x0}}{0.35\Delta\varphi}(\varphi - \varphi_{VB} - \Delta\varphi) & \varphi > 0.65\Delta\varphi \end{cases} \tag{2}$$

Where the maximum heat release rate is

$$M_{x0} = \frac{2}{0.7475\Delta\varphi} \tag{3}$$

The ignition angle is

$$\varphi_{VB} = \begin{cases} -2 & e < 0.66 \\ 4(-e + 0.66) - 2 & 0.66 \le e \le 0.91 \\ 50(e - 0.91)/9 - 3 & e > 0.91 \end{cases} \tag{4}$$

The heat release duration angle is

$$\Delta\varphi = \Delta\varphi_0 (n / n_0)^{0.5} \tag{5}$$

The mechanical efficiency is

$$\eta_m = 0.4(n - 60) \times 0.01 + 0.82 \tag{6}$$

Where,

$\Delta\varphi_0$: Heat release duration angle at rated condition with no performance failure_

n_0: Running speed at rated condition_

n: Running speed at calculated condition_

e: Cyclical fuel charge ratio of calculated condition to rated condition.

A three-zone scavenging mode with fresh air, exhaust gas and mixing zones was used. Turbocharger compressor and turbine experimental performance maps were included in digitized form and the code can interpolate within the data to find the operating point.

2.2 Hull-propeller-engine Model

According to the ship trial when ship draft was 5.86 meters with clean hull, no ocean current, no wave, no excess 2 scale wind the ship sailing speed was 21.16 knot and the main engine speed was 93.3 r/min. Then the propeller rotating torque M_p, propeller propulsive force T_p, ship drag force R, propeller consuming power P_p and the engine indicated power P_i can be as

$$M_p = 3294 K_M n_p^{\ 2} \tag{7}$$

$$T_p = 3059.4 K_T n_p^{\ 2} \tag{8}$$

$$R = 6.627 v_s^2 \cdot Y_R \tag{9}$$

$$P_p = 20686 K_M n_p^3 \cdot Y_R \tag{10}$$

$$P_i = P_p / (\eta_m \eta_{rt} \eta_w) = 24393.6 K_M n_p^3 \cdot Y_R \tag{11}$$

Where Y_R is a gain factor which can express different navigation conditions and hull conditions of the ship as:

a) Hull cleanliness

$$Y_R = 1 + (0.50931\text{g}\, \frac{20t+125}{125}) \tag{12}$$

Where t is the duration since the latest hull cleaning in terms of year.

b) Wind scale

$$Y_R = \begin{cases} 1.0^{-\cos\alpha} & \text{Light breeze} \\ 1.5^{-\cos\alpha} & \text{Fresh breeze} \\ 1.8^{-\cos\alpha} & \text{Gale} \\ 2.5^{-\cos\alpha} & \text{Voilent storm} \end{cases} \tag{13}$$

Where_is the angle from wind direction to ship sailing direction.

c) Rudder angle

$$Y_R = \begin{cases} 1.0 & 0^0 \\ 1.12 & 7^0 \\ 1.25 & 25^0 \\ 1.40 & 30^0 \end{cases} \quad (14)$$

d) Shallow and narrow navigation channel

$$Y_R = \begin{cases} -11.11x^2 + 13.33x - 2.0 & h/T < 4 \ , \ v_s > 0.3\sqrt{gh} \ , \ v_s < \sqrt{gh} \\ -4x^2 + 8x - 2.0 & b/B < 20 \ , \ v_s > 0.5\sqrt{gh} \ , \ v_s < 1.5\sqrt{gh} \end{cases} \quad (15)$$

$$x = v_s / \sqrt{gh} \quad (16)$$

Where,

v_s :Ship sailing speed(m/s)_

h: Channel depth(m)_

T :Ship draft(m)_

b: Channel width(m)_

B: Ship width (m).

e) Ship draft

$$Y_R = Y_R / T_s \quad (17)$$

Where T_s is ballast draft.

2.3 Real time Simulation Algorithm

To meet the demand of rapid operational response, long running duration and little error accumulation for engine room simulator, a new algorithm was made based on the control volume engine model. Within the possible running range of main engine, running speeds n_1, n_2, , n_{10} and fuel racks S_1, S_2, S_{10} were selected and thermodynamic variables under each running speed n_i and each fuel rack S_i (i=1,2, ,10) were calculated with the control volume method which formed a variable matrix A

$$A = \begin{array}{c} \\ n_1 \\ n_2 \\ \cdot \\ \cdot \\ \cdot \\ n_m \end{array} \begin{array}{c} \begin{array}{ccccc} s_1 & s_2 & \cdot\ \cdot\ \cdot & s_n \end{array} \\ \begin{bmatrix} a_{1,1} & a_{1,2} & \cdot\ \cdot\ \cdot & a_{1,n} \\ a_{2,1} & a_{2,2} & \cdot\ \cdot\ \cdot & a_{2,n} \\ \cdot & \cdot & & \cdot \\ \cdot & \cdot & & \cdot \\ \cdot & \cdot & & \cdot \\ a_{m,1} & a_{m,2} & \cdot\ \cdot\ \cdot & a_{m,n} \end{bmatrix} \end{array} \quad (18)$$

$$(m = 10, n = 10)$$

Suppose the present running speed is n and actual fuel rack is S during simulator s training, thermodynamic variables in vector B under running speed n and 10 fuel racks S_i (i=1,2, ,10) are firstly got with Newton interpolation method as

$$\begin{array}{c} \quad s_1 \quad s_2 \quad \cdot\ \cdot\ \cdot \quad s_n \\ B = \{ b_1 \quad b_2 \quad \cdot\ \cdot\ \cdot \quad b_n \} \end{array} \quad (19)$$

Then the actual thermodynamic variable C can be got under actual running speed n and actual fuel rack S as

$$C = \frac{(s-s_{i+1})(s-s_{i+2})}{(s_i-s_{i+1})(s_i-s_{i+2})} b_i + \frac{(s-s_i)(s-s_{i+2})}{(s_{i+1}-s_i)(s_{i+1}-s_{i+2})} b_{i+1} + \frac{(s-s_i)(s-s_{i+1})}{(s_{i+2}-s_i)(s_{i+2}-s_{i+1})} b_{i+2} \quad (20)$$

Where $s_i < s < s_{i+1}$

With this algorithm thermodynamic variables under any performance condition can be obtained with only eleven interpolating calculations and without plenty of iteration calculation of differential equation, which meets the demand of real time simulation. As every performance condition is computed from the variable matrix A and has nothing to do with the former running points, it avoids error accumulation in computation and satisfies the requirement of long service duration of engine room simulator.

When driven by torque, a new running speed of main engine n and sailing speed of container ship v_s can be got as

$$n = n + (M_e \times \mathrm{sgn}(Dr) - M_p \times \mathrm{sgn}(n) - M_f \times \mathrm{sgn}(n)) / 2 / \pi / Je$$
$$v_s' = v_s + (T \times \mathrm{sgn}(n) - R \times \mathrm{sgn}(v_s)) / m / (1 + 0.06) \tag{21}$$

Where,

M_e: main engine torque moment (N.m);
Dr: main engine running direction;
M_f: propeller resistant moment (N.m);
m: ship mass (kg).

3. Fault Simulation

3.1 Simulated Objectives

Besides routine operations engine room simulator should also execute under emergency situations or with engine performance failures. This kind of training is very difficult to carry out on board ship and therefore very economical in simulator training which can be of great benefit to seafarers calm emotion and strong ability dealing with the urgent situations. The urgent training courses for marine main engine have been stipulated in STCW 78/95 as shown in Table 1.

Table 1. Urgent Training Courses for Marine Main Engine in STCW 78/95

Emergency operations	Local control:	Starting, stopping, accelerating, decelerating, reversing.
	Emergency control:	Over-control, restriction-canceling, emergency-stopping.
	Emergency operation:	Fuel cut-off, piston withdrawing, turbocharger stopping.
	Over speeding and over loading:	
	Abandoning and fleeing:	
Fault Fixing	Main engine fault:	Turbocharger surging, scavenging belt firing, trouble shooting of thrust bearing, cylinder, piston ring, etc.
	Facility fault:	Remote control system, monitoring system, safety system, cooling system, lubricant system etc.
	Axial and propeller fault:	Trouble shooting of main shaft, main journal bearing, fix pitch propeller or controllable pitch propeller.

3.2 Fault Models

Main engine faults can be classified as malfunctions, structural faults and abnormal boundary conditions. By varying input data and model coefficients of the control volume model engine faults can be simulated. The selected input data and model coefficients of some simulated faults referential to normal condition are shown in Table 2 ~ Table 4. Besides thermodynamic variables, some other multi-media symptoms such as exhaust fume, abnormal noises were also used to simulate the faults as shown in Table 5.

Table 2. Input Data and Model Coefficients for Structural Faults

Performance Fault	Input Data and Model Coefficients		
	Normal Data	Abnormal Data	Data Descriptions
Fuel injector needle worn	80 °CA/g_f	104 °CA/1.1g_f	Injection duration angle/ Fuel charge
Fuel injector nozzle deposit	-2.5°CA/80 °CA	5.0 °CA/96 °CA	Ignition angle/Injection duration angle
Fuel pump plunger worn	-2.5°CA/80 °CA	-1.25°CA/104 °CA	Ignition angle/Injection duration angle
Turbocharger bearing worn	0.98	0.88	T/C mechanical efficiency
Piston scraping	M_f	0.3M_e	Engine mechanical resistance
Propeller blade taken off	M_p	0.8M_p	Propeller resistance torque

Table 3. Input Data and Model Coefficients for Malfunctions

Performance Fault	Input Data and Model Coefficients		
	Normal Data	Abnormal Data	Data Descriptions
Fuel injection too early	-2.5 °CA	-15 °CA	Fuel ignition angle
Fuel injection too late	-2.5 °CA	15 °CA	Fuel ignition angle
Scavenging belt deposit	0.45	0.20	Air flow coefficient at inlet port
Exhaust port deposit	0.50	0.40	Air flow coefficient at outlet port
Carbonized piston top	300_	500_	Piston top average temp.
Cylinder jacket air-blocked	1.0	0.20	Heat transfer coefficient to liner wall
Turbocharger air filter blocked	0.1033 MPa	0.095 MPa	Air inlet pressure of T/C
Turbo nozzle foul	$0.0054m^2$	$0.0035m^2$	Flow area of turbine nozzle
Exhaust boiler deposit	0.103MPa	0.1074MPa	T/C exhaust back-pressure
Too much water in fuel	100%	50%	Fuel charge of all cylinders
Main bearing lubricant poor	0.89	0.70	Engine mechanical efficiency
Piston seizuring	M_f	$2.0M_e$	Engine mechanical resistance

Table 4. Input Data and Model Coefficients for Boundary Conditions

Performance Fault	Input Data and Model Coefficients		
	Normal Data	Abnormal Data	Data Descriptions
Ambient temperature too high	27_	45_	Compressor air inlet temp.
Ambient temperature too low	27_	0_	Compressor air inlet temp.
Propeller fishnet-bound	M_p	1.2 M_p	Propeller resistance torque
Cylinder liner cooled poorly	200_	500_	Liner surface average temp.
Piston top cooled poorly	300_	600_	Piston head average temp.
Inter-cooler cooling water inlet temperature too high	45_	70_	Cooling water inlet temperature of inter-cooler
Inter-cooler cooling water inlet temperature too low	45_	0_	Cooling water inlet temperature of inter-cooler

Table 5 Multi-media Symptoms of Simulated Faults

Faults	Abnormal noise	Exhaust fume	Animation
Fuel Injection too early	Knocking inside chamber	Gray gas	
Fuel injection too late		Gray gas	
Scavenge port deposit	Turbocharger surging	Black gas	
Fuel injector needle worn		Block gas	
Fuel pump plunger worn		Block gas	
Piston ring leakage		Block gas	
Exhaust passage deposit	Turbocharger surging	Block gas	
Cylinder liner crack		White gas	
Scavenge case firing	Turbocharger surging	Block gas	Firing in scavenge belt
Piston scrapping	Knock inside chamber	Gray gas	
piston seizuring	Rubbing noise inside	Block gas	
Turbine nozzle foul	Turbocharger surging	Gray gas	
Turbocharger worn		Block gas	
Exhaust boiler deposit	Turbocharger surging	Block gas	
Crankcase explosion	Explosion		Dark smoke at crankcase door
Propeller blade taken-off	Big noise		

3.3 Operation Assessment

Every fault is provided with up to eight choices for seafarers to select. Each choice has an operation description and an assessing score. If selected operation is correct to the simulated fault the assessing score will be counted in; otherwise the assessing score will be discounted. Some incorrect operation choice can even induce consequent faults, that is, if these incorrect operations are selected, other critical faults will occur afterwards and the assessing score will be very low. Table 6 gives out the operation descriptions, corresponding scores and possible consequent fault for the simulated piston-scrapping fault.

Table 6 Operation Assessment for Piston Scrapping Fault

Provision Operations	Score	Consequent Fault
Check the temperature of each jacket cooling water, cut off fuel to this cylinder and run M/E continuously at lower speed.	40	
Increase piston-cooling lubricant to this cylinder.	40	
Check and increase cylinder lubricant to this cylinder.	20	
Increase jacket-cooling water to cylinder to strengthen liner cooling.	-80	Piston seizure
Open the indicator cock to get rid off accumulated air and dirtiness.	20	
Stop M/E gradually, lift out the piston and examine it carefully.	20	
Stop M/E immediately, lift out the piston and examine it carefully.	-70	
Pour kerosene to piston s interface firstly if the piston is stuck and then lift out the piston slowly.	30	

Assume the assessment score matrix is B and selection item vector is C

$$B = \begin{bmatrix} s_{11} & s_{12} & . & . & . & s_{1n} \\ s_{21} & s_{22} & . & . & . & s_{2n} \\ . & . & . & . & . & . \\ . & . & . & . & . & . \\ . & . & . & . & . & . \\ s_{m1} & s_{m1} & . & . & . & s_{mn} \end{bmatrix} \tag{20}$$

(m=33,n=8)

$$C=\{c_1\ c_2 \quad c_n\} \tag{21}$$

Where,

$$c_i = \begin{cases} 0 & not \quad selected \\ 1 & selected \end{cases} \tag{22}$$

If $i^{\#}$ fault is simulated and operation choices are selected, the assessment score w will be

$$w = \sum_{k=1}^{8} s_{ik} \cdot c_k \tag{23}$$

The assessment report can be printed out after training, which includes trainee name, training course, selected operations and assessed score.

4. Software Design

Developed in Visual Basic visible programming language, the main engine simulation system includes 20 software interfaces such as gas combustion chamber, supercharging and air exchanging, oil lubricating, gas pressure indicating, fuel pressure indicating, bar graph variable, piston ring wearing, condition monitoring, thermodynamic report and fault operation.

With timer1, timer2, timer3 software timers, main engine system keeps contact with other hardware facilities such as dynamic MIMMC panel, audio devices, local control console, remote control console, bridge control console, power distribution board. It also keeps contact with other simulation software systems such as instructor system, auxiliary machinery system, alarm system and instruction system.

According to instructor s commands, main engine simulation system can run under different models as

l Testing model: Self-testing the software function with standard data file. This model is used for self-checking of simulation system when necessary.

l Online model: Communication is kept with all the hardware facilities and software systems via network. Any operation on hardware facilities can take effect upon all simulation systems. This model is used for full-scale training of marine engine room.

l Isolation model: Simulation system is divided into power station system, main engine system and auxiliary machinery system isolated from each other. This model is used for small-scale training for some a specific system.

l Offline model: Communications between hardware and software systems are cut off and all the operation can be only executed on software interfaces. This model is used in the student training terminals where landlubbers can get to know some background knowledge and basic operation rules.

With timer1 the software system continuously obtains commands such as running model, ship navigation condition, time scale and fault code from instructor system at 5 seconds intervals. With timer2 it receives boundary variables from auxiliary machinery system and sends out calculated results to auxiliary system and alarm system. With timer3 it gets user operation on hardware consoles and sends out digital parameters to hardware gauges or indicators. As mentioned above the simulation system can emulate most of faults or accidents of marine main engine, which happen scarcely on board ship and reinforce seafarers ability to treat with emergency situations and casualties. This can be of great significance to safe navigation at sea.

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Author s Biography

Hu Yihuai, Male, born in 1964. He got his Ph.D. from Wuhan Science & Technology University in 1993 and worked as a postdoctoral researcher in Huazhong University of Science & Technology during 1993 to 1995. He works now in Shanghai Maritime University as a teacher, especially in the research into fault diagnosis of machinery systems, development of engine room simulator and teaching in marine engineering.

Establishing a Simulation, Training and Research Center — Achieving the Vision

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ABSTRACT

The Institute of Maritime Technology, Research and Analysis (IMTRA) at California Maritime Academy (CMA), under the aegis of the Department of Continuing Education has obtained funding for the acquisition of an Oil Spill Crisis Management Simulator. This simulator will be the core of, and the vehicle for, establishing a Simulation, Training and Research Center in Vallejo. In the effort to realize the vision of establishing a world-class Center which will serve a variety of clients, the Institute has formed a unique team of state and federal agencies directly concerned with both the prevention of, and recovery from, spills. It is also envisioned that the selected simulator manufacturer will be an active, long-term partner on this team. The Center will add to the simulator suite at CMA for undergraduate use, and open avenues for graduate level research in the hydrography and hydrology of the modeled geographic areas as well as in the modeling of the databases themselves. The development of Continuing Education Spill Response training courses, courses in Leadership and Crisis Management, and opportunities for agencies and industry to model and test contingency plans will help support the Center financially. This paper will discuss the model created to establish the center from initial funding through creation of the team and their integration into an Advisory Board for the definition of the simulator and of the functions of the center, the process of defining and acquiring the simulator, and the vision of how the center can grow into the caliber of institution intended. The intent is to provide a model which other Maritime Universities can use to meet their needs and opportunities.

1. Introduction

This paper describes the evolution of a model for establishing what is intended to be a world-class simulation, training, and research center built around a spill and crisis management simulator. The evolution of the model, and of the center, is a work in progress. Our experience is not purported to be the ideal way to achieve the goal, but it is hoped that some of what has been accomplished to date may be of use to others who wish to move in a similar direction.

1.1 The Vision

The concept of establishing a Simulation and Research Center has been under discussion at California Maritime Academy for a number of years. CMA currently has seven simulators, ranging from full-mission Bridge and Steam simulators, Radar and GMDSS simulators, through part-task diesel and power plant simulators, to an out-dated Liquid Cargo simulator. The construction of an on-campus Simulation Center is an item in the master plan, and is scheduled for funding and construction within the next five years. Appropriately, this Center is intended to support the undergraduate curriculum as its primary customer, with Continuing Education using the simulators as scheduling permits. The on-campus Center is considered essential to providing requisite simulation support to the undergraduate programs as the student body expands to a planned size of 750 cadets.

Vision, however, is not limited to or by planned programs. The ideas and concepts underlying the thoughts and vision of a simulation and research center looked at university growth beyond current parameters to what could be. The concept was that several areas of growth could be addressed in a multi-disciplined package that included the development of a graduate degree program, the establishment and development of a simulation and research center, the development of Professional / Associate of Science / Preparatory programs, and the establishment of a Nautical Center, in conjunction with the siting and development of a Simulation, Training and Research Center. Expansion of the uses of the Simulation Center, partnering with industry / simulator researchers / other California State University system campuses / University of California campuses / local Community Colleges / the United

States Army Reserve, etc., and developing new courses of study and training were and are a part of the vision. Siting the Center off-campus not only addresses a limited availability of space problem, but also takes advantage of the potential availability of land and facilities as a result of the closing of a nearby naval shipyard. With these thoughts in mind, several potential opportunities have been explored over the last few years, none of which have yet to bear fruit.

1.2 T/V Neptune Dorado

The Tankship Neptune Dorado is an 813-foot, single hull crude carrier, of 65,000 DWT. She was built in Poland in 1985 and is Singapore flagged. She is owned by Elmhirst Private, Ltd. And operated by Polembos Shipping, Ltd. She was carrying a cargo of 628,000 barrels of Cossack Crude Oil from Dampier, Australia.[i] On 19 September 2000 the U.S, Coast Guard Marine Safety Office, San Francisco Bay (MSO) received a pre-arrival package from the operator of the T/V Neptune Dorado with documents confirming compliance with U.S. regulations that allowed MSO to schedule an examination of the vessel. T/V Neptune Dorado arrived in San Francisco Bay on 23 September, and proceeded to anchor in Anchorage 9. MSO received no notification of any problems or hazardous conditions on the vessel, other than that the autopilot was inoperable (arrangements had been made for its repair).

MSO personnel boarded Neptune Dorado on 24 September to conduct a tank vessel exam and issue a tank vessel exam letter. The exam uncovered serious material problems that endangered the ship, its crew, the cargo, the Port of San Francisco, and the environment of San Francisco Bay, USCG (2000), Enclosure (4), p1. There then followed a series of detentions, expulsion orders, appeals, illegal lightering, and involvement of both the Eleventh Coast Guard District (San Francisco) and the Coast Guard Investigative Service. The further discovery of substantial quantities of oil in Neptune Dorado s segregated ballast tanks in contradiction of representations made by officers and crew about the vessel s condition, indicating the possibility of criminal activity on the part of the master, operator, and/or owner, resulted in the Captain of the Port requesting assistance from both the federal Department of Transportation and the federal Department of Justice on 6 October.[ii] The Investigations Department of the MSO initiated a Marine Violation/civil penalty case against the vessel. An *ad hoc* investigating team was formed on the vessel composed of the Duty Investigation Officer and MSO marine inspectors on scene. The investigating team reviewed and took possession of various vessel logs, many of which exhibited signs of tampering and intentional falsification. The investigating team advised the CGIS agents on scene of the suspected falsifications. Subsequent interviews of the officers and crew led to the arrest of the master on suspicion of violating 18 U.S.C. 1001 (making false official statements).

In a saga that lasted for another two and one half months Neptune Dorado s cargo was successfully off-loaded, the ship was thoroughly inspected and ultimately allowed to depart to Singapore to effect required repairs before being allowed to return to service. On December 19, 2000 a final plea agreement and related compliance agreement were signed by all parties in the interest. At this time, the civil and criminal cases that were pending against the vessel s master and operator, were settled out of court resulting in three felony convictions, a $2.5 million fine, and an enhanced oversight compliance agreement for all the operator s vessels, USCG (2001), Enclosure (4), p17.

2. The Stakeholders

Through negotiations with the U.S. Attorney involved in the Neptune Dorado case, funds from the civil penalties in that case, to be administered by the Eleventh Coast Guard District, were set aside for an oil spill simulator. Eleventh Coast Guard District Officers contacted California Maritime Academy to see if CMA was interested in being the site for the oil spill simulator. With an answer in the affirmative, the stage was set for the first steps in the development of a Simulation Training and Research Center with the oil spill / crisis management simulator as the keystone.

2.1 The Resource Trustees

The U.S. Coast Guard brought into the equation the concept of including what they referred to as the resource trustees. These trustees were federal and state agencies with a vested interest in spill prevention and response. The trustees were the Coast Guard (Department of Transportation), the Environmental Protection Agency (EPA) (federal), the Department of Commerce, the Department of the Interior, and the State of California Department of Fish and Game s Office of Spill Prevention and Response (OSPR). The inclusion of these entities as trustees with a vested interest in the administration and use of the earmarked funds sets an important conceptual foundation for the development of the organizational structure of the center and the consequent use of the simulator.

2.2 The Steering Committee

Eleventh Coast Guard District officers visited the CMA campus in the summer of 2001 to establish initial communications with the Academy and to set the stage for the first meeting on the subject of the oil spill simulator of what would become the steering committee for defining what the simulator should look like. Represented at this initial meeting in December 2001 were the Coast Guard, California Maritime Academy, the Office of Spill Prevention and Response, the U.S. Environmental Protection Agency, and the National Oceanic and Atmospheric Administration. This working level group set the stage for establishing the technical specifications for the simulator. Perhaps more importantly, it also set the stage for how the stakeholders, those agencies with an interest in how the simulator would be used and how the center would be administered to meet the community s needs, would participate. The group constituted itself as an *ad hoc* steering committee for defining simulator specifications and for addressing which agencies should be included in the community. The inclusiveness and enthusiasm of the participants of this initial meeting were essential elements in establishing how the project would evolve. The decision to consider themselves a steering committee gave everyone an ownership in the project that continues and is, and will be, a key factor in acceptance and use of the simulator and the center.

The funds earmarked for the simulator had by this time been transferred to the National Fish and Wildlife Foundation, San Francisco, pending their release to California Maritime Academy by the Coast Guard. It was decided by CMA that the appropriate repository for the funds when released would be the California Maritime Academy Foundation in order to avoid mingling these funds with the general fund.

2.3 The Advisory Board

It is envisioned, and agreed by the participants, that the steering committee will evolve into an advisory board for the Simulation, Training and Research Center. The California State Lands Commission, the U.S. Army Corps of Engineers, and the U.S. Fish and Wildlife Service have also been invited to join the steering committee. State Lands and Fish and Wildlife participated in the most recent meeting where the key points of the Request for Proposals for the simulator were finalized. The format and procedures for the advisory committee have yet to be determined. It is expected that these also will be the product of evolution and will be developed through achieving consensus among those involved.

The participation of the members of the steering committee/advisory board is considered to be a most important factor in the development and success of the center concept. When the steering committee was convened for the first time the meeting included a demonstration of the Coast Guard s *Pisces* system by representatives of Transas USA and Precision Planning and Simulations, Inc. This system was developed for the Coast Guard by Transas Marine in 1997-98. The intent of the demonstration was to establish baseline knowledge of what an oil spill simulator would consist. A significant benefit of the demonstration was that it stimulated participation in defining what the steering committee thought would be needed, and thus a sense of ownership in the project on the part of the stakeholders. As a consequence, the steering committee has evolved into the advisory board by consensus rather than appointment. This is not to say that additional members will not be invited to join the advisory board. Expansion of the board in the future to include others, such as industry and charitable foundation representatives, particularly those with an interest in ecology and environmental protection, is envisioned. But a core of those interested in using the simulator and the resources of the center has been identified and are a part of the development process.

3. The Simulator

In Section 1.2 of the Request for Proposals (RFP) (the Tender) for the simulator the purpose of the simulator is described in detail:

The purpose of the Spill Management Simulator (SMS) is to provide a training, research, planning and outreach **tool** for team management, coordination, and leadership relating to marine spill response and recovery. The SMS will provide a vehicle for management team training to assist the various stakeholders (agencies, trustees) with improving preparedness, communication, coordination and cooperation. The process will provide the ability for the stakeholders to identify shortfalls and tradeoffs of the various plans and strategies.

The SMS will be used for the identification, analysis, evaluation and enhancements of curre nt and proposed strategies for resource protection, planning (Area Plans, Contingency Plans, etc.). This includes prevention, preparedness (drills), response and impact analysis. The SMS will aid professionals in the evaluation of their assumptions by providing simulated trial exercises of the existing strategies. Area plans, sea plans and site strategies can be evaluated and different alternatives and options tried on the SMS.

The SMS system will integrate all existing information resource databases as best as possible.

The ultimate goal is the protection of natural resources and to reduce the potential damage of a spill. CMA (2002)

The purpose as quoted above represents very specifically the concern and intent of the steering committee that what was to be acquired meet the needs of the various stakeholders as they themselves saw them. Thus it serves not only as a statement to potential bidders as to the desired design and capabilities of the simulator, but also a statement of intent on the part of the stakeholders. The RFP goes on to address technical specifications in detail and also expands on simulation functions, training capability, research and development, etc.

3.1 The Partnership

California Maritime Academy brought into the equation the concept of partnering with the successful contractor in order to establish a long-term mutually beneficial relationship where the contractor and CMA participate in the continual development and growth of the SMS system. The Academy intends to actively pursue the involvement of graduate students and researchers in the use of simulator for academic and physical research in ecology related and computer science fields. It is anticipated that the selected contractor will participate in the research programming and development so that the simulator modeling will be continually enhanced as a result of the research into the hydrology and hydrography of the geographic databases. Obviously, the envisioned relationship goes well beyond the traditional contractor-customer model where the buyer gets today s model and then either buys upgrades or watches their simulator be overtaken by the development of new models. To be a true partnership, however, there have to be advantages for the contractor as well. Along with the research and development benefits, and the opportunity to validate models, the structure of the agreements with the contractor will have to provide some financial return to the contractor for participation in the partnership.

This fairly innovative approach to the customer/contractor is of interest also to the steering committee. One of the concerns expressed during that committee s deliberations was that reinventing the wheel should be avoided to the maximum extent possible. This position was expressed specifically in relation to the availability of several mathematical models (some of which have been developed by the agencies represented on the committee) for predicting the movement of water (tides and currents, river flow), oil(s), and atmospheric gases. The committee felt strongly that the software selected for the simulator should be able to take advantage of this modeling and integrate available modeling into the simulator. Thus, the concept of an on-going partnership between the contractor and the center (CMA) was attractive from the point of view of taking advantage of developments in modeling, no matter what the source.

3.2 The Phases

Considering that the ultimate spill management simulator desired would exceed the available funding (approximately $300,000.00 U.S.D.), the decision was made to develop the system in three phases. These phases are:

- Phase 1: Basic Spill Simulator
- Phase 1A: Environmental Impact Analysis Module
- Phase 1B: Remote Internet Capability of User Stations
- Phase 2: Expansion of simulator to include additional spill modules
- Phase 3: Expansion to a full crisis management system.

The contractor selected for Phase 1 is expected to be the contractor selected for Phases 2 and 3. A detailed bid proposal and firm fixed price will be required for Phase 1, and budgetary prices will be required for Phases 2 and 3. Phase 1A, the Environmental Impact Analysis Module, and/or Phase 1B, Remote Internet Capability of User Stations will be implemented in either Phase 1 or Phase 2, depending on cost and available funding. In support of this a firm fixed price will be provided for Phases 1A and 1B as options in Phase 1. Moving on, the Phases 2 and 3 will be contingent on the successful completion of Phase 1 and the availability of additional funding.

As stated above, the initial funding for acquisition of the simulator will come from monies received from the T/V Neptune Dorado case. Additional monies for the funding of the remaining phases of the project and the establishment, construction, and administration of the center present an on-going challenge for CMA and the board of advisors. In addition to funding through grants from state and federal agencies, funds from penalties imposed as a result of further civil and criminal cases, and funds from grants from charitable foundation, the business plan for the center calls for it to cover some of its costs through providing services to federal and state agencies and to industry. The use of the simulator to test and verify area and contingency plans, and the development and offering of courses in incident response and team management, and in academic and physical research as well as in plan development are all potential sources of revenue to help support the center.

3.3 Phase 1

The proposals from the contractors bidding on the simulator are due to CMA the beginning of October 2002. Once a selection is made, the basic spill simulator will be housed in existing facilities on campus. Sometime in the winter/spring of 2003 the basic spill simulator should be on-line. The basic simulator will consist of the Instructor/Operator Station (IOS) Module, and the Response Information Management System as diagramed in Figure 1; and the Spill Module as diagramed in Figure 2. Hopefully the basic simulator will include the Phase 1A Environmental Impact Analysis Module as illustrated, and the Phase 1B Remote Internet Capability of User Stations.

The spill movement module in the Spill Module will include sophisticated computer based mathematical models that calculate the behavior of the oil or chemical (the product). The movement (trajectory) and fate of the product over time will be modeled, both on the surface and in the water column. The shape, size thickness, and movement of the product under varying conditions such as currents, water temperature, water salinity, wind and sea state will be calculated and the movement displayed on a two dimensional electronic chart.

The spill cleanup module will include simulation of the effects of booms, skimmers and other equipment or devices. The module will simulate mechanical containment and recovery techniques, including effectiveness and efficiency. It will simulate the configuration of towed and stationary protective booms and performance characteristics such as skimmer recovery rates. The Instructor/Operator will have the ability to alter the performance characteristics of the equipments for specific exercises. The module will include the effects of chemicals, such as dispersants, and of *in-situ* burning.

The shore clean-up module will allow for the analysis and training for the cleanup of the shore when spilled oil reaches coastlines. This module will be able to calculate what will happen to the product over time based on product type, weather conditions and type of shoreline; calculate the change in product mass, volume and thickness over time; and analyzed the amount of product debris that needs to be collected.

The Resource Information Management System Module will include a database of all response resources such as those available from depots. This information can be from actual real world databases that are downloaded to the simulator and can be modified for each training session or contingency plan exercise. The database will be designed to accept electronic file transfers so that information can be downloaded from actual databases, and the simulator databases will be able to be modified without affecting the actual data. This data will be comprised of such elements as personnel, location of airfields, location of depots, land transportation vehicles, vessels, aircraft, booms, skimmers, chemicals (dispersants), absorbents, and other equipment, chemicals or devices.

The Instructor/Operator (IOS) Station Module will be a workstation where instructors and operators predefine, prepare, control and evaluate training scenarios. The station will also allow instructors to set-up, design, modify, control and monitor exercises. They shall be able to set initial conditions, and be able to control throughout the exercise the magnitude of the spill, alter environmental conditions, define the state of available resources to respond to the spill, and control the efficiency and operation of equipments such as skimmers, booms, boats and aircraft.

The Environmental Impact Analysis Module (Phase 1A) will provide sophisticated models for predicting and analyzing the impact to the ecology and shorelines. The models will use habitat-specific information to determine the biological effects of a spilled product, and seasonal estimates of wildlife, including mammals, fish, shellfish, birds, reptiles, plants and other organisms. They will predict the impact on the wildlife to include the predicted percentage killed or injured, basing the mortality probability on existing data that has been collected for the San Francisco Bay area.

The Remote Internet Capability (Phase 1B) will be to provide a web-based interface to the simulator. This will allow each of the module workstations to be operated in remote locations, such as client s offices. There will be full interaction of all users. This effort will include a web site design and a server capability to allow for file transfers and interactive interface to the simulator.

With these specifications the basic simulator will be of sufficient sophistication to meet the immediate needs of the stakeholders for the testing of area and contingency funds and to meet the needs of industry in their design and testing of the required contingency plans, both afloat and ashore.

Session IV – Maritime English

Chair: Mr. M. Pourzanjani

Verbal Communication failures and Safety at Sea

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I am Russian, and you are the Turk
Why do we need this English?
(A joke)

ABSTRACT

The significance of English language, as a working language of the international shipping industry does not call any doubt. The safety and overall performance of the international fleet depends on the skill to apply it. The ability of a non-native speaker to have a good command of the Maritime English is very much influenced by the ability to think in it in the frameworks of the maritime profession. One of the relevant aspects to make the teaching and learning processes more effective is to power up the thought activity of a seafarer using English.
To develop this ability it is necessary to involve in teaching and assessment processes both the professional English teachers and professional seafarers.
The paper highlights and analysis some findings in assessment and examination of seafarers in Maritime English from the view point of non-native speaker.

1. Introduction

The process of globalization dictates higher requests to a level of knowledge of language and skill to apply it. The knowledge of vocabulary is not sufficient to work in multinational crew.
Globalization of the shipping industry and application of modern technologies on board vessels demand a high level of education, training and certification of seafarers. The modern seafarer is not that who is able only to push corresponding buttons of hi-tech navigation devices or knows terms in frameworks MSCP. He/she first of all the highly educated officer, capable to make effective decisions on board a vessel and effectively work in multinational crew in various complex and extreme situations. Historically developed that English became the means for the communication at sea that is why the overall performance of the international shipping industry, safety at sea and protection of an environment in many respects depend on a level of command of the language. The very important ability of a seafarer is a skill to apply Maritime English directly, not using the native language. This is not simple and here are a lot of contradictions, but it stimulates arranging the teaching process in Maritime Universities in English that is not always possible to carry out due to various national reasons. Sometimes it seems we live in time of the second attempt of the Mankind to build the Babel tower already having some experience of construction the first one.

2. Structure of the communication - the general information.

The communication at sea plays extremely important role for "*safer shipping and cleaner oceans*".
Out of the four basic communication skills, i.e. listening and speaking, reading and writing, listening and then speaking are the most complex and complicated ones. Plus, listening and speaking amount to more than 85 % of the total communication requirements a deck officer has to cope with in his or her services on board and in the harbor (Trenkner, 2002).

UK P&I Club found out that deck officer error contributes 43 %, crew error 21 %, shore error 21 %; pilot error, including VTS, 12 %, and engineer officer error contributes 3 % to casualties registered worldwide.
Canadian pilots stated that language barriers on foreign registered vessels always , often or sometimes prevent to as much as 79.3 % an effective exchange of information with the master and officer of the watch, (Trenkner,2002). A great part of this casualties occurred due to communication failures.

In psychology it is accepted to call the person transmitting the information as *a communicator*, and the person who accepts the information *as a recipient*. For example, the Master is the communicator, and the watch officer is the recipient; the pilot is the communicator , and the helmsman is the recipient. The communication at sea is information interaction which is maintained by seafarers during performance of their functional duties. The communication may be *internal* and *external* one.
On board the vessel (internal communication) there may be two types of professional communication: the so-called *descending communications* – the communications of the Master with the subordinate staff that usually prevails, but undoubtedly there is an *ascending communication* of subordinate stuff with officers and the Master. Besides this the external communication with other ships and shore stations is played big role . The

example of such communication between the Master, Chief Mate, Watch Officers and Ratings is submitted on fig. 1.

In shipping industry the so called *controlled communication* prevails. Controlled communication is the information interaction of seafarers which is fixed in the duty rules and mandatory procedures determined by national and international regulations. Controlled communication procedures may be appreciable, calculable and planned beforehand. SMCP and GMDSS procedures may be as an example .
But in emergency there may occur an *uncontrolled communication*, that may not be planned beforehand.
The formal criteria of completeness of the communicative act is the fact of an observable reply by the communicator of his/her message from the recipient , i.e. presence of an authentic feedback from the recipient about physical receiving of the message. For example, the helmsman should repeat the Master's command prior to realize it.

The basic steps of the communication process which determine efficiency of communicative influences on the person can be designated as follows:

1. Comprehension of idea of the message by the communicator.
2. Nonverbal behavior of the communicator (nonverbal coding of information: gestures, a pose, a mimicry ...).
3. Verbalization of messages by the communicator.
4. Perception of nonverbal behavior by the recipient which may be influenced by various types of hindering.
5. Perception of the verbal message that may be received in noise conditions as well.
6. Conceptualization of the idea of message.
7. Realization of action incorporated in the message.

Communication effectiveness :
The communication is considered as *effective to the process* when communicator has received the confirmation on acceptance of his message by the recipient.

The communication is considered as *uncompleted* if there is no feedback confirming the reception of the message by the recipient.

The communication is considered as *effective to the result* when during the dialogue communicator has reached the goal by means of communication.

In the most of cases people communicate by means of *dialogue*. Dialogue is a method or tool to solve facing to people problems by means of communication.
All wheel orders given should be repeated by the helmsman and the officer of the watch should ensure that they are carried out correctly and immediately (SMCP,2001).

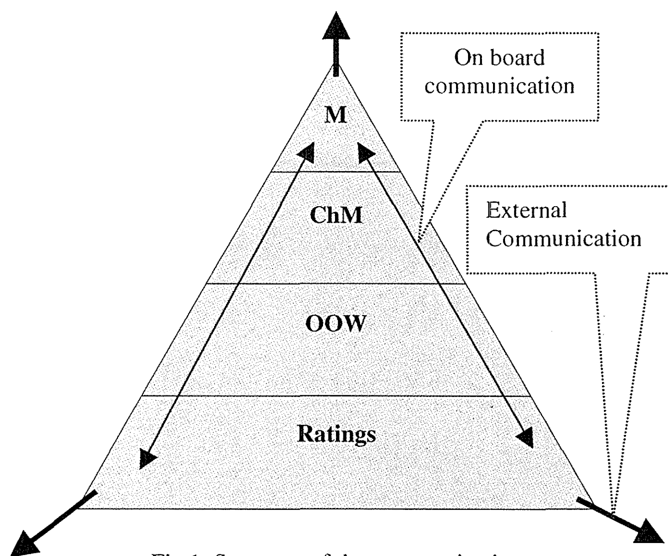


Fig.1. Structure of the communication

The most complicated task in communication is to formulate the idea of a message so that the interlocutor had not to strain after its acceptance, internal translation and understanding. The communicator then is not should to explain in addition what he or she meant. This statement directly concerns also to native speakers. In communication procedure all participating parties carry the responsibility for its effectiveness .

The different purposes and tasks of communication demand from interlocutors the changing of strategy in speech behavior and speech activity. But nevertheless our daily communication widely uses different types of clichés and stereotyped speech blocks which serve frequently in repeating speech situations. MSCP are also constructed by this principle. So we consciously apply restrictions of English language or use some standards .
Maritime English does not make use of all the means of the English language but only of those which are suited to meet the communicative requirements of a given maritime context-that is why Maritime English is regarded a restricted language as others ESPs (English for special purposes), too (P. Trenkner, 2002).

The understanding of words is represented by the most elementary operation of decoding of the message. The real situation influences on conceptualization of words in dialogue. The simplified model of understanding of speech is observed only in case of perception of text in a foreign language. What also the Maritime English for non-speakers is.
It is necessary to distinguish the true understanding of the message from memorizing it.
All the kinds of activity of a person include the element of forecasting ,or by another words *anticipation* , i.e. there is « a language probability » which allows to predict word combinations or a word in a given context that helps to react adequately and quickly in speech contact, but it occurs when the subject of conversation is known to interlocutors. Own speech as well is predicted in many cases subconsciously. Without forecasting of own speech with respect to its basic context no coherent and intelligent statement can be pronounced on the subject of communication.
OOW usually foreknows, what questions will be set to him by the VTS operator and what information is necessary for the pilot or for the external interlocutor, but there are also mishaps. *The following conversation is a wonderful example of the dangers of using VHF as a means of collision avoidance (MARS reports,2002):*
Ship A - " Vessel on my port bow, this is the vessel on your starboard bow, with a CPA of 0.15 miles (sic) come in please ".
Ship B - " Yes, what is your position "?
Ship A - " Second Mate ".
This was overheard on VHF Ch16 in the Malacca Straits. It is clear that the context of a communication was not identified by OOW of ship A.

3. Communication failures

There is not any doubt that the crew of a vessel should carry out precisely all the functional duties which in many respects depend not only on knowledge and skills in such disciplines ,for example ,as navigation or engineering , but on the ability to apply correctly and competently the English language which nowadays is set be considered as an additional professional discipline in MET universities of non English speaking countries. To operate the multinational crew, not having clear means of communications is impossible and a known question *"How does she answer the helm?"* may be paraphrased as to *How does the crew answer in English?*. Language is a rudder of a communication. Shiphandling is carried out with the help of a rudder, and the crew management is made by means of a language. The crew should be controlled in all situations, and therefore it is a little bit strange, that amendments to Convention STCW 78 do not contain enough requirements on English language for engineers and ratings. Effective communication with ratings is impossible, if they will not understand the instructions of officers.

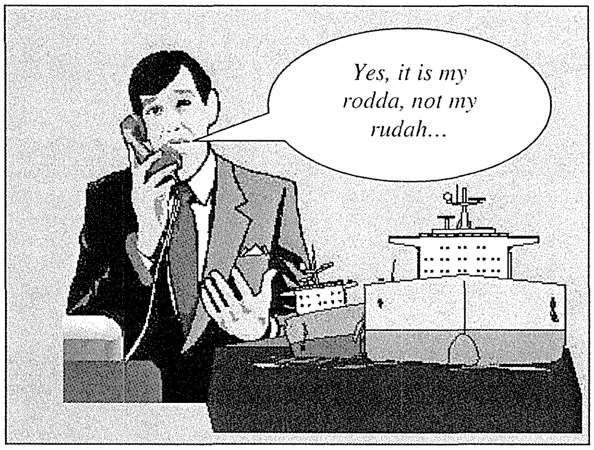
There are a lot of reasons of communication failures leading to emergencies: it can be language incompetence or low qualification level with good English . For example, we observed the case when the OOW (for the first time in his life !?) has seen the ship's track on the screen of a radar and has reported to Master in fluent English that he sees a trace of a rocket flying directly to the vessel. There was an emotional explosion on the navigating bridge and consequence of which is not necessary to describe here. Is this a fact of communication failure ? . Obviously, yes , it is the communication failure due to low qualification level of the watch officer.
Another example gives a typical Maritime English failure in communication:

This report (MARS reports, 2002) concerns a series of VHF transmissions, which were monitored over a period of three days. A vessel was transmitting a message in poor English as follows:
" all ships, all ships, this is............ I have problem with my rudder. My speed is 14 knots. Asking all ships to keep clear of me ". A position followed.
At one point during these broadcasts, which had been greeted with some derision by various other listeners, catcalls and foul language, one vessel asked if the originator was having problems with his radar. The words sounded almost identical in the accents of the different nationalities and there were much repeats of:
" it is my ruddah ", Is it your rada? "," Yes, it is my rodda, not my rudah " etc.

Amusing though this was at the time, the question has to be asked why was a vessel, presumably a capital asset of some considerable value, possibly with a cargo of equal or more value, steaming at 14 knots with faulty steering gear? And why are the persons ultimately responsible for the operation and insurance of this asset allowing such poor quality officers to man the vessel?

In principle it is better to avoid an inclusion of similar pronounced words in mandatory communication procedures.
Language is the main tool of a dialogue and if the non recognition of such as words *radar* and *rudder* can lead to an accident then a wrong pronunciation and understanding of phrases *How are you?* and *Who are you?* may lead to a severance of diplomatic relations between the states.

A lot of years ago an amusing case has happened with me during the final state examination in English. Examiner requested to explain him the idea of a Great Circle Sailing. The first question was " What is a Great Circle? " To my shame I could not recollect of essence of a right answer because all my thoughts were in English but not in navigation. Supposing, that the teacher of English does not know the navigation, I have invented the answer, having formulated it correctly in English and abnormally from the view point of navigation. In the result the teacher of English language has put me "excellent", but the professor of navigation, who was involved in the examination team, has paid attention to the fact that, I do not know the navigation and he has disagreed with the mark "excellent." So let us try to find the answer who was right in this situation: the teacher of English or professor of navigation? There is no doubt that the truth was on side of the professor of navigation (Loginovsky, 2002).



Here we observe the communication failure happened due to professional incompetence of the student and the teacher in navigation.

The closer social and professional experience, the more easy people understand each other.
Status-and-role dialogue is based on expectations of that the communicating person will observe the speech norms peculiar to his/her rank and to his/her position in a society and this is determined by the character of mutual relations with the interlocutor.

The multinational crew of a vessel undoubtedly reduces level of safety at sea and this is due to not only the lack of a common native language on board ,but also due to various social experience and various cultures of crew members. Here is an instructive example of the communication failure because of various social experience of partners speaking with each other, (I.N.Gorelov, K.F.Sedov, 1998).

The six-year old son eats an apple and thoughtfully asks his father:
-Daddy, why the apple I bite off, becomes brown?
-The matter is, father answers, - that there are different chemical substances in an apple, including iron. And so, when iron enters into the chemical reaction with oxygen, which exists in air, it is oxidized . As a result of reaction the substance that painted an apple in brown color has been formed.
For some time the six-year old son keeps silence. Then the child asks shyly:
-Daddy, and whom did you talk with?

The example shows the communicative failure which has arisen as a result of a difference in social experiences of interlocutors.

Even if people communicate in the native language of loss of the information can reach up to 50 %, and in emergency the person can remember less than 20 % from the perceived message.

The reason of a communication failure may be due to the big difference of levels in command of English , that is why the standardization is necessary. For example if Russian and Turk seafarers can communicate effectively among themselves in Maritime English it does not mean at all, that the same level of understanding should be if they communicate with native speakers in the same Maritime English. For more understanding the most of special subjects in MET institutions in non-English speaking countries should be delivered in English. For native speakers a principal cause of a communication failure may be « too good command of the English language » and also the professional incompetence, and for non speakers this is professional and language incompetence.

It is a very hard work for non native speaker to approach the native speaker language level. During teaching and learning process of the foreign language the native language in most cases acts as a handicap. In one of L. Leshe's theories (I.N.Gorelov, K.F.Sedov, 1998) it is necessary to build a technique of teaching of foreign language using the principle that from the very beginning up to the very end the second language as less as possible contacted with the system of the native language in a learner's mentality , therefore L. Leshe has acted against traditional "grammar and translation method". Under the same theory « single-shot learning » of the second language is doomed for a failure – constant practice is necessary for maintenance of it at the certain level. *Maritime English may not be reduced to a purely terminology based concept*, (P. Trenkner, 2002). It is obviously, if we speak about the globalization of shipping industry , the time has come to accept English as the *working language* in MET institutions and to give it the status in similar conception for working languages as required by the revised Regulation 14 of Chapter V of SOLASD 1974 . Especially, it concerns IAMU members.

4. Self- assessment of Seafarers in Maritime English

We try to overcome linguistic barriers, diligently learning English language as Seafarer should be able to communicate without interpreter especially in emergencies. There is no doubt, that during the communication procedure plenty of difficulties occur. We have carried out some research in the group of Russian Seafarers consisting from 100 person (Masters-4; Chief mates-22; Second mates – 21; Third mates-14; 5 year of education students from AMSMA - 39) and have asked them to answer the question: *What nationalities are the most difficult for you to understand their English ?*

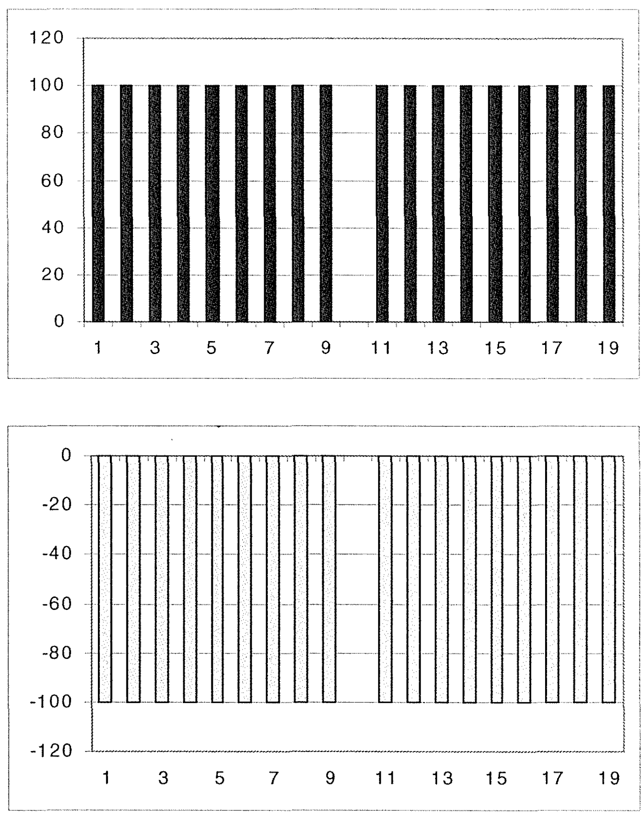


Fig.3. Positive and negative answers

Nationality	%
Englishmen	**47**
Americans	**13**
Filipinos	9
Chinese	5
Arabs	5
Frenchmen	5
Turks	3
Spaniards	3
Greeks	2
Germans	2
Irish	2
Australians	2
Latinos	1
Hungarians	1
Koreans	1
Hindus	1
Russians	1

The answers are presented in the table.

It is hardly right to make a conclusion that this set of 100 Russian Seafarers is representative, but from the first two lines with the big share of confidence it is possible to say that :

- ✓ Certainly ,the command of Maritime English of the biggest part of the presented group leaves much to be desire.

- ✓ English-speaking Seafarers bear not the less but the more responsibility for the effective communication with the non speakers.

	Question	+	-
1.	If you speak English, what language do you think in?	E	R
2.	When you listen, whether you translate the heard in your native language?	no	yes
3.	When you listen and write down, what language do you write down in?	E	R
4.	If you need to memorize the sense of something told you in English what language you use to remember?	E	R
5.	If in emergency you cannot make a correct phrase in English, whether it prevents you to communicate?	no	yes
6.	Do you watch the lips of the interlocutor during conversation?	no	yes
7.	Does the distance the between you and your interlocutor influence on the process of understanding of speech?	no	yes
8.	Do you strain your attention and hearing for understanding of speech?	no	yes
9.	Does your inability to tell correctly influence on a level of communication?	no	yes
10.	If the language level of your interlocutors is higher than yours one does it influence on your ability to communicate?	no	yes
11.	Are you getting tired during the long listening of the English speech?	no	yes
12.	Do you read fluently the professional text?	yes	no
13.	Can you estimate fluently the basic information in the professional text?	yes	no
14.	Can you use the navigational charts and publications in English?	yes	no
15.	Can you work in a multilingual crew?	yes	no
16.	Did you work in a multinational crew? How many years?	yes	no
17.	Is your crew multinational now?	yes	no
18.	Had you sometimes difficulties in communication with VTS - operator?	no	yes
19.	Had you sometimes difficulties in communication with pilot?	no	yes

The Questionnaire for a self-estimation of command of Maritime English for the same group of Seafarers has been developed and presented above . The answers marked by respondents as "+» show that they suppose having a high level of Maritime English , and marking by "-" as not good in Maritime English.
If to take all the answers as positive (the ideal English-speaking deck officer) the results of them are shown on the top graph of fig. 3. Negative answers (the "ideal" know-nothing deck officer) are shown on the lower graph on fig. 3. Number of question is shown on a horizontal axis, vertical axis is marked in percent units, (the question 10 is excluded). Fig.4 presents the average results of research.

The main results are as follows:

- ✓ 37 % of respondents suppose they think in English.
- ✓ 25 % of Seafarers do not translate the heard into Russian.
- ✓ 75 % of Seafarers make notes in English.
- ✓ The majority of the group suppose , that there are no problems in use of charts and nautical publications in English
- ✓ The majority did not face problems in

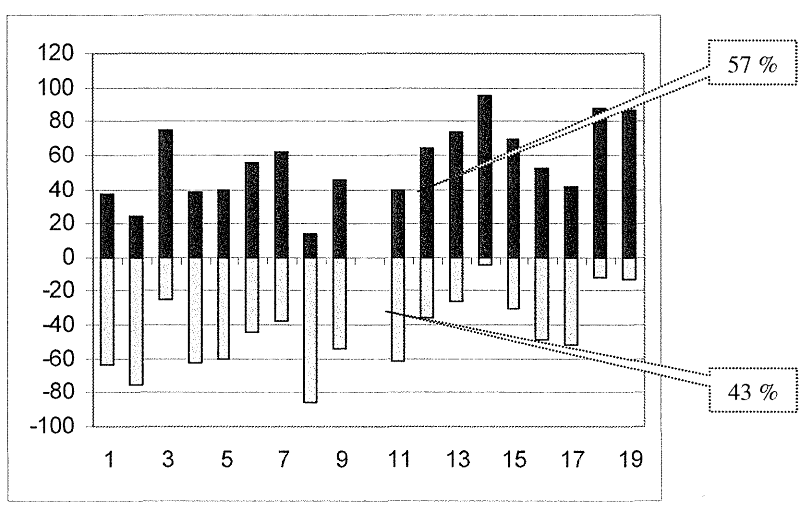


Fig.4. The "average" Deck Officer

communication with the pilots or VTS-operators.

- ✓ 56 % of Seafarers suppose they do not pay attention to an articulation of the interlocutor.
- ✓ 14 % of seamen do not strain their attention and hearing for understanding of the English speech.
- ✓ 62 % of Seafarers think that distance between them does not influence on a level of communication.
- ✓ 52 % of respondents worked in multinational crews.
- ✓ 70 % of Seafarers suppose they can work in multinational crews.
- ✓ 52 % of Seafarers worked in multinational crews are correlated with 57 % of positive answers in general.
- ✓ **43 %** can cause communicative failure. This figure 43 % correlates with the data from work of Trenkner, (P. Trenkner, 2002).

5. STCW 78/95 requirements

If we shall read the STCW 78/95 Code, then in the table A-II/1 concerning knowledge, understanding and professionalism in the English language we shall find the following, (STCW78/ 95):

Knowledge, understanding and proficiency:
Adequate knowledge of the English language to enable the officer to use charts and other nautical publications, to understand meteorological information and messages concerning the ship's safety and operation, to communicate with other ships and coast stations and to perform the officer's duties also with a multi-lingual crew, including the ability to use and understand the Standard Marine Navigational Vocabulary as replaced by the IMO Standard Marine Communication Phrases.

Methods for demonstrating competence: examination and assessment of evidence obtained from practical instruction.

We have tried to evaluate « Knowledge, understanding and proficiency » of every Seafarer from this group. Two Chief Mates who according to the questionnaire have estimated themselves have been chosen from researched group of Seafarers, as shown on fig. 5. From the graph it's clear that the Officer "B" evaluated himself higher than the officer "A".

After the self assessment , they have passed testing by the Seafarer-examiner using the principle of « decomposition of concepts », (Loginovsky, 2002). The essence of which is that Examinee is asked the initial question (Fig.6) After the answer, the targeted terms from this answer are selected. The goal of the examiner is to make the examinee to clarify the targeted terms. Then the procedure is repeated. This iterative algorithm is prolonged up to a definite amount of questions and targeted terms, which can be established in advance. The number of right answers determines the score. Thus, the student is examined in Maritime English, maritime terminology, depth of knowledge in particular subject, ability to discuss on special topic. And also the seafarer trains to answer the questions and finally to think in English.

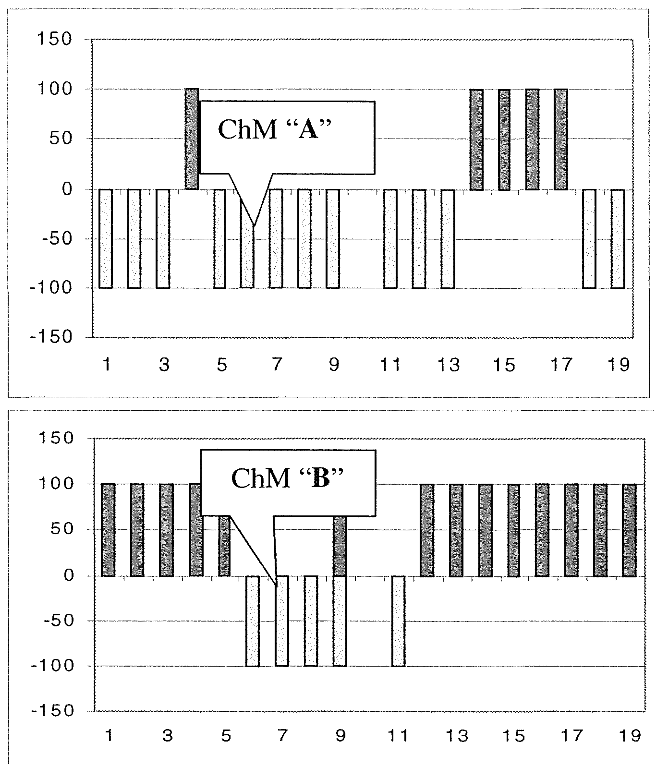


Fig.5. A self-assessment of Chief Mates "A" and "B"

Let's consider an example.
Question 1: What is a Dead Reckoning Position (DR)?
Answer 1: It is a position obtained using ONLY the **Courses** steered and the Distances run. Such distances are derived from the Log or from Engine Revolutions, (Nicholls's Concise Guide to Navigation ,1987).

The term **Course** is selected as a targeted term and the second question is about the **course** … etc.

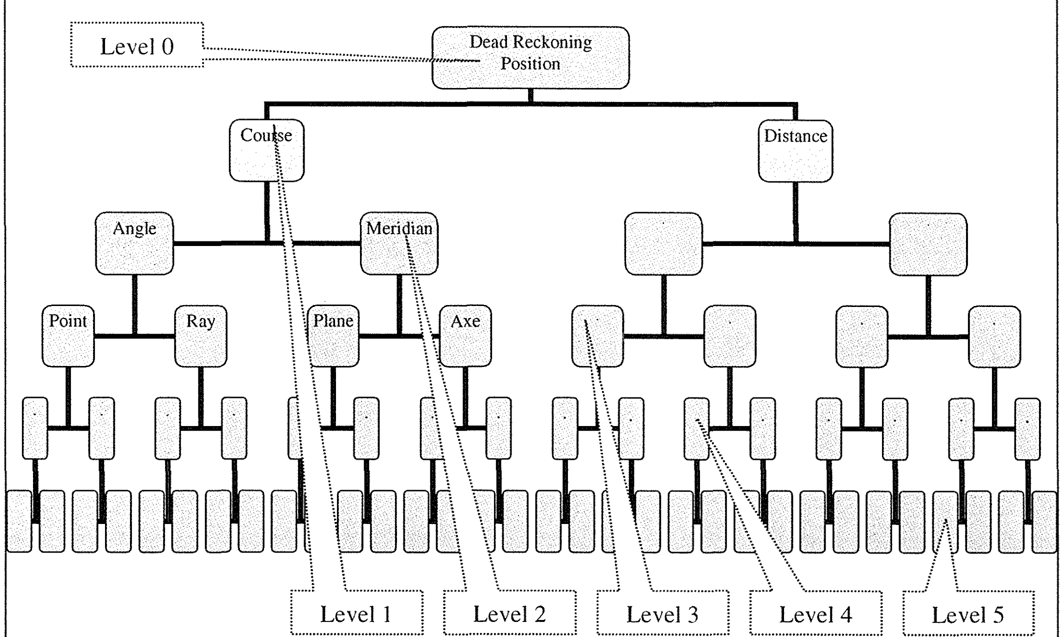


Fig.6 . Decomposition of concepts

Assessment by the decomposition method allows to check up not only the knowledge of Maritime English, but also a level of erudition of a Seafarer. This test was passed by officer "B" with the score 5 and by officer "A" with the score 2.
The pyramidal model of testing may be used as an adaptive testing procedure where the thick line shows a route of tested Seafarer , whose results of performance of tasks are marked in the top table of figure 7. The positive and negative answers are marked by "+" and "-" accordingly. If the test contains 9 questions then the best result is I9, and the worst is I1.

0	A	B	C	D	E	F	G	H	I
+	-	+	+	+	+	+	-	+	+

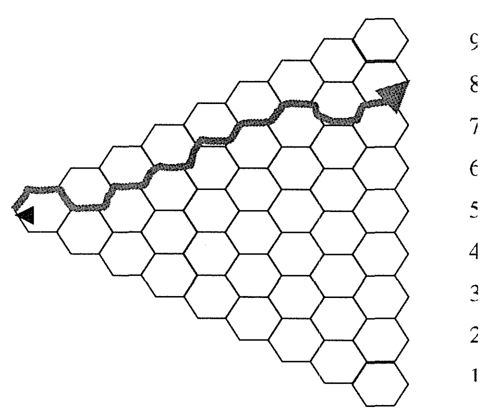


Fig.7. Pyramidal testing model

6. Conclusion

Safety and overall performance of the international fleet in many respects depend on qualification of Seafarers and their skill to use the means of communication the Maritime English of which is the base. Efficiency of teaching, learning and testing of Maritime English is not possible without professionals Linguists and professional Seafarers. The professional Seafarers having sea going experience, education and corresponding academic degrees in non English-speaking countries should be actively included in teaching process that enables to educate and train the high qualified Seafarers. A lot of attention should be paid to the objective assessment and evaluation. It is obviously, if we speak about the globalization of shipping industry and multinational crews, the time has come to accept English as the *working language* in MET institutions and to give it the status in similar conception for working languages as required by the revised Regulation 14 of Chapter V of SOLAS 1974 . Especially, it concerns IAMU members.

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SOME ASPECTS OF THE SEAFARERS' LANGUAGE COMPETENCE DEVELOPMENT

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ABSTRACT

The maritime English language knowledge, understanding and proficiency of the University graduates (deck/ engine officers) is the issue of the utmost importance for the Foreign Languages Department. One of the most complicated tasks for the department is the necessity to simultaneously work with the cadets of different basic knowledge of English (cadets of the same group): some of them are the graduates of high schools specializing in languages, but the others - are from some distant villages where they didn't study language at all. The STCW convention specifies the minimum standards of competence for deck/ engine officers regardless of the above fact. The instructors have to be very inventive trying to make odds even.

A new approach to the teaching language for special purposes has been developed using both traditional and intensive methods of language teaching. One of the best ideas (in our opinion) happened to be the re-arranging of the curriculum hours. A five-year period of learning English, i.e. some years only 2 academic hours per week, has been replaced by the so called "cycles". The total quantity of the academic hours allocated for the language has been re-arranged into the said cycles. The duration of each cycle is four to five weeks (depending on year of studies) which means absolute concentration of the cadets on one subject - ENGLISH. Each cycle includes at least two language aspects: English for special purposes (deck/ engine officers) and everyday English. The required grammar material is used as a foundation both for the maritime and spoken English syllabi. Another thing which made for the success of the whole undertaking was the implementation of the rhythmopedia. The latter is a method of the intensive presentation of foreign language information against a background of rhythmostimulation, its retention in memory by means of technical aids and its actualization during the group - communication in class. The method serves as contributory factor for the active assimilation of a considerable amount of information and the development of imaginative abilities in a student. The whole process of the teaching has been re-considered: including the class-rooms, used materials and text-books, given tasks and played roles . The cadets are supposed to play their part in one and rather long-lasting play named "A daily routine of a deck/ engine officer in charge of a watch". Even the special course "Tune into Maritime English" has been developed, singing songs "Taking a pilot on board" or "Clearing the Ship Inward", etc. the cadets can practice and learn how to properly pronounce the words and improve their knowledge of the standards phrases for communication at sea. A set of computer tests based on the studied materials , home-reading of the IMO Resolutions, other conventional documents, pilot book, COLREGS, etc. help to keep the desired level of the cadets' motivation and verify their knowledge and understanding of the various aspects of maritime English. We also believe that the competence of the instructors in the issues dealing with the shipboard routine of the watch officers, their desire for self-education and utilization of the latest technologies in teaching, as well as well-prepared and timely updated materials will keep in line with the required level of the graduates proficiency.

1. Introduction

Since its inception the International Maritime Organization has recognized the importance of human resources to the development of the maritime industry W.A. O Neil

The process of mastering any profession and achieving the required level of competency in it is rather multilateral and time-consuming. The efficiency of a specialist training at the stage of his professional education, the ways of the professionalism achievement have both theoretical and practical importance. There are too many inexpert and incompetent people in various industries whose work have already resulted in huge losses in economy, industry, agriculture, politics. Lack of due professionalism leads to loss of people, ships, natural resources, environment pollution. The issue of improving the professional training of seafarers to ensure the world fleet accident-free operation is and has been the topic of discussions of the IMO Sessions, industry associations conferences and meeting. The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) has adopted the detailed list of the requirements a navigator should meet depending on his rank and the ship s type.

A navigator (both Master mariner and his mates) represents the whole State; the progress of the international contacts, safety of the ship and her crew operations depend upon the degree of his English language (as an official Maritime language) proficiency, knowledge, skills, capabilities and his communicative culture. Consequently the professional competency of a navigator- watchkeeper is inconceivable without knowledge of

Maritime English at the level of a very competent user . The language competence of a navigator should meet very strict international standards specified by the STCW 78/95.

World processes generate the social order directed to the system of the professional education in general and methods of the professional communication pedagogy in particular. The pedagogical objectives directly follow from the social goals and social point of education. The increased social requirements to the development and the educational level of an individual, new conditions of life , the latest achievements in science and technology change both the methods of teaching and the pedagogical practices content. The development of new teaching methods, review of the already existing ones with the account of the actual educational objectives alterations is a social task equally with the pedagogical one. The issue of the qualitative improvement of the professional education is closely linked with the development of more sophisticated, scientifically substantiated methods of the educational-cognitive activity control, making the creative abilities more active. With the increase of the scientific information, more and more complicated system of knowledge, skills, experiences and abilities should be put into the students consciousness within the shorter period of time. The latter task require to activate some internal reserves. Introduction of modern technologies into the process of teaching is also the integral part of the updated educational reality making for a success of the professional education.

2. Language Competence

The dictionary defines *competence* as a A specific range of skill, knowledge , or ability . More specific definition of the term is given in the Guidance on the Implementation of IMO Model Courses : The term competence should be understood as the application of knowledge, understanding , proficiency, skills, experience for an individual to perform a task, duty or responsibility on board in a safe, efficient and timely manner .

The competence is always connected with the definite field of activity. We are basically interested in the knowledge and abilities of a mariner in foreign language. The language competence of a seafarer (master-mariner and watchkeeper) includes the whole complex of his knowledge, lingual skills and abilities acquired in the course of education and training and aimed at the solution of various professional tasks. The STCW Code includes the English language knowledge, understanding and proficiency into one of the basic functions of an officer in charge of a navigational watch *Navigation at the operational level*. The Code requires Adequate knowledge of the English language to enable the officer to use charts and other nautical publications, to understand meteorological information and messages concerning ship s safety and operation, to communicate with other ships and coast stations and to perform the officer s duties also with a multilingual crew, including the ability to use and understand the Standard Marine Navigational Vocabulary as replaced by the IMO Standard Marine Communication Phrases .

The language competence also includes the awareness in the following: a) professional field— i.e. in the field where one tries to gain real success and become an expert; b) linguistic field- i.e. in the units, structures and systems of the foreign language required to study any language in general; c) social-psychological field- i.e. in the field of communication processes. The language competence n equally with other personal peculiarities cannot be considered the final feature of an individual. The best indication of the language competence presence is that the University graduate by the beginning of his seafaring career has already obtained the whole conglomeration of the required abilities, skills and knowledge. The availability of the above mentioned items will allow the graduate to effectively solve various professional problems including the communicative ones as well. The main criterion of the seafarers language proficiency level assessment is his ability in the course of the professional career to make the relationships in the best possible manner stimulating confidential and trustworthy attitude to himself, the ship and the crew. Accident-free ships operation, especially with the multinational crews sometimes totally depends on the language competence of her officers (primarily-navigators). On account of the above mentioned, the problem of the seafarers language competence development gains a special importance. The improvement of the existing system of the professional language training in view of the said could be done by

- Re-distribution of the subjects studied at the early stages of the professional education;
- Transferring the language- for- the- professional- purposes studies to later stages;
- Re-considering the methods and techniques used in teaching the foreign language for professional purposes;
- Using the latest scientific and technical achievements in the classroom.

2.1 Some Difficulties in Teaching Foreign Language for Professional Purposes

The increased demand for a sound and competent knowledge of a foreign language is a feature of our days. However the situation in the language-teaching industry, as we may call it, is rather diversified[1].On the one hand, methods for teaching languages are getting more and more sophisticated, highly technological and- what is

[1] The author means the situation with language teaching in Russia

rather important- costly. On the other hand, the providers of language training services (in our case- the departments of foreign languages) are experiencing financial problems like the whole educational system in the country. Only some instructors have an access to computer-based technologies, the Internet and Web sites. This is without mentioning the insufficient quantity of academic hours provided by the curriculum for foreign language studies.

The existing system of teaching foreign languages for special purposes at the Technical Universities has some specific features which make the whole process of language teaching and studies rather complicated and difficult. For example, sometimes we have to teach the junior students the foreign language for special purposes. It means that the students having rather vague idea of their profession have to study the foreign language for professional purposes. The curriculum for the students of some specialization includes a two-year course of professional foreign language: the first and the second ones. So we have to teach a first-year student of the Refrigeration Department the ways of repairing, let s say, of an evaporator or some other machinery in English (!) The results of such work are well-known: the best students can learn the required terminology and, hopefully, they will be able to understand some original specifications or other written materials. Their ability to use the foreign language in professional communication leaves much to be desired. The developed approach and the very situation in language teaching had to be changed if we were going to train a professional meeting the international standards and requirements. One of the most important steps on the way to improve the existing system of language teaching was to re-arrange the curriculum hours allocated for the English language studies[2].

Traditionally the cadets of the Maritime Faculties of the higher educational establishments in Russia study Maritime English during the whole period of his/her studies at the University. It means a great quantity of academic hours dragged out for a five-year period of studies. In practice the distribution of hours within a semester could bring up to two, four or sometimes even six academic[3] hours per week. The first and the second year cadets had weekly two or three pairs of English, but the fifth-year cadets had a chance to study English once a week. It was rather difficult to explain the specific features of the ships daily routine for a first year cadet and absolutely impossible to insert the required minimum into the two-hours class of English for a fifth-year cadets. That system proved to be ineffective.

Another problem for the department is the necessity to simultaneously work with the cadets of different basic knowledge of English (cadets of the same group): some of them are the graduates of high schools specializing in languages, but the others - are from some distant villages where they didn't study language at all. The STCW convention specifies the minimum standards of competence for deck/ engine officers regardless of the above fact. The instructors have to be very inventive trying to make odds even.

Low motivation in learning foreign language is also the issue of concern of the language teachers, especially in case with the training specialists for fishery fleet. The fact that their relatives or whoever been a crewmember of some coastal ship and have never been abroad can dominate in their mind. Their shortsightedness could hardly be overcome. The psychologists underline that the initial period of a junior student/ cadet studies at the University includes a number of aspects, such as: psychologically-pedagogical; socially-psychological; personally-motivational; etc. Some zones of difficulties the student/ cadet meet during his studies are behind the mentioned aspects. One of the most important among them is the personally-motivational aspect linked with the formation of the positive motives in studies as well as the individual features of a future professional, real expert in his field/ industry. This aspect could be considered as the uniting one; it implies as the required conditions both the psychologically-pedagogical and socially-psychological as well as a number of others.

2.2 Background

Research of the psychologically-pedagogical problems of the professional education stage has been carried out in the country for a long time. The development of some specific methods of teaching, implementation of new means and techniques of presenting the materials, enrichment of the types and forms of classes — the result of the laborious work of many language educational theorists and researchers. The necessity to lean for support on the data of linguistics and psychology in teaching foreign languages (both specific and general) is a well-known postulate. The practical expediency of some lingual-psychological concept in connection with the specific conditions, aims and objectives of teaching makes for the generation of the principles to form a desired course or method. The social demand in practical command of foreign language marked the changes in language learning from the system of language as a whole to developing the speech actions, speech skills and speech behavior. The appearance of new methods of teaching aimed at practical results was determined by the new psychological and linguistic theories. The task of developing the communicative competence has been done by the representatives

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[2] The mentioned changes have been implemented for some faculties and departments of the University. Though the Navigation Department of the Maritime Faculty pioneered the above. Therefore the author summarizes the results of a-ten-year-experience of new approach in teaching Maritime English.

[3] In Russian Federation one academic hour equals to 45 minutes, but the Universities usually divide the classes into the so called pairs , which mean two hours, i.e. 90 minutes, having a short 5 minute-interval between hours.

of audiolingual and audiovisual method. When considering the principles in the foundation of these methods in teaching foreign languages one can find that the set of such principles disproportionately reflects predominance either of linguistics or psychology. Central to the techniques of audiolingual method was the behaviorist belief that learners could be trained to speak English correctly by listening and then responding to units of language presented in carefully graded sequence. The audiolingual method was characterized by the excessive passion for purely mechanical exercises, lack of speech exercises, underestimation of the native language role and individual features of learners; unjustified gap in teaching oral and written language. Although aspects of audiolingual method have been carried through to the communicative approach, it is now recognized that teaching needs to incorporate a broader and more realistic view of language use and language learning, views which have emerged from research into second language acquisition. The research has exposed the limitations of the audiolingual method, but, it is important to recognize why this method gained currency during 60s/70s. Audiolingual method was a reaction to the traditional practice of foreign language teaching, which was based on techniques for teaching the ancient classic languages of Latin and Greek. The students of these languages were required to read rather than speak, learning was traditionally based on analyzing and memorizing structure for the purposes of translation. The system was known as the grammar translation method. Although it may have worked well for classical scholars, it cannot cater adequately for those who need to be able to speak in foreign languages nowadays. The globally-structural imitation audiovisual method is based on the vocabulary selected from oral speech. But the merit of the method in selecting the vocabulary tends to be a serious disadvantage because of the vagueness of the term *structure*, badly developed hierarchy of structures in various models of courses created by outwardly the same methodology. The audiovisual method is more than the audiolingual one based on psychology. At the same time in spite of the mentioned limitations, the cornerstones of both methods, such as the priority of oral speech, the selection of basic models and speech patterns as well as globally-structural foundation of audiovisual method, had a positive impact on further development of the foreign languages teaching methods and methodology. The situational principle marked the emergency of the communicative approach in language teaching. The communicative approach is characterized, first of all, by the denial of the audiolingual and audiovisual methods ban to use the learners native language as one of the means of semantization, the grammar explanations are restored in rights . The decisive role belongs to the realization of the learners demand in own communicative intentions. For seafarers to be able to communicate effectively one needs to be able to use and understand English in a range of situations. Being able to use English means that the seafarer can combine the building blocks of language (grammar, vocabulary, phonology) to express himself clearly and appropriately in speech and writing. Being able to understand English means that the seafarer can interpret messages that he hears and reads correctly and can respond to these messages appropriately and comprehensibly. When a seafarer can demonstrate the ability to do this, he proves his communicative competence in English. The ultimate aim of the communicative approach is that instructors should teach in a way that develops communicative competence. Introducing communication practice helps language learners to become confident in their ability to use English. By actively communicating in English, learners develop their communicative skills, strategies and knowledge of the language itself. Successful communication requires more than the ability to integrate language systems and skills. The learner also needs to understand how social contexts and specific situations influence the choice of language and the type of communication. The underlying principles of the communicative approach are that:

- language is a tool of communication
- teaching should be student-centered
- English should be taught through English
- students learn by active involvement
- learning tasks should reflect real life communication.

The communicative student-centered approach encourages active learning via student involvement. With the instructors guidance, supervision and encouragement students are encouraged to think about and experiment with language. While instructors can direct and facilitate learning, students themselves have ultimate responsibility for their own progress. Research has shown that people who learn languages successfully have a well developed appreciation of their own learning styles and preferences that enables them to build on their strengths and improve their weaknesses. Instructors can assist students to become aware of their personal learning by encouraging students to reflect upon their own progress on a regular basis. The issues of the language learners motivation have great importance with this approach. The motivation, interest, desire, psychological comfort, positive emotional relations of the communication partners are the required conditions of a successful language learning. There exist a number of trends in modern psychological and pedagogical theory which define the educational process as mutually mediated activity both of a student and an instructor. The specific problem of modern pedagogical psychology is the problem of a dialogue in teaching or the problem of a pedagogical communication. If the instructor shows that he/ she is actively interested in the students as individuals, the learners will respond well, contributing to a good rapport and a productive learning atmosphere.

The necessity for individuals to be prepared to work with and support each other is one of the terms the learning could take place.
There exist another tendency of changing from the informative to the so called active strategies and methods of teaching including the elements of problem-rising and research; transition to the developing, making more active and game-playing ways of managing the educational process.
Rapid development of the technologies, the surplus of information and overloading of various nature, time deficit is the objective characteristics of the modern period. Under the circumstances the ability to properly use one s own psychological reserves, awareness of the means and ways of psycho-regulation helps to avoid the nervous breakdowns and stresses abound in our life. No wonder some psychologists and psychotherapists[4] have made an important contribution to pedagogy in general and to the development of the new methods of language teaching.
Another trend in foreign languages teaching is the Intensive method founded on the suggestopedic system. There appeared a number of methodic concepts interpreting the basic ideas of suggestopedia in different manner. They use the information stockpiled by such sciences as communicative linguistics and social-psycho-linguistics, psychology of speech activity and psychology of communication, social psychology, pedagogy and methods of foreign languages teaching. The said trend though containing the main features of suggestopedia, differs from it and is considered by many scholars as one of the ways to realize the scientific technical progress tendencies. Based on the principles of personal-communicative and operational approach it is a realistic way to foreign language learning.

2.3 The Updated Approach

To keep in line with modern tendencies in society and maritime community; to comply with the requirements for graduates of technical universities, colleges, academies, etc training professionals for the industry the government supported educational institutions, like the Fisheries University, have to find some ways to optimize language training. The process keeps on going, the search is under way. It brings both positive and negative results. Nothing ventured, nothing gained.
The updated approach to the teaching language for special and general purposes has been developed using both traditional and intensive methods of language teaching. Twelve years ago the instructors of the Foreign Languages Department of the Far Eastern State Technical Fisheries University decided to take a chance and try to change the existing state of things. The first step on the way to optimize the foreign language studies was to re-distribute the subjects studied at the early stages of the professional education, as well as hours allocated for language studies. The summarized quantity of the academic hours allotted for the foreign language studies has been divided into three cycles; the term *cycle* is used by the instructors of the Foreign Languages Department to denote the complete periodic course of language teaching.. Since then only a third year cadet-navigator begins to study English. By that time he has already had a sailing practice. Every third-year cadet has to be certified as an able-seaman; he has already got some basic knowledge of the profession. He has already been abroad - the fact which helps to keep the motivation in learning language rather high. It means one thing: a prepared and well-motivated person will begin study foreign language for professional purposes. The updated curriculum includes three cycles of English both for professional and everyday communication. The duration of a cycle differs depending on the year of studies, namely: four weeks for the third and fourth year cadets and five weeks for the fifth year cadets. The second step which helped to better arrange both classroom and individual work of cadets was the implementation of rhythmopedia, a method of intensive presentation of a new material.
The assessment of the language competence level reached by the cadets is done by the experienced language instructors and seafarers. Each cycle comprises the classes of general and specific English. The methodology of the new approach is based on the principles of the communicative approach to language teaching. This approach meets the requirements of STCW in that it promotes practical, communicative competence in English.

2.4 Basic Terminology

It s rather important to clarify the terminology used. Methodological papers and textbooks of the last decades often use the term *intensification* . The term itself is rather broad, so any attempt to reach the final results in a rapid way is considered to be the intensification. However not any intensification is productive. Teaching is productive when every student reaches the desired result at each stage of the training.
An educational activity is a purposeful process responding to the demands for knowledge, skills, abilities and professional education. It results in changes to and enrichment of the learners inner world. The success of an educational activity is directly dependent on the planning and organization of the process of learning itself. Students potential abilities are used in a methodically organized, specially planned progression of studies, and this process contains the actual reserves for the intensification of the teaching process.
Thus the achievement of productivity in a students work under the direction of an instructor, as well as his individual work, might be considered as an intensification of training. Number one: it maximizes possible

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[4] Like G. Lozanov with his method of *Suggestopedia* based on the principles of psychology and the science of *suggestologia,* the latter is a science of the release of a latent reserves of an individual

concentration of time allocated by the curriculum for language studies. Number two: it increases the volume and durability of material comprehension per time unit, taking account of all psychohygienic considerations. An important role is assigned to the technical means, teaching devices used in combination with linguistics, psychology and psycholinguistics.

When solving the problem of optimal teaching conditions, it is extremely important to consider the external factors affecting a learner, his/her individual response to such influences, plus the adequacy of his/her internal psychophysical state to the given external condition.

Intensifying the process of teaching is impossible without considering a number of factors which have a direct impact on it. These factors are as follows: the regularity of memory functioning, knowledge of the most efficient modes of work, the speech articulation processes, the internal laws of expression, the optimal environmental parameters required to create a specific internal state of a student. This means, such intensification is impossible without setting up special conditions under which the reserves of a human body could be effectively revealed and used. We believe the most efficient method to intensify the teaching process in one which not only gives good final results but is also economic concerning the time consumed and the efforts of the instructor and learner. A method which activates intellectual work makes for the removal of natural tiredness, i.e. provides for a psychophysical effect. Among the factors defining the intensification of teaching are the productivity of the learner/instructor, and the rational distribution and structure of educational information.

3. Ways to Optimize Teaching English

Rhythmopedia (developed by the specialists of the Kishinev State University; Foreign Languages Department) is a method stipulating for the intensification of teaching. It involves the intensive presentation of foreign language information against a background of rhythmostimulation, retention of such material in memory by means of technical teaching aids and its actualization in classroom group communication. The method serves as contributory factor for the active assimilation of a considerable amount of information and the development of the learner s imaginative abilities. Rhythmopedia is a teaching method which presupposes a whole complex of interdependent methods and mutually conditioned internal and external factors to ensure the intensification of the foreign languages teaching process. Rhythmostimulation is a tool which enables to improve work of memory, to activate attention and to remove tiredness.

Multiple test show that the most effective memorization of linguistic information takes place with the human brain in an intermediate state, not in its maximum activity or active wakefulness. Rhythmostimulation is one of the means to bring the brain into such state. Rhythmostimulation is a biorhythmic effect with physical factors (light, color, sound and music) onto the optic and auditory centers of brain. In the process of memorization most parts of information are fixed by memory consciously; at the same time there exist another part of information which is memorized unconsciously. This fact is explained by the specific state of human mentality, as in the case of the decrease in wakefulness level and muscle relaxation, combined with some special forms of the material presentation. The same information presented in visual and aural images simultaneously results in a rapid increase in the volume of the memorized information. Hence audiovisual presentation of material done with technical teaching aids acquires crucial importance. It makes for the realization of the most important didactic principle: the combination of visual and aural aids.

The successful functioning of rhythmopedia is determined by:

- the rhythmic work of students during rhythmopedic show
- the rhythmic character of the presentation of the rhythmostimulation elements
- the rhythmic organization of material, i.e. presentation of materials in the form of interdependent sensory fragments
- the rhythmic way of presenting material for learning during the memorization show, i.e. within strictly set time intervals
- the rhythmic character of the accompanying music
- the rhythmic work of students while doing the laboratory work
- the rhythmic/ regular changes in various types of classroom activity
- the rhythmic repetition of all rhythmopedia elements within a cycle

The basic idea of rhythmopedia is the utilization of gradually decreasing rhythm in the process of learning in order to set an organism into a state in which the work of the brain is made more active. Rhythm is used as an instrument to adapt the students organism to the process of learning. Rhythmopedia as a methodological complex presupposes the organization of students independent work and a stage which consists of the organized classwork. The work based on the method comprises the following stages:

- Presentation of new material during a rhythmopedic show in special laboratory.
- Memorization of the presented material during the laboratory work.
- Actualization of the presented and primarily memorized material in English-speaking environment in real-life communication practiced during the instructors/students classwork.

Rhythmopedia provides for:

1) an increase in the volume and durability of new material memorization;
2) effective control over the independent work of students;
3) group-communication during the classes using the students knowledge of the new material;
4) stimulation of learning;
5) the development of skills, understanding, abilities and knowledge in various communicative situations.

The method serves as contributory factor for the active assimilation of a considerable amount of information and the development of imaginative abilities in a student.

4. Classroom Management

To get the desired results the whole process of the teaching has been re-considered: including the class-rooms, used materials and text-books, given tasks and played roles . The cadets are supposed to play their part in one and rather long-lasting play named "A daily routine of a deck/ engine officer in charge of a watch". The syllabus of each cycle has been thoroughly worked out to include materials mostly required for seafarers when abroad. The materials to be used by the instructors in their classwork include but not limited by the information presented during the rhythmopedic show and then revised at the laboratory work. The rhythmopedic show consisting of about 75 phrases containing new words, word combinations and grammar material is minimum to begin the work on the whole theme. On the average we study one theme a week, but the very theme could be rather capacious. For example, when studying Shopping one has to able not only to do the shopping somewhere, but express his attitude to the purchased goods, exchange opinion on the quality and price of the things, complain of the bought articles, say compliments, etc. While studying Places where one lives a student has to be able to invite his new acquaintance to his place, explain how to get there and how long can the road take. The first cycle includes such topics as description of a ship; duties and responsibilities of the ship s crew, watchkeeping, piloted movement, etc. The principles of VHF communication, cables and telexes-writing, as well as other equally important information is studied by the third year cadets. The second stage of language learning include the ships clearing in/out procedure; shipboard papers; cargo works, etc. The fifth year cadets have to study accidents at sea and their prevention; environment pollution prevention; GMDSS procedures, etc. Radio communication and paperwork(writing practice) - are the integral aspects of each cycle. The topics for the discussion at the general English classes include the information and situations a seafarer meet when being in foreign countries, i.e. introduction, checking in/out at the hotel, at the doctor, shopping, etc. Instructors are recommended to establish micro-situations from real life, where students cannot have failed to use the material presented during the rhythmopedic show and primarily memorized during the laboratory work. Grammar, vocabulary and phonology are the three language systems that make up the building blocks of English. They are the integral part of the whole system, but we do not teach English explaining it, we teach English through English. An instructor both of professional and general English does his best to establish an English-speaking environment in the classroom and the specific atmosphere of friendliness, positive emotions. We practice periods of relaxation during the classes, as a student has to stay in the classroom for about six hours per day. Jokes, funny and curious stories are the everyday practice of the instructors. Drawing pictures can assist in memorization of the mooring ropes, parts of ships especially for those learners who have good motor memory. The instructors of general English use the existing course Tune into English : songs help much to cope with some difficult language aspects, like phonology. Even the special course "Tune into Maritime English" has been developed, singing songs "Taking a pilot on board" or "Clearing the Ship Inward", etc. the cadets can practice and learn how to properly pronounce the words and improve their knowledge of the standards phrases for communication at sea. Sometimes instructors practice not the real-life situations but they use some fantastic, hard-to-believe models and situations. Most of our learners are young 18-20 year people rather inexperienced, some of them tend to say I don t know what to do under the circumstances or I don t have the slightest idea But if they are forced (by the instructors formulating the tasks during the classes or some other way) to react, to communicate even in these situations they are no doubt will be able to find their way in any even the most difficult circumstances. A set of computer tests based on the studied materials , home-reading of the IMO Resolutions, other conventional documents, pilot book, COLREGS, etc. help to keep the desired level of the cadets' motivation and verify their knowledge and understanding of the various aspects of maritime English. We also believe that the competence of the instructors in the issues dealing with the shipboard routine of the watch officers, their desire for self-education and utilization of the latest technologies in teaching, as well as well-prepared and timely updated materials will keep in line with the required level of the graduates proficiency.

5. Summary

It is the issue of the utmost importance that a seafarer has an ability to create safe and efficient voyages especially in multilingual crew. The step on the way to success in it is the language competence of a seafarer.

Not a single deck officer can pretend to be called a professional without this basic knowledge. No matter the approach, method or whatever practices in learning English used; one can select from the best of many methods. The aforementioned approach is the combined effort of the DALRYBVTUZ Foreign Languages Department instructors to reach the most important goal — to teach a cadet the way he is able to comply with the STCW requirements to ensure accident-free ship s operation.

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A TEACHING AND LEARNING RESEARCH MODEL FOR MARITIME ENGLISH COURSES

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ABSTRACT

Special ship operations present communication problems and challenges with multicultural crews. Although the International Safety Management (ISM) Code concentrates on communication in a common language that makes clear the implementation of shipboard procedures, the interpretation of written and oral procedures and commands as well as responses to them are often different from the original intention. The concept of Maritime English is thus restricted by the requirements of the IMO Standard Marine Communication Phrases and the IMO Model Course 3.17 Maritime English. Lack of operational-level knowledge of English can be the root cause of casualties. Management-level knowledge of English helps to minimize communication problems and to prevent the recurrence of these casualties. Corrective and preventive action processes also require knowledge of written English in order to submit commitments to external parties. The common language of claim handling is English as well, with relevant correspondence and objective evidence stated in a reporting mechanism. Clearly, it is impossible to cover this topic with Standard Marine Communication Phrases in current Maritime English courses. This study evaluates the actual expectations and needs of stakeholders in the shipping business like ship management performance due to the requirements of flag states and port states and compares them with the existing content of Maritime English Courses. Shipboard safety as well as environmental management systems require the implementation of English as a second language. This directly affects the training needs and methodologies at Maritime Education and Training Institutions. Maritime English courses are discussed and a model is proposed for management-level knowledge requirements of Maritime English.

KEY WORDS: Maritime English, Integrated Management Systems Teaching, Teaching Methodology

1. Introduction

Maritime English is restricted by the requirements of the IMO Standard Marine Communication Phrases. The use of written and oral English for navigation officers and an adequate knowledge of English to enable the engineering officers to use English publications to perform duties are stated by the STCW Code in accordance with A II/1 and A III/1 IMO (1995). The IMO Model Course 3.1 Maritime English is the other reference, and serves as a minimum requirement to teach the student nautical terms and basic shipboard phrases including basic engineering terminology. However, the actual expectations and needs of stakeholders in the shipping business should be integrated with the existing Maritime English courses to produce a more efficient and effective model for these courses.

There has always been a strong motivation for young people to become seafarers in order to learn history and experience the cultures of other countries. But seamen must also live and work together with people of diverse cultures in a closed community over a long period of time. The frequent turnover of a ship s crew is common practice and new crew members have to integrate quickly and effectively. Despite modern technology, seafaring still demands that a seaman maintain her or his best effort and high skills. Unforeseeable elements and continuously changing operating scenarios require strong efforts and clear decision-making capabilities. No machine can or will replace a seaman; the human being remains the decisive factor.

Taking into consideration the above professional constraints, masters and senior officers should have both the professional expertise and the language skills to reduce the risks that affect the quality of ship management service.

Ismail Deha ER would like to express his deepest gratitude to Prof. Thomas Moore for his invaluable advice, comments and suggestions.

Although most masters and senior officers are not native speakers of English, they do try to carry out their professional activities in English. Thus the English training needs of masters and senior officers should be reviewed and will be discussed more precisely in the following sections of this article.

2. Identification of Advanced Expectations

English as a second language has an important role for the efficient implementation of international requirements for non-native speakers who are employed as masters and senior officers. With the success of a Safety Management System implementation at ship management companies, there has been a significant move by many shipping companies towards ISO 9001:2000 and ISO 14001 certification Er (2001). Now the most popular ship-operating organizations and ship-management companies are implementing the requirements of Quality, Safety, and Environmental Management Standards.

Under increasing pressure from authorities like Port State Controls and P&I (Protection and Indemnity) Club and Insurance requirements, and also under pressure to maintain classification matters and ensure clients satisfaction, ship management companies are being forced to provide proof of the quality of their management Er et al (2001). Management of the statutory certificate requirements like Safety Construction, Safety Equipment, International Oil Pollution Prevention, Safety Radio Telegraphy, Loadline, Minimum Safe Manning, and other classification requirements, especially the ISM Code IACS (1996) and registration of the ISO 9002 (1994 version), are carried out by the ship management companies (Er and Sogut, 1999) . The ship management companies who have registered Quality Assurance certificates are now under pressure to establish their management practices in accordance with the year 2000 revision of the ISO 9000 standards.

At the present, a key goal in the shipping business is that top management of ship management companies get involved in the establishment, maintenance, and improvement of the quality management systems. This includes defining quality policy and measurable quality objectives (relevant to different functions and levels), quality planning, reviewing system effectiveness, identifying opportunities for continual improvement, providing sufficient resources, strengthening internal communication to ensure that all employees are aware of the importance of satisfying the requirements of the IMO s Conventions, and a charterer s needs and expectations. To enhance charterer confidence, ship management companies must determine overall charterer needs and expectations (including the IMO s Conventions, Port State Control requirements, Insurance and P&I Club requirements and applicable regulatory requirements like port of call etc.), and convert them into quality system requirements.

To ensure that the above requirements are met, masters and chief engineers need to establish formal arrangements to communicate with related parties about inquiries and complaints regarding non-conforming service or any other feedback from the customers about the carriage of cargo. In addition to that, the masters and chief engineers, the key drivers of this business, need to establish procedures and methodologies for measuring satisfaction, for defining the standard to be achieved, as well as for reviewing the nature and frequency of measurement. When the standard is not met, improvement actions need to be implemented, and results have to be evaluated and fed back to top management

To comply with the Resource Management requirements for staff who affect the shipping business quality, the company needs not only to provide adequate training, but also to review the effectiveness of the training, to ensure that the staff is competent and continuing to improve. Furthermore, the company also has to identify, set up, and maintain the information, facilities (including hardware and software facilities, with supporting services), and the work environment (including crew health and safety, work methods and ergonomics). These items are not clearly indicated by any international standards or IMO conventions, especially for the shore-based staff competency at ship management companies.

3. Model For Management Level Requirements

The multicultural character of the crews causes additional communication problems and challenges. The IMO has recognized the wide use of the English language for international navigation communications and needs to assist maritime training institutions in meeting the objectives of safe operation of ships and enhanced navigational safety through the standardization of language and terminology. On the recommendation of the Maritime Safety Committee, the IMO Assembly adopted Resolution A.918(22) in November 2001 to address this issue. The purpose of the Standard Marine Communication Phrases is to assist in the greater safety of navigation and of the conduct of the ship, to standardize the language used in communication for navigation at sea, in port-approaches, in waterways harbours and on board vessels with multi-lingual crews, and to assist maritime training institutions in meeting the objectives mentioned above. STCW.7/Circ.11 (2001). It is intended that through constant repetition on ships and in training establishments ashore, the phrases and terms used in the Standard Marine Communication Phrases will become those normally accepted and commonplace among seafarers and should be used as often as possible in preference to other wording of similar meaning.

The question arises whether the Standard Marine Communication Phrases are sufficient to comply with the expectations of stakeholders and mandatory international requirements of rules and regulations that are stated in SOLAS, MARPOL, COLREG, LOADLINE conventions and other international standards. It is impossible to cover all the needs with Standard Marine Communication Phrases. These phrases might be only a portion of Maritime English without including marine engineering terminology, relations with port state controls, classification societies, P&I Clubs, contingency management etc. In this respect the philosophy of the teaching model and knowledge management processes that are illustrated in Fig.1.and Fig.2 could be utilised for the curriculum development phase of Maritime English for seafarers to assure the satisfaction of life-long expectations.

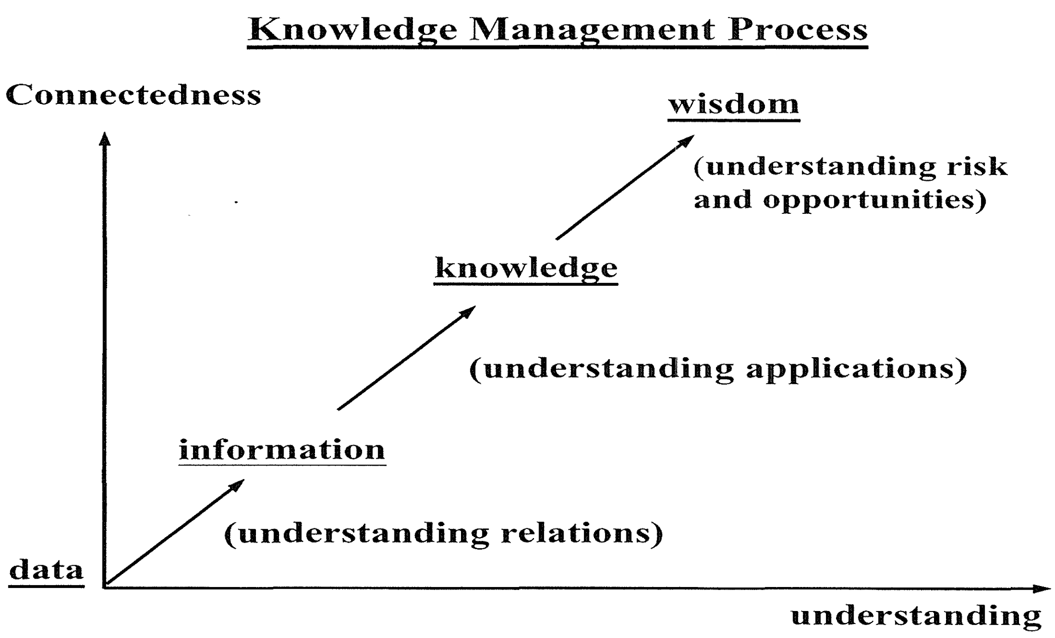

Fig. 1 Teaching Management for Knowledge Management

Taking into account the perspective of Management-Level Maritime English knowledge, the following modules are proposed in Table 1 for covering the needs of the maritime industry.

Table 1. Proposed Modules for Management Level Knowledge Requirements

MODULE - I			MODULE - II	
1.	Identification of ships, and merchant ship classification		6.	Analysis of ship s constructive parts, sections, machinery equipment identification for various types of ships.
2.	Ship Dimensions & Tonnage		7.	Principles of Classification Society Surveys & PSC inspections for various types of ships in accordance with SOLAS Conventional requirements
3.	Commercial Ship Management		8.	Principles of Classification Society Surveys & PSC inspections for various types of ships in accordance with MARPOL Conventional requirements
4.	Technical Ship Management		9.	Ship s Trading and Statutory Certificates
5.	Identification & functions of stakeholders of a Ship Management Company		10.	Surveys & Assessment Principles of Statutory Certificates
MODULE - III				
11.	Principles of Correspondence & Job Application		14.	Spare Parts, Store Requisition, Supply Correspondence
12.	Preparations & Recording of Shipboard Performance Records		15.	Non Conformance Management including Accidents, Hazardous Occurrence Reporting
13.	Principles of Planning Maintenance Systems		16.	Docking preparations, records & relating correspondence

4. Conclusion

Eighty-five percent of current sea accidents occur due to human failure. In an emergency, communication problems between crew members can make the situation worse. These problems are typical in multi-national crews where the first language is not English. Due to misunderstandings and ambiguity, less critical situations have already turned to tragic catastrophes. The world s largest container vessels and even tankers are operated by less than twenty people. This reduction of crew members leads to a concentration of responsibilities. Specialists responsible for particular tasks are now replaced by just one person responsible for several tasks. Although this situation is sufficient for normal operation, the crew members will very likely lack specialized knowledge for emergency situations. In case of an accident this particular expert knowledge will be crucial.

Lack of operational-level knowledge of English is not the only cause of these casualties. Management-level knowledge of English will also minimize the defects and prevent the recurrence of these deficiencies. The corrective and preventive action process also requires knowledge of written English for submitting commitments to external parties. The common language of claim handling is English as well, so relevant correspondence and the objective evidence should be clearly stated in the reporting mechanism. It is impossible to cover these topics with Standard Marine Communication Phrases.

In addition, relations with Port State Control Inspectors, Classification Society surveyors, P&I Club surveyors require a technical based oral and written English to clarify the nature of the subject on board the ship. The content of Standard Marine Communication Phrases is not adequate to manage these communications.

To overcome all the above constraints with the proposed management-level English knowledge modules, life-long training is the best solution. Reduced crews demand a broader knowledge of each crew member. But this impairs the availability of knowledge and so the ability to respond effectively in the case of emergency. Theoretical and some practical training can be done ashore, where training centers and excellent trainers are available. That means that training will be initiated in training institutions, but not effectively activated for the specific practices prior to joining ship; training will be continued on board after embarkation. This result requires a cross-reference between clause 6 of the ISM Code and STCW Code. The proposed modules require lifelong learning with the following objectives:

- Basic training is the responsibility of the training institutions
- The operation of equipment and machinery as well as shipboard procedures are the responsibilities of both training institutions and ship managers.
- Continuous training on board ships is the responsibility of the ship managers and manning agencies in cooperation with the training institutions.

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Maritime English Training for Non-native Speaking Mariners

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ABSTRACT

IMO officially promoted English as the language of the sea in the STCW 95 Convention and Code, adopted the ISM Code to reduce and eliminate communication failures and developed the SMCP for ensuring safety. In these circumstances the lecturers of Maritime English for non-native English speaking students face the task to meet the requirements of the new convention by means of reliable syllabi, classroom materials and techniques in order to facilitate learners to adequately master Maritime English. We need to take into account local training circumstances and ensure that international legislative requirements are met. A training system that works well in one country is not automatically successful when exported to a different environment. In our presentation, which is based on the expertise of Maritime English lecturers of Kyiv State Maritime Academy, we will consider the primary role of competence in general English while comprising Maritime English syllabus; another issue of our consideration is the communicative approach as the principal method applied to teaching and learning Maritime English, adopted in order to meet the specific communicative needs our learners will have on board ships. We will also view the concept of using simulators as an effective tool for Maritime English Teaching.

1. Introduction

English has been adopted by the IMO, officially, as the language of the sea. STCW 95 requires that every mariner must have an adequate knowledge of it. The legislation nowadays emphasizes the importance of the English language proficiency in relation to safety at sea. This is widely recognized at every level of shipping industry from legislative institutions to shipowners. In recent years a growing awareness of the necessity of choosing the best techniques in teaching Marine English has become evident. Lecturers should chose the best approach in teaching Marine English aiming to develop main language skills: oral and aural speech, grammar, reading and aural comprehension. As an international language, Maritime English is used as the means of communication in Maritime Industry between people often none of whom is a native user of the language. Thus any study of Marine English Language must include data on the forms and strategies employed by practicing people in Maritime industry who are non-native speakers of English. Clearly, Maritime English lecturers in a definite maritime educational establishment have a unique set of variables to work with, all of which influence the content, structure and method of local training.

In the circumstances when English is studied as a foreign language in an artificial bilingual environment, the problem of Marine English syllabus and principles of teaching will always be of great importance. Detailed syllabus & planning, good facilities, qualified & methodologically correct teaching are required to solve the problem of English language acquisition for non-native speaking mariners.

2. Facets of Maritime English

Maritime English can be divided into 4 main sections:

1/ General education in the English language

2/ The English used by those dealing with the navigation, safety communications, cargo operations, everything used for work of the deck department.

3/ The English used by those concerned with the main and auxiliary engines, the electrics, electronics — their operation and maintenance — everything used for work of the engineering department.

4/ The English used by those concerned with the commercial business of the merchant marine, Maritime Law procedures, insurance etc.

Let us consider the role of the students competence in General English. General education in the English language is necessary for all the students of ESP. Seafarers need to have good command of General English for the following reasons:

(1) General English is a necessary foundation for Maritime English because when the trainees come to the maritime content of the syllabus, they must have already covered all topics of General English and essential Grammar. Only being aware of the basic vocabulary, structure and phonology of the language, they pay grater attention to terminology, peculiarities of syntax and style.
(2) General English helps seafarers cope easier with all situations they face while serving aboard merchant ships, the more so if it is a multilingual and multinational crew.
(3) Since English is studied as a foreign language in an artificial bilingual environment under instruction, it turned out more helpful to start with a common core of General English and gradually pass over to Maritime English instead of intermingling them.

These reasons should be considered when composing English Language Programme for the whole period of study in the Maritime educational establishments.

3.Communicative Approach as the Basic Principle of Teaching Maritime English

Teaching Maritime English in Kyiv Maritime Academy and Kyiv Maritime Training Centre is based on the **Communicative approach** considered the most effective for professional and safety purposes practically in all higher educational establishments in Ukraine. Our programmes are designed to teach seafarers to communicate in English with confidence and fluency, to improve command of English grammar and extend the range of professional vocabulary.

Both Russian and Ukrainian proponents now see it as an approach (and not a method) that aims to (a) make communicative competence the goal of language teaching and (b) develop procedures for the teaching of the four language skills (reading, writing, speaking and listening) that acknowledge the interdependence of language and communication. However, there is no single text or authority on it, nor any single model that is universally accepted as authoritative.

Communicative Language Teaching implies the formation of phonetic, lexical, grammatical skills by involving learners into communicative situations that are close to the situations of real communication. This approach is aimed to the **practical usage** of the communicative skills. Hence the learning situations imitate real communication. We keep in mind that process of learning foreign languages cannot completely coincide with the process of real communication, so it s a question of highest possible approaching of studies to real life situations by means of:

a) communicative-oriented structure of a lesson;
b) communicative-motivated behavior of a teacher;
c) thorough selection of materials, topics, situations, handouts reflecting professional needs of students;
d) authenticity of materials *(that is, the language must be naturally generated by the students special purpose)*;
e) thorough selection of active and passive vocabulary and grammar;
f) situational oriented task instructions;
g) implementation of various reading strategies;
h) tolerance of error *—errors which do not impede successful communication must be tolerated*;
i) formation of intercultural competence

Finocchiaro and Brumfit (1983) contrast the major distinctive features of the Audiolingual Method and the Communicative Approach, according to their interpretation:

Audio-lingual	*Communicative Approach*
1. Attends to structure and form more than meaning.	Meaning is paramount.
2. Demands memorization of structure-based dialogs.	Dialogs, if used, center around communicative functions and are not normally memorized
3. Language items are not necessarily contextualized.	Contextualization is a basic premise
4. Language learning is learning structures,	Language learning is learning to communicate.

sounds, or words.	
5. Mastery, or "over-learning" is sought.	Effective communication is sought.
6. Drilling is a central technique.	Drilling may occur, but peripherally.
7. Native-speaker-like pronunciation is sought.	Comprehensible pronunciation is sought.
8. Grammatical explanation is avoided.	Any device which helps the learners is accepted - varying according to their age, interest, etc.
9. Communicative activities only come after a long process of rigid drills and exercises.	Attempts to communicate may be encouraged from the very beginning.
10. The use of the student's native language is forbidden.	Judicious use of native language is accepted where feasible.
11. Translation is forbidden at early levels.	Translation may be used where students need or benefit from it.
12. Reading and writing are deferred till speech is mastered.	Reading and writing can start from the first day, if desired.
13. The target linguistic system will be learned through the overt teaching of the patterns of the system.	The target linguistic system will be learned best through the process of struggling to communicate.
14. Linguistic competence is the desired goal.	Communicative competence is the desired goal (i.e. the ability to use the linguistic system effectively and appropriately)
15. Varieties of language are recognized but not emphasized.	Linguistic variation is a central concept in materials and methodology.
16. The sequence of units is determined solely by principles of linguistic complexity.	Sequencing is determined by any consideration of content, function, or meaning which maintains interest.
17. The teacher controls the learners and prevents them from doing anything that conflicts with the theory	Teachers help learners in any way that motivates them to work with the language.
18. Language is habit so errors must be prevented at all costs	Language is created by the individual often through trial and error.
19. Accuracy, in terms of formal correctness, is a primary goal.	Fluency and acceptable language is the primary goal: accuracy is judged not in the abstract but in context.
20. Students are expected to interact with the language system, embodied in machines or controlled materials.	Students are expected to interact with other people, either in the flesh, through pair and group work, or in their writings.
21. Intrinsic motivation will spring from an interest in the structure of the language.	Intrinsic motivation will spring from an interest in what is being communicated by the language.

(1983: p.91-3)

Let us look upon the basic principles of Communicative Approach as applied to teaching Marine English.
Practical orientation is to be achieved by using **materials** that have the primary role of promoting communicative language use.
We consider task-based materials to be absolutely necessary for communicative teaching Marine English. All the activities are to be presented in the form of one-of-a-kind items: cue cards, activity cards, pair-communication practice materials, and student-interaction practice booklets. In pair-communication materials, there are typically two sets of material for a pair of students, each set containing different kinds of information. For example, such materials can assume different role relationship for the partners (e.g., an Officer and a Cadet on the bridge). Another example, the materials can provide information for the partners to fit their respective parts into a composite whole.

We agree with many proponents of Communicative Language teaching who advocate the use of authentic , from-life materials in the classroom. These might include language-based **realia**, such as signs, telexes, original ship documents or graphic and visual sources around which communicative activities can be built, such as maps, symbols, graphs, and charts.

Linguistic information should be chosen to be taught not simply because it exists, but rather on the basis of what contribution it can make to the performance of specific tasks which are both communicatively useful and relevant to the seafarers professional language needs.

Situational orientation of a lesson means that everything happening at the lesson should be close to real life situations. It is to be achieved, first of all, by situational and communicative nature of instructions to tasks. Explaining what is meant by this principle requires examples.

Non-communicative	Communicative
Read the article and answer the questions.	You are going to read an article about the importance of steam power to a shipping company. Read these questions then scan read the article to find the answers (Marlins Study Pack II)
Read the messages, answer these questions and write replies to the messages.	You are the Captain on Board a newly built container ship called the Meridian Star. You have just berthed and have a busy 24-hour period ahead in which all crew are required to assist in loading operations. You have to deal with the communications below. Read theses questions. Then read the messages. Write a telegram or letter in reply to your manager, describing the situation on board and explaining your proposed course of action. (Marlins Study Pack II)
Listen to the dialogue and answer the questions.	Listen to the dialogue. The Steward is telling the Catering officer about some news he has just heard on the radio. Tell why the Steward and Catering officer are worried. (Marlins Study Pack II)
Read the text and complete the gaps with appropriate words	Read the text. A specialist in cross-cultural issues is giving a talk to a group of shipping managers. Complete the gaps with appropriate words. (Marlins Study Pack II)

We suggest that classroom instructions incorporate the following features:

a) opportunities for students to be exposed to real communication,
b) opportunities for students to engage in using real communication
c) activities which are meaningful to students and which will motivate them to become committed to sustaining that communication to accomplish a specific goal.

It should be pointed out that textbooks you use might not be obviously based on the Communicative approach. It is a teacher s skill that really matters in structuring their classes so as to provide opportunities for students to be actively engaged in real communication.

Of course, we admit that not all exercises can be made communicative-oriented. Especially it s difficult to transfer grammar into communicative-oriented tasks and activities. We propose that grammar instruction, within the limits of the possible, should be offered as a supplement to, but not instead of real communicative experiences.

Situational orientation of the lesson is also to be achieved by **communicative-oriented structure of the lesson** itself. We agree with the methodologists who propose that lesson should incorporate the following basic components: 1) a general theme (e.g., Visiting a crewing agency: asking for information) and theme presentation, 2) a task analysis for thematic development (e.g. understanding the message, asking questions to obtain clarification of specification, taking notes, ordering and presenting information etc.), 3) a practice situation description (A seafarer asks to see the Director of the crewing agency. He does not have an appointment. What information should the secretary get from him?), 4) a stimulus presentation (e.g., a model conversation scripted or/and on the tape), 5) checking up comprehension, 6) conversational activity — *there are many types of them in Communicative methodology*(e.g., You are the manager of a crewing agency. A seafarer asks to see your Director. He does not have an appointment. Gather the necessary information from him and relay the message to the Director), etc. Of course, this model does not claim to be universal, and teachers are encouraged to display resourcefulness, talent and classroom management skills.

4. Peculiarities of SMCP Teaching

IMO developed the SMCP to ENSURE SAFETY FIRST. Following the guidelines included in the introduction that t he SMCP builds on a basic knowledge of the English language in a simplified version of Maritime English to reduce grammatical, lexical and idiomatic varieties to a tolerable minimum , it is compulsory to teach them after getting acquainted with the conventions of general English. It is also preferable to incorporate them in the comprehensive syllabus after teaching the general maritime English topics so that students are already familiar with at least half of the words and phrases in the glossary. However, special attention should be given to GMDSS standard messages and VTS standard phrases as well as the application of message markers and the patterns they follow. This is of utmost importance in order to reflect present Maritime English language usage on board vessels and in ship-to-shore/ship-to-ship communications and to comply with IMO VTS Guidelines. Students must be acquainted with the block language which sparingly uses, or frequently omits, the function words *the, a/an, is/are,* avoids contracted forms, provides fully worded answers to "yes/no"-questions and basic alternative answers to sentence questions, provides *one* phrase for *one* event, etc. They must know that it is only the SMCP that feature such a simplified kind of English and get used to it.

5.Simulator-assisted Language Training. *Full Mission Bridge simulator as a tool for language training*

There already exist some methodological research as to the usage of GMDSS simulator in process of teaching Maritime English. Full mission bridge simulators have nearly perfected the transfer of learning and training since they allow the student to transfer the learned knowledge (of relevant disciplines), skills and training almost in their entirety.
Since the academic year 2002/2003 in Kyiv State Maritime Academy we are running an experimental programme, aiming to check the effectiveness of Full Mission Bridge Simulator as an effective tool in teaching Maritime English for cadets of 4th and 5th years of study (Navigational Department). It is early to speak of any results so let us consider only some aspects we took into account while organizing the experiment.

First of all we would like to mention that simulator-assisted lesson is the last one in the thematic lessons block aiming at recapitulation of the set of definite topics (e.g. *Pilotage*, *Steering and Sailing Rules*, *Navigation in Extreme Conditions* etc). Simulator-assisted English classes usually takes a period of 2 (for some topics — 3) academic hours. All the simulator-based lessons are inserted into Maritime English Syllabus so that they form an integrated training session with ordinary classes.

The rule of exercise states that those things most often repeated are best remembered. A vivid and exciting experience sometimes teaches more than usual routine lessons. Hence for achieving our purpose we chose combination of simulation exercises with ROLE PLAY as a main training technique. Before the role-play, the objectives for it must be explained. After asking for volunteers, selecting the role-players and the observers, the trainer together with Maritime English lecture should issue the role-play brief verbally of in writing. A thorough briefing of all procedures that are to be accomplished during should be provided.

Maritime English lecturer works together with a trainer to compose the necessary kind of exercises to make them suitable for imitating real communication and directed towards the purpose of language learning. The mere emulation of reality teaches nothing. It goes without saying that the training objectives and outcomes must be clearly stated and understood.
Simulator-assisted training Maritime English training is a matter of arguments and on-going search. However nobody can deny that simulator-based education is important element in developing the total competency of a future watchkeeper.

6. The Lecturer s Professional Competence

What is Maritime English Lecturer s professional competence consists of? It incorporates Knowledge, Skills and Attitudes. Knowledge consists of (a) knowledge of the English Language and linguistic competence, (b) knowledge of syllabus designing and types and (c) knowledge of methods, techniques and approaches in ELT. Professional skills consist of the ability (a) how to design syllabus materials, (b) how to implement methods and techniques in class and (b) how to improve skills of the students in speaking, reading, writing and listening; and Attitudes means (a) knowledge of own students motivation and their needs (b) to establishment of mutual understanding with them, for which of course you (c) have to have certain knowledge in psycholinguistics and sociolinguistics.

The lecturer s role should not be limited to that of passive recipient of an approved method, text or syllabus. Rather, the lecturer s role and skills should be developed to ensure that he/she can act as a critically aware and well informed judge of how training tools and methods can be used to best effect. Lecturers in Maritime English have a very difficult task to fulfill. Ultimately, however, success depends on the expertise, enthusiasm of the lecturers themselves and their desire for the constant self-improvement.

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A Comparative Analysis of the IAMU Member Schools to Teach and Test Proficiency in Maritime English

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ABSTRACT

The English language has been adopted as the official language of communication in the air and maritime industries. Despite international agreement to use English, there have been many difficulties in teaching, and assessing the outcomes of the teaching of Maritime English for decades. Some research has been conducted to examine these difficulties in the airline industry and the maritime industry. There exist some cross discipline training techniques stemming from this research based upon the theories and techniques in Crew Resource Management (CRM), Bridge Resource Management (BRM), and Space Flight Resource Management (SFRM).

Parallel to the teaching and assessing problems, there have also been many difficulties in reaching a training and testing proficiency in English communication that meets the international standards of the STCW 95 requirements in the maritime industry. The complexity of language and barriers of cultural communication have been experienced as potential problems by multinational crews.

This paper concentrates upon the difficulties of teaching and assessing the outcomes of the teaching of Maritime English at the Member Schools of the International Association of Maritime Universities (IAMU). A positioning model is developed to identify and measure the positions of the IAMU Member Schools in comparison with each other. A multidimensional scaling technique of the multivariate data analysis is used to analyze the data received through questionnaires. The results of the analysis indicate the relative positioning of the IAMU Member Schools in teaching and testing proficiency in Maritime English. This information provides the foundation upon which the model of this research is built. Consequently, some strategies based upon the results of the analysis are developed to reduce the problems and difficulties in this context.

1. Introduction

Several factors have contributed to the seemingly sudden focus on the crisis in Maritime English training worldwide. In addition to the obvious demands of STCW 95, there is the shift in accident analysis from the mechanical to the human factor; an increase in multinational maritime crews; and a public focus on maritime accidents that increasingly jeopardize human lives and the environment.

The International Convention of Standards of Training, Certification and Watchkeeping for Seafarers, 1978 (STCW) concentrated on technological improvements (construction quality and improved equipment) rather than on human factors, training and operating procedures. Jennifer Kiefer, a contractor with the U.S. Coast Guard s Human Element and Ship Design Division, reminds readers of Proceedings of the Marine Safety Council it was the Americans who formally proposed at the IMO s December 1992 Maritime Safety Committee (MSC) meeting that the 1978 Convention be reviewed with a focus on the role of the human element in maritime casualties (Kiefer 31). With mounting evidence that the human element was the major cause of accidents, a two and a half year review resulted in amendments adopted in July 1995 (to come into full implementation in 2002). The human factor, and especially competence in English, which had been established as the lingua franca of the maritime industry as early as the 1978 Convention, emerged fully.

In the early section of this study, a literature survey and a description of the current situation regarding the difficulties in Maritime English are reviewed. A hypothesis is developed regarding the IAMU Member Schools to follow some guidelines to reduce the difficulties in Maritime English at Member Schools using English as a foreign language. In addition, a model is developed in the following section to identify specifically the positioning of the IAMU Member Schools with respect to each other. The results of the analysis of the model are discussed both in terms of their operational implications as well as of their methodological ones.

2. Literature Survey

In the early 90s, the US Department of Transportation (USDOT) and the US Coast Guard (USCG) were working on human factor studies that culminated in the 1995 report People Through People (PTP). Evidence supported that over 80% of all maritime accidents worldwide was the result of human error, yet the majority of maritime safety resources focus on eliminating accidents by reducing material failures and system problems" (PTP 5). Two government offices, Marine Safety, Security and Environmental Protection and Navigation Safety and Waterway Services, spearheaded a long-term strategy that refocused prevention efforts based on awareness of cause by human error. The plan, it was recognized early on, would have to be participatory, systematic, and non-regulatory in its learning-implementation approach. Because risk management is a responsibility shared by governments, industry, classification societies, and mariners, all parties had to work cooperatively.

2.1 Current Situation

That same principle is working now in the International Association of Maritime Universities (IAMU) to focus on and collectively improve the teaching of Maritime English for maximum effectiveness. Work Group III of IAMU under Professor Malek Pourzanjani is now addressing the issue of the teaching of Maritime English at IAMU schools and plans to develop a model course as well as address the issues of training current seafarers already serving the world fleets. To establish a baseline for where we are now, it was decided at the Group III meeting in Istanbul in March 2002 to conduct a survey of how IAMU MET schools are currently teaching Maritime English. The survey vehicle used was developed by a work team* at Maine Maritime Academy that had been working independently on the issue of improving the instruction of Transportation English for the NASA International Space Station. The survey was modified for IAMU use and distributed via e-mail during spring 2002.

The difficulties of teaching and assessing the outcomes of the teaching of Maritime English have been recognized for over a decade by IAMU Member Schools and others represented by the participants in annual conferences of the International Maritime Lecturers Association (IMLA). Many entities are now working on the problems. For example, Istanbul Technical University Maritime Faculty, with the assistance of the Japan International Cooperation Agency conducted an International Seminar on Maritime English in March 2002. Currently, the Tokyo University of Mercantile Marine (TUMM) plans to work with IAMU and the Association of Maritime Education and Training Institutions in Asia Pacific (AMETIAP) on a three-year program to establish a model program for teaching Maritime English.

As a baseline to work from, we propose to identify where we are now. Hence we have analyzed a survey conducted among IAMU Member Schools to establish a positioning model to identify and measure the positions of the current status of how we teach Maritime English. A multidimensional scaling technique of the multivariate data analysis was used to analyze data received from the returned questionnaires. The results of the analysis indicate the relative positioning of the IAMU Member Schools in teaching and testing proficiency in Maritime English. Consequently, some strategies to improve the teaching and testing of Maritime English will be proposed. The Maine Maritime Transportation English Group has already established several hypotheses that they would like to test in the development of a model for the effective teaching of Maritime English. The survey analysis establishes a baseline for the model.

While the hypothesis was presented both at the Work Group III session in Turkey in March 2002 and to colleagues at the International Seminar on Maritime English, we present it again here in conjunction with the analysis of the IAMU Survey on the Current Status of Teaching Maritime English at participating IAMU Member Schools.

2.2 Hypothesis

Based upon the findings of the 1999 MARCOM Report (The Impact of Multilingual and Multicultural Crewing on Maritime Communications), we presumed that a proposed model for teaching and assessing Maritime English for the various IAMU schools would have to be flexible on both ends of the educational continuum; that is, on the entry end and the exit end. Both ends of the continuum are moving targets. Each school must establish its own level of beginning English proficiency (recognizing there are many variables from one country to the next), but a general level can be agreed upon before the student can enter the specialized Maritime English phase of training. Then on the exit end, the schools will have to develop a standard for proficiency until an international standard satisfying STCW 95 goals is in place.

The findings of the MARCOM report were that one Maritime English syllabus would not meet all needs for various reasons. For example:

- in some countries students are separated into nautical and engineering tracks and have different English syllabuses depending on the track and level
- in other countries one English classroom has students from both tracks as well as students with technical backgrounds, perhaps even students returning for upgrades, with years of sea experience and possibly a few fishermen as well.
- Class sizes may vary from 5 to 60, etc.

(MARCOM, Vol. 2, pp.76-84)

In addition, there was no consensus among respondents to the MARCOM questionnaires about what Maritime English is, let alone how it should be taught. Some accepted the Standard Marine Communication Phrases (SMCP), but most agreed that these do not meet all needs. In fact, at the Asian Shipowners Forum: Seaman s Committee in Hong Kong in November 2000, delegates argued that the SMCP should be completely reorganized to be a useful reference document. They suggested that the length be reduced to contain only essential operational and safety-related marine communication phrases. Further, they suggested that rather than mariners genuinely learning to communicate in English, instead they were learning phrases by rote and not understanding the meaning, thereby leading to less than safe communication.

While the MARCOM report found it unlikely that one Maritime English syllabus would suffice, they nevertheless offered a thorough outline of areas of content that should be covered. Our work group sees the outline as a solid foundation for both oral and written case studies to supplement SMCP as content for a Maritime English course. We have adopted the following hypothesis for the establishment of a working syllabus for the teaching and testing of Maritime English at selected IAMU schools.

We propose three stages for the study:

- First, a questionnaire to establish current practices for the teaching of Maritime English
- Second, the selection of control group schools to follow our proposed syllabus and procedure
- Third, outcomes assessment compared between control group schools and other schools attempting to comply with STCW 95 goals.

Our hypothesis is as follows:
Hypothesis: The teaching and testing of Maritime English will be most successful if the control group schools follow these guidelines:

- Immersion in Maritime English experience; ideally the maritime specialty instructor(s) is also the Maritime English instructor as in the ITUMF model of captains who had also completed IMO Model Course 6.19.
- If the former situation is not possible, the next choice would be a team of an experienced maritime instructor and a native speaking English instructor teaching the specialty simultaneously.
- Preferably, English technical training vocabulary be used at the outset to avoid the tendency to revert to the first language in a crisis.
- Listening and speaking skills should be emphasized above others in simulation situations, especially simulated stress situations.
- Native English speakers should be utilized, in person or via audio streaming on the Internet, CD-ROM, etc., as often as possible in case studies.
- Maritime English Teaching (MET) content be derived from field testing at control group IAMU schools as opposed to textbook theory.
- MET content and methods be standardized insofar as possible from field experience at the control group schools.
- Teaching materials be affordable, accessible, shared globally through developed Internet systems.

Recognizing that people learn differently, we support current pedagogical practice that mixes various approaches so that all types of learners are served. The content, learner, and the platform should accommodate the following learning styles: tactile, visual, auditory, factual, creative, sequential, non-linear, individual, collaborative. The development of e-learning platforms among IAMU Member Schools will facilitate serving the various learning styles in a financially feasible infrastructure.

3. Quantitative Approach and The Model

A conceptual model is developed in this section to illustrate and explain the key elements and their relationship affecting the positioning model. These key elements are converted to measurable variables for testing the hypothesis. The key elements represent the characteristics of different IAMU Member Schools. Data of these schools were received through questionnaires as per attached in Appendix 1, of a survey conducted by the Transportation English Working Group at Maine Maritime Academy, as noted earlier. A conceptual model of the positioning model representing the current and comparative situation of the IAMU Member Schools to teach and test proficiency in Maritime English is illustrated in Figure 1. The conceptual model is derived from a similar study, which was conducted earlier, on shipping services using a similar multivariate approach (Yercan).

The positioning model provides a framework for the comparison of IAMU Member Schools in Maritime English. The main hypothesis of the model is presented below. This model is operationalized in the following section, using the multidimensional scaling (MDS) technique of the multivariate data analysis. Data from IAMU Member Schools are processed by the MDPREF (MultiDimensional Preference) software program of the MDS(X) Series of MDS Computer Programs, which leads to the illustration, in graphic form, of the positioning of the IAMU Member Schools to teach and test proficiency in Maritime English (Coxon).

Hypothesis: English native speaking IAMU Member Schools and those using English as a foreign language are positioned differently in teaching and testing proficiency in Maritime English, and this is illustrated using a variety of characteristics.

The positioning of the IAMU Member Schools can individually be identified and their comparative positions can be measured accordingly. It is assumed that a differentiation among these groups of Member Schools exists. The hypothesis will be examined in detail in the following section.

4. Analysis, Results and Discussions

This section of the study consists of the methodology of the analysis of the IAMU Member Schools in comparison to each other and the results of the analysis. Some discussions are also given in this section.

4.1 The Methodology of The Analysis

The stages of the methodology of the analysis, which constitute an MDS approach, consists of the required data, method of data collection, selection of questions, collection of raw data, response rate, score ratings of data, application of data into the multidimensional scaling technique, and finally, analysis of data application.

A multidimensional scaling technique is used for the application of data of the IAMU Member Schools into the MDPREF program. Data required for this application include both quantifiable and non-quantifiable characteristics of the Member Schools. Data requirements for this application are based upon the hypothesis developed in the previous section. The collection of data is made through a questionnaire survey based on a 5-Likert scale, which was conducted by the Transportation English Working Group at Maine Maritime Academy. Questionnaires were used as a common method to collect primary data from the Member Schools. 15 out of 35 IAMU Members responded to the questionnaire survey via e-mail. The questionnaire consists of a total of 46 questions. However, data of 42 questions were used according to the type of data received from the Member Schools. This data was disqualified for use in the analysis because a number of requirements have to be met before the data can be analyzed in the MDS. These include the removal of questions where there is insufficient data — i.e. less than half of the Member Schools answered 2 questions, which leads to the removal of these questions based on insufficient data; and 2 more questions were removed because the same answers were received from the Member Schools, which leads to undifferentiated data. Subsequently, raw data were converted into score ratings for application into the software program. Data received from the Member Schools for each question were ranked accordingly.

The input data for the application consists of a 42x15 matrix in which rows are considered as subjects representing 42 variables, the characteristics of the IAMU Member Schools, and columns are considered as stimuli representing 15 different IAMU Member Schools, which responded to the questionnaire survey.

4.2 The Results of The Analysis

The comparative positioning of the IAMU Member Schools is illustrated in this section, as the result from the MDS analysis. Figure 1, which is produced by the output program of MDPREF, presents a summary of the results in two dimensions.

4.2.1 Representation of The Results

Figure 1 is a two dimensional graph representing the similarities and correlations between the IAMU Member Schools in terms of their characteristics regarding teaching and testing proficiency in Maritime English.

Axes of Dimensions

Variables on the axes of the dimensions were derived from the matrix calculated in the output program of MDPREF. The absolute values of score ratings, representing the characteristics of the IAMU Member Schools in these matrices, group together. Therefore, similar variables representing various characteristics of the IAMU Member Schools to teach and test proficiency in Maritime English group as a common characteristic, in general.

The y axis represents a general characteristic that appears to be the most significant one for the IAMU Member Schools on the basis of the results derived from MDPREF. This vertical axis illustrates the correlation coefficients between characteristics of the IAMU Member Schools in general within a range of +100 and —100. Similarly, x axis represents a group of characteristics that appears as the second most significant one for the IAMU Member Schools in this illustration. The range of correlation coefficients for this horizontal axis also varies between +100 and —100. These significant characteristics are depicted by the output program automatically and are derived from the calculated correlation matrix. A number of characteristics representing Maritime English teaching quality and English language skills of students appear to be the most significant characteristics stemming from the automatic calculations of MDPREF. A number of significant characteristics representing Maritime English teaching quality are related to the importance of Maritime English teaching: availability of instructors for Maritime English; availability of teaching materials; availability of courses for students to practice Maritime English; total time spent teaching English; availability of plans to improve the English language skills of instructors; availability of techniques used to develop and improve English language skills of students; and availability of ESL/ESP programs. Similarly, some of the significant characteristics, which represent English language skills of students, are related to previous English language experience; availability of opportunities for students to practice their Maritime English; and availability of native speaking instructors for Maritime English.

Configuration of the IAMU Member Schools

The stimuli, the IAMU Member Schools in this study, are represented as points in a multidimensional space, a two-dimensional space in this case. The configuration of the 15 IAMU Member Schools is illustrated in the figure by points represented by the initial letters of their names. The names of these schools are also listed as a note in Figure 1. It should be noted that there is no dominance or ranking of the member schools; the sequence of the Member Schools, which is given as a note in Figure 1, is based on alphabetical order.

The configuration of the IAMU Member Schools in the figure is based on the MDPREF correlations. IAMU Member Schools having similarities with each other and displaying similar characteristics group together in the figure representing their close positioning and similarity in teaching and testing proficiency in Maritime English. This is also specified this way: when the angle of two vectors, passing through two points and originating from the origin, in an n-dimensional space, becomes smaller, its cosine approaches 1 and this is an indication of high correlation; in the present case, a close similarity between the IAMU Member Schools (Hair *et al*, Chatfield and Collins, and Moinpour *et al*).

Configuration of Characteristics

Variables are denoted by vectors, which represent the characteristics of the IAMU Member Schools (Hair *et al*, 1998). The configuration of the 42 characteristics is derived from the survey conducted by the Transportation English Working Group at Maine Maritime Academy. These characteristics do not dominate each other; however, the sequence of the characteristics is based on the items on the questionnaire. As already indicated, characteristics of the IAMU Member Schools are illustrated according to their correlation coefficients. Various points overlay each other because of the close relationship, reflecting similarities in teaching Maritime English.

4.2.2 The Results

The interpretation of the data consists of the stimulus points, positioned to ensure maximum agreement with the subjects vectors. The interpretation of the position of stimulus points is made according to the spread of the subject vector ends. In Figure 1, the stimuli points representing the 15 IAMU Member Schools are illustrated by AMC-Australian Maritime College, Australia, CMU-Constanza Maritime University, Romania, DMU-Dalian Maritime University, China, DEU-Dokuz Eylul University School of Maritime Business and Management, Turkey, PUC-Polytechnical University of Catalonia, Spain, GMA-Gdynia Maritime Academy, Poland, KSMA-Kiev State Maritime Academy, Ukrania, KUMM-Kobe University of Mercantile Marine, Japan, LJMU-Liverpool John Moores University, U.K., MMA-Maine Maritime Academy, U.S.A., MNMU-Mokpo National Maritime University, Korea, SMMM-National School of Merchant Marine of Marseille, France, OMTC-Odessa Maritime Training Center, Ukrania, RCMS-Rijeka College of Maritime Studies, Croatia, and CMA-The California Maritime Academy, U.S.A. The rest of the points are the subject vectors representing the 42 characteristics of these Member Schools. Their significant representation is based on the data received via the questionnaire survey conducted by the Transportation English Working Group at Maine Maritime Academy, as mentioned earlier. The following are the results from Figure 1:

IAMU Member Schools grouping together represent a close positioning in teaching and testing proficiency in Maritime English because of similar characteristics, i.e. higher correlation.

In general, the IAMU Member Schools in English native speaking countries — Australian Maritime College (AMC) in Australia, Liverpool John Moores University (LJMU) in the U.K., Maine Maritime Academy (MMA), and The California Maritime Academy (CMA) both in the U.S.A., are positioned close together on one side of the map in Figure 1 demonstrating similarities in various fields. These include: majority of students speaking the English language as a native language, and therefore, not having a separate teaching program for ESL and/or ESP — except Liverpool John Moores University — nor for Maritime English; availability of English native speaking instructors, and therefore, unavailability of plans for the improvement of the English language of instructors; availability of courses for students to practice Maritime English; availability of technical manuals of maritime related equipment written in English; unavailability of a standardized international exam for measuring English language proficiency of students — except The California Maritime Academy; unavailability of techniques used to improve listening and reading skills of students in the English language; majority of students between the ages of 18 and 25, etc.

Similarly, the IAMU Member Schools in the countries where the English language is a foreign language, are also positioned close together having similar characteristics to each other. These schools are Constanza Maritime University (CMU) in Romania, Dalian Maritime University (DMU) in China, Dokuz Eylul University School of Maritime Business and Management (DEU) in Turkey, Polytechnical University of Catalonia (PUC) in Spain, Gdynia Maritime Academy (GMA) in Poland, Kiev State Maritime Academy (KSMA) in Ukrania, Kobe University of Mercantile Marine (KUMM) in Japan, Mokpo National Maritime University (MNMU) in Korea, National School of Merchant Marine of Marseille (SMMM) in France, Odessa Maritime Training Center (OMTC) in Ukrania, and Rijeka College of Maritime Studies (RCMS) in Croatia. Similar characteristics, which these Member Schools have, include: students speaking their own language other than English; majority of students having English language experience of either between 2 and 4 years, or more; administrators of Member Schools agree that English is the language of the sea, and therefore, all of these schools — exceptGdynia Maritime University in Poland and Rijeka College of Maritime Studies in Croatia, have a separate teaching program either for ESL and/or ESP or Maritime English or both; having difficulties for students to practice their English and/or Maritime English with English native speakers; availability of development plans for the improvement of the English language of instructors whose native languages are not English; having good or satisfactory proficiency levels of Maritime English for instructors teaching Maritime English or of ESL and/or ESP for instructors teaching English; unavailability of the situation to test oral proficiencies of students in simulated maritime situations; opportunity for students to learn Maritime English at the school and availability of technical manuals of maritime related equipment written in English to help students; availability of techniques used to improve listening, reading and writing skills of students in the English language, but having a lack of providing some opportunity for students to practice speaking English, etc.

Interestingly, some of the IAMU Member Schools position according to the geographical position of their countries. For example, Constanza Maritime University in Romania and Gdynia Maritime Academy in Poland position very close to each other illustrating very similar characteristics and both of these schools are situated in Eastern Europe. Similary, Dokuz Eylul University in Turkey, Rijeka College of Maritime Studies in Croatia and Polytechnical University of Catalonia in Spain, which are geographically situated in the Mediterranean region of Europe, also have similar characteristics to each other, in general, and this is illustrated in Figure 1 by their close positioning on the map. These results may stem from their similar points of view in terms of cultural and educational issues. Furthermore, another similar situation exists in the similarities between Dalian Maritime University and Mokpo National Maritime University, which are located in Eastern Asian countries — China and Korea, respectively. Their close positioning is also illustrated in the same figure.

IAMU Member School characteristics that group together are similar to each other in a way that matches the explanations provided by Hair *et al* and Chatfield and Collins. Some of the variables representing the characteristics overlay each other by illustrating high similarity, e.g. unavailability of English native speaking instructors and unavailability of the opportunity for students to practice their English at the IAMU Member Schools where English is a foreign language; unavailability of separate teaching programs for ESL and/or ESP or Maritime English and unavailability of technical support for improvement of language skills of students at the English native speaking IAMU Member Schools.

5. Conclusions and Recommendations for Future Research

5.1 Operational Conclusions and Recommendations

A positioning model is developed to identify and measure the positions of the IAMU Member Schools in comparison to each other. The main hypothesis that was tested and accepted by the positioning model of this study is that English native speaking IAMU Member Schools and the Member Schools speaking English as a foreign language demonstrate different characteristics and position themselves in different places on the positioning map. Particularly, this clustering and grouping of the schools take place regarding the provision of technical support for students and the use of the English language as the native language. In the case of not having English native speaking instructors, the Member Schools make efforts to fill this gap at least by providing good or satisfactory ESL/ESP and/or Maritime English teaching programs and technical support for improvement of language skills of students. However, the need for English native speaking instructors is strongly highlighted by the administrators of these schools. These major results largely match the hypothesis developed earlier in this study.

In addition, the results of the positioning model also match the hypothesis, developed earlier in this study, regarding the teaching and testing of Maritime English being successful if the control group schools follow certain guidelines. These guidelines particularly support the idea of a team of experienced maritime instructors and English native speaking instructors cooperating with each other and teaching related courses accordingly; English native speaking instructors being utilized either in person or via audio/video streaming on the Internet or by distance learning programs; using English technical training vocabulary; standardization of Maritime English content and methods; and teaching materials being affordable, accessible, and shared globally through developed Internet systems.

Consequently, some support could be provided by English native speaking IAMU Member Schools to the Member Schools using English as a foreign language. This support could reduce the difficulties of teaching Maritime English at the Member Schools and provide a basis for improvements in teaching and testing proficiency in Maritime English at IAMU Member Schools.

5.2 Methodological Conclusions and Recommendations

Although there are many applications and considerable research has been undertaken with respect to positioning, there is a lack of research as well as a shortage of applications in measuring maritime education services. More specifically, the minority of positioning studies has concentrated in perceptions in education, as noted earlier.

In addition to the positioning model of this study regarding the current practices in the teaching of Maritime English, further research is, therefore, required particularly for the measurement of the application of a new proposed syllabus and procedure at control group schools. Furthermore, additional research is required to find out the comparison between control group schools and other schools attempting to comply with STCW 95 goals.

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Turkey, Gdynia Maritime Academy (GMA) in Poland, Kiev State Maritime Academy (KSMA) in Ukrania, Kobe University of Mercantile Marine (KUMM) in Japan, Liverpool John Moores University (LJMU) in the U.K., Maine Maritime Academy (MMA) in the U.S.A., Mokpo National Maritime University (MNMU) in Korea, Odessa Maritime Training Center (OMTC) in Ukrania, and Rijeka College of Maritime Studies (RCMS) in Croatia, Polytechnical University of Catalonia (PUC) in Spain, National School of Merchant Marine of Marseille (SMMM) in France, The California Maritime Academy (CMA) in the U.S.A.

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Endnotes

*The Transportation English working group at Maine Maritime Academy has included many professors; currently the group includes: Professors Donna G. Fricke (MMA), Susan K. Loomis (MMA), Thomas Moore (MMA, on leave at Koc School, Turkey), Laurie C. Stone (MMA), and Funda Yercan (Dokuz Eylul University, Turkey on leave at MMA during academic year 2001-02).

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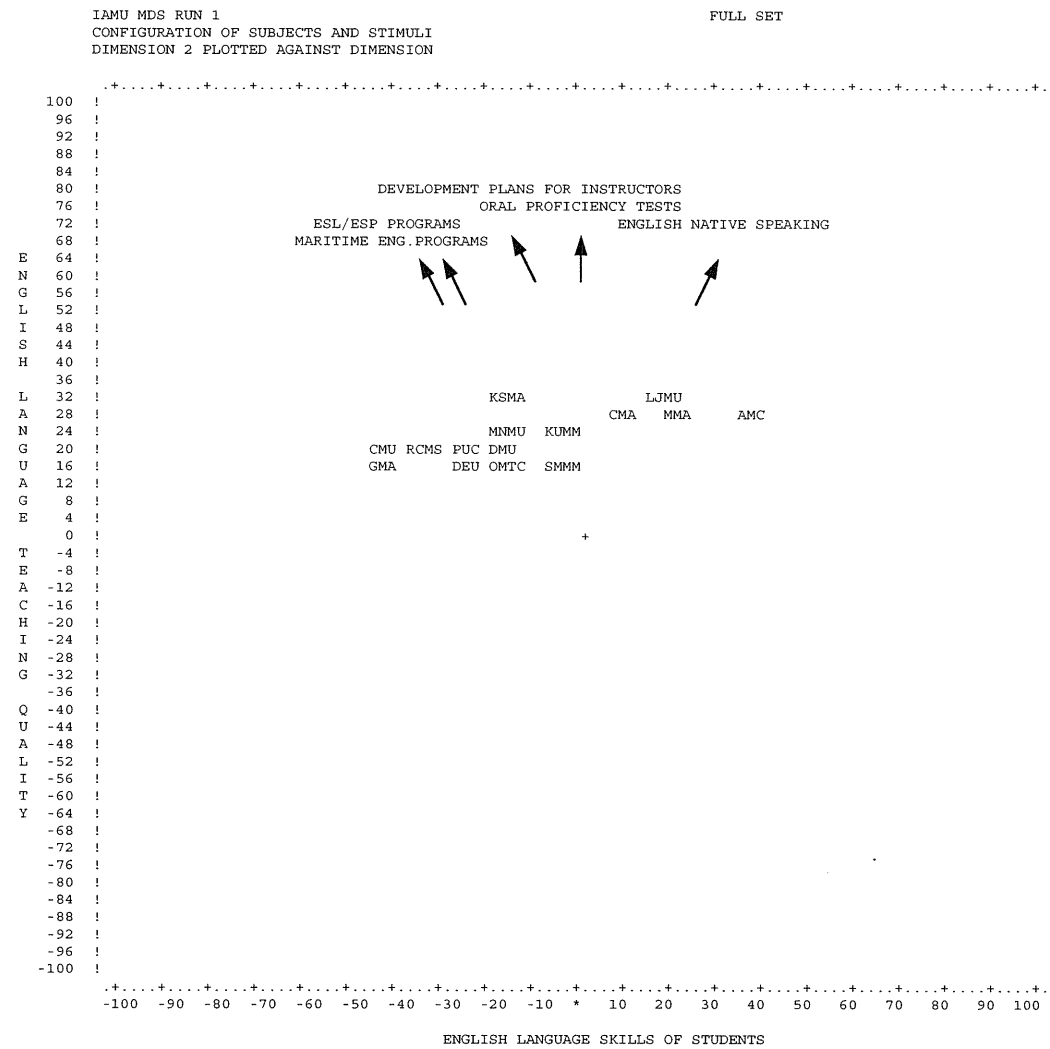
Figure 1. Configuration of correlations between the IAMU Member Schools and their characteristics to teach and test proficiency in Maritime English



AMC-Australian Maritime College, Australia
CMU-Constanza Maritime University, Romania
DMU-Dalian Maritime University, China
DEU-Dokuz Eylul University School of Maritime Business and Management, Turkey
PUC-Polytechnical University of Catalonia, Spain
GMA-Gdynia Maritime Academy, Poland
KSMA-Kiev State Maritime Academy, Ukrania
KUMM-Kobe University of Mercantile Marine, Japan
LJMU-Liverpool John Moores University, U.K.
MMA-Maine Maritime Academy, U.S.A.
MNMU-Mokpo National Maritime University, Korea
SMMM-National School of Merchant Marine of Marseille, France
OMTC-Odessa Maritime Training Center, Ukrania
RCMS-Rijeka College of Maritime Studies, Croatia
CMA-The California Maritime Academy, U.S.A.

APPENDIX 1°: Maritime English Project Questionnaire
For Administrators at IAMU Member Institutions

Please answer the questions for the situation at your institution, limiting your attention to officer training programs in deck, engine, or deck/engine combined.

1. Please provide basic information about your institution, including basic entry requirements and a website URL. (Include a catalog in English, if available.)
2. Describe the demographic type of your students.
  a. Percentage of mother tongue of students: ___%_______(mother tongue); ___%________(mother tongue)
  b. Age range of students: between 18-25:_____; between 25-30:_____; older than 30:_____
  c. On average, previous training in the English language: yes no
  d. Previous sea going experience: percentage _________
3. Do you agree that English is the language of the sea? If so, please answer the following questions.
4. Do you have a separate teaching program for English as a Second Language (ESL) and/or English for Special Purposes (ESP)? If so, please answer Question #5.
5. Describe your current program for teaching English as a Second Language (ESL).
  a. When did this program begin?
  b. How many full-time instructors of English teach in this program?
  c. How many students are in this program?
  d. How many average years of English language experience have students before entering this program?
6. Do you have a separate Maritime English teaching program? If so, please answer Question #7.
7. Describe your current program for teaching Maritime English.
  a. When did this program begin?
  b. How many full-time instructors of English teach in this program?
  c. How many students are in this program?
  d. On average, how many average years of English language experience do students have before entering this program?

0-2 years   2-4 years   over 4 years

Maritime English Project Questionnaire
For Administrators at IAMU Member Institutions

Please fill in the appropriate box for the level at your institution. Support could be received from designated instructors.

1: Very poor **2**: Poor **3**: Fair **4**: Good **5**: Very good **n/a**: Not applicable

	1	2	3	4	5	n/a
Regarding Students						
1. Availability of teaching materials/equipment used to improve listening, speaking, reading and writing skills of students at your institution						
2. Availability of native English speakers to help students practice maritime English						
3. Oral proficiencies of students are tested in simulated maritime situations						
4. Availability of courses at our institution for students to practice maritime English						
5. Availability of technical manuals of maritime related equipment written in English						
6. Review of technical manuals of maritime related equipment in English						
7. Total period of time for learning maritime English at our institution						
Regarding Instructors						
8. Availability of English native speaking teachers at our institution						
9. Proficiency level of maritime English among the instructors of maritime related courses (i.e. navigation)						
10. Proficiency level of maritime English for instructors teaching Maritime English						
11. Availability of plans for the improvement of the English language of instructors in maritime related courses						
12. Instructors of maritime related courses at our institution benefit from faculty development plans						

Maritime English Project Questionnaire
For Teachers of TOEFL or ESP at IAMU Member Institutions

Please fill in the appropriate box for the level at your institution.

1: Very poor **2**: Poor **3**: Fair **4**: Good **5**: Very good **n/a**: Not applicable

A. In general:

	1	2	3	4	5	n/a
1. Total time spent for teaching the English language at our institution						
2. Testing of student English language proficiency						
3. Level of standardized international exam for measuring English language proficiency of students						
4. Participation of students in class discussions using English language						
5. Availability of courses at our institution for students to practice English						
6. Availability of native English speakers at our institution to help students practice English						
7. Availability of instructors who hold a certificate in the teaching of English as a Second Language (ESL) or English for Special Purposes (ESP)						
8. Required (English language) proficiency level sufficient for instructors teaching English						
9. Availability of plans for the improvement of the English language of instructors						
10. Instructors teaching English at our institution benefit from special development plans						

B. Listening / Speaking / Reading / Writing skills:

	1	2	3	4	5	n/a
Listening						
1. Availability of techniques used to improve the listening skills of students						
2. Availability of films and videos in English for students to practice listening skills						
3. Availability of techniques used to develop and improve the listening skills of students in order to prevent them from translating into their own language						
4. Availability of techniques used to develop and improve the ability of students to think in the English language						
Speaking						
5. Participation of students in class discussions using maritime English						
6. Students can practice speaking English with native speakers at our institution						
7. Oral proficiencies of students are tested in simulated maritime situations						
Reading						
8. The level of phonics instructions						
9. Availability of special reading courses in English for students						
Writing						
10. Availability of English writing course						
11. The level of English writing skills of students is checked regularly						

Session V — Information Technology/Distance Education

Chair: Dr. Abdel-Galil

Information Technology and Distance Learning: Keys to Global IAMU-MET Collaboration?
Peter Muirhead
WMU

Successfully Incorporating Internet Content and Advanced Presentation Technology into Collegiate Courses: Lessons, Methodology and Demonstration
Ronald F. Smith
Massachusetts Maritime Academy

Practical Solutions for A Veritable Maritime Online Library
Eugen Barsan
Constanta Maritime University

Distance Learning Courses for Seafarers
Jerzy Hajduk, Pawel Krause
Szczecin Maritime University

Information Technology and Distance Learning: Keys to global IAMU-MET collaboration

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ABSTRACT

The paper examines global developments in distance learning methods and in computer and Information Technology systems, and considers the role they could be playing in a changing MET environment in the future.

What opportunities might CBT and global connectivity bring to MET and how can MET institutions become more closely involved in the future needs of both the onboard and shore based MET environment? The author reports on a comprehensive global survey of 90 MET institutions, finalised in 2001, which sought feedback on current and future use of new teaching technology and methodologies, and discusses the issues raised by such findings.

Planned developments by the World Maritime University for future outreach to the global community via the Internet/World Wide Web, built on the excellent computing and information technology facilities now in place at WMU are described and commented upon.

The paper concludes by examining several questions. Can we create a collaborative Web-based MET centre for access by any mariner at sea or student ashore? How might distance learning methods and online connections be used to help create a communications environment to enhance this approach? How might IAMU use such technology to develop a collaborative role in global MET?

1.Introduction

In the 21st century, the maritime education and training community finds itself facing an explosion of new developments in communication tools, simulation, software training programs and expanding use of computers linked to the Internet and the Web. Computers and computing are the catalyst behind many changes affecting maritime industry operations. The modern ship today is a floating computer centre, increasingly provided with links to the office ashore and home. The potential for the use of technology for ship operations, training purposes, social needs and for personal education needs is tremendous.

Maritime educational institutions also face the challenge today of utilising new technology, communications and teaching methodologies in order to enhance the learning environment of tomorrow. Whether offering on-campus or off-campus courses, computers and IT resources are rapidly becoming indispensible delivery tools. We may not like these trends as traditional educationalists, but they are here to stay and students expect that their educational needs will be increasingly centred around such platforms in the future. This demands the provision of the best in new technology and the development of new teaching techniques by teachers while still maintaining the best practices of education. MET institutions need to consider the opportunities that the Internet and World Wide Web links offer them in relation to future global collaboration. Let us consider some key aspects.

2. Developments in Information Technology

2.1 Global Connectivity

The Internet and the World Wide Web today have become the indispensible tools of the Information Society, using a common language for seamless communication across networks. According to Netsizer (2002) the Internet today comprises more than 192 million domain servers or hosts. CyberAtlas (2002) also estimates the number of Internet users at 445 million in August 2001 rising rapidly to 709 million at the end of 2004. Governments, business and general community services are increasingly dependent upon the Internet. For education institutions it is rapidly becoming the backbone of many of their operations and services. Few institutions today do not have a Web page advertising their portfolio of products and services. On land we take for granted the growing availability of broadband links. When we send an e-mail from Europe to say Australia, we do not concern ourselves with the route it takes which may be a combination of varied land routes and undersea cables. The short time taken however never fails to astonish us. However when we open up an Internet site, the download time for a complex web page may be considerable if low technology links are being used, with resulting frustration! In parallel the demands for digital data storage are also growing very fast. For ships, direct access to land based telephone lines, coaxial cables or fibre-optic connections is out of the question and they have to rely on satellite links at sea for broadband connections to land links. Satellite links are still an expensive medium when talking of broadband capability, but access will becoming easier and cheaper through future new services.

Let us take a look at where other technology links are heading? Consider Internet voice technology, real time video and conferencing services, distribution of resource materials and delivery of online e-lectures for example. Many of these require broadband connectivity. It is often overlooked that many of our daily communications go through undersea cables. Mills (1998) estimated that there were more than 600,000 kilometres of fibre-optic cables on the floors of the world s seas, a figure still increasing rapidly according to Hudson (2000). The Fibre-optic Link Around the Globe (FLAG) cable between Europe and Asia (FEA) that opened in November 1997 is 28,000 kms in length using a mixture of undersea and land based fibre optic cables. The China-US cable (opened in 2000), at 30,000 kms length, has a total capacity of 80 gigabytes per second, enough to carry four million phone calls simultaneously. However, FLAGs latest multi-terabit dual cable under the Atlantic Ocean (FA-1), which opened in September 2001, has a capacity of 2 x 2.4 Terabytes which means an ability to transmit up to 30 million simultaneous clear-voice transmissions or 200 hours of video every second. To meet the urgent need for better communications in Africa ambitious plans have been formulated to ring Africa (Africa One project) with 32,000 kms of undersea fibre-optic cables with some 30 landing points at key coastal cities (Cybergeography.org)

Looking at satellite communication links, current Inmarsat High-Speed Data (HSD) services are rated at 56/64 Kbps. VSAT technology can lead to rates up to 2 Mbps. These services are still relatively costly for the individual. Some future services however may provide a better cost solution. New generation Inmarsat 4 satellites will provide up to 432 Kbps. Inmarsat s Mobile Packet Data Service, which became available to the maritime industry in November 2001, enables the MPD terminal on a ship to become just another terminal to the Internet having continuous connection. You only pay for the packet you send. A future development with potential is Teledesic - a satellite based global «Internet in the Sky« service offering, through a constellation of non-geostationary satellites, a wide range of data, voice and video communication capabilities. A variety of user terminals will accommodate "on-demand" single channel rates from 128 kbps up to 100 Mbps on the uplink and up to 720 Mbps on the downlink.. Teledesic plans to start operations in 2005.

Plans for replacing the current Internet Protocol with Next Generation Internet (NGI) using IPv6 are already gathering momentum as the current Internet capacity of IP addresses is rapidly used up. Broadband research in the USA (e.g. Abilene Project) has reached the stage where the entire USA Library of Congress could be transferred in just 7 seconds! Many governments have initiated national projects to provide access to broadband technology for education and the business community at large.

So high speed connectivity is likely to be assured on the land and undersea. Can ships expect to have access to broadband Internet, e-mail and streaming video links anywhere, anytime in the future? Trials are being conducted in a number of countries using satellite communications, CBT and distance learning methods for onboard training, education and leisure activities. Norwegian ship operators and management companies have designed vessel specific training systems, using CBT modules onboard and at locations ashore (Marintek, 2002). Many owners are pursuing such a path. Using current and planned communication links and services for training outreach and interactivity onboard and ashore offers much potential for interaction between personnel on board and shore based training programs and tutors (shipowner or institution).

Looking to the future, it is clear that many shipowners have embarked down a path increasingly centred on the concept of the IT office-at-sea . By 2005 there will be very few ships not equipped with LANs and computers. By implication, there will be demands for retraining or employment of officers and crew who have a capability and confidence to operate within such a world. Shore-based personnel will also need to extend their knowledge and skills to interact with the changing environment. Will port and shipping industries use continuing education as a vehicle for the retraining and upgrading of their employees in the workplace? The lead taken by Australia in using distance learning to provide working personnel in the port and shipping industry with access to continuing education is a model the rest of the maritime world should consider. MET institutions will need to consider what role they can play in providing a broader range of educational services. They will also need to determine if they are prepared to provide the necessary communications and computing equipment and teaching skills to deliver such courses in the future.

3. Developments in Distance Learning

Today we have the technological keys to unlock the traditional system of learning to free people to pursue lifelong learning anywhere, anytime. Technology is altering all the traditional ground rules. Cyberspace education operates without frontiers, walls or barriers. It is an interactive learning environment, globalized by technology links. It is a concept that can just as readily find a home at sea as ashore in the future. The combination of computers, networks and multi-media capabilities is clearly a formidable educational tool. But distance learning is more than just sitting at a computer terminal accessing the Internet.

What do we mean by the term distance learning or distance education ? Willis (1994) considered that Distance learning takes place when a teacher and student(s) are separated by a physical distance, and technology, i.e.voice, video, data and print, is used to bridge the instructional gap . Open learning lays the emphasis more on learner choice than on the provider. Correspondence courses , popular forms of self study and self improvement in the pre-1970s should not be confused with distance learning programs for two reasons, firstly they lacked structured learning material and secondly, and most importantly, the means of communication were extremely limited and slow.

The characteristics of distance learning can thus be described as enhanced access to learning resources, program outreach, and student interactivity (asynchronous or synchronous). Outreach means that learning can take place anywhere at anytime. Interactivity ensures the student does not learn in isolation. However the focus of learning is now student centred.

Let us examine some current activities. For example, the British Open University (2002), the foremost distance learning institution in the world, currently has over 160,000 students using the university s online e-mail conferencing system. 178 OU courses require the student to have online access. In 2001, the university produced 773,000 CD-Roms, 30,000 Floppy discs and 3,000 DVDs. The University of Phoenix (2002), the largest private University in the USA with 116,000 students, has online plans to convert itself into a bookless college through the use of e-textbooks. Some 60% of its 37,600 distance learning students have their course fees reimbursed by their employers, reflecting growing acceptance of online learning. Athabasca University (2002), which for 30 years has been Canada’s leading distance education specialist, now has some 24,000 distance-education students, 550 distance education courses, and 60 distance education programs. Dunn (2000) suggested that more than 50,000 University level courses were now available through distance learning delivery systems.

The University of Washington (2002) offers abbreviated versions of its short courses online at no charge. MIT Knowledge Updates (2002) broadcasts live and synchronous ten minute segments via satellite and Internet using PIVOT (Physics Interactive Video Tutor). Students can access PIVOT 24 hours a day, every day. Even more momentous was the decision by MIT, in April 2001, to place all of its more than 2000 courses online by 2010 through its Open CourseWare Project (Goldberg, 2001). Work commenced in November 2001. These materials will be freely available online to anyone.

3.1 Globalisation of Education

The trend towards globalisation of business has spread to the international education sector in the last few years. The cyberspace world of education is no exception. Recently announced initiatives in e-university developments include proposals by the Higher Education Funding Council for England to set up a consortium of UK and overseas partners to create a virtual e-university without a physical campus, at a cost of £200 million. Goddard (2000) reported that News International has formed a partnership with 21 Scottish Universities to market and distribute distance learning courses. Educause (2001a) stated that Thomson Learning and Universitas 21 (a consortium of 16 universities) have agreed to put up $25 million each to develop degrees in business and technology for the Asian and Latin American market. Centred in Asia, it will draw upon Thomson s textbook division and 100 e-learning courses from the constituent members. The Global University Alliance (2002) is another global university group with ambitious plans. Hardly a day passes without another cluster of educational establishments announcing their arrival on the distance learning scene. Some institutions have developed off-campus cyberspace centres to provide a potentially larger student population with a gateway to ongoing education.

To effect distance learning delivery today, many institutions employ a Web based Education Management System (WEMS) using ready-made platforms such as Blackboard, WebCT, Lecando or Luvit to mention but a few. These are actively used to deliver and manage institutional distance learning programs. However, not everyone involved in distance learning considers that such platforms are satisfactory for academic purposes. While WMU plans to develop its own system, MIT and Standford University (2002) are developing, through their Open Knowledge Initiative (OKI), a free online course management system. It is expected to be available in late 2003.

Such is the pace of growth in distance learning delivery that it has been predicted by the Association of Governing Boards in the USA that as many as one third of the existing independent colleges and universities will close in the next 10 years (Educause, 2001).

3.2 Distance Learning and the Maritime Market

An examination of global maritime institution web sites does not reveal any evidence of great activity in delivering maritime distance learning courses, a view supported by research (Muirhead, 2001). In Australia, students have had access to maritime distance learning courses through the Australian Maritime College since 1987. Market research showed a clear desire by many individuals working in maritime related jobs shore to pursue further qualifications. Today they can enrol in postgraduate certificate, diploma and Master degree distance learning programs in maritime management, maritime business, stevedoring management, and marine surveying utilising printed and online instructional material, the Internet, e-mail and tele-conferencing, without having to step inside the institution. Most students are employed in jobs ashore. New areas under development include certificate of competency courses for deck watchkeeper and shipmaster.

A number of centres in Britain, including the Centre for Advanced Maritime Studies in Edinburgh, the North West Kent College and the Institute of Chartered Shipbrokers in London, between them offer a range of courses by distance learning covering ship and port management and operations, marine surveying, ship agency and maritime law. The FUMAR project in Norway started in 1997 and involves the collaboration of four maritime academies, offering 9 subjects between them by distance learning including management, navigation, GOC, finance, law etc.

3.3 The Seafarer and Technology

At sea, technology has the potential to allow much refresher and upgrading training to be carried out onboard that currently require seafarers to attend a course ashore. Digital ship (2001) reported that Maersk Line had placed sixteen SimFlex simulation systems onboard their ships for use by cadets for rule of the road and basic shiphandling training, with potential tutor links to the Institute ashore. Even at ratings level distance learning programs for career advancement to watchkeeper level have been available onboard ships in Australia for some years now. For the mariner, the opportunity for private study at sea, a service long denied him or her, will become reality as Internet links become more common onboard ship. Access to web based communications such as net-chat, net meeting and news groups has further extended the range of possibilities. Why shouldn t the mariner be able to take an educational award program at sea via an Open Learning University or from a delivering Maritime Cyberspace Education Centre in future?

Surveys by NEA (2000) showed that e-mail is the preferred mode of communication by over 70% of distance learning students in the USA. There is no reason why students at sea should not develop similar level of access to course tutors. Support through CD-ROM and online marine databases ensures that library information can be readily available. Software companies such as Videotel and Seagull are leading the way in providing maritime related learning resources in an easily accessible format at sea.

Overall then, there is no technical reason why many aspects of education and training could not be carried out on a ship as well as on shore through the supportive medium of distance learning. The real constraints are developmental costs of materials, access to computing and communications technology, course fees, availability of learning time and self motivation. The motivational aspect of persuading crew members to use CBT methods to enhance their knowledge and skills needs careful attention. However, distance learning methods combined with IT resources have the potential to extend the regime of learning to both the shipboard environment and the shore based workplace.

Many large commercial businesses today run their own internal training centres , utilising distance learning methods, IT and communications technology to full advantage. The potential for a greater collaborative effort between the maritime industry and MET institutions to offer and deliver quality training and/or educational services to those at sea and ashore remains great.

4. A survey of MET Institutions on the future use of new teaching technology and methods

A recent program of research (Muirhead, 2001) undertook a comprehensive survey of MET institutions around the globe, focusing on current and future use of new teaching technology and methodologies. The 90 institutions responding produced an interesting picture of capability and future intentions.

4.1 Staff access to technology

Table 1 Academic Staff Access to Computing Technology and Multi-Media

Region	**Europe**	**Asia-Pacific**	**Africa M-East**	**America**	**Global**
Resource	Yes%	Yes%	Yes%	Yes%	Yes%
CD-ROM, DVD	93	80	50	91	83
CD-RW drive	93	60	50	100	79
Scanners	90	88	67	100	88
Laser printers	95	88	67	75	87
Colour printer	95	80	67	91	87
Digital camera	76	48	25	83	62
Multi-media	54	72	42	42	55

Table 1 shows that there is a high degree of access by academic staff to CD-ROM, CD-RW, printer and scanner technology in Europe and America, and reasonably so in Asia Pacific. There is room for growth with compact disc technology and printing support in the Africa-Middle East region.

4.2 Staff Training and Use of CBT Laboratories

The outcomes show globally a high level of use of computer laboratories for group learning and CBT (77%) yet only 64% of institutions offer training to academic staff to use such equipment in the learning process (Figure 1). One of the key outcomes of the METHAR European MET research project was the notable lack of training in new technology for teaching staff in maritime academies in Europe.

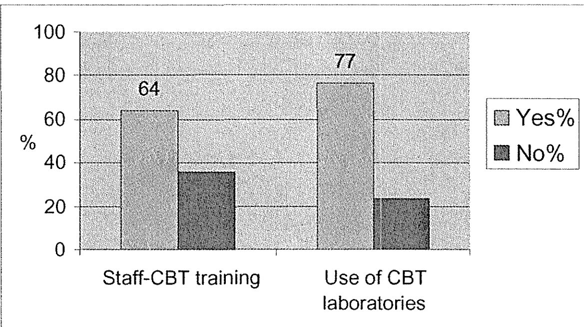


Figure 1 CBT Training & Use of Laboratories

4.3 Maritime Courses by Distance Learning

It is probably not surprising that distance learning courses are not offered by institutions in the Africa-Middle East region, as the survey provides clear evidence of a lack of availability of technical resources to warrant it. Access to maritime distance learning courses is highest in the Americas according to the survey returns, but USA maritime academies do not show evidence of offering much in the way of maritime distance learning courses on their web sites.

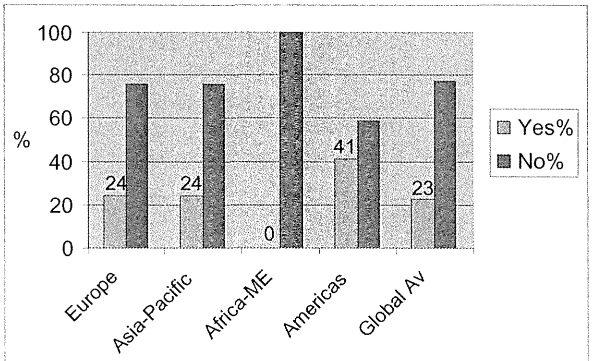


Figure 2 Courses by Distance Learning

4.4 Future developments

Future developmental intentions of institutions up to the year 2005 were sought, with the focus particularly on two aspects, firstly that of computer technology and its use in the internal teaching and learning process, and secondly that of external delivery via distance learning using online communications and multi-media tools.

Table 2 Future Developments (2000-2005) - by Region
(percentage of positive responses)

Questions°: Do you plan to°:	Europe	Asia-Pacific	Africa-ME	Americas
Create CBT Laboratories?	78	81	100	91
Give all students e-mail access?	64	75	75	100
Give all students Internet access?	68	70	82	100
PC projectors to all classrooms?	59	73	75	80
Give IT/CBT training to teachers?	94	96	92	100
Purchase new simulation facilities?	78	82	73	67

There is a general desire to create CBT laboratories with modern PC based equipment. These two aspects go hand-in-hand. Apart from the Americas, there is less than full enthusiasm for giving students access to e-mail and the Internet. There is an overwhelming acknowledgement that the teachers need special pedagogical training to use new technology and methodologies effectively. The lack of experienced practictioners in the CBT and distance learning field is another negative factor to translating expressed developmental desires into practical reality. The reported failure of a number of well known distance learning ventures in the USA in the last 12 months (Temple, Columbia, DePaul and US Open Universities) illustrates the difficulties of getting a sound foothold in the market (Educause).

Responses to future intentions in the area of distance learning were as follows:

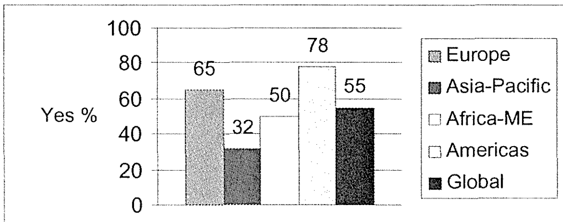


Figure 3. % Institutions planning to introduce distance learning over next 5 years

Generally the Americas and Europe are more enthusiastic for this means of delivery, whilst the Asian region in particular does not see it as a major area of development in the near future.

Table 3 Plans for developing maritime courses through distance learning
(Percentage of positive responses)

Questions: Do you plan to:	Europe	Asia-Pacific	Africa-ME	Americas	Global Av
Develop DL materials in house?	89	41	83	100	75
Use a Web site to manage DL?	80	43	100	86	72
Develop a multi-media studio?	61	53	71	44	57

There was high level of interest (75%) from the 44 institutions that gave a positive response as to whether they planned to offer maritime courses via distance learning in the next 5 years, by developing their own distance learning materials in-house. The least enthusiasm for this approach was in the Asia-Pacific region.

Overall the results of the survey indicate that MET institutions are well aware of the importance of using computing and CBT now and in the future, and many are making a determined effort to meet industry s future needs. Many others clearly lack the expertise and the funds to develop such capabilities without additional support from industry and governments.

5. World Maritime University —Developments in Technology

The World Maritime University itself plays an important role in providing a pathway for graduates across the broad spectrum of the shore-based maritime industry. Since 1983 over 1700 students from 144 countries have graduated and taken their educational experiences back to serve in the administration, port, shipping and education and training sections of the industry.

The quality of academic standards and credibility is dependent upon many factors. In today s modern educational world, the provision of up-to-date computing and Internet services is crucial. Since 1997, all staff and students have had access to and use of email and the Internet, by links through the Swedish University network SUNET. Through 1998 and 1999 the WMU network was upgraded and all computers and accessories in the WMU were replaced.

A new multi-functional multi-media interactive computing laboratory holding 20 computers was opened in 1999, creating new avenues for the instructor and teaching methods. During 2001, a second laboratory of 25 computers was modified, to provide the instructor with a similar interactive capability. At the same time live audio and video links were created between one of the laboratories and an adjacent classroom for trialing of distance learning delivery techniques. A small multi-media studio is planned for 2003 so WMU can produce some of its own educational materials for internal student access and external delivery. The University supplies each student in the hostel with a computer that is linked to the WMU network.

The PC-based laboratories today provide all the IT and multi-media support required for the highly acclaimed WMU English Study Skills Program (ESSP) as well as Computer Assisted Learning (CAL) in the academic programs. Figure 4 opposite provides a general view of one of the multifunctional laboratories.

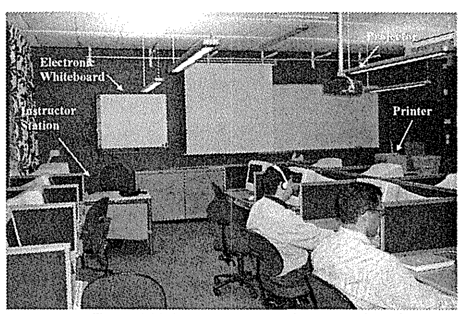
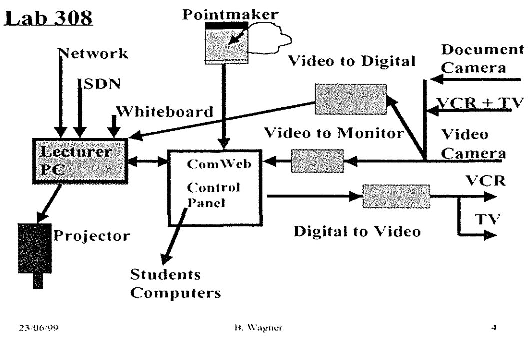


Figure 4. PC Lab: Looking towards the Instructor Station (left)

The technical design allows data or digital signals to be taken from the Network, Internet, Electronic Whiteboard, Pointmaker, video visualizer camera, VCR, TV and other sources through the instructor PC to the students PCs via ComWeb, to the large screen via the SVGA projector, and to VCR or TV. The Visualizer is a particularly versatile tool which, when used in conjunction with a TV monitor or video projector, allows for images of documents, overheads, slides, and negatives to be presented at a very sharp level of image. Figure 5 over illustrates the schematic layout of the multi-functional laboratory.



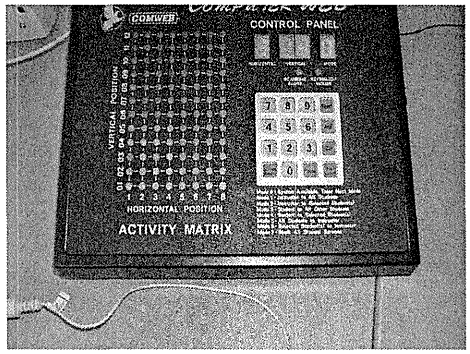


Figure 5. Laboratory Schematic Layout

Figure 6. ComWeb Control Panel

The instructor can communicate to any combination of the 20 student computers in the room, show any form of media display on the monitors, on the large screen, interact directly on student screens or allow students to take control of classroom activities. This is achieved using the COMWEB KnowledgeWeb system shown in figure 6 above. The panel is a special-purpose, hybrid, monitor-keyboard-mouse-audio-video-data switching device controlling an array of analog and digital sources and functions.

Stepping from the world of delivering conventional classroom lectures to engaging students through a computer assisted learning laboratory is a challenging and daunting task. Delivering courses «at a distance presents further challenges to the teacher. Some issues to be considered include:

1. What does it mean to learn at a distance ?
2. How to engage the attention, motivation and involvement of the student in these environments?
3. How to develop effective links between visual materials and student understanding?
4. How to prepare study materials for the learning environment?
5. How to communicate effectively with a student at a distance ?
6. Can the classroom experience be replicated for learners at a distance?

6. Technology and connectivity for collaborative global roles

6.1 Can we create a collaborative Web-based MET centre?

WMU is the lead partner of a European Union thematic network research project called METNET. The purpose of this project is to improve the quality, harmonise the contents and extend the applicability of MET in the European Union. The network acts as a cluster for the exploitation of results emanating from related previous research projects such as METHAR and MASSTER. In this way much of the unfinished business of these projects is being carried forward to applied conclusions. It involves collaborative effort between institutions, industry and government bodies.

As an example of cooperation, a number of train the trainer courses are being created by small teams in Europe dealing with the use of marine simulators, marine pollution, and the impact of modern technology in teaching. The research teams have made good use of the Internet, Web and FTP sites to develop the courses collaboratively. The establishment of online connections to create a working communications environment that will enhance collaborative activities is technically easy. The difficult task is getting colleagues to contribute effectively at a distance , many of whom have other priorities in their schedule. This difficulty should not be underestimated in establishing collaborative links of any kind.

Muirhead (2000) proposed a regional cooperative cyberspace simulator training centre with web site access to a range of simulation training software, exercises and assessment. A collaborative MET centre based on the models described earlier (Universitas 21, GUA) is quite feasible, but one needs to be clear on the purposes and advantages to be gained in establishing such a centre?

6.2 How might distance learning & online connections be used to create a communications environment?
WMU itself is currently creating a comprehensive academic intranet to provide a more interactive site between the registry, academic programs, lecturers and students. Future developments involve the evaluation of WMU s web education management needs for delivery of distance learning modules. The creation of the latter is being considered for future outreach to graduates, on-line access to WMU professional development courses, and delivery of foundation study modules to new entrants. Links between laboratories and lecture rooms for seminar activities for example, development of in-house study materials from a multi-media studio, and direct delivery of WMU lectures to regional centres around the globe are some of the initiatives under consideration for the future

We have seen that communications technology and web based management software is readily available to create a communications environment for global interactivity between MET institutions. Several examples of web based groups of international education institutions have been identified. IAMU needs to determine what is the purpose of developing a collaborative network — data exchange, collaborative research, delivery of courses online, creation of common standards? Such a platform will need considerable investment in people, time and money to bring it to fruition and keep it dynamic and active.

6.3 How might IAMU use such technology to develop a collaborative role in global MET?
The IAMU membership comprises universities and university level colleges around the globe. All have varying levels of access to the Internet and e-mail services. The degree of access to computers, Information Technology and multi-media tools by staff and students is not uniform but is sufficiently well developed to provide a sound base from which to develop an interactive communications platform. The key issues to be faced in creating such an IAMUNET are the policies, purposes, platform specifications, developmental and operational funding, and site management. The failure of several distance learning centres in recent times leads the author to issue a word of caution in getting too ambitious too soon. Perhaps IAMU would be wise to establish a user group through Netscape or Yahoo! at first to see if members of an IAMU consortium are sufficiently motivated to make it work online.

7. Conclusions

Computing and communications technology are here to stay. Many MET institutions are endeavouring to ensure that they are equipped for a future role that will incorporate the use of information technology resources, distance learning methods and well-trained academic staff. In the field of education, a number of universities have formed international education alliances to deliver courses by distance learning globally. It is too early to see whether they will be successful. It is evident that there is a clear technical capablity of developing an interactive and collaborative network between different IAMU institutions around the world. What is not in evidence yet is whether the skilled and motivated human resources, needed to establish and make such a network successful, are both available and willing to achieve this.

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Successfully Incorporating Internet Content and Advanced Presentation Technology into Collegiate Courses: Lessons, Methodology, and Demonstration

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ABSTRACT

We are in the midst of a technological transformation that is fundamentally changing the way people access, assimilate, and present information. The view that computers and related technologies, such as the Internet, are only educational tools is no longer valid. Rather, they represent an information and technological revolution that will have an equal to or greater impact on society and on education than that of typography during the mid-15th century. New technologies have enabled students to access information rapidly and visually. Reading is not as central to their learning as it once was. This has implications for all instructors. How will instructors take advantage of such utilization of the Internet and successfully integrate this new and innovative content into their classrooms to more effectively engage their students? What effect(s) will these developments have on pedagogy, the instructor s position in the classroom, and especially upon the students? This article will describe cover these, and other issues, describe why and how this professor incorporated online content and various presentation technologies into his survey and seminar courses, the lessons learned, and the pedagogical impact this approach has had upon his courses. It is, in short, a personal testimony, which has broad applications.

1. Introduction

I am a tenured Associate Professor of History teaching Western Civilization II and the Ancient History and the Medieval History seminars at the Massachusetts Maritime Academy, one of the nine Massachusetts state colleges. As an adjunct professor of history at Bridgewater State College (MA) I also teach Western Civilization I and II. The combined student load between these two institutions is 115 to 145 students per semester.

Between 1972, when I began my higher education career at the Massachusetts Maritime Academy, and the last half of the 1980s the academic level and classroom skills of my students changed dramatically for the poorer for various social, educational, and cultural reasons. A majority now were visual learners, and therefore the traditional textbook/lecture pedagogy had become increasingly difficult for them to comprehend and to utilize. Not surprisingly, test scores were lower on increasingly easier tests and the additional effort necessary to address these and other problems poor classroom skills and a lack of historical mindedness consequently reduced the amount and level of the content in the course. But a more insidious issue exacerbated this situation: I was growing stale in both my presentation and enthusiasm for the course.

Confronted by these realities new methods of presenting the Western Civilization courses had to be devised. Supplementary visuals slides, some video, overhead maps, documents, and occasional pictures were incorporated into the lectures. Detailed lecture outlines were provided to assist the students note taking. To address poor writing and critical thinking skills seven to nine two page papers were assigned per semester dealing with specific historical issues. Content was adjusted to address the students lack of basic knowledge about Western society. Prior to exams study guides for the textbook were distributed to assist students in gleaning potential exam material from that source.

These adjustments had some success. Writing and comprehension skills did improve, but the overall results still remained unsatisfactory. Examinations had become less rigorous over time and student test averages continued to slowly decline. Most significantly, the additional time and effort necessary to address my students academic deficiencies consequently reduced the amount and academic level of the content presented in the course. We were spending more time covering less and less material. Adopting new textbooks was futile in meeting these academic needs. Textbook publishers are very aware that students have increasingly ignored their publications. They have responded to this challenge by producing less challenging and bland Brief Editions , which have been stripped of the detail that would make the text interesting. Thus, these new and improved texts proved ineffective in addressing student resistance to reading traditional texts and despite my efforts these remained as unread as my earlier adoptions.

I was faced with a fundamental choice. Given the continuing academic deficiencies of my students, either I could place my emphasis on attempting to address these problems and lay less stress on course content, or raise my content level to an appropriate collegiate level and leave many students behind. Neither was an acceptable option. At this point I began to seriously analyze the impact of computer and Internet technology upon my students and to comprehend the deep significance of the personal technology revolution on how my students learned.

The development of personal technology the home computer, computer games, the Internet, cable TV has changed the way information is disseminated and absorbed. Students have become acculturated to acquiring data rapidly and visually. They can spend hours playing a video game, watching television, or programming a computer, but not ten minutes effectively reading a textbook. Indeed, the cultural act of reading has become less important, even irrelevant, to them, as the new technology has made reading less necessary to the general attainment of knowledge. A recent article in the *Washington Post* makes it clear that the vast majority of students now use the Internet *exclusively* to research their papers and assignments[1]. More importantly, most students now expect their collegiate experience and courses to reflect these technological advances**.** Recognizing that one can not be a technological Luddite, I concluded that it was imperative to harness this technology that my students accessed daily for the higher purpose of engaging them in developing their knowledge and their thinking and analytical skills.

I soon discovered that these academic issues facing my students were cross-cultural. In August 2001, I was asked to give a lecture and demonstration of the use and impact of online content and presentation technology in my courses to Fulbright professors, who were spending the summer in the United States. As I described how my students academic capabilities had declined over the past several years, I noted that this could be a phenomenon unique to the United States culture. These professors, representing Nigeria, Italy, Argentina, Bosnia, and Japan, halted me immediately. Not so, they replied. Each had experienced exactly the same issues with their students during the same time period. Cultures will differ, but student academic needs and challenges will not.

2. Incorporating technology

2.1 Description of the Online Textbook Adopted for the Western Civilization Course

In 1998 while investigating the possibilities of utilizing Internet based content in my courses, I was made aware of iLrn s (www.iLrn.com) online, multimedia Western Civilization textbooks. After reviewing the *Western Society* online text and finding it reflected solid scholarship, I adopted it on a trial basis. The results were remarkable. Many of my early concerns portability of the text, access to computers, differing levels of student computer literacy, etc. proved to have little basis in reality. Rather, test scores improved an average of 8-12 points on more extensive and more difficult exams than those employed earlier. The students found the material more understandable and accessible. They did much more reading on many more topics than when the traditional textbook/lecture approach had been employed and I could hold them more accountable for the material. On average 70%-80% of my students at both colleges have preferred this technologically based pedagogy to the standard textbook/lecture instruction.

I have used iLrn s online textbooks for 9 semesters with over 800 students. Initially, iLrn was simply a supplement to my standard textbook and a support for some lecture notes. But since the iLrn text has developed into a pedagogically sophisticated and increasingly interactive site that combines popular platform capabilities with solid content, it is now the sole required content for my survey classes. The iLrn text is not a digitized textbook. Ilrn, the interactive learning network, is an easy-to-use content delivery and classroom management system comprised of multimedia learning resources and teaching tools within a very robust online site. Its content is original and pedagogically designed to be used and read online.

I presently utilize the *Western World Since 1500* and the *Western World from Antiquity to 1650* in my Western Civilization classes. These online texts provide me with a plethora of ways to enhance my presentation and to more fully engage my students in the course. For instance, The complete *Western World from Antiquity to the Present* contains 70 chapters, 300 primary source readings, numerous glossary definitions and profiles of key historical figures, and interactive modules that engage the students in the learning process through active participation and visual representation of trends and concepts that are difficult to demonstrate using static text. The text itself is designed to engage the student. For example, students can highlight specific paragraphs and compose and save their own notes about the text on screen for later reference. The cost per student this coming semester will be $15.00.

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The material is highly customizable. The site provides an adopting instructor a personal site, *My Workplace*, from which one can customize titles by reordering chapters by adding and/or deleting units of chapters or entire chapters, inserting new content from other iLrn titles, or creating a new chapter from scratch. I can also annotate the chapters with my own comments, views, and instructions, which only my students can read. In short, I can create a personalized text for my students, which reflects how I wish to have the subject presented.

From *My Workplace* I can manage my class rosters, track quizzes, report grades, post memos, and facilitate discussion threads. A Faculty Lounge can be also be accessed, which provides syllabi, outlines of chapters, module exercises, a quiz tool, a faculty chat room, and a student roster that lists names, e-mails, and the time each student has spent on the site. None of the other traditional, static textbooks or online content providers that I have investigated have been able to provide the same level of depth of original scholarship and the ability to engage the student as effectively as the iLrn s robust and innovative presentation of Western Civilization.[2]

ILrn provides me with an excellent foundation upon which to incorporate other online sites and approaches into the presentation of my courses. Over the past three or four semesters, I have utilized other online sites to supplement the content provided by iLrn. For example, the British Broadcasting Corporation maintains a number of excellent history sites that employ flash based animated maps. A BBC site about World War One, which had an animated map of the Western Front from 1914-1918, was used in my lecture on that topic to illustrate the evolution of the conflict in Western Europe.

3. General Pedagogical Principles of my Approach to using Online Content and Presentation Technology

As I have become more comfortable with Internet content and with presentation technology, I have developed certain basic pedagogical principles in applying these technologies in my courses.

1) *I do not abandon what I do well.* The utilization of technology does not mean that an instructor must, or should, discard his teaching strengths. I believe, and my student evaluations confirm, that I am a very competent lecturer and so I continue to maintain the lecture as a significant part of my presentation. However, I use the technologies to *enhance* my presentations in order to more effectively *engage* my students in the topic in a manner that will make it come alive to them. This pedagogical approach was confirmed by a very interesting study that was commissioned by Dr. Murray Goldberg, the founder of WebCt, and reported by him in a keynote address at the NAWeb2001 Conference at the University of New Brunswick, Canada, in October 2001.

Independent investigators studied the level of positive response of students in Dr. Goldberg s course to three different pedagogical approaches in presenting the material: (a) lecture only, (b) computer based only, and (c) a combination of lecture and computer based learning. The results were instructive. The lecture only and the computer only pedagogies had the same results: 25% of the students in each section rated their response to the course as highly positive. However, 50% of the students in the combination section scored the course as a highly positive experience. This illustrates the next point.

2) *Technology must be incorporated into a course*. One cannot tell students to simply use the technology. Unless they understand and see that it is an integral part of the course and that it has real value to them, students will not utilize it to its highest and best use. ILrn s online, interactive textbook is effective not only because it is well designed and engaging, but also because it *is* the students primary text and it is effectively employed in the course. They need to use it to do well in the topic. Again, the purpose of any technology should be to *enhance* the instructor s presentation and to *engage* the students in that particular field.

3) *What people see* ***and*** *hear they learn best.*

4) *Have a pedagogical purpose to what one does with technology*. This is vital. One can incorporate online content and technology into a course, but it if does not have a clear pedagogical purpose, it is like cotton candy: it looks good, tastes good, appears to have mass, but when one bites into it, the cotton candy is all air and no substance. Many sites also have what is called the Wow factor one looks at the site and goes Wow!. However, while the Wow factor is helpful in gaining student interest, it is not sufficient absent strong content, visual or otherwise, to justify the incorporation of such sites into the central core of a course. Using technology without a pedagogical goal has a detrimental effect upon the students learning and understanding of the discipline.

5) *I do what I find stimulating and enjoyable*. Professors are paid to profess and to provide educational leadership and guidance to their students. An important aspect of this work is to evaluate what will be used in the course. If I find certain material, teaching styles, and assignments stimulating, this will energize my presentation of that material to the benefit of my students.

6) *Do not abandon standard presentations if these are appropriate and effective.* The term, Technology does not only include high technology, but also overhead projectors, transparencies, slides, and video. Occasionally, certain content will only be available in these formats. For example, certain static map topics are still superior to those that are found on the Internet. This will change over time, but for now I occasionally utilize certain maps and overheads in my lectures along with the Smart Board and Internet content.

4. Impacts and Lessons Learned

I have found the incorporation of technology and online content into my courses to be an outstanding experience for me and for my students. What are some of the impacts and lessons that I have learned?

1) *As I have become more comfortable with online content and technology, my use of it has increased and become more sophisticated*. For example, after successfully using this technology in the traditional classroom setting for three semesters, I decided to present the course in our computer labs with the iLrn and/or other sites projected in the front of the room. This has allowed me to make full use of the technology as a teaching tool, enabling the instant presentation of interactive maps, highlighting content, and incorporating additional Internet links to enhance the subject. In the fall of 2001 I began using the Smart Board, an interactive white board (72) produced by Smart Technologies, Inc., as my presentation device. Freed from having to use the computer s mouse, the Smart Board essentially allows me to manipulate and electronically highlight the online content with a simple touch. This has proven to be an exceptionally effective innovation. Other technological tools e-mail, embedded hyperlinks, and bulletin boards are also employed or soon will be in these courses.

2) *I have moved from a heavy reliance on lecture to a more Socratic approach, employing technology, and the interest it engenders in the students, to encourage analysis, interpretation and critical thinking about historical issues, events, and primary documents*. Employing technology and the interest it creates in students is used to involve the student more in their own learning. Since I know that my students will cover the material in their assignments more readily in the online format that in the traditional print presentation, I hold them more accountable for their work and for understanding the subject(s).

3) *Basic historical knowledge is still important, but communication skills, particularly writing, and critical thinking are equally emphasized.* Traditional objective exams have been eliminated and student evaluation rests upon a series of interpretative papers, weekly quizzes, and two collaborative student projects. Students are also expected to actively engage in the rational discussion and debate of historical issues and questions.

4) *Study exercises for the interactive modules have been created and ways to use computer technology and Internet content to improve note taking and their general classroom skills explored.* In some instances this has been as simple as teaching students how to copy and paste online content into Microsoft Word, where it can then be easily edited and placed into outline form for future study.

5) *Seek partnership alliances with private corporations and/or associations to advance the educational goals of the course and to enhance the educational experience of the students.* The employment of technology as a core aspect of one s pedagogy leads an instructor to think innovatively in other ways as well. In this case I was inspired by my son s work with Scientific Applications International Corporation, where he is involved in designing war games and situational simulations for the U.S. military and for the C.I.A. If it is appropriate for the U.S. government, then why not for my Western Civilization course? In exploring an outstanding site about Napoleon (www.napoleonguide.com) that I wished to display in lecture, I discovered a review of an upcoming release by Breakaway Games, Inc. of a sophisticated computer game about Napoleon s greatest victory, Austerlitz. Such companies not only have an exceptional understanding of visual pedagogy and game theory; they also pay very careful attention to historical detail. What better way for my students to learn how remarkable Napoleon was as a commander than to fight one of his battles? I realized that a well-directed, collaborative student project, centered on student teams, who would engage in combat with each other, would have numerous educational benefits. They would need to understand the tactics and the operational parameters of the various units. The teams would have to maintain a clear overview of the big picture without losing site of the details of the battle. To win in this simulation would require each team to be organized, work together, learn how to effectively manipulate its forces, build a strategy, but be able to adjust to meet unforeseen circumstances and the fog of war , anticipate future situations, and to have a knowledge of the period. And they would have to accomplish this in an exceptionally competitive atmosphere. These are all skills that would not only serve them well at the Academy, but also in the corporate world. This concept was discussed informally with some students to gain their views about such a project. The enthusiasm was universal, even to the point of some students from the spring semester asking if they could be part of the simulation if it were implemented this fall.

I called Breakaway Games, which was very receptive to the idea of using its games for military simulations in a history course. Not only had it developed game for Austerlitz, but also for Waterloo and for the Peloponnesian War. The latter could be used in an Ancient History seminar. Recently, I visited Breakaway Games outside Baltimore, MD. Details are still be worked out, but there will be a pilot program this fall incorporating a military simulation using Breakaway Games *Waterloo* and/or *Austerlitz* in my Western Civilization class. I will have access to outstanding products and support, Breakaway Games will gain academic insight, expertise, advice, and promotion to what could be a significant secondary market for its products, and my students will benefit from innovative and entertaining educational approach that utilizes a technology, computer games, of which they already well acquainted.

6) *Classroom configuration has a direct bearing on student learning.* This is a well-established pedagogical concept, but it becomes even more significant with the incorporation of presentation technology in a classroom[3] Generally, students learn best in classrooms when there is clear eye-to-eye contact with each other and with the instructor and they can sit in small groups. I have found that the least effective design is having students sit in rows, which is usually the standard classroom configuration be it a lecture hall or a regular classroom. This setup requires the instructor to move about the room to overcome the inherent design flaws in making direct contact with the students and any collaborative work or discussion in the class among the students in much more difficult to implement. Clearly, almost all computer labs are poorly designed for learning. Most have the computers in rows with the monitors on the desks effectively concealing the student and blocking a clear view of the room. While this may be minimally acceptable for teaching computer applications, it makes using the labs for other courses more difficult. Computer labs should be designed with the computer stations grouped in units and with monitors located in the desks. Not

only does this enhance the teaching of computer science, but it also creates an excellent environment for utilizing the labs for the presentation of other subjects that utilize computer technology and online content into the course. These same principles apply to designing standard classrooms.

7) *Administrations must make sufficient investment in their IT/Visual Aids departments and in the technological infrastructure necessary to support technological advances.* Not making this investment is like trying to build a house without a foundation. How can faculty and administrators be expected to embrace technological change and new approaches if the server does not work, there is not enough bandwidth to support applications, and help is not available when one needs it? This professor is fortunate to be at an institution that has made the necessary investments in IT and in its technological infrastructure. Therefore, we are able to explore various ways to use innovative technologies in our classes. Others are not so privileged. Upon giving a demonstration at Curry College, an excellent four year liberal college outside of Boston, of the Academy s technologically based pedagogy in teaching history, it was discovered that Curry College employed one person as the IT department for the entire college. Until this deficiency is addressed, Curry College will be hindered in its ability to incorporate new technologies into its administration and into its curricula.

8) *Any technology must be easy to operate and to understand.* A few faculty will take the time to learn how to set up computers, LCD projectors, and Smart Boards for their classes, but the great majority will not. Unless the technology be it Internet, computer-based, or presentation technology is configured in a manner that only requires the instructor to turn on the power and use it, a majority of faculty will be reluctant to employ it. They have not been trained to hook up such equipment, generally there is insufficient time before class to do so, and it adds an extra layer of work to the preparation for the class. If it is desired that faculty will experiment with using technologically based approaches in their classes, then the technology must be very user friendly.

5. Additional Lessons

There have been other lessons as well. Employing technology does not reduce the preparation necessary for the class presentation. An important component of this preparation is to work with the IT department in setting up the in-class technology so one has sufficient time to have everything working properly prior to class. The instructor should consider the IT department to be part of his educational team. Also, since on rare occasions the technology will not operate exactly as planned, a backup presentation should be available.

In the United States most academicians may be liberal politically, but they are conservative pedagogically. Many view technology as a threat to rigorous educational standards and/or to their central position in a course. This was illustrated at a panel on using online content in history classes at the 2000 American Historical Association convention in Boston, MA. There were approximately 200-300 historians in attendance and the panel gave a good presentation. At the conclusion the Chair addressed the audience and warned that technology would replace professors in the classroom. This is an unfortunate misconception. Technology does not, nor should it, replace the professor and if it can substitute itself for a professor, then that professor should not be teaching. Rather, I have found that it has enhanced my work and since students are already comfortable with computer and Internet technology, they perceive this teaching approach as progressive and as cutting edge. Therefore, my authority as the professor at the center of this course is strengthened, student attention spans are better, their enthusiasm for the discipline is excellent, and more content is effectively covered.

Nonetheless, these concerns and fears must be taken into account when planning to incorporate technology and related innovations onto a campus and into the curricula. Administrations must not simply impose new technologies, online platforms, and content onto their faculties and students. Without the proper assessment of the purpose and use of technology and without building a reasonable consensus for the need of these improvements, at best they will not be properly utilized and at worst opposition to such innovation will arise. For example, a former faculty member of a prestigious New England liberal arts college[4] related the story about a dean of that institution, who decided that the faculty should use WebCt to upgrade course management and presentation. WebCt was installed on the campus server and the faculty was told to use it. However, little, if any, training was provided, IT support was insufficient, and although some faculty did successfully determine how to use the WebCt platform in their courses, most found the WebCt initially challenging , time-consuming to use, and, not surprisingly, saw little benefit to this wellintentioned policy. So rather than encourage innovative change, it created resistance to technology supported pedagogy among some faculty. The dean, who implemented this poorly structured policy, later left the college for another position, leaving the WebCt issue unresolved. This unfortunate experience will make it more difficult later to build faculty support to realize additional technological change on that campus.

The Massachusetts Maritime Academy s administration has approached technological upgrades and innovation more effectively. The Academy has committed itself to install up-to-date Smart Technology[5] presentation equipment (Smart Boards, multi-media presentation podiums, and more) in a computer lab, one classroom, and a newly constructed lecture hall. However, prior to making this decision, with the support of the Admiral and the Academic Vice-President an informal committee to oversee and to coordinate the assessment of technological upgrades was formed. It consisted of the Academic Vice-President, the IT Director, the Director of Continuing Education, the Commandant of Cadets, the Academy Development Officer, and a member of the faculty. Each academic department was asked what type of presentation technology would be useful to its discipline(s) and individual faculty advice was actively sought. The Nautical Science Department, for example, made a case for creating a Smart Technology classroom on the training vessel. A sample of students was also given the opportunity to provide its views. A general consensus was established regarding the necessity for and the level of this investment. The committee then met with a vendor to review the Academy s needs and resources, discussed the vendor s later proposals, and made the decision to commit to this program. At each stage of this investigation, interested parties both in the administration and in the faculty were kept informed of developments and given the opportunity to provide advice. This approach, a cooperative effort between the administration and the faculty, will insure that this investment in technology will encourage innovation, yielding significant educational dividends for the Academy, the faculty, and the students. Such an approach would be equally effective in addressing other potentially powerful issues such as intellectual property rights.

6. Conclusion

This technological revolution is here to stay and exciting developments are on the horizon. This revolution is expanding most rapidly outside the United States and Western Europe. Within a few years 3 billion additional people will be connected to the Internet[6], resulting in an enormous diffusion of knowledge and ideas. Technological innovation must be encouraged and maritime colleges are well suited to take the lead in this area. Because of their technical orientation maritime institutions have already utilized various levels of simulations and computer technology in some disciplines, but not in all academic areas. New technologies need to be rationally assessed and incorporated into the academic programs for sound pedagogical purposes. The principles of using and incorporating various technologies into academic courses outlined in this paper are generally applicable to other institutions and to disciplines other than history. This professor s experience has validated this approach. My use of online, customizable content and Internet technology in my Western Civilization courses has led to the evolution of an innovative pedagogy in those classes, which has invigorated my teaching, and more effectively engages and enthuses today s increasingly visual and technologically oriented students.

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[1] See *Point.Click.Think?* , **The Washington Post,** Tuesday, July 16, 2002, Page **C01**.
[2] To examine the iLrn online textbook go to www.ilrn.com.
[3] For a discussion on this and other factors that affect how students learn see *How People Learn: Brain, Mind, Experience, and School* (2000) published by the National Research Council. This excellent overview of studies on learning can be read online at www.nap.edu.
[4] The name of this college will be given upon request. The name was withheld since it was not possible to confirm this incident with another source due to summer break. However, this is not a unique story. Similar experiences on other campuses exist in great abundance.
[5] To learn about the technology that the Massachusetts Maritime Academy is planning to install, visit Smart Technology s website at www.smarttech.com
[6] This information is based upon conversations with Dr. James Duderstadt, President Emeritus, University of Michigan, and with Dr. Daniel Atkins, Professor and founding dean, University of Michigan s School of Information, January 2000.

Practical solutions for a veritable maritime online library

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ABSTRACT

One of the actual objectives of IAMU/WG III is to find the general framework for a Virtual Global Maritime University.

In order to design a good course, the basic starting point is the bibliography that you could use for drawing up the course. In my opinion, from all scientific domains that are subjects of high degree studies, the maritime field is the most "water-tight", regarding the free access to information.

In the last seven years I have spent hundreds of hours surfing the Net in order to find useful documents for updating my courses, or in order to see how other maritime universities teach the same things. I was very disappointed that after all these hours I have foundmyself almost empty handed.

For example, the only free navigational monograph available on the Internet is "Bowditch - American Practical Navigator". Indisputably, the USA is the world's no.1 country regarding free information access over the NET, and the web sites of USCG, NIMA or NOAA could be mentioned as very good examples for a "XXI Century freedom of information" model.

A Virtual Maritime University will be great, but in order to achieve this aim a lot of resources (human, financial, time) are required. Speaking only of the financial aspects, such a job will cost tens of thousands of dollars.

The goal of my paper is to propose a far more inexpensive and quick solution that will provide online useful resources for maritime students and teachers. I want to suggest some practical means for **creating a real online library, with real free downloads, without copyright problems and constantly updated**. On the other hand, this could be the first step for the future IAMU Virtual Maritime University.

1. Introduction

One of the final documents edited at the end of the 2nd General Assembly of IAMU held in Kobe, was "The Action Plan of IAMU for 2001-2002". One of the main activities for the WG 3, as stipulated in this action plan, refers to the "Development of a framework for a Virtual Global Maritime University".

During the plenary workshop - session VII, of the 2nd General Assembly of IAMU, Mr. Barrie Lewarn from the Australian Maritime College, presented a paper called "Maritime Education and Training - the Future is Now". This paper underlined the challenges that must be faced by maritime education, in order to respond to the actual practical needs of the maritime field and to the actual evolution trend regarding teaching and dissemination methods.

I was very interested by the conclusions of this presentation and I saw that the same paper also impressed the editorial board of IAMU Journal, because they reprinted it in IAMU Journal vol.2, no. 1 in March 2002.

In his paper, Mr. Barrie Lewarn concluded that "A truly global maritime university could be developed: not at WMU, but an organization set up and run in a business like manner, taking the best courses and skills from the partner institutions, and using flexible learning techniques to the maximum: a virtual maritime university."

Starting from this, between March and July 2002, I have made an Internet investigation, in order to find what is the actual state of facts regarding virtual maritime universities initiatives in the world and how the IAMU member universities are prepared to fulfill such a task.

At the same time, I have to say from the beginning that I am not of the same opinion as Mr. Lewarn regarding the concept of virtual universities, mainly because I do not agree with the idea of distance learning in maritime education. Furthermore, I am against any intentions of IAMU to sell knowledge and information. Of course, building a real virtual university is a very costly task and could not be probably undertaken by any of the IAMU members alone, without external financial support. In my opinion, these efforts must be ruled by the idea of cooperation between the maritime universities in order to offer free knowledge access, and not of doing business and making a profit.

Because money is always a problem, the main aim of my paper is to present the cheapest way for our universities to promote their experience, skills and knowledge, mainly to the worldwide students interested in learning new things.

2. State of facts regarding Virtual Maritime Universities

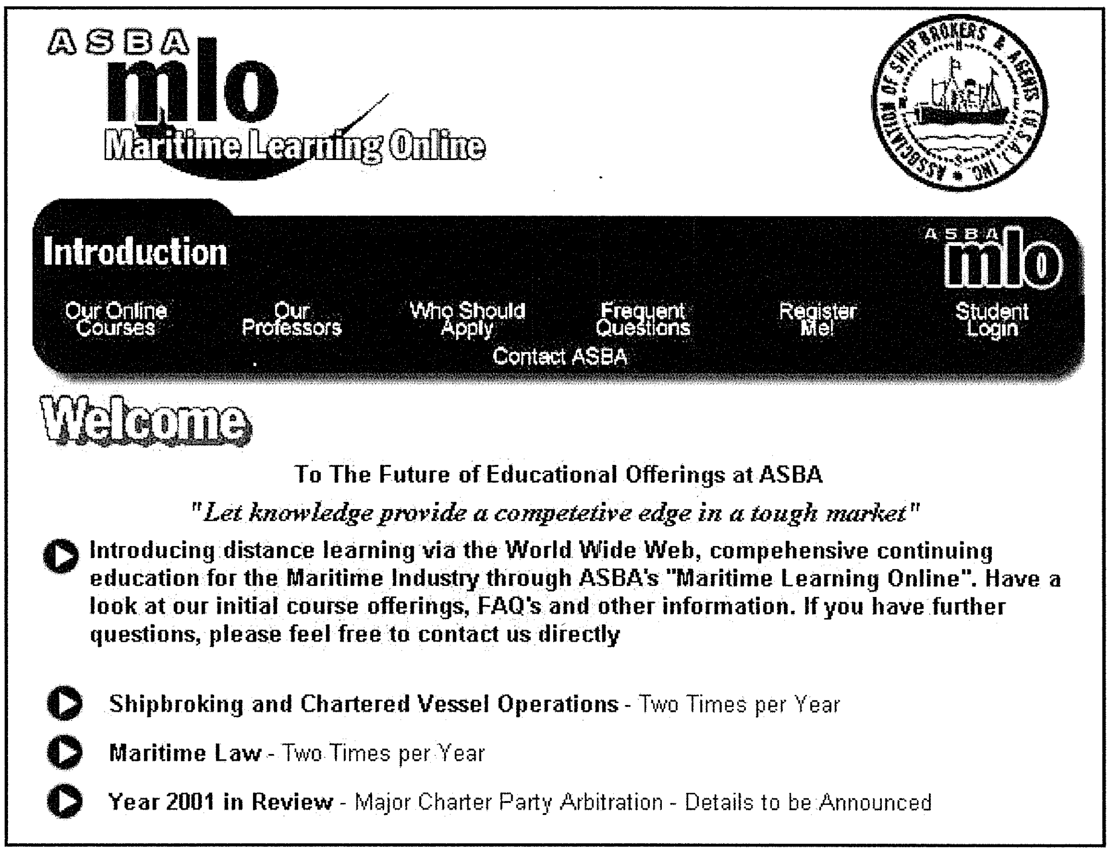
In many academic fields, the universities are already adopting the new electronic technologies and implementing new learning techniques based on computers and multimedia facilities. As a result, there are already a great number of virtual universities that promote distance learning and online courses. The leading role in this process belongs to the economic, business and management higher education sectors. Undoubtedly, this process was facilitated by the specific of the disciplines and courses that are held in these universities, much more suitable to be delivered without the physical presence of the students.

In the maritime education field, such initiatives are far beyond and there are not many signs that things will change considerable in the near future. Many computer fans will say that the maritime sector is too conservative and reluctant to the new technologies. Such criticism is only partially true and I agree with it only if we are talking about direct learning techniques.

During my Internet investigation I've found **only two** Virtual (more or less) Maritime Universities (VMU) and these WEB sites prove that, technically speaking, it is possible to adopt such dissemination methods, even for maritime studies. These already running VMU are:

q **ASBA** Maritime Learning Online (http://www.asba.org/Learning/start.html)

This WEB site was created by the Association of Ship Brokers & Agents USA (ASBA), a non-



governmental association that had realized that such an initiative could bring advantages for the maritime industry. The course modules offered for online learning are orientated towards maritime management and maritime law and their target audience is primarily post graduate people, which are already working in shipping:

- College Students
- Ship Brokers, Charterers and Agents
- Lawyers for continuing education or interest in a Maritime focus
- All others considering employment in the Maritime field
- Chartering Managers and Operations Executives

Upon registration, each student will be provided with his/her password for purposes of logging on to the ASBA continuing education web page.

Each student will select his/her time for attending the "virtual" class every two weeks (by reading classroom lectures). Each student must also read the textbook and other more traditional reading materials. Students will be required to ask questions of the course instructor via the ASBA web based bulletin board. At the end of the course, ASBA will award a certificate upon satisfactory completion of the program.

ASBA offers two types of courses:

- BASIC PRINCIPLES OF MARITIME LAW - 12 weeks duration

Main course topics:

- The Sources of Maritime Law,
- Maritime Arbitration.
- Fundamentals of Freight,
- Bills of Lading: Applicable Laws, Function and Use,
- International Conventions Relating to Carriage of Goods by Sea.
- Delivery of Cargo,
- The Duty of the Carrier to Make the Vessel Seaworthy,
- Faults of the Shipper,
- Charter Party Forms and Functions,
- Loading and Discharge, Laytime, etc.,
- Elements of Salvage,

The second course provided by ASBA is:

- SHIPBROKING AND CHARTERED VESSEL OPERATIONS - 12 weeks duration

This course primarily concerns the carriage of goods under charter parties and it was designed to provide comprehensive information for those involved in shipbroking, vessel operations, ship management, agency, export/import trading, marine insurance.

Main course topics:

- Basic Responsibilities Under Charter Parties
- ASBATIME cont. - The Role of Shipbrokers
- The NYPE Form - Agency/Ship Agents
- Commodities and Cargo Considerations
- Charter Party Forms and Clauses
- Laytime & Demurrage/Despatch
- Tanker Chartering
- Marine Arbitration & Admiralty Law

I have reproduced parts of these courses syllabus in order to underline the topics that are already delivered by means of distance learning. As we can see from ASBA experience, we have here a law course and an ship economics course. Most of these course topics have no relevance for STCW 95.

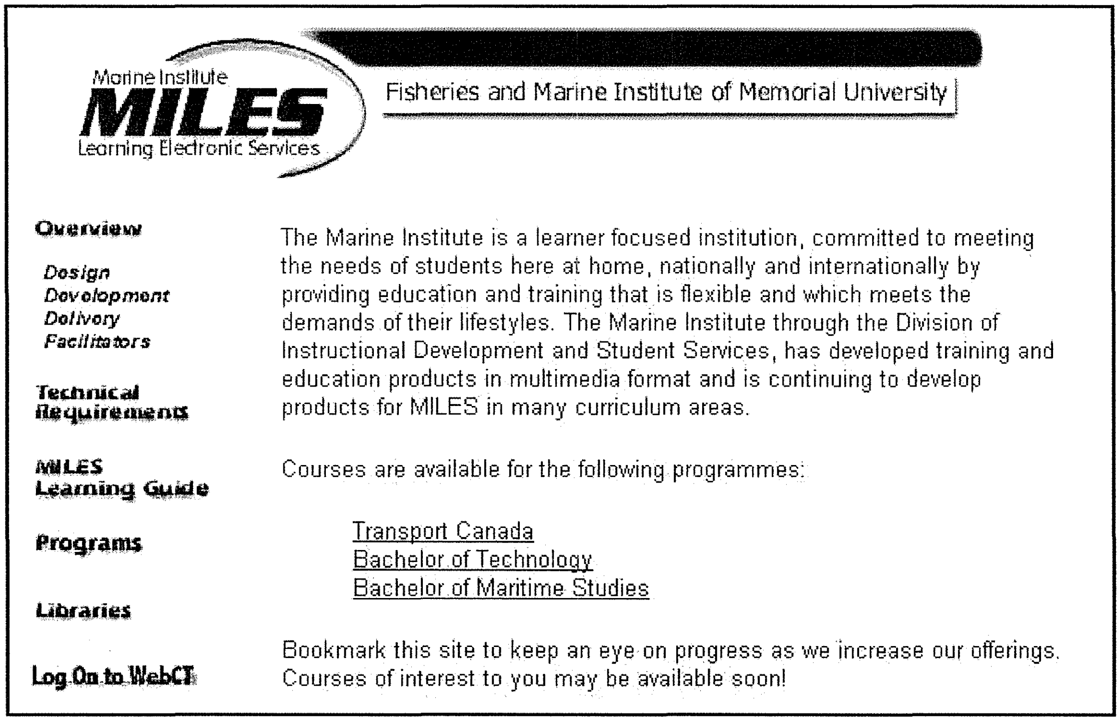
- The second Virtual Maritime University that I will bring into focus is **MILES** (Marine Institute Learning Electronic Services), part of "Memorial University of NewFoundland", Canada. (http://www.mi.mun.ca/miles/).

They develop distance education products with a complement of skills that includes: project leadership, instructional design, content development, media production, and learning technology programming and support. Depending on the course, delivery may be conducted through the Internet, CD ROM and interactive conferencing with learning technology software.° The learning technology consists of a suite of tools that provides inter-active exercises, such as group discussions, presentations, and information sharing.

General directions and instructions for the CD ROM and how to access the WWW are mailed prior to the start date of the course. Once registered for the course, students will receive a username and password. Courses may use texts, required and recommended readings, CD ROM and on-line learning technology to facilitate learning.

The Marine Institute through the Division of Instructional Development and Student Services, has developed training and education products in multimedia format in the following curriculum areas:

- Transport Canada - for deck or engineering officers
- Bachelor of Technology - specialization in Ocean Engineering
- Bachelor of Maritime Studies - specialization in Maritime Business



The emphasis of the "Transport Canada" courses is on training personnel who have the necessary sea-going or workshop experience to challenge each level of certification. For example, for already certified deck officers, MILES provides through "Transport Canada" curriculum courses for a Master Mariner degree. For this specialization, the online courses delivered are: Navigation Instruments, Ship Management, and Meteorology. This means that only 30% of the curricula for Master Mariner is delivered online. Instead, for the Bachelor of Maritime Studies (Maritime Business) curricula, 75% of the courses are prepared to be accessed online.

This difference between the two curricula regarding the number of online courses, proves once again that for the training of navigational personnel the distance learning is not yet considered the best solution. Practically, MILES offers only a Master Mariner degree, and the enrollment for these courses is permitted only for certified officers.

Surfing the NET, I have discovered another WEB site that pretends to be a portal for virtual maritime training.

This site is "Maritime E-campus" (http://www.maritime-ecampus.com/), administrated by KMSS (Kongsberg Maritime Ship Systems). Here we can not speak of a real virtual university, this site being only a portal that has links to some maritime schools: Kalmar Maritime Academy, Svenborg International Maritime Academy, Alesund Maritime. The INTERNET facilities are used only to book online the courses offered in a traditional manner by these Institutions. The aim of KMSS is to promote through his site the Norwegian maritime schools.

As we can see, for the moment there is not anywhere in the world a Virtual Maritime University able to deliver training for maritime officers, in accordance with STCW 95 curriculum.

Speaking again of STCW, I have to declare that I do not agree at all with Mr. Lewarn when he says, *"as professional educators we should be ashamed that it has taken an international convention (STCW 95) to drag maritime education and training into the world of modern education practice"*. I am convinced that for the great part of our universities, the STCW 95 Convention is only a checklist, useful for checking if our own maritime curriculum fulfills all the topics required by STCW. In my opinion, it is the IMO Model courses 7.01-7.04, that seem to be more useful, even if these courses are not yet fully updated to all STCW 95 requirements. We can find here a guide for the minim number of teaching and practical hours for the disciplines that could contain all the STCW subjects.

For us, these IMO courses are the strongest argument when we have to persuade our Ministry of Education, that the maritime education program needs more teaching hours than a regular engineering curricula.

On the other hand, the STCW have nothing to do with "modern education practice". Undoubtedly, we can speak about the STCW 95 provisions regarding the use of simulators (radar and engine) as a modern technique for practical training and assessment of seafarers. But, on the other hand, we have to admit that this Convention failed to certify that the hours of training on (an approved type) simulator could be the equivalent of at least 4 times the same period of seagoing practice, in respect of navigational watch duties. With or without STCW specifications, we had already updated our courses in respect of the new technology applied, for example, in navigation. Consequently, we present DECCA, LORAN-A or OMEGA only as elements in the historical evolution of electronic position fixing systems, teaching the students only about the use of LORAN-C. Also, we explain the advantages of GPS satellite system on the old TRANSIT system, and we are training our students for the use of ECDIS and integrated bridge operation.

3. Online libraries

After finishing my search of the NET for Virtual Maritime Universities, I have started to review the IAMU members WEB sites, in order to see how each university provides online access to information for their own students and staff.

The result of this investigation was not very encouraging for me, as to one of the IAMU main goals: **"the passing of the world's existing skill and knowledge"** - *see IAMU News (No.1 March 2000)*. "Passing" knowledge, in IAMU policy means not only to provide this new information to our own students, but also to undertake all efforts to spread this knowledge to all the interested people in the maritime sector.

My findings will be synthesized in the following table and the "Comments" column legend is:

A = WEB pages in English (Yes/No)
B = Electronic Library (Yes/No)
C = Online documents (Yes/No/Password required)
D = Free documents (Yes/No)
E = Free teaching materials
F = Links to other INTERNET sources of information (Yes/No)

- "documents" = books, e-journals, abstracts, papers, presentations, etc.
- "online documents" = documents that could be read online or downloaded
- "teaching materials" = courses, presentations, tests, examination papers, etc.

Abbreviations used in table:

- Y = Yes
- N = No
- Ps = password required

Table 1 - Online library facilities on IAMU members WEB sites.

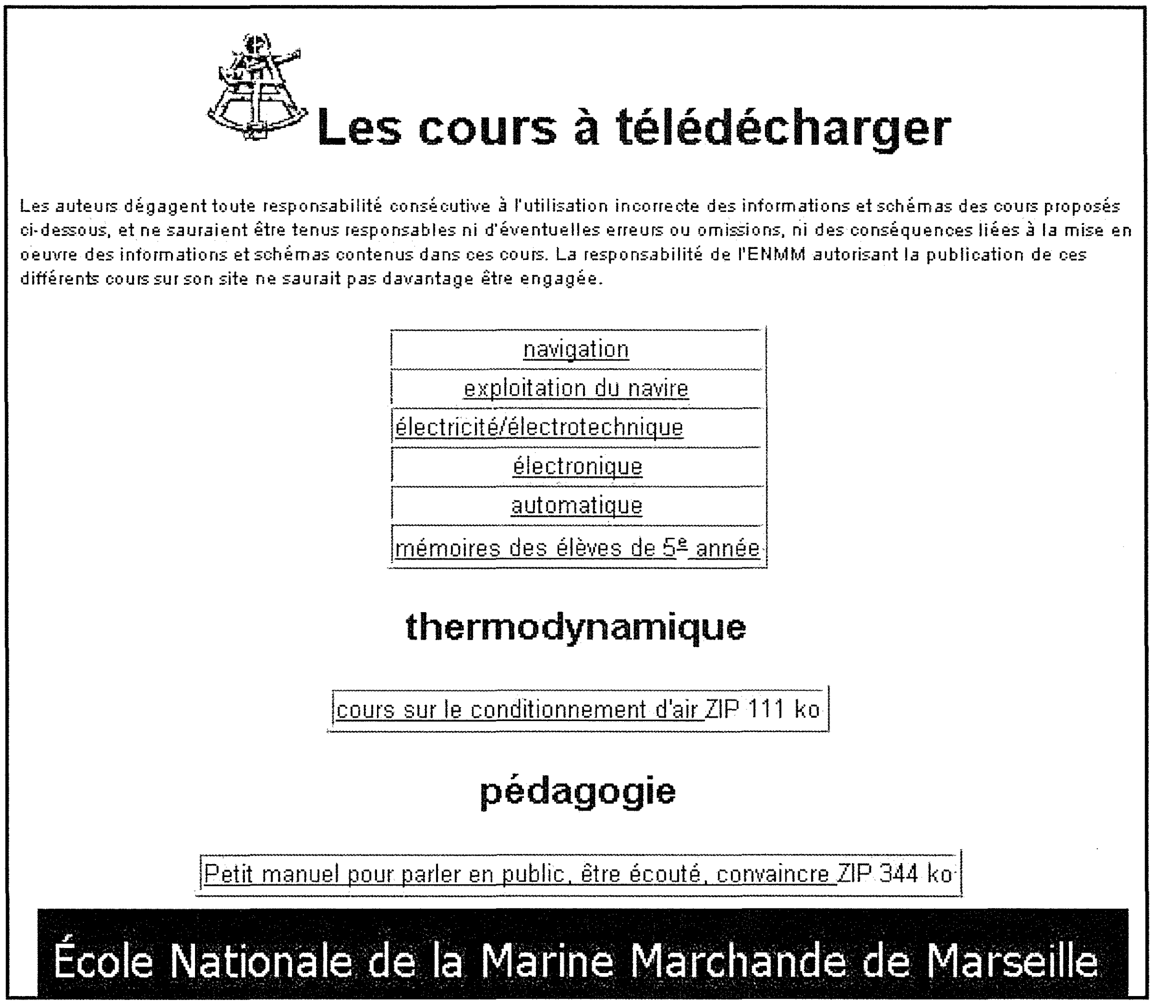
IAMU Member	Country	Home page address	Comments					
			A	B	C	**D**	**E**	F
ITUMF - Istanbul Technical University, Maritime Faculty	TURKEY	http://www.tdf.itu.edu.tr/	Y	Y	N	N	N	N
KUMM - Kobe University of Mercantile Marine	JAPAN	http://www.kshosen.ac.jp/english/	Y	Y	N	N	N	N
AASTMT - Arab Academy for Science, Technology and Maritime Transport	EGYPT	http://www.aast.edu/	Y	N	N	N	N	N
AMC - Australian Maritime College	AUSTRALIA	http://www.amc.edu.au/	Y	Y	Ps	N	N	Y
Southampton Institute Maritime Faculty	UK	http://www.solent.ac.uk/	Y	Y	Ps	N	P	Y
MMA - Maine Maritime Academy	USA	http://www.mainemaritime.edu/	Y	Y	Ps	N	N	Y
WMU - World Maritime University	SWEDEN	http://www.wmu.se/	Y	Y	Ps	N	N	Y
Admiral Makarov State Maritime Academy	RUSSIA	http://www.gma.sp.ru/	Y	N	N	N	N	N
Constanta Maritime University	ROMANIA	http://www.imc.ro/	Y	Y	Y	N	Y	N
Dalian Maritime University	PEOPLE'S REPUBLIC OF CHINA	http://www.dlmu.edu.cn/	N	N	N	N	N	N
Faculty of Nautical Studies, Polytechnical Univ. Of Catalonia	SPAIN	http://www.upc.es/fnb	Y	Y	Y	Y	N	Y
Gdynia Maritime Academy	POLAND	http://www.wsm.gdynia.pl/	Y	Y	not responding			
Korea Maritime University	KOREA	http://www.kmaritime.ac.kr/	Y	Y	not found			
Liverpool John Moores University	UK	http://www.livjm.ac.uk/	Y	Y	Ps	N	N	Y
Massachusetts Maritime Academy	USA	http://www.mma.mass.edu/	Y	Y	not responding			
Mokpo National Maritime University	KOREA	http://www.mmu.ac.kr/	Y	N	N	N	N	N
Nicola Y.Vaptsov Navak Academy	BULGARIA	http://www.naval-acad.bg/	Y	N	N	N	N	N
Odessa State Maritime Academy	UKRAINE	http://ma.odessa.ua/	Y	under construction				
Rijeka College of Maritime Studies	CROATIA	http://www.pfri.hr/	Y	Y	N	N	N	N
Dokuz Eylul University School of Maritime Business and Management	TURKEY	http://www.deu.edu.tr/smbm/INGILIZCE.htm	N	N	N	N	N	N
Shanghai Maritime University	PEOPLE'S REPUBLIC OF CHINA	http://www.shmtu.edu.cn/	Y	N	N	N	N	N
Szczecin Maritime University	POLAND	http://www.wsm.szczecin.pl/	Y	Y	not responding			
Tokyo University of Merchantile Marine	JAPAN	http://www.ipc.tosho-u.ac.jp/	Y	N	N	N	N	Y
University of Cantabria/Santander	SPAIN	http://centros.unican.es/marinacivil	Y	N	N	N	N	N
U.S. Merchant Marine Academy	USA	http://www.usmma.edu/	Y	Y	N	N	N	Y
The California Maritime Academy	USA	http://www.csum.edu/	Y	Y	Y	Y	N	Y
E.N.M.M. Ecole Nationale de la Maritime Marchande de Marseilles	FRANCE	http://hydro.marseille.free.fr/	N	Y	Y	Y	Y	Y

Note: Last INTERNET survey was undertaken on 15th of July 2002.

Out of 27 maritime universities (all IAMU members), 67% have an electronic library WEB page. Some of these universities possess huge collections of books, periodicals, articles and papers, related to the maritime sector. But, as we can see from columns D and E, only 11% have on their sites free documents and only 7% of them have free teaching materials on their web PAGES.

What is the purpose for allowing acces to your own information resourses only for your own students and staff? One explanation could be that you want to win a possible competition with other similar universities and you think that restricting others access to knowledge, your students will be the best.

In a competitive world like ours, this could be a good reason. Why then so much fuss and annual IAMU conferences where we are talking about curriculum harmonization and methods to train better seafarers?



Conclusions & Final Proposals

We think that for the moment we cannot afford to consider maritime students simple "customers". We have to bear in mind that 80% of the maritime accidents are produced by human error. A Virtual Maritime University built from the beginning with the purpose to deliver long distance nautical courses only for gaining us much money as possible, could be a great mistake.

Sometimes I compare our graduates with the graduates from medical universities, because all of them, soon after their graduation have to deal with real situations, with great responsibilities, and with a very narrow margin of error.

I am not aware that we have at this moment any medical school that graduates distance learning students. As patient, would you let on the hands of a doctor, knowing that his diploma was granted after an ODL educational program? Why do you thing that a ship owner will act differently when he will have to employ a young Third Officer, graduated from the IAMU Virtual maritime University?

Even the management of our universities through a "market funded and centered" policy could be a mistake. We can all see what the effect of such a policy was, in the last years. Many maritime universities renounced to train seafarers and changed their curricula towards maritime economics, maritime law, ocean science or engineering. In many European countries (UK, Germany), such a process was dictated by the lack of students that want to embrace a seagoing carrier. indeed we have to try to find some extra financial resources in order to compensate the lack of governmental funds. But this could be done by courses on demand, master courses or other postgraduate courses and not by transforming the general maritime curriculum to the needs of the present market.

Globalisation and massification of education means, in my opinion, in the first place, unrestricted access to information, especially in the education field.

If we accept to organize the IAMU Virtual University as a major source of free source of information, in the maritime field, such an action will not bring profits. For implementing a VMU we will need:

- expensive hardware;
- expensive software;
- hundreds of hours of work for building the WEB site of the VMU;
- a permanent team for maintenance and updates.

In such a case, it is very possible that IAMU could not find financial resources for creating such a WEB site.

That's why we want to propose you the followings:

- for the beginning, let's try to remove the protections of our own, already existing electronic libraries, to all interested visitors and to prove that IAMU members really promote unrestricted international cooperation and exchange of knowledge in the maritime field;

- if you have documents that are under copyright protection, you can use a software for e-books, that is much more cheaper than a security or online learning software. The e-book will permit the online reading of the book, page by page and the printing of desired page. A very good example of this facility could be seen on the WEB site of US National Academy Press (www.nap.edu/). In this Library we can already find good nautical books and I think that a link towards this site must be mentioned on our own INTERNET pages.

- documents without copyright problems, could be put in our online libraries with no restrictions. This information, in electronic format, must be available for direct download. In this category we can include:
    - course supports or PowerPoint presentation of this courses;
    - papers (or the PowerPoint slides) presented at different Conferences;
    - articles published in maritime journals;
    - best students final projects or graduation papers.

For non-native English speakers no extra effort for the translation of these documents is required. In the first place, an abstract (or even the title) in English will be sufficient, plus contact information, in order to facilitate the connection with the author.

Sometimes, even a picture, drawing or scheme could be sufficient for solving a problem or dilemma, without the reading of the afferent text in a foreign and unknown language.

In a second phase we can bring all this documents together an a special HTML page opened on IAMU WEB site. If we will have to much material to transfer, we can adopt another method. On the IAMU electronic library page we will maintain only a list of the available publications, with links towards the maritime univerities e-libraries.

I think that such a attitude from our universities in respect of knowledge dissemination will be very useful for many maritime students and seafarers. From my point of view, this is the very meaning of a University as partner in the society.

Maybe, in the near future we will find some applicable methods for certifying, let's say, First Deck Officers or First Engineers: distance learning for updating the theoretical knowledge, short stages of training and assessment using simulators, online tests for evaluation. I think that we can discuss about the best practical solutions for such a task. But the basic maritime education and supervised training for the Officer of the Watch must be maintained**, for at least another decade**, in the classical manner. And please, do not make the mistake to consider the "classical" learning process similar with "old fashioned" methods.

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Distance Learning Courses for Seafarers

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ABSTRACT

The requirements of STCW 78/95 Convention need levels of knowledge, understanding and skill for all seafarers on each level of responsibility. Traditional methods of teaching require classroom, equipment, teachers or instructors. Now more and more subjects and themes may be prepared as computer programs for self-learning by seafarers for tutor distance supervision only. These programs should include self-tests and self-assessment to prepare for final exams. It is true, however, that another part of the training process is real practice on ships and exercise on simulators.
The paper presents new original general methods of using the CD-ROM and Internet for the training of seafarers. The main goals are specially focused on criteria for self-assessment during manoeuvring training. This idea is the invitation for all IAMU members to create in co-operation a new approach for seafarers training in respect of STCW 78/95 requirements.

1. Introduction

The 21st Century is regarded as the starting point of the era of a computer-based society. The term era of the computer-oriented society implies that there are coming changes encompassing the whole of the world population. Developments of computer technologies will globalise many fields of life. Capital, information and goods have gained unprecedented mobility (range and time). The diverse effects of this process include social, economic and political aspects. Educational services are one type of goods. These undergo the process of globalisation as well. The technology enabling such changes is advancing amazingly fast. The implementation of what today may seem to be a vision will not take generations or even years, but days. If we do not take up the challenge created by the new educational system, we might just neglect a chance of enhancing safety at sea by further improving the training quality through widened access to systems increasing this quality. Training aims at imparting knowledge and skills. Both the STCW 95 Convention and maritime administration regulations define the required training and certification of seafarers. Training courses for seamen fall into two groups: *voluntary* and *obligatory*. The latter are training courses for a certificate indispensable to perform a particular function. This type of training is the subject of further considerations.

The idea of Open & Distance Learning (ODL) was introduced about 30 years ago when the Open University was set up in Great Britain. Today, using networks such as Internet or subjects prepared on CD-ROM we do not have to travel to participate in classes at a school based anywhere in the world. The only requirement for the school is to have the necessary hardware and software. The computer enables us to take part in classes in (virtual) navigation, shiphandling, power plant operation, electrical engineering laboratory etc. It is sure that our knowledge of English may be tested too. The advantage of the system is that access is ensured at any time from any computer connected to the network. Course books, CD-ROM or audio and videotape materials support the educational process.

ODL gets rid of most formal barriers hampering access to knowledge acquisition and opens opportunities for self-instruction in convenient time and place; similarly, progress in one s studies may be evaluated. This system of learning, instead of the direct teacher-learner contact, offers such ways of communication as e-mail, telephone, Internet, videoconferences and others. Permanent access to knowledge is offered to anyone interested: learnt material may be revised, the knowledge and skills may be checked without participating in a conventional course. This is essential for refreshing and updating one s knowledge.

The methodology puts emphasis on interactive learning which makes the process much more effective. Although group interactivity is limited, individual work with a computer is more intensive. When training centres are located far away, trainees save substantially on travelling and accommodation expenses. As far as voluntary training by ODL approach is concerned, it will be offered only if it proves profitable.

2. Limitations

The implementation of ODL for obligatory training requires solving problems grouped in four categories:

1. Legal — distance learning has to be recognised as an authorised form of education. The criteria for such recognition have to be defined, problems of recognising certificates issued by foreign centres, taking exams in a centre outside the jurisdiction of a maritime administration and recognising exam results, legal and organisational exam requirements have to be met by examiners and examinees.
2. Economic — profitability of this type of training, fees, payment arrangements.
3. Organisational — satisfying all the requirements of maritime administration supervision, access, manner of paying fees etc., unification of training contents and exam criteria, co-operation between training centres.
4. Methodological — clear-cut definition of the contents of knowledge and skills constituting the ODL subject. It is known that there are skills that may only be acquired on a simulator, in a lecture room or training ground. Although there is no doubt that the ODL is effective in imparting knowledge, acquiring skills is not so obvious.

First of all, what is lacking is a legal framework for recognising the ODL outcome. The regulations of many countries allow only such training facilities as lecture rooms or training grounds. Another essential problem today is the cost of creating relevant programs (tools for simulation programs — availability and price); these costs are so high that even leading training centres cannot afford them.

Solving economic, organisational and methodological problems seems possible. Legal issues, however, have to be considered on a forum of institutions supervising training centres. The solutions provide a basis for devising training courses covered by certification resulting from STCW 95 Convention. Is therefore the idea of ODL for maritime training bound to be successful? It seems that the basic necessary conditions are approved criteria and programs for ODL run by marine training centres and detailed examination procedures interrelated with the system.

3. General idea

The diagram in Fig. 1 presents the requirements structure of the STCW 95 Convention on the level of management. Without questioning this structure, which is in force today, we obtain a certain schematic system which must be filled with content. This content should be as follows:

1. indispensable knowledge in the scope of each subject (module),
2. check-up tests along with established criteria of passing,
3. simulation programs for training with the possibility of selecting variables,
4. simulation programs for testing skills.

Knowledge covering the subject scope should be skilfully portioned (it should include definite initiation levels) and be imparted through text, figures, photographs and short films. The menu should include a link of definition blocks of terms applied, and it should be made certain that there is a possibility to seek out entries through headwords.

Tests checking the level of knowledge should always be drawn out of a base of questions covering the whole subject matter imparted in the module. Not more than 30% of the base content should be taken out in a single drawing. In order to rule out the possibility of passing a test at random it is suggested that the number of tests taken should be limited to five at the most.

At the present moment simulation programs allow a training of abilities in an ever wider scope. Training programs should provide the possibility to select variables, which determine the difficulty level of the task. The difficulty level selected by the student combined with the criteria should, at the end of the task performed, give the training advance level compared with the general requirements of this module on a relative scale.

Simulation programs for skill testing should be drawn out from a certain package of simulation tasks, where the result should be evaluated with consideration to the difficulty level of the task performed. Besides the adequacy of simulation models applied it is of essential significance to select objective criteria permitting to assess the quality of the performance. As in knowledge testing, it is suggested that the number of drawings should be limited to five at the most. It should be stressed that at the present moment even professional simulators do not have modules of assessing the quality of task performance, or have them built-in in a limited form. This is an ideal setting for scientists to demonstrate their skills in working out such assessment systems.

4. Example

The presented example of a schematic module structure concerns the Navigation function and the problem ªManoeuvre and handle a ship in all conditions . It is focused on the theme Berthing and unberthing under various conditions of wind, tide and current without tugs . According to the conception presented the model should be constructed taking into consideration the following (Fig.2):

1. GENERAL VIEW OF THE SUBJECT.
   - 1.1 Knowledge — range and connections with other functions
   - 1.2 Knowledge test — point of view and criteria
   - 1.3 Skills — general idea and possibility (training)
   - 1.4 Skill test — general approach and criteria
   - 1.5 Terms (Glossary)
2. SHIPS
   - 2.1. Size and parameters
   - 2.2. Characteristics of manoeuvring
   - 2.3. Ship s movement - general approach
3. AREAS
   - 3.1. Classification
   - 3.2. Depths, dimensions
   - 3.3. Limitations
4. PROCESS
   - 4.1. Ship s movement ahead
     - 4.1.1 using main engine (propeller)
     - 4.1.2 using rudder
     - 4.1.3 using bow thruster
     - 4.1.4 using anchor
   - 4.2. Ship s movement astern
     - 4.2.1 using main engine (propeller)
     - 4.2.2 using rudder
     - 4.2.3 using bow thruster
   - 4.3. Berthing
     - 4.3.1 berth-ship contact
     - 4.3.2 using ropes
     - 4.3.3 hazards
5. EXTERNAL ELEMENTS
   - 5.1. Wind
   - 5.2. Current
   - 5.3. Tide
6. SITUATIONS
   - 6.1. Berthing by starboard side
   - 6.2. Berthing by port side
   - 6.3. Berthing by stern first
   - 6.3. Berthing with anchor
   - 6.4. Unberthing
7. FINAL TEST: analysis, conclusions

When constructing criteria of ship manoeuvring the focus should be on the following:

- The vessel s swept path,
- The energy emitted on fender devices during the first contact,
- The size of ship s propeller current (using strong manoeuvres),
- Manoeuvring tactics (courses and speeds of the vessel on approaching)
- Time of the manoeuvre performed.

The present state of knowledge is at present sufficient to define the above-mentioned criteria and evaluate them automatically while the simulation is being performed.

5. Conclusions

The present progress noticed in information science and communications translates to all areas of human life, and so it is in education. New methods applied for working out teaching materials are today only half-measures. The method of distance learning which avails itself of technological progress is gaining significance. The method is applied in an ever wider scope in education on every level of it, university education included.

Distance learning is not used in the training of sailors today, which is due to a number of causes. Lack of international legal norms in this scope should be counted among the most important ones. There is no clear leader in the matter to take over the conduct of such a project, its coordination and liability with regard to its content. This role has so far been played by IMO; but the question should be posed if a society of the kind of IAMU might not be the initiating party; a society that groups institutions training sailors on the highest level; an institution acting on a global scale throughout the world, which assembles a large intellectual potential of persons best acquainted with methods and needs of sailor training. There can be only one answer; IAMU is the institution that should be the leader in this matter.

Finances are another problem. With the back-up of governments, IMO finances some projects bound with the safety of navigation, sailor training included. Existing courses are updated and new model courses are started, recommended by STCW 95 Convention. The question that arises in this situation is whether in the 21st century model courses are not out-of-date; whether one step forward should not be made to implement a different form of such courses that would assume a change in sailor training in the near future.

Considering all conditions I suggest what follows:

1. Initiating work within the scope of IAMU aimed at creating a program of a new system of training and examining sailors, based on the norms currently in force.
2. Raising the problem of distance learning at the forum of IMO by national delegations.
3. Using the materials (programs) created within the framework of the program carried out for training one s own students during normal and extramural studies.

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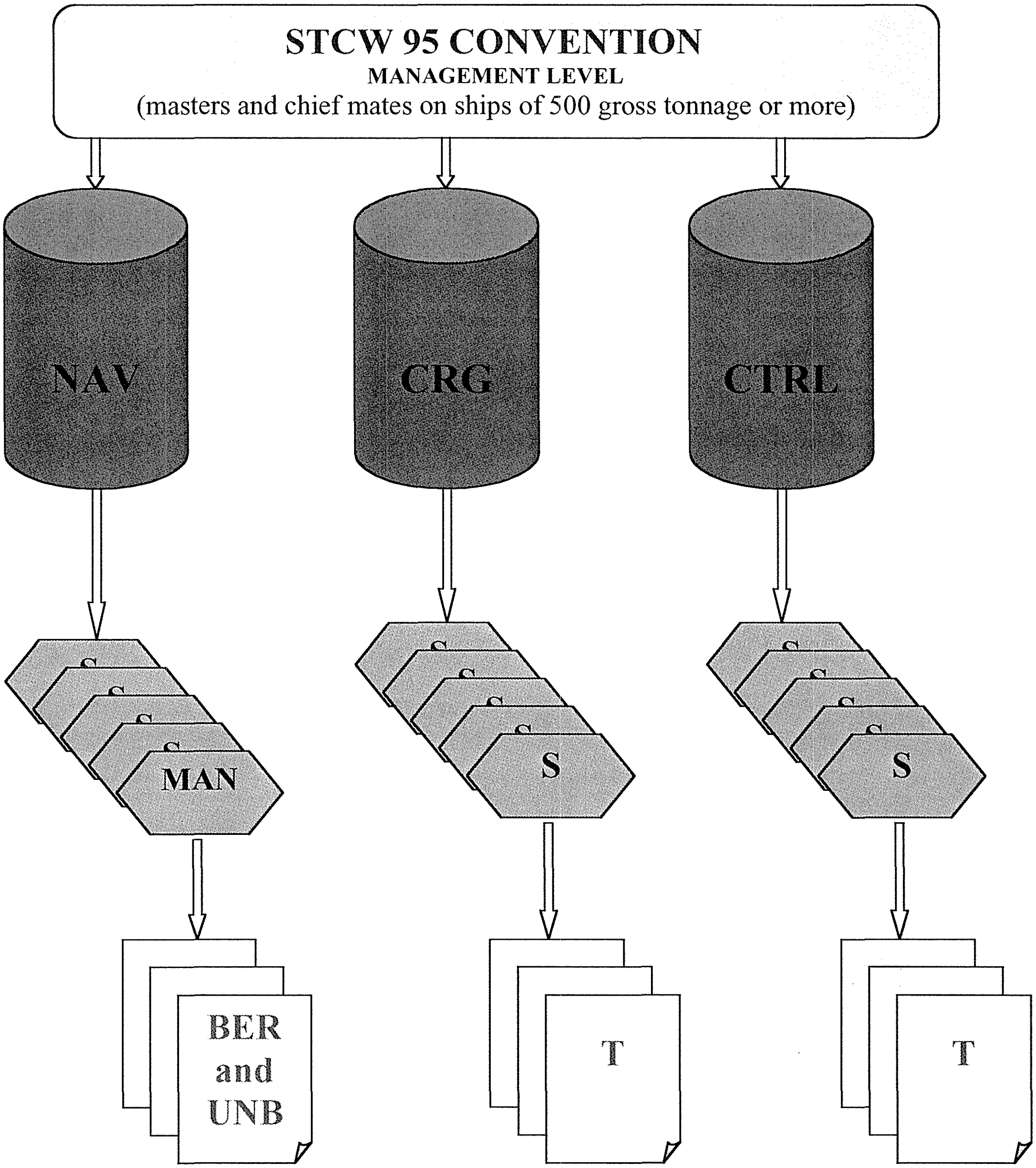

Legend:

Functions:
NAV — Navigation at the management level
CRG - Cargo handling and stowage at the management level
CTRL — Controlling the operation of the ship and care for persons on board
S — General subject
MAN — Manoeuvre and handle a ship in all conditions
T — General theme
BER and UNB — berthing andunberthing under various conditions of wind, tide and current without tugs.

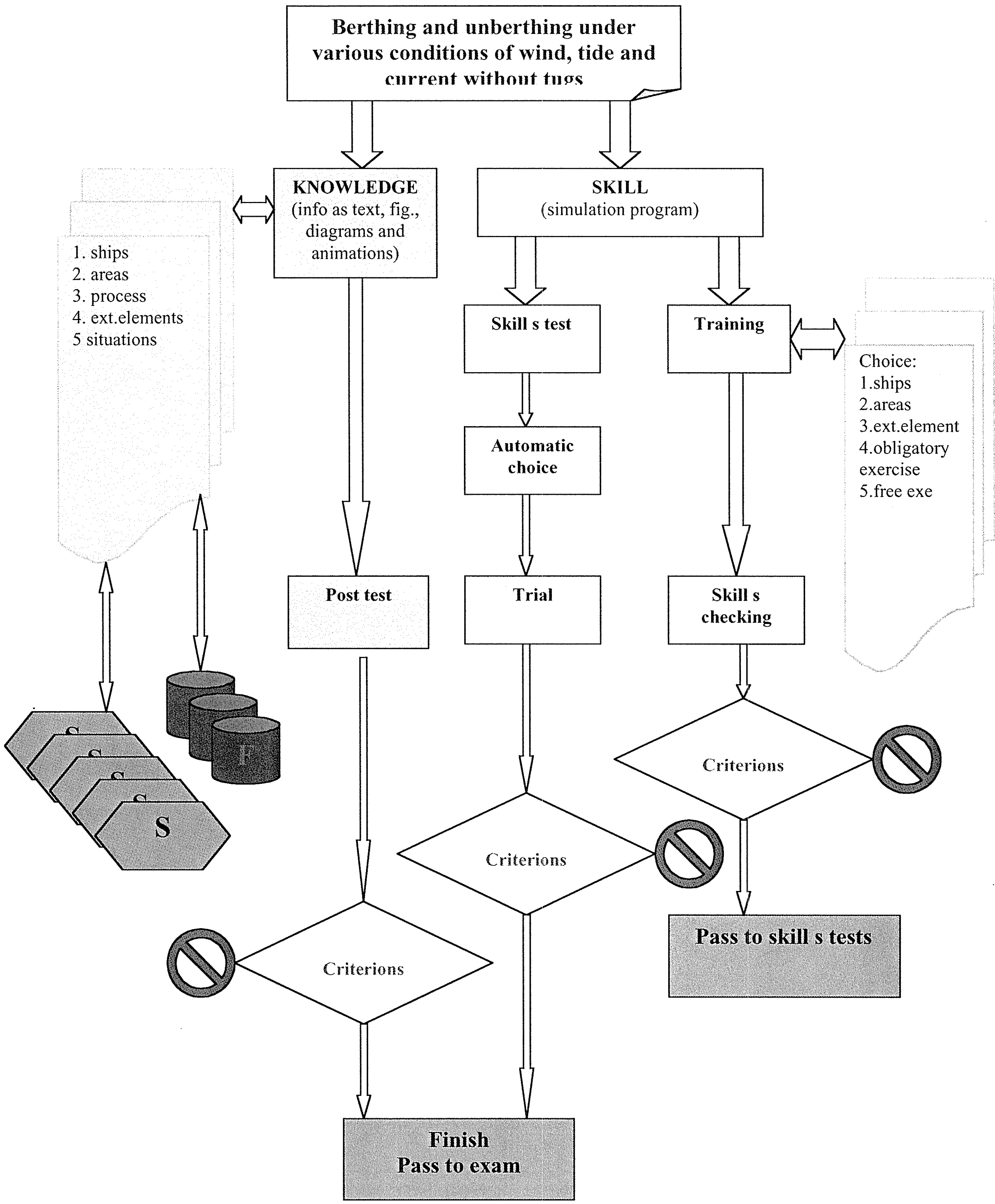

Fig. 2. Block diagram of the scenario of the theme Berthing and unberthing under vario s conditions of wind, tide and c rrent witho t t gs

Session VI — WG 1

Chair: Capt. M. El-Ashmawy

Seafarer Training: Does the System Defeat Competence?
Barrie Lewarn
Autralian Maritime College

Master's Course in Maritime Safety Developed in Constantza Maritime University — The First Step to A Virtual Maritime University
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Improvement of Marine Engineering Curriculum Using the Engine Room Simulator
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Hu Xianfu
Shanghai Maritime University

Seafarer Training - Does the System Defeat Competence?

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ABSTRACT

This paper reviews the use of competency based training (CBT) techniques in the context of seafarer education and training. It postulates that there are still many barriers to overcome before the key objective of STCW 95 is achieved.

STCW 78 focused on what seafarers needed to know to be deemed competent. Courses tended to be academic in nature, classroom based, teacher centred, with assessment based around formal written exams. Post STCW 95 the emphasis of training is supposed to be on what seafarers need to be able to do. Courses should be practical in nature, activity based, student centred, with assessment based around the demonstration of acquired skills. Empirical evidence points to the fact that there is some way to go before the post STCW approach is achieved.

The paper illustrates how marine administrations can, through their systems to approve training, focus on matters which make the use of CBT difficult if not impossible. The IMO model courses have some value as guides but the way they are used in many circumstances also makes the use of CBT techniques unlikely. The structured, term/semester based approach to the delivery of learning taken by most educational institutions also acts against the easy use of CBT. Also some academics argue that CBT and degree level studies are not readily compatible approaches to learning.

The paper concludes with a brief discussion of what could be done to remedy the situation so that the competence of seafarers can continue to be improved.

1. Introduction

For many years educationalists have utilised objectives to define what students should be able to do on completion of the learning experience. Having defined what they should be able to do educationalists also devise valid and reliable ways to test that students can do what they are supposed to be able to do. Over the years this approach has had a number of names including Criterion Referenced Training, Learning by Objectives, and now Competency Based Training (CBT). In an educational sense CBT is not new so why is it now important to maritime education institutions?

STCW 78, failed for a number of reasons, one of which was that, in an educational sense, it loosely described what a seafarer had to know to be deemed competent. Knowing something and doing something are two different things - I know the theory of ship handling but that does not mean I can actually handle a ship. The test for knowledge alone can be separate from the test for doing (competence) but the test for doing (competence), by default, incorporates the test for knowledge. The test for knowledge alone is not a valid test for doing (competence). The international standard, STCW 78, only described what seafarers needed to know. It is therefore not surprising that maritime education institutions and marine administrations responsible for issuing certificates of competency focussed on what students knew rather than what they could actually do. In simple terms a Certificate of Competency was a misnomer, it was really a Certificate of Knowledge!

STCW 95, in educational terms, is a welcome change as it should finally bring maritime education into line with accepted educational practice however, for many institutions CBT requires both a radical change in thinking and a radical change to the way teaching and assessment occurs. This is the educational challenge posed by STCW 95 that many institutions and marine administrations have still not fully embraced.

Implementing CBT to meet STCW 95 requires institutions to go back to the educational basics and this, of course, requires staff who are properly conversant/trained/educated in curriculum design. STCW 95 is not a curriculum and for valid training to occur it needs to be massaged and expanded into a coherent course curriculum document. From this it is then necessary for the teaching staff to use their educational skills to determine the most appropriate way for students to achieve the required competencies and, importantly, how they are assessed to ensure the competencies are achieved (Lewarn, 1999). Somewhat obvious - yes; but unfortunately there are impediments.

This paper postulates that there are both marine administration system and education system impediments which militate against the fully effective implementation of the CBT concept espoused by STCW 95. The evidence for this view is empirical and primarily based around discussions with IAMU and AMETIAP colleagues as well as a benchmarking study conducted during 2002 for PETRONAS Malaysia.

2. Competency Based Training

CBT focuses on skills and competence. Particular importance is placed on the way in which competence in newly learned skills is demonstrated and assessed. This can pose a challenge to the more traditional approaches of teaching and learning which are still common in many maritime education institutions. Emphasis must be on what seafarers need to be able to do, courses should be practical in nature, activity based, student centred whereby students take greater responsibility for their own learning, and with assessment based around the demonstration of newly acquired skills.

CBT recognises that skills may be acquired in different ways over different lengths of time. In some countries workplace learning is integrated into the national education system. This is achieved using national training packages, trained assessors in the workplace and formal processes to recognise workplace learning when students undertake campus based learning. This approach has caused education institutions to re-evaluate how courses are structured and assessed so that the flexibility of CBT can be maximised for students.

Recognition of prior learning is a key point of CBT. It is predicated on the simple concept that once competence has been demonstrated and assessed that skill has been learned. This implies that assessors are competent to assess ie trained and experienced, and assessment techniques are valid and reliable ie the assessment tests what is purports to test and that test results are consistent over time.

In an educational sense CBT concepts are not new in that they emphasise what the student should be able to do on completion of a learning process, how students should be assessed to demonstrate that learning has occurred, and what standard should to used to determine competence. These simple educational concepts also underpin STCW 95 however, much of the evidence to date seems to indicate that both attitudes and systems are still relatively inflexible. This can be interpreted to mean that full implementation of STCW 95/CBT concepts into seafarer education is still some way off.

3. Marine Administration Constraints

Marine administrations are responsible for the implementation of STCW 95. In the context of seafarer training they are responsible for approving training institutions including staff, facilities and equipment, as well as courses. In addition they are also responsible for auditing approved institutions. It is within these systems that clashes between current education practice and administrative interpretations can be observed.

Marine administrations approach their responsibilities in quite different ways eg Australia, Japan, Malaysia and USA approved seafarer training systems are quite different. Whilst these differences reflect national needs and interpretations of STCW 95, in an educational sense it raises some interesting anomalies.

Both Australia and USA provide 'front end' education which includes all competencies required by STCW 95 to the highest level as well as the sea service necessary for the first watchkeeping certificate. In Australia the marine administration accepts completion of the course as the primary measure of competence but 'audits' graduates by conducting an oral assessment of each graduate before issuing a certificate of competency. In USA students who have successfully completed their course are required to also undertake additional, written marine administration examinations before a certificate of competency is issued. In this latter case students appear to be assessed twice on the same competencies. Why: what has happened to the recognition of prior learning?

In Malaysia seafarer students also undertake 'front end' education which includes all competencies required by STCW 95 to the highest level as well as some sea service. However, having completed their sea service for each level of certificate of competency these students are required to undertake further courses and examinations before attempting the marine administration oral examination. These certificate of competency preparation courses, which can be 6 months in length, repeat the competencies covered in the 'front end' course as well as those they have been using at sea. Why: what has happened to the recognition of prior learning?

STCW 95 requires a minimum of 12 months sea service before a trainee deck officer/cadet can attempt the first watchkeeping certificate of competency. The Australian marine administration requires a minimum of 18 months sea service. Why: is it conservatism, tradition or lack of understanding of modern education techniques?

Some countries recognise time aboard training ships and training time in simulators as counting towards sea service requirements. In some cases this sort of highly structured practical training may be counted by marine administrations at, say, double time. This reduces the actual time spent aboard an operational commercial vessel well below the STCW 95 12 months. Why: is it because some marine administrations can see the value of such training being much greater than the traditional at sea training?

From an educators viewpoint this leads to an obvious question. Just what is the purpose of sea service? Is it to gain experience of real life shipping; is it to learn and practice skills which cannot be readily learned or practiced elsewhere; is it to demonstrate skills learned; is it tradition? Most trainees undertake some form of structured learning program whilst at sea, frequently a training record book, but there is much evidence to suggest this is not taken as seriously as it should be. STCW 95 promotes the idea of "assessment of evidence obtained from one or more of the following: approved in-service experience .." It also suggests that "any person conducting in-service assessment of competence of a seafarer .. shall .. have received appropriate guidance in assessment methods and practice .." (IMO, 1996). This approach promotes the concepts of CBT but marine administrations appear very reluctant to support increases in the use of formal workplace assessment of competence beyond the rather traditional training record book approach. Why: if STCW 95 can embrace the concepts of CBT what is it that marine administrations find so difficult?

IMO model courses are, conceptually, a good idea provided they are viewed as guides upon which teachers can build to develop appropriate teaching and learning experiences. In a number of countries marine administrations have taken the view that the courses they approve must follow exactly an IMO model course. The highly prescriptive nature of model courses eg number of hours required to achieve competence, is at odds with the CBT approach espoused by STCW 95 and the following is an illustration of the problems which can arise. In the relatively recent past Australia had been successfully running GMDSS course which were about a week in length but, more importantly, ensured that students were able to properly demonstrate their competence with GMDSS. The Norwegian marine administration objected to this approach and refused to recognise Australian GMDSS certificates based on the view that the course was not long enough and was not aligned with the IMO model course. As a consequence, the Australian marine administration decided that rather than argue the CBT case it would require Australian GMDSS courses to be 2 weeks in length. Norway then agreed to accept Australian GMDSS certificates. The fact that the real issue is competence, not course length, was apparently lost on two marine administrations which were very deeply involved in the preliminary work for STCW 95. Model courses also date very quickly and, at present, there is no systematic updating process. The dangers of relying on model courses should be self evident to all.

4. Education System Constraints

Most education systems work on courses (programs) in years, subjects (courses) in semesters, terms or blocks with a designated number of hours per week being allocated to specific subjects. This assumes that a student needs 'x' amount of time to achieve 'y' outcomes. Whilst this approach may have some validity for the more traditional approach to the delivery of teaching and learning it does not make the proper implementation of CBT particularly easy. Most education institutions have set assessments at set times however, few institutions have systems which allow students to attempt assessments for competence when they consider themselves to be ready. This latter CBT approach is not easy to manage, goes against the structural approach to education expected by both faculty and students, and continues to encourage a teacher centred approach to learning. What is needed is a paradigm shift to a far more flexible approach to teaching and learning. The old paradigms are increasingly irrelevant and are being replaced by new paradigms. These fundamental shifts in education are reflected by Inglis et al (1999) and are summarised in Table 1 (Lewarn, 2002).

Table 1. Old and New Paradigms in Higher Education

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

CBT is part of the new paradigm and requires an output based approach to teaching and learning systems rather than the more traditional input based approach most commonly found in use today.

5. Conclusion

STCW 95 has almost certainly improved the quality of seafarer education and training particularly in relation to the educational practices of institutions and faculty. However, it is evident that there is a range of conflicts between the CBT concepts espoused by STCW 95, the understanding and interpretations adopted by marine administrations, and modern approaches to teaching and learning.

If it is assumed that STCW 95 properly defines what competencies seafarers should possess, then education institutions should be focused on how such skills and competencies are gained and assessed, whilst marine administrations should be focused on ensuring the teaching and learning system produces skilled and competent graduates. Whilst the marine administration can perform its function in a wide variety of ways including approval processes, audits, random testing, oral testing etc it is postulated that marine administrations should not prescribe how competence is achieved and assessed. This is the task of education institutions and their faculty and is consistent with the approach taken by STCW 95.

The boundaries between marine administrations and education institutions need better definition so that educators can educate and marine administrations can focus on quality control to assure competence. Specific course content, course length, delivery techniques and assessment techniques are not the business of marine administrations. In simple terms better definition of who does what could further improve the effectiveness of STCW 95.

Empirical evidence points to a level of dis-satisfaction by educators as they seek to move towards a more output driven model of education. This dis-satisfaction is partly caused by the overly restrictive and prescriptive approaches taken by marine administrations and the relative inflexibility of the input driven model of education still most commonly found in use today.

Does the system defeat competence? Defeat: probably not. But it does reduce the potential effectiveness of teaching and learning in a CBT environment. The system impediments identified in this paper are worthy of more rigorous research if the philosophy espoused by STCW 95 is to be achieved.

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Master's Course in Maritime Safety Developed in Constantza Maritime University -The First Step to a Virtual Maritime University

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ABSTRACT

To ensure that maritime Security and Safety is one of the most important issues of today s navigation and IMO is very interested in the fact that. since the beginning, IAMU dedicated a Working Group III to the Maritime Safety.

Since the result of all these approaches must be transferred and disseminated to the maritime (off shore and aboard) workers, in 2000 Constanta Maritime University initiated, a cooperation between five IAMU Universities in order to develop a Master s Program for Maritime Safety(MSMD). The project was founded by the European Commission under a SOCRATES Program. Since the elaborated curricula have an international content, the core of the MSMD could be used, in an electronic format, for the Maritime Virtual University

1. Introduction

In 2000 Constantza Maritime University initiated a cooperation between five IAMU Universities in order to develop a Master s Program for Maritime Safety(MSMD). The project was founded by the European Commission under a SOCRATES Program.

The five involved Universities are:

- Constantza Maritime University
- Southampthon Institute;
- Universidad Politecnica de Cataluna;
- Wyzsza Szkola Morska Szczecin;
- Wyzsza Szkola Morska Gdynia.

The program lasted for two years (2001-2002) and the Master s Program will start at Constanta Maritime University on October 2002.

2. Development of the Master s Course Curriculum.

Team building was a process which involved representatives from every partner university (rector or dean). It took into account the ability to work in a team and the field of competence. This resulted in the following team of experts:

- Doina Carp, Ph.D - Romania (the coordinator - CMU)
- Capt. Eugen Barsan - Romania (CMU)
- Professor G deMelo- Spain (Barcelona)
- Costel Stanca, drd. Romania (CMU)
- Gelu Batrinca,drd. Romania (CMU)
- Prof. Malek Pourzanjani UK (Southampton)
- Z Szozda, Ph.D Poland (Szczecin)
- W Czyzewski, Ph.D Poland (Szczecin)
- A Weintrit, Ph.D Poland (Gdynia)
- Ignacio Echevarrieta, Ph.D Spain(Barcelona)

3. The style of work

Two work-meetings, the first located in Southampton and the second in Barcelona actually took place.

At the Southampton meeting, the staff established the initial structure of the Master s program, the main topics and the first contact hours allocation by using the brainstorming method in the beginning; the result is the following:

- Maritime Technology (50 contact Hrs)
- Navigational Safety (25 contact Hrs)
- Risk Based Safety (25 contact Hrs)
- Maritime Finance (50 contact Hrs)
- Maritime Operations (50 contact Hrs)
- Research Methods (25 contact Hrs)
- Security and Safety (25 contact Hrs)
- Legal Issues (50 contact Hrs)

The design and drawing-up of these courses was also divided between the five Universities and it was agreed that the first delivery of the above mentioned courses should be done by their authors.

At the meeting proceedings in the Maritime Faculty of Barcelona Technical University the discussion took place on the relevance and suitability of subjects as well as on the time allocation for each unit. Having examined in detail the various proposals and their impact on the course structure, some alterations were brought to the original proposals that allowed for an inclusion of a Unit on Marine Pollution. It was agreed that the Marine Pollution course should be prepared by CMU. It was also agreed that full units should be allocated 56 contact hours and half units 28 hours. The revised structure will have the following format:

Table 1

Course topic	Contact hours
Legal Issues	56
Maritime Technology	28
Navigation Safety	28
Risk Based Safety	28
Maritime Finance	28
Research methods	28
Security and Safety	28
Maritime Operations	56
Marine Pollution	56
TOTAL	336 hours

The structure of the course was altered as follows:

Table 2

Unit	1st Semester	2nd Semester	3rd Semester	Total
Legal Issues	4			56
Maritime Technology	2			28
Navigational Safety	2			28
Risk Based Safety	2			28
Maritime Finance	2			28
Maritime Operations		4		56
Marine Pollution		4		56
Research Methods		2		28
Security and Safety		2		28
Project			6	84
Total hours/week	12	12	6	420 Hrs
Each Semester = 14 teaching weeks				

It was agreed that although this course will be delivered in a modular and unitised format, for administrative and Romanian Government purposes the course structure will be reflected as follows: discussion on the course content was stimulated by a document produced by Constantza Maritime University as a result of a working group discussion on this subject.

At the end of July, the academic staff of CMU decided the final curriculum of the MSc. Course Maritime Safety in accordance with the last requirements imposed by the Romanian Ministry of Education. These final arrangements are shown in Table 3.

Table 3

Unit	1st Semester	2nd Semester	3rd Semester	Total
Legal Issues	2	2		56
Maritime Technology	2			28
Navigational Safety	2			28
Risk Based Safety		2		28
Maritime Finance		2		28
Maritime Operations	2	2		56
Marine Pollution		2	2	56
Research Methods	2			28
Security and Safety			2	28
Project Management			2	28
Project			4	56
Total hours/week	10	10	10	392 Hrs
Each Semester = 14 teaching weeks				

At the end of this meeting, it was stated that the start of the academic year at CMU is the first week in October. It was agreed that the final project meeting would be held at CMU during the first or second week of October. It was argued by the Chairman that the 1st week would be preferable as students would be introduced to the development team and CMU staff will have time to debate any issues they might bring up.

It was noted too that CMU is planning to run the course starting October 2002, and may invite the development team to deliver part of the course that they had prepared. Following the processing of applications CMU will decide whether the Bridging course on introduction to Maritime industries is necessary.

One of the most important discussed issues was the Examination regarding English Language Level. It was decided that the test should consist in three parts:

- Reading Comprehension (will measure the ability to read and understand short passages on technical topics related to maritime documents);
- Written English (the essay component of this English test; will measure the ability to express ideas in acceptable written English in response to an accessible, assigned topic);
- Spoken English (will measure the ability to orally communicate in English).

4. The evolution of MSMD

4.1 The comparison of the two programs emphasizes the differences between the national points of view on maritime subjects. So, the introduction of Maritime Pollution (for two semesters) as a dedicated subject and not as part of Maritime Technology is the result of the pressure of West- European universities.

4.2 The introduction of the English Language Level Examination represents one of the first tangible results of the first International Seminar on Maritime English (Istanbul, 2002).

4.3 The change in the number of the hours allocated to each subject is the result of the accordance between the usual modular structure and the Romanian academic regulations.

Supplementary information regarding the Maritime Safety MSc. could be found on our WEB site (www.imc.ro)

CONSTANTA MARITIME UNIVERSITY

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MASTER DEGREE PROGRAM FOR MARITIME SAFETY

Summary of the project:

- The goal MSMD is to increase the contribution of each seafarers to the safety and the environmental protection.

  The objectives of MSMD are:

1. to ensure that the European management shore-based and near-shore maritime functions have the potential to perform their tasks properly and safety (the wider!);
2. to inoculate a safety culture amongst ship and port managers trough the graduate;
3. to reconciliate different perspectives of safety management (commercial versus marine).

5. Conclusions

5.1 Even if MSMD was not elaborated especially for virtual students, the content could be used for this purpose as well, since following the discussions concerning the content and delivery method each subject was brought to its essentials and devoid of any personal touches. The result is in fact the actual core of the subject and is the most appropriate content to be prepared in an electronic version.

5.2 The Examination regarding English Language level ensures the access of all international students to the knowledge of this program.

5.3 The procedure of work could be used for all other international course development.

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Improvement of Marine Engineering Curriculum Using the Engine Room Simulator

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ABSTRACT

The Engine Room Simulator (ERS) course design is initially established as a parallel to the updated version of IMO Model Course 2.07. IMO Model Course is so general that needs to be modified with available functions and systems of the ERS as well as according to the use of the ERS for the purpose of the course. For example, Model Course 2.07 subjects are not clearly defined for management level of training.

With the cooperation of Japanese International Cooperation Agency (JICA) and Istanbul Technical University Maritime Faculty (ITUMF), ERS of ITUMF was installed in June 2001 and ERS based courses were integrated into the marine engineering curricula. Current ITUMF ERS courses aim to develop knowledge and skills of senior level ITUMF students on the regular operation, watchkeeping, and malfunction detection of engine room machinery and systems. In order to achieve an integrated education and training process; classroom briefings, workstation guided exercises with checklists concept, and full-mission ERS are utilized. An important element of simulator use in the curricula has been focus on the compliance with STCW-95 competency evaluation requirements. This highly integrated simulator-based education and training system has been ramping-up to full operation to provide integrated individual and team training in the marine engineering professional courses.

This paper outlines the specifications of ITUMF simulator and provides a progress report on the recent improvements in the marine engineering education curricula, which includes lessons learned from the early development stages and integration into the marine engineering curricula. The authors also discuss the feasibility of the use of ERS to establish higher-level skills, such as risk management, teamworking, and internal and external communication. The final part of the paper includes the use of ERS for the initial research studies at ITUMF for safety management.

1. Introduction

Japanese International Cooperation Agency (JICA) and ITUMF started a project at ITUMF for the improvement of Maritime Education and Training in 1999. The project duration is scheduled for five years. Since the start of the projects, the following are some of the achievements completed:

- Installation of a full-mission ERS,
- Installation of a Ship Handling Simulator (SHS),
- Training of instructors,
- Start of education and training of ITUMF students using ERS,
- Initiation of Research Projects on Safety Management,
- Study on Curricular activities,
- Realization of International conferences and seminars on related fields,
- Establishment of new short-term Maritime Safety Training & Certification (MSTC) training courses, such as ARPA-RADAR, Medical First Aid & Medical Care, Tanker Familiarization, Advanced Tanker Course, English/SMCP, Advanced Fire Fighting,, etc.

JICA-ITUMF projects are now in a stage that all available tools such as SHS and ERS could be used both for training and education of ITUMF students and for the training and certification of seafarers serving onboard. With long and successful efforts, the simulator building of ITUMF is completed to serve to the plan for the utilization, which is that the simulator building is a ship . Having ERS installed in 2001, ERS based courses were already introduced into ITUMF marine engineering curricula.

This paper focuses on the effective utilization of ERS in four-year marine engineering program along with other training methods; namely: utilization of labs and workshops, training on a Training Ship and Merchant Ship training.

2. Training & Education Using ERS

Maritime training institutions all over the world started recognizing the value of simulation systems as training as well as evaluation of competence level tool. The International Maritime Organization (IMO), the highest international maritime body, has now officially promoted the use of simulators[1]. Its endorsement is embodied in the international convention on Standards of Training, Certification, and Watchkeeping for Seafarers 1978, as amended in 1995 (STCW Convention & Code). The convention makes ARPA-RADAR training mandatory and recommends the use of simulators for training as well as for the assessment of competence[2].

The ERSs are designed to simulate various machinery and equipment as used in the engine room of a ship using generally a diesel engine as propulsion system. The development of computer technology has had a dramatic influence on simulators and most now run on highly structured PC-based programs. ERSs could be a PC based self-training software or could include panels and interface equipments. Kluj (2001) proposed the following convention for the classification of simulators:

- **B (like Basic) Class simulators -** include CBT Software and/or Basic Machinery Simulators like Main Engine, Auxiliary Boiler, Separator, etc. which has a software to be run on a single PC/workstation.
- **P (like Personal) Class simulators** — usually simulate a model of an engine room and main engine type, which has a software runs on a single PC or on the set of several networked PCs co-operating.
- **F (like Full) class simulators** — simulates all of the engine room environment, machinery, and systems with physical appearance and sound effects.
- **S (like Special) class simulators** — specialized simulators, usually programs running on a single PC.

The above-defined convention for classification of ERSs will be used throughout this paper. The main purpose of all simulators is to simulate the systems as much similar as possible for a good utilization in education and training. The advantages of the utilization of ERS in MET are summarized by Cicek *et al.* (2002) as follows:

- The operations of the machinery are simulated as close as possible to their actual conditions,
- Training for both normal and abnormal condition repeatedly is possible,
- It is cost-effective,
- It is time effective,
- It offers a flexible and controlled schedule of the training curricula,
- It makes controlled evaluation of the students possible,
- It make standardization of a marine engineering education & training curricula possible,

The biggest advantage of using ERS as a training tool is the possibility of creating malfunctions repeatedly to train students for increasing their troubleshooting skills. However, even though ERS simulates the real engine room environment and systems, still ERS is not the actual working place of trainees. Therefore, effective utilization of ERS along with laboratories and workshops, training on a merchant ship, and training using a training ship would be most effective. Cicek *et. al.* (2002) studied comparatively the effective training methods and made some recommendations for IAMU Universities to utilize all available training methods efficiently and effectively to come up with a high-level training curricula. And now this paper utilizes the tables and conclusions that they made to initiate a study on baseline for an effective utilization of ERSs in marine engineering undergraduate program.

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[1] IMO: Engine Room Simulator, IMO Model Course 2.07, IMO Publication, 1989.

[2] IMO: STCW95, International Maritime Organization (IMO), 1996, 92-801-1412-3.

3. Specifications of ITUMF ERS

ERS (Engine Room Simulator) system was installed into ITUMF in June 2001 as a part of the JICA-ITUMF Project. The ERS System is Norcontrol made, which is a full-mission type of simulator for a container type of ship. The ERS of ITUMF is consisted of two types of simulator, namely full mission simulator and PC based simulator. Both of them were produced by KMSS (Kongsberg Maritime Ship Systems). ITUMF ERS consist of the following secions:

- Engine Room: interactive mimic panels that simulates all machinery and systems in an engine room. M/E local control stand is used for local control with telegraph. Two workstations are utilized for control of details of systems. Sound system simulates the noise produced by Main Engine, DGs, compressors, boiler, drains, etc.
- Engine Control Room: includes engine remote control console (ECC) with telegraph order, AutoChief, PowerChief, power-distributing panels (DG power panels, TG, power consumers, full electrical switchboard synchronization, emergency generator switchboard and shore connection), and two workstations.
- Instructor s room: from where all ERS system can be controlled, malfunctions can be created, and scenarios can be arranged.
- Exercise room: 6 workstations, used for self-training.
- Classroom — for briefing/debriefing sessions with the networked utilization ofsnapshots of training.

The general specifications of the Engine Room Simulator are summarized in Table 1.

Table 1. Specifications of ITUMF Engine Room Simulator.

Type	ERS-L11 SULZER 12RTA 84-Container, KMSS
Vessel	4,200TEU Container Ship LOA : 295m, Breadth oulded : 32m, Draught : 12.6m, Dead-weight : 55,000tons
Main Engine (ME)	SULZER 12RTA 84 Bore: 840 mm, Stroke: 2,400mm, MCR: 48,600 kW ME Speed: 102 rpm, Number of Cylinders: 12, ME Indicated Pressure: 17.0 bar, Scavenge Air Pressure: 2.4 bar, Number of Air Coolers: 3, Number of TG s: 3 Specific Fuel Consumption: 165 g/kwh.
Electric Power Plant	Diesel G.: 1,810kW x 2sets, Turbo G.: 2,250kW x 1set, Emergency G.: 1set
Steam Generation Plant	Oil fired boiler, Exhaust gas boiler: 0.75MPa, 12.0tonf/h

The ERS execution can be frozen at arbitrary situation, and the condition can be stored and reloaded as an initial condition. Instructor can make various scenarios using with actions and malfunctions menu based on both time and event. Since both two types of simulators, workstations (P) and full-mission (F), are completely same system except for hardware such as levers, buttons, etc, it is very easy and effective to develop application from self training to full mission with a team training. The snapshot ability of the software makes briefings and debriefing sessions more active with the inclusion of recorded snapshots of the training. Also, evaluation editor module of the software can be used for the assessment of actions of students during an exam or training.

4. Improvements in Marine Engineering Curricula with ERS

The major role of the marine engineering department of IAMU member universities/faculties is to provide their undergraduate students with effective and high-level education and training to allow them to be highly competent marine engineers. ERS based courses have recently begun to attract notice as a new training method because of the several advantages over the traditional methods as mentioned earlier. Based on these advantageous, Cicek *et al.* (2002) proposed the following additional competences for being a qualified engineering officer:

- Teamwork among engineer officers (how to be a part of the team)
- Leadership (how to organize the team)

- Safety culture and management of the risk in the machinery space (how to predict and prepare for an accident)
- Aspect of the human error (the causes, behaviors and results, human-machine interface, etc.)
- Communication aspects (how to communicate in multicultural environment with standard use of English)

Cicek *et. al.* (2002) pointed out that education and training curriculum to demonstrate these additional competences should be provided to undergraduate students of IAMU member universities. ERS training could be used to give marine engineer candidates higher-level qualifications discussed and proposed above. For example, the use of ERS for team-management and for communication skills could very efficiently be arranged because of the opportunity of preparing the scenarios based on the type of the training and education. Furthermore, by providing a scenario of simulated severe accidents in the machinery space, marine engineer candidates will be able to experience the situation without any damage to training equipments. Through this type of training, marine engineer candidates can learn the safety culture for the management of the risk (i.e. the aspect of human error). Simultaneously, the behaviors of the trainees during this type of training recorded on ERS will provide the academic staff of the department of marine engineering with opportunities to do research on human factor issues for safety management. Therefore, authors proposal is that IAMU institutions should introduce and use the state-of-the art ERSs in the undergraduate curricula. Proposed utilization of ERS in marine engineering curricula has two main parts. These are:

- ERS as laboratory tool in marine engineering courses, and
- Utilization of ERS as a training tool.

4.1. ERS as a Laboratory Tool:

The simulators can be used not only for training of candidates but also for other educational purposes and even for investigating engineering problems (Hikima, 2001), i.e. in courses such as Marine Diesel Engines, Operations & Troubleshooting, Auxiliary Marine Engines, Marine Electrical Systems, Refrigeration & HVAC Systems, Thermodynamics, Automatic Control Systems. Last few decades, some qualitative techniques such as automation of both navigation and engineering systems in shipping industry have contributed to productivity and saving of manpower on board, resulting a tendency of crew reduction. Nowadays having 3-4 engineers onboard is common. Therefore, skills and experience for a qualified marine engineer have been changing last decades due to the technological innovation such as remarkable improvements of computerized control systems. Therefore, the training of students in state-of-the-art simulators is beneficial. For example, Hikima *et. al.* (2001) showed how students as well as experienced engine room personnel were able to adjust PID controllers with the use of an engine room simulator, which is a very difficult experience to gain onboard a ship.

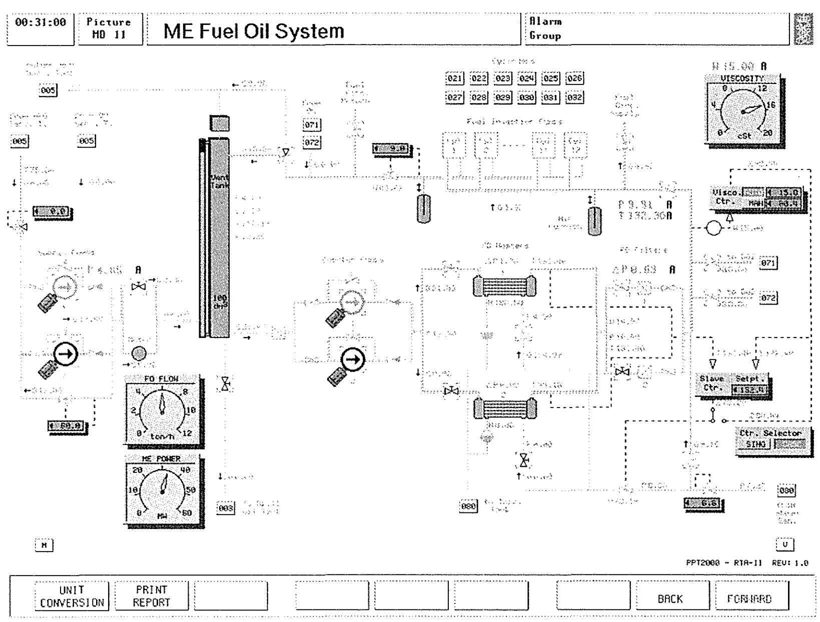

Figure 1. Adjusting PID Values of Viscosity Controller in ME Fuel Oil System.

At ITUMF, until now, ERS was used as a laboratory tool in Automatic Control Systems and Marine Diesel Engines Courses. For example, learning to familiarize with controllers in engine room systems and fine tuning of PID controllers is possible with the utilization of ERS as a laboratory tool. Figure 1 shows a viscosity control system in ITUMF ERS. On the other hand, authors of this paper believe that utilization of ERS in the above mentioned courses make students grasp of subject easier and also the cumbersome number of credit hours of ITUMF engineering courses, which is a total of 3192 hours of Undergraduate Engine program of ITUMF due to the IMO and Turkish Higher Education requirements (Sag and Cicek, 2000), may noticeably be decreased.

4.2. ERS as a Training Tool:

In ERS training courses, aim is to develop knowledge and skills of students on the regular operation, watchkeeping, and malfunction detection of engine room machinery and systems. On successful completion of this course, marine engineering candidates should be able to:

- Handle comfortably the *start-up procedures* of the individual engine room machinery and associated systems.
- Learn and practice the *regular watch keeping operations* in the engine room.
- Do practices to obtain skills for detecting *malfunctions for troubleshooting* to manage the possible breakdowns - bringing the engine room systems from abnormal condition to normal one.
- Develop *higher level skills* such as *risk management*, *team working* understanding in the engine room, and improvement of *internal and external communication skills* in the engine room.

The first three qualifications are mainly to meet STCW95 convention requirements. The last two of the above qualifications are more advanced training which was called Type B training (Nakazawa et al., 2001). Nakazawa et al. (2001) describe the Type B Training criteria as training for recovering the abnormal condition to normal one based on the knowledge and experience. For this purpose, training in ERS for recovering process repeatedly, for controlling the panic, is needed. To achieve completion of these qualifications, three new ERS based courses were proposed and described in Table 4.1. An effective utilization of these ERS-based courses in a 4-year marine engineering undergraduate program is shown in Table 3.

Table 2. Proposed ERS Courses.

Proposed ERS Courses	Lect.	Ex.	Total (Cr.)	Total (Hrs.)
ERS Course Operation Level (5^{th} Sem.)	1	3	4	56
ERS Course Management Level (7^{th} Sem.)	0.5	2.5	3	42
ERS Course Advanced Skills (8^{th} Sem.) (Team Manag. Comm Skills. Risk Manag.)	0.5	2.5	3	42

Table 3. Proposed Utilization of ERS-based Courses in Marine Engineering Programs.

<table>
<tr><th></th><th>Fall (1^{st}) Semester</th><th>Spring (2^{nd}) Semester</th><th>Summer</th></tr>
<tr><td>1^{st} Year</td><td>Intr. Marine Engineering Courses</td><td>Intr. Marine Engineering Courses
(ERS as lab tool (C, B): Int. to Marine Engines)</td><td rowspan="2">Training Ship
+
ERS (P, B)
(2 months)</td></tr>
<tr><td>2^{nd} Year</td><td>Marine Engineering Courses
(ERS as lab. Tool (C, P): Marine Electrical Systems)</td><td>Marine Engineering Courses
(ERS as lab. Tool (C, P): Marine Diesel Engines, Aux. Marine Eng. I.)</td></tr>
<tr><td>3^{rd} Year</td><td>Marine Engineering Courses
(ERS as Lab. Tool (C, P): Automatic Control Systems)
+
(ERS Course (P, F): Operation Level)</td><td colspan="2">In Service Training
(Merchant Ship)
(min. 4 months)</td></tr>
<tr><td>4^{th} Year</td><td>Marine Engineering Courses
(ERS as Lab. Tool (P, S): Aux. Mar. Eng. II)
+
(ERS Course (P, F, S): Management Level)</td><td>Marine Engineering Courses
(ERS as Lab. Tool: Refrigeration & HVAC Systems)
+
ERS Course (F)
(Advanced Skills)</td><td>Graduation</td></tr>
</table>

B: Basic Type ERS, **C**: CBT, **P**: PC or Workstation Type ERS, **F**: Full mission ERS, **S**: Specialized ERS.

The major roles of engine officers onboard ship are mainly operation and management. Therefore, firstly, the training should focus into these two types of training. Table 4 shows the contents of ERS Courses proposed. Notice that these contents may construct a baseline for a future study among members of IAMU and may dynamically be changed based on the type and availability of the ERS. The contents of the courses described in the first two columns were selected to comply with STCW Code, Table A-III/1 and Table A-III/2 respectively. The topics in the third column, which is ERS Course Advanced Skills: Team Management, Communication Skills, and Risk Management, are for higher-level education of students. The concept explanation of each of these courses is made in the following sub-sections.

Table 4. Contents of Proposed ERS Courses.

ERS Course Operation Level (5th Semester) (Type A Training)	ERS Course Management Level (7th Semester) (Type A + Type B Training)	ERS Course Advanced Skills Team Management, Communication, Risk Management (8th Semester) (Type B Training)
- Familiarize with the Engine Room - Start and Shut down individual engine room machinery and associated systems. - Observation of response parameters - Prep. Main Engine - Manoeuvring - regular watch keeping operations - Operate, evaluate and monitor engine and system performance.	- Plan and schedule the operations-Operate, evaluate and monitor engine performance. - Do practices to obtain skills for detecting malfunctions for troubleshooting to manage the possible problems for bringing the engine room systems from abnormal condition to normal one (scenarios — Type B Training). - Manage fuel and ballast operation - Utilize resources, equipment, and information effectively.	- Develop higher level skills such as; - risk management, - team working understanding in the engine room and leadership practices - Internal and external communication skills development in the engine room. - Scenarios for simulating situation where management of panic condition is needed at most. Emergency procedures. - Case studies to reflect the real situation where team management is evaluated. - Utilize recourses and personnel effectively.

4.2.1. ERS Course Operational Level (5th Semester):

Operational level of STCW95 training is aimed in this course. This course is particularly important to be offered in 5th semester since students must do in-service training during 6th semester. Mainly workstations were used in this training. When students come to a certain level, students practice the regular watchkeeping and observation of readings. Traditional checklists are used in this training. The checklists are formed with a plain technical English. In later part of this course, utilizing ERS, students practice startup of individual systems, maneuvering, filling the logbook, watchkeeping, and observation of parameters. Notice that the operation level based ERS course is completed before the long-term training.

4.2.2. ERS Course Management Level (7th Semester):

Management level of STCW95 training is aimed in this course. Having this course studied in 7th semester after the long-term training, students will have the opportunity of having training on the development of troubleshooting skills, evaluation of system performance, management of ballast operations, etc. Type B training explained in previous section is focus in this course (Nakazawa *et al*, 2001).

4.2.3. ERS Course Advanced Skills (8th Semester):

Risk Management: The engine room is designed so that, even if the initiating even is an operating error, serious risks may not occur as long as the safety system is working properly. However, if operation errors and troubles with the safety mechanisms occur simultaneously, a great number of risks are estimated to occur in the engine room system (Nakamura, *et al.*, 1999). There may be an argument that a marine engineer does not always need theoretical knowledge if he has adequate experience. However, if he/she meets an incident for the first time and which he/she has inadequate knowledge about, he/she may fall into panic easily. Human factors become an issue in these cases (Nakazawa, 2000). The United States National Transportation Safety Board and several international organizations site that statistically %70-%80 of all investigated commercial marine accidents are due to human errors[3]. To reduce the human errors, training for troubleshooting repeatedly with a good communication and team working is needed

[3] National Transportation Safety Board Report, Washington D.C., PB98-916401, NTSB/MAR-98/01.

and therefore, utilization of ERS for this purpose is proposed. For this purpose, this part of the course is about to increase the ability of student s over the control of risk. The training for having the knowledge and experience of what situations creates and leads to make human errors may create qualifications to control panic, stress, and fatigue and to focus on what to do correctly under these difficult circumstances. This case is currently under investigation at ITUMF and the details were explained in Section 5 of this paper.

Communications Skills: In order to benefit from the advantageous fully, the simulators are started being also used for Maritime English education & training of students (Bas *et al.*, 2002). Although most of the chief engineers and engineering officers are not the native speakers on a worldwide basis, they are trying to carry out the most of their engineering activities in English. Although Standard Communication Phrases (SMCP) is in force, there is no any clear identification for the marine engineering terminology yet. IMO Model Course 3.17 Maritime English defines only the basic engine room preparations and the planning of activities in cooperation with the deck department. However, communication in the engine room is so important in terms of eradicating of marine accidents which are considered to be based on communication failures. In this respect, it is authors wish to have a study on the standardization of internal and external engine room communications and use ERS for this purpose as well. One part of this study is using a standard technical English during lectures. For example, experience has shown that the application of the checklist concept in engine room training and operation are found to be very useful. (Kluj, 1999).

Engine Room Team Management (ERTM): Team working understanding in the engine room and practices. Knowing the fact that human communication is not only through a language, teamwork scenarios are also being prepared to train students for both internal and external communications and for English improvements. The development of standard communication phrases should be studied by related colleagues of IAMU for the engine room training and education of students with navigation and maneuvering scenarios.

The examination and assessment methods for these courses are presented in Table 5. The student however must be present for the entire course and participated in all of the exercises and activities.

Table 5. ERS Examination and Assessment Methods of ERS Courses.

ERS Course Operation Level (5th Semester)	ERS Course Management Level (7th Semester)	ERS Course Advanced Skills Team Management, Communication, Risk Management (8th Semester)
- Duration of study using Workstations, following the Checklists - Startup procedures in workstations, - Operation in the Full-Mission ERS - Short Exams from Checklists - Instructors Oral Ex. (and/or instructor s opinion)	- Exams for Troubleshooting using the Full mission ERS - Homework Projects and Exams for the Evaluation of Engine Performance and Associated Systems	-Oral Exams, -Performance evaluation with team in F Type ERS

5. Research Studies at ITUMF Using ERS

Some research studies were also started along with education and training using Engine Room Simulator. Uchida *et. al.* (2002) performed experiments on the feasibility of research on safety management using the ERS. For this purpose, experiments in ERS on human behavior were carried out. For performing these experiments, besides of ERS, an Eye Mark Recorder (EMR) was used. The EMR can detect the movement of examinee s viewpoint and record viewpoint coordinate data on PC and/or VTR continuously together with viewing images. EMR system is compounded from head cap unit, controller, PC and VTR as shown in Figure 2. Examinee puts the head cap unit on during a measurement, so that examinee can move his head freely. If examinee carries portable battery, controller and portable VTR stored in a knapsack on his back, there are no restrictions of his movement. ERS scenario was made as a typical case of watch keeping at an engine control console that is change over the control responsibility from bridge to ECC, stand by engine and half slow down. The flowchart of this scenario is shown in Fig. 3. It takes about 10 minutes from the experiment beginning to the end.

The contribution to the improvement of maritime safety has been set to an ultimate target and the measurement of one of human behavior that is eye movement in ERS has been carried in this research. It is expected that one can approach to the goal by execution of following processes based on the obtained results.

- Individual teaching based on grasp of personal characteristics

- Use a replay of various example of typical case as education and training material
- Conduct of measures beforehand by grasp of potential dangerous factors of miss-operation and oversight of profitable information, etc.

Experimental results obtained from the research study in ERS until now are summarized as follows:
- One of human behavior, eye movement, was measured during watch keeping in ERS by using EMR.
- There are definite differences in the human behavior between skilled engineers and beginners even under the quite simple scenario.

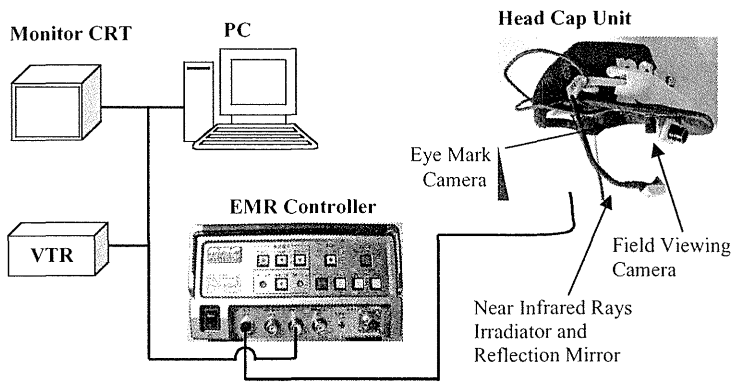

Figure 2. General arrangement of EMR

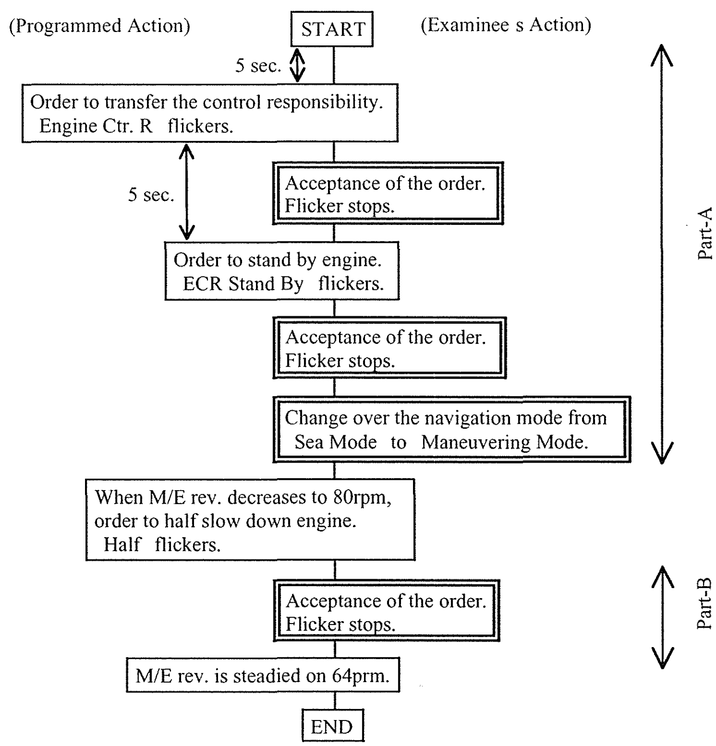

Figure 3. Flowchart of ERS experimental scenario

The following items are the subjects for a future study utilizing ERS at ITUMF:
- Data accumulation and the examinations of data processing

- Development of experimental scenario for more complex operations
- Development of experimental scenario for malfunction managements
- Concrete proposal for maritime safety

6. Conclusions

Based on the results of the previous sections, it is concluded that ERS training could be used to give marine engineering candidates higher-level qualifications discussed. For example, the use of ERS for team-management and for communication skills could very efficiently be arranged because of the opportunity of preparing the scenarios based on the type of the training and education. Through this type of training, marine engineer candidates can easily learn the safety culture, how to manage the risk and the aspect of the human error. Simultaneously, the behaviors of the trainees during this type of training recorded on ERS will provide the academic staff of the department of marine engineering with opportunities to develop research topics in order to prevent mistakes by human errors. The concrete findings and outcomes of the research currently under investigation will be presented at later stages.

ERSs could be used both as a laboratory tool for fundamental marine engineering courses and as a training tool based on operation and management level training, and fro advanced skills. In this paper, an example of utilization of ERS in a marine engineering program is presented. It is authors wish that the presentation of this paper initiates a study among Marine Engineering Departments of IAMU member universities for the establishment of a standard but flexible and dynamic four-year marine engineering program.

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Simulation and Application of Auxiliary Machinery Systems for Seafarers Training

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ABSTRACT

The paper reviews the function of auxiliary machinery simulation system in a broad range of possible applications to the performance, evaluation of and training for marine operations. Main real time mathematical simulation models of auxiliary machinery systems are established. Typical performance failures and structural faults of auxiliary machinery systems were simulated. Interfaces and software programs of auxiliary machinery simulation system are designed and main functions and applications are briefly introduced.

1. Introduction

Along with rapid development of computerized and automated vessels all over the world, auxiliary machinery has been widely used on board ship. It is necessary to train engineers and crew to meet the operational requirements of modern ships with a lot of automatic control equipment. Elaborate and strict requirements for technology management, safety operation and emergency disposal have been defined in the international convention on Standards of Training, Certification and Watch-keeping for Seafarers in 1978, modified in 1995(STCW78/95) by the International Maritime Organization (IMO). Meanwhile, rules for marine simulator s training and evaluation were defined in considerable detail by Maritime Safety Administration of China (China MSA) in June 1998. It is a common sense that using marine simulator instead of a part of seafarer experience at sea can train modern senior officers rapidly and effectively. Auxiliary Machinery Simulation (hereafter AMS) system is an important sub-system of marine simulator.

2. Marine Auxiliary Machinery on Real Board Ship

In the past decades, progresses were numerous and rapid; remote and automated controls (with provision for local manual operation) operated from air-conditioned, soundproof compartments have come into common use. As these devices are now reliable, engine rooms are often unmanned for long periods. These changes have been naturally accompanied by some simplification of main systems, but have brought about a great increase in auxiliary machinery.

Auxiliary machinery covers everything on board except the main engines (or main boilers) and power station, and includes almost all the pipes and fittings as well as many items of equipment providing the following functions:

Supply the requirements of the main engines (or main boilers), for example: circulating water (include high temperature fresh water, low temperature fresh water and sea water), forced lubrication, fresh water generator, coolers, condensers, air compressors, oilfired and exhaust gas composite boiler, exhaust gas unit, fuel oil reception, transfer and treatment unit, etc.

Keep the ships dry and trimmed, for example: bilge and ballast systems.

Supply the domestic requirements, for example: fresh, salt, sanitary sewage systems, refrigeration, heating and ventilating system.

Moor the ship and handle cargo, for example: windlass, capstan, winches, steering engine, cargo-handling equipment and other special deck machinery.

Provide for safety, for example: fire detection and fighting, lifeboat engines and launching gear, watertight doors, etc.

Pollution protection, for example: oily water separator, sewage treatment unit and incinerator, etc.

Various duties of a marine engineer all relate to the operation of the ship in a safe, reliable, efficient and economic manner. A board-based theoretical and practical training is therefore necessary for a marine engineer. He must be a mechanical, electrical, air condition and refrigeration engineer, as the need arises. At his first voyage, maybe he does not at first realize that the essentials of certain arrangements do not vary greatly from ship to ship. After some experience he will find that he can familiarize himself in a strange ship quite rapidly, for example, bilge, ballast, fuel oil transfer, fresh water, sanitary water and other important systems.

AMS system is considered to be effective tools for the training of seafarers. Its importance is growing steadily, as more stress is being put on effective operational skills of the crews. To develop, improve and maintain the necessary skills and to test them, AMS at various levels of sophistication are used more and more frequently. AMS provides substitute shore-based operational environments in which the required skills can be developed, practiced and tested. It also contributes the cost-effectiveness, high capacity, emergency, fail-safety, intensity and controllability of training and testing, which are practically impossible to achieve under the job circumstances on board ship. Consequently, it became leading tools for the training of seafarers and for improving the safety and efficiency of marine operations.

3. AMS Mathematical Model

Auxiliary machinery systems, mainly made up of pipes and valves, etc., carries and controls the flow of a number of fluids at various, frequently varying, pressures and temperatures. The functions, requirements arising from ship construction, the nature and management of the machinery and regulations of certifying authorities, create situations in which systems basically simple, become complex and bring into use a variety of composing and fittings, which include pipes, valves, pumps, tanks, strainers, heat exchangers and controllers, etc.

(a) Tank s Level Equation

$$L_F(t) = L_{F0} - \int_0^t \frac{C_{FTVO}}{100} \cdot \frac{F_M(t)}{S_F} dt + \int_0^t \frac{C_{FTVI}}{100} \cdot \frac{F_{FP}(t)}{S_F} dt \tag{1}$$

Where,

L_F—fuel oil tank level, m;

C_{FTVO}—percentage of fuel oil tank outlet valve, $\%$;

C_{FTVI}—percentage of fuel oil tank inlet valve, $\%$;

F_M—reading of flowmeter, kg/h;

F_{FP}—discharge of fuel oil purifier, kg/h;

S_F—fuel oil tank area, m^2;

Other tanks level equations are not described.

(b) Valve Equation (HUANG Qinghong and HOU Xiaogang, 2001)

$$y_1 = (K_i dt + y_0) \cdot C_V \tag{2}$$

(c) Pump Equation (HUANG Qinghong and HOU Xiaogang, 2001)

$$y = F_M \cdot C_{PV} \tag{3}$$

(d) PID Controller Equation (HUANG Qinghong and HOU Xiaogang, 2001)

$$y_1 = y_0 + \left[K_p (x_2 - x_1) + 1/T_i \int_0^t (x_2 + x_1) dt + T_d (x_2 - x_1 + x_0)/dt \right] \tag{4}$$

Where,

K_p—proportional gain;

T_d—differential time constant;

T_i—integral time constant.

(e) Oil Tank Temperature Alternation Equation

Here gives an example of diesel oil tank temperature calculation equation as

$$T_{DTK} = \frac{AT_{DTK0} + (BT_{40} - CT_{DTK0})t - \frac{(K_{5S} + K_5)T_{DTK0}t}{2} + (T_0 K_{5S} + T_S K_5)t}{A + (B + C)t + \frac{K_5 + K_{5S}}{2} t} \tag{5}$$

Where,

$$A = L_{DTK0} S_{DTK} \rho_D C_D$$

$$B = (C_{22} C_{25} E_3 Q_3 + C_{28} C_{29} E_2 Q_2) C_{30} \rho_D C_D / 3600$$

$$C = (C_{34} Q_{DS} + C_{d2} Q_{d2}) \rho_D C_D / 7200$$

$$K_5 = V_5 K_{50}$$

$$K_{5S} = \frac{L_5}{L_{5\max}} K_{5S0}$$

$$V_5 = \begin{cases} 1 & T_5 < 50 \\ 1 - \dfrac{1 - \dfrac{T_{5M} - T_0}{T_S - T_{5M}} \cdot \dfrac{L_5}{L_{5\max}} K_{5S0}}{T_{5M} - 50} (T_5 - 50) & T_5 \geq 50 \end{cases}$$

(f) Strainer Pressure Differential Equation

$$DP(t) = DP_0 + \int_0^t \beta F_M(t) C_{FVI} dt \tag{6}$$

(g) Heat Exchanger Equation (XU Xiaoyan, 2000)

Here gives an example of static model of surplus steam condenser as

$$t_w(t) = t_s(t) - \frac{1.16 g F_{FW} (t_{V2} - t_{V1})}{\alpha_m S_V} \tag{7}$$

Where,

t_{V1}—temperature of high temperature fresh water inlet in surplus steam condenser,_;

t_{V2}—temperature of high temperature fresh water outlet in surplus steam condenser,_;

t_s—saturation temperature of steam,_;

t_w—condensed water temperature at surplus steam condenser outlet,_;

α_m —mean coefficient for heat exchange of liquid film on pipe s surface, $W/(m^2.\_)$;

S_V—total area of pipe s surface for exchange heat, m^2;

g—the acceleration of gravity, m/s ;

F_{FW}—high temperature fresh water s total flow, m^3/h;

(h) Simulation Algorithm of Mathematical Models

Quadruple order Runge-Kutta method is used in the algorithm of differential equation. Its basic idea is to pick up more nods such as n in the range of x_i, x_{i+1} to predict their approximation slopes, and then weight and mean them as the approximation of average slope. A quadruple order Runge-Kutta format in common usage is shown as follow:

$$x_{n+1} = x_n + \frac{h}{6}(k_1 + 2k_2 + 2k_3 + k_4) \tag{8}$$

Where,

h is the step.

$$k_1 = f(x_n, u_n)$$

$$k_2 = f\left(x_n + \frac{k_1}{2}, u_n + \frac{h}{2}\right)$$

$$k_3 = f\left(x_n + \frac{k_2}{2}, u_n + \frac{h}{2}\right)$$

$$k_4 = f(x_n + k_3, u_n + h)$$

The mathematical models of auxiliary machinery systems discussed in this paper have been realized by suitable algorithm in microcomputer. They have been confirmed by experiment and have obtained satisfactory result.

It is well known that more than 80 percent of accidents at sea are caused by human factors. The demands of computerized and automated vessels operations require that engineer should be taught more than the standard technical skills of their craft. Besides routine operations, AMS should also be executed under emergency situation or with some performance failures. This kind of training is very difficult to carry out on board ship and is therefore very economical in simulator training which can be of great benefit to seafarers calm emotion and strong ability dealing with the urgent situations. Over 100 typical performance failures of auxiliary machinery were simulated.

4. Development of AMS Software System

Development of AMS software system mainly realizes man-machine interfaces (hereafter MMI), models and communication of AMS. Generally, there are compressed air system, cooling water system, fuel oil system, lubricating oil system, oil-transferring system, oil purifying system, composite boiler system, incinerator system, bilge water system etc on board ship. In order to be convenient for operating and training, PID controller, system configuration and ITS (Intelligent Tutoring System base on expert system) are appended.

4.1 Development Environment of AMS Software

AMS software is the most important section with computer-based simulator system. In order to develop AMS software, the first thing is to select a development environment. It is a good selection to use Visual Basic integrated development environment and dynamic link library (DLL) of DAC system under WINDOWS operating system to develop AMS software (SHI Weifeng, 2002), because WINDOWS 9x/2000/NT operation system are widely used, and API functions called for WINDOWS can be used for multimedia developing of AMS. For example, sound simulation development of air compressor running and system alarming, picture or diagram simulation development of some man-machine interface. DLL functions called for WIONDOWS for DAC system is used for communication between AMS software and hardware. So digital signals and analog signals can be inputted and outputted.

4.2 The Network Structure of AMS

AMS system can be installed in personal computers (PC) with local area network (LAN) system based on WINDOWS 9x/2000/NT-operation system. The communication protocol of AMS system is TCP/IP protocol. AMS system is made up of some hardware and software. There are four sections of hardware system. The first section is microcomputer local area network (LAN) system, which is used for computer-based training (CBT) education of AMS. The second section is remote control console (RCC). The third section is dynamic mimic panel (DMP). The fourth section is simulated control consoles or boxes. They include fuel purifier control box, lubricating oil purifier control box, composite boiler control box, oily water separator control box and refrigerator control box, etc. The hardware includes data acquisition and control (DAC) equipment of industry microcomputer, which is made up of three parts as industry microcomputer, DAC interface and operation equipment. The structure of DAC is shown in Fig. 1. There are 20 computers which are used for trainees to learn basic operation of auxiliary machinery systems. There is one multimedia computer and overhead/data projector used for multimedia teaching of central classroom.

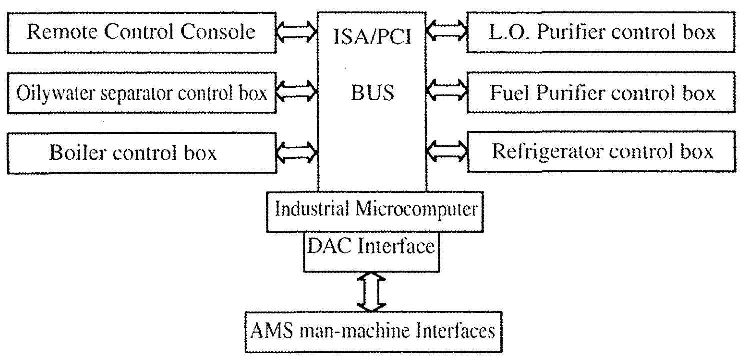
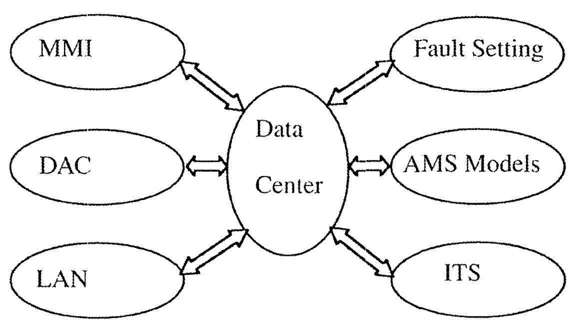


Fig. 1 Data acquisition and control system

4.3 Software Structure of AMS

There are seven units in AMS software system. The first unit is data center unit of AMS system, and is shared by other six units. The second unit is auxiliary machinery models unit. Running conditions and dynamic process of auxiliary machinery systems are simulated in this unit. The third unit is software man-machine interface (MMI) unit, which is CRT operation interface of AMS. The fourth unit is DAC software unit, which is a connection unit between hardware and software. Switch signals and button signals of hardware are acquired. Parameters and display s status of AMS software are outputted through the DAC unit. There are functions of measurement value transform and functions of logic status encode or decode. The fifth unit is LAN



unit. Under WINDOWS operation system with TCP/IP network protocol, this unit is used to communicate among trainer s computer, trainee s computer and industrial computer of AMS. The sixth unit is fault simulation and setting. The seventh unit is ITS system, which is for trainee examination. The structure of AMS software is shown in Fig. 2.

4.4 Man-Machine Interface

Using Visual Basic integrated environment under WINDOWS operation system, a series of MMI were developed. Because many interface elements are offered by Visual Basic integrated environment, MMI of AMS software is very similar to real marine auxiliary machinery on board ship and can be made much more friendly with trainees, which is very important for AMS to be used in marine engine training and studying. There are 45 MMIs in the AMS software system. These MMIs mainly include configuration system, cooling water system, compressed air system, fuel oil system, lubricating oil system, composite boiler system, incinerator system, bilge water system, sewage system, fault setting system and ITS, etc.

5. Application of AMS

The performance of human operator cannot be separated from technical, organizational and other circumstances. Therefore, safety factors are intrinsically interrelated. To obtain insight into this mutual dependence and combined impact, it is necessary to be included in the evaluation of safety the human performer in his operational environment. As a result, owing to the complexities of the operation and essential role of the human task performer, the evaluation of risks cannot be adequately carried out and documented until operational experience and, unfortunately, the related casualty statistics support it (FAN Yongsheng, CHENG Fangzhen, etc., 2000).

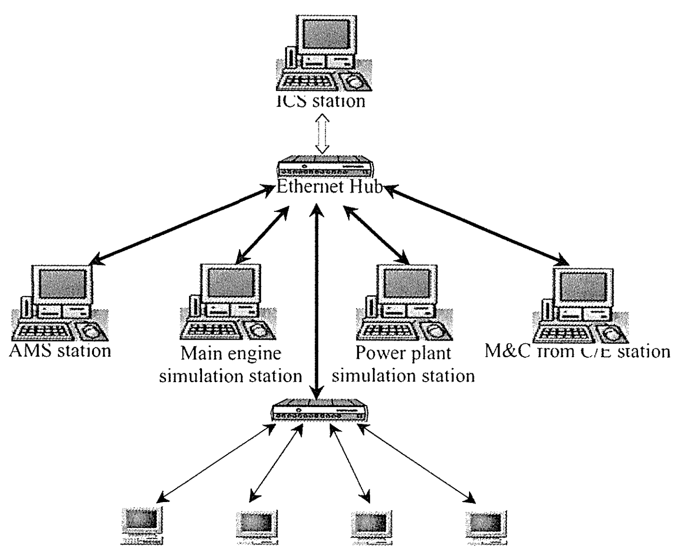
Intelligent Tutoring System (ITS) based on expert system is one of CBT functions. It can monitor and control trainees terminals on line. According to set status of AMS and selected items of trainer, one of experiment items will be produced by ITS. After that, trainee can begin his operating on software and/or hardware. ITS will record the operation step by step. The records include trainee s name, commenced time, completed time, position and contents of operating. According to correct rate of operation, ITS gives a score automatically. Result of operating will be printed through ITS station computer.

The functions of AMS were divided into two kinds: training function and evaluation function. Training function especially stresses controllable operation environment, physical and doing reality, abnormal condition to train trainees regulation operation and management, to master special operation method and process at some unusual conditions. Training program can be separated into four sections:

To lean layout and operation rules of auxiliary machinery on real board ship.
To operate and manage auxiliary machinery at normal conditions.
To operate and manage auxiliary machinery at emergency, dangerous and abnormal conditions.
To optimize operation and management of auxiliary machinery systems.

Evaluation function particularly emphasizes on trainee ability of operation, management and solving problems. AMS system can set some special operation condition, e.g. emergency dangerous and abnormal work condition to evaluate trainee s general ability. Alternation between trainer and trainee is also important in realizing trainer s controlling, monitoring, recording, evaluating and brief summary. AMS system can emulate most of failures or accidents of auxiliary machinery and reinforce seafarers ability to treat with emergency situations and reduce accidents due to human factor, which may have significant impact on the safety and efficiency of navigation at sea.

AMS system contacts with dynamic mimic panel, audio devices, local control console, remote control console, bridge control console, power distribution board, all kinds of control



boxes and some other hardware. It also communicates with other software systems via ICS station, such as main engine simulation system, remote control simulation system, power station simulation system, alarm simulation system, chief engineer monitoring & controlling system and instruction controlling system. According to instructor s commands from ICS station, AMS system can be operated in testing mode, isolation mode, online mode and offline mode (HU Xianfu, HU Yihuai and CHEN Baozhong 2002). Testing mode is used for self-checking of AMS system with standard data when necessary. In isolation mode, the software can be used as one of sub-system of the whole engine room simulator. Online mode is used for full-scale training of marine engine room (shown in Fig. 3). Any operation on hardware facilities can take effect upon all simulation systems. In offline mode, the software can only be used in personal computer without any hardware and other sub-system of marine engine room simulator. This mode can be realized in the 20-student-workstations where trainee can learn the operation rules and some background knowledge of auxiliary machinery.

Based on LAN, AMS system continuously obtains commands of running mode, ship navigating condition, time scale and failure code from ICS, receives main engine speed, main engine starting/stopping signal, main engine fuel rack, cylinder cooling water temperature, power supply of pumps and other control signals from main engine system, power station system and chief engineer (C/E) monitoring & controlling (M&C) system, sends out calculated results to main engine system, power station system, chief engineer monitoring & controlling system and alarm system. It gets user operation on hardware consoles and gives out digital parameters to hardware gauges and indicators. As mentioned above, the simulation system can emulate most of failures or accidents of auxiliary machinery systems which happen scarcely on board ship and reinforce seafarers ability to treat with emergency situations.

AMS system has been used in simulator training of marine engineers and can satisfy the requirement of related IMO conventions and codes.

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Session VII — WG 2

Chair: Prof. T. Fukuoka

Development of An Integrated Simulation System for Analyzing the Swinging Movements of A Ship at Anchor and Its Application for Educational Use
Kinzo Inoue, Hideo Usui, , Rong Ma
KUMM

Proposal of A Mathematical Model for Optimizing Resources in Marine SAR Services
Dr. Francisco Jose Correa Ruiz, Dr. Francisco Sanchez de la Campa, Dr. Maximo Azofra Colina
University of Cantabria

Maritime Security Education and Training Needs Post 9/11: The Response of the United States Merchant Marine Academy
Jon S. Helmick
United States Merchant Marine Academy

Augmented Reality: A New Tool to Increase Safety in Maritime Navigation
Chuck Benton, Jefferson Koonce
MMA

Development of an Integrated Simulation System for Analyzing the Swinging Movements of a Ship at Anchor and its Application for Educational Use

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Abstract

As we know, due to wind action, a ship at anchor sways periodically, and this characteristic movement can be called a swinging pendulum movement._It is very difficult to understand and to explain such a complicated phenomenon. To help understand this difficult phenomenon, the authors developed the integrated simulation system (ISS) for educational use.

ISS uses various outputs which, when produced from a mathematical model simulating a ship at anchor, create an animation. This simulation system is a visual educational system, which not only has the function of simulating a ship at anchor, but°also displays changing forces in real-time. The system can also estimate the danger of dragging anchor and show how the anchor-dragging mechanism works.

To verify the educational effect of ISS, an experiment was performed, with impressive results. Students felt that a lecture supported by ISS was easy to understand and believe that it is necessary. The improved educational effect when studying the swinging movement of a ship at anchor was confirmed using animations produced by ISS. As a visual study resource, ISS and its animation provide a better understanding than a typical lesson in a classroom because of its simplicity.

We believe that ISS cannot only be used for educational purposes, but also as an assessment system for experiments that evaluate the safety of a ship at anchor. Such a system may be useful to researchers in other field. This paper only discusses ISS s educational use and now efforts are being made to increase its usefulness.

1.Introduction

As we know, due to wind action, a ship at anchor sways to the right and the left periodically like a pendulum. This movement is characteristic of anchoring ships and can be called a swinging pendulum movement.

This movement occurs with regularity of the drifting motion in the horizontal direction along with a combination of rapid yawing motions at both sides of the swinging pendulum movement. The hull sways like a pendulum from right to left and from left to right, just like a figure-of-eight (8). Moreover, in the process of this movement, impact force acts on the anchor at both sides of the orbit. Such swinging pendulum movement and impact forces acting on the anchor are produced by the combination of external force of the wind, hydrodynamic force that acts on the hull and restoring force of the anchor cable.

It is, therefore, very difficult to understand and to explain such a complicated phenomenon of ships at anchor, especially to our students who only receive explanations in lectures with some illustrations.

However, to assure the safety of ships at anchor, knowledge about the relations of these forces, understanding of the dynamic mechanism of the swinging movement and the relationship between hull posture in a swinging movement and changes of force acting on the anchor are very important to students who will become seafarers in the near future.

To help them to understand such a difficult phenomenon, the authors developed the integrated simulation system (ISS) for educational use.

ISS uses the various outputs which, when produced by a mathematical model simulating a ship at anchor, shows the animation displays. This, in turn, makes it easier to understand the complexities involved when a ship has to anchor and can also analyze many phenomena in accordance with the anchoring.

This simulation system is a visual educational system, which not only has the function of simulating a ship at anchor, but°also displays graphically swinging pendulum movement in animation to help students learn how a ship at anchor swings and understand the relationship between changes of anchor chain tension and hull postures. The system can also estimate the danger of a dragging anchor and show how the anchor s dragging mechanism works. So, it can also assess the potential danger of a dragging anchor and can analyze the mechanism of a dragging anchor.

2.Development of an Integrated Simulation System for Anchoring Ships

2.1 Introduction of the System

This integrated simulation system was developed by means of O2 workstation manufactured by Silicon Graphics, Co. Ltd. Its development language is Computer Language C. The user interface is Motif and the graphic library for displaying images is OpenGL. The composition of this system is shown in Figure 1.

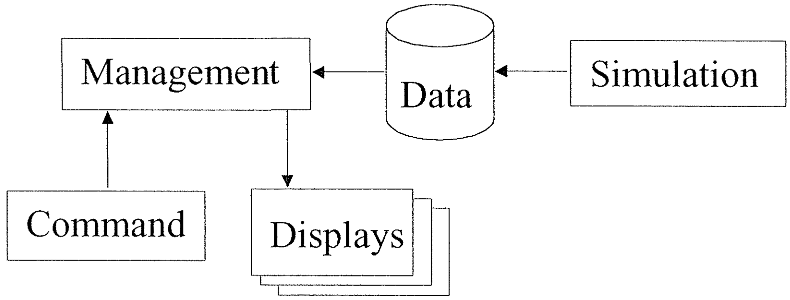

Fig.1 Composition of the system

This system consists of five sections such as simulation, command, management, data and displays section. The simulation section calculates ship motion by a mathematical model simulating a ship at anchor. The command section receives and transfers user s operational commands to the management section. The management section reads the data that are transferred from the simulation section, and relays them to the display section. The management section also computes all the correlative data for displaying and transmits the computed results to the display section to be shown on the display window.

Signal showing the end of drawing process returns back to the management section to let it transmit the new data for the next drawing process.

2.2 Function of the System

This system has three different modes for displaying. Figure 2 shows an example of education mode. This display mode is designed for educational use. It gives us informations for understanding of dynamic mechanism of the swinging movement of a ship at anchor.

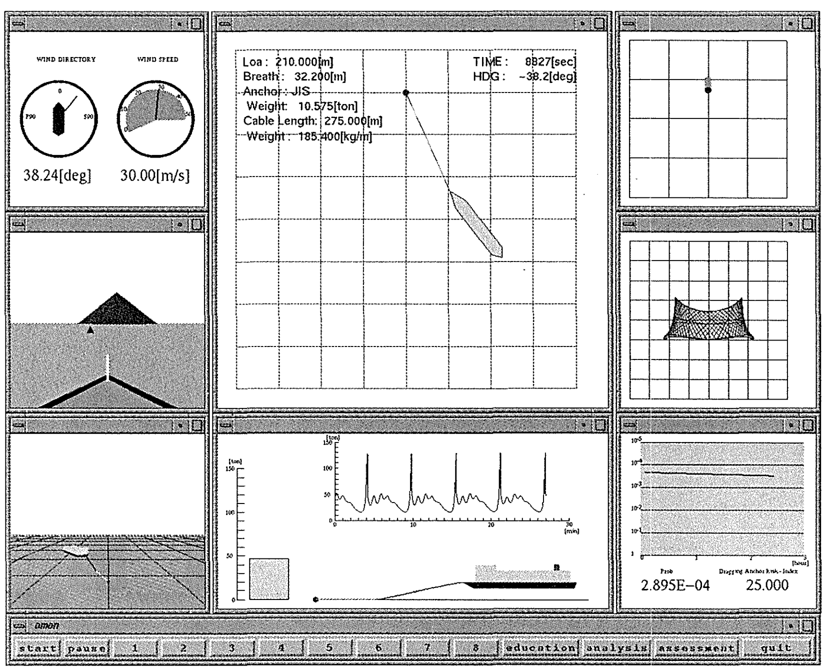

Fig.2_An example of a display for education mode

Figure 3 shows an example of analysis mode. This display mode is designed for movement-analysis of a ship at anchor. It gives us informations of phenomenon that forces and moments acting on a hull and anchor chain influence to the swinging movement of a ship at anchor.

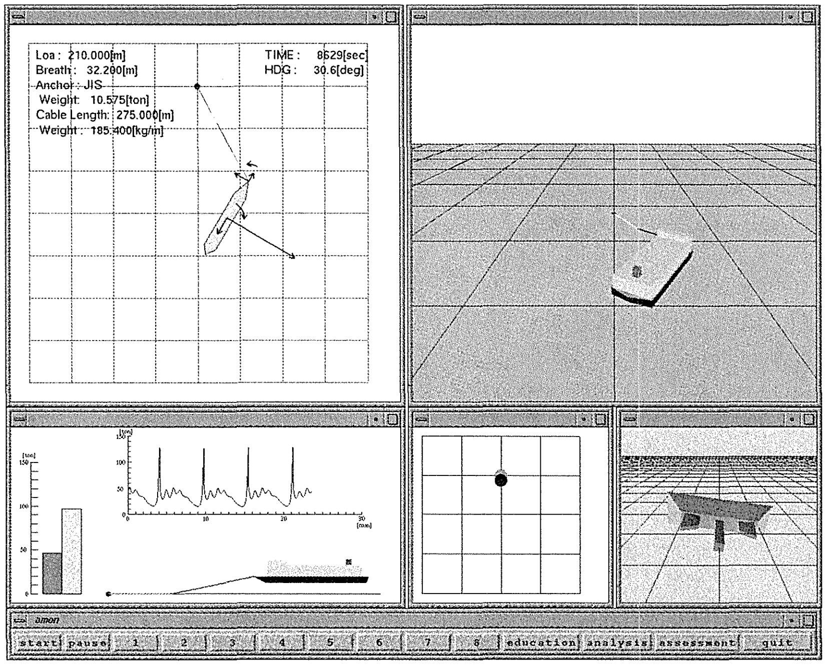

Fig.3_An example of a display for analysis mode

Figure 4 shows an example of assessment mode. This display mode is designed for safety assessment. It gives us informations of the mechanism of dragging-anchor due to the swinging movement of a ship at anchor.

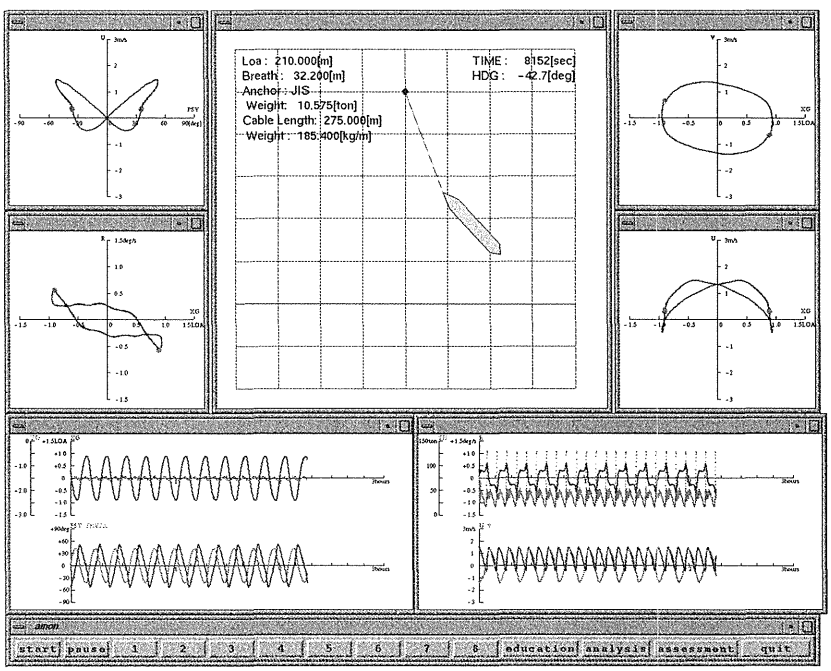

Fig.4_An example of a display for assessment mode

2.3 Function of Education Mode

The operation buttons on the user interface are arranged at the bottom of the screen. A user pushes a button to start, suspend and close a screen or choose one of the screens at his or her will. The display window can be changed to educational, movement-analysis or safety-evaluation-aimed ones. Educational window is fixed as a starting one. The display contents are as follows:

(1) Swinging movement display (of two dimensions) of a ship at anchor (bird's-eye view);
(2) Wind direction and wind velocity indication;
(3) Hull movement orbit (center of gravity, bow and stern);
(4) Anchor chain tension (by time series);
(5) Anchor movement orbit;
(6) Swinging movement display of three dimensions (viewpoint: bridge);
(7) Swinging movement display of three dimensions (viewpoint: windward);
(8) Probability of anchor dragging and anchor_dragging risk index numeral .

2.4 Display Windows

(1) Swinging movement display (of two dimensions) of a ship at anchor (bird's-eye view)

Swinging pendulum movement is described graphically in animation to be seen from the sky. Students can see not only a swinging track statically but the postures changing continuously of the hull second by second. This helps students learn how a ship at anchor swings.

Besides, this window shows the parameters used for simulating calculations, which provides them of a good opportunity to observe the change of the movement caused by different settings of the parameters. Seeing the heading angle changing by time, they also can know how to estimate a ship movement by the changing of heading angle.

(2) Wind direction and wind velocity indication

Changes in wind direction and wind velocity are basic information for mariners to judge the swinging movement of a ship at anchor. Students must learn the relationship between the swinging movement and the wind direction shift on the display and the display (1).

In addition, they learn how to judge the ship movement by monitoring wind direction as well as wind velocity.

(3) Hull movement orbit (center of gravity, bow and stern)

Concerning to the center of gravity in the hull, its bow and stern, their loci are displayed. The hull posture at every fixed time is also displayed on this window. This shows students clearly the typical swinging movement is that of a figure of eight, and they can know well how large the deflection range and the occupied water area can be.

(4) Anchor chain tension (by time series)

Changes of anchor tension can be shown graphically as time goes on. They can see its tension change in real-time. And they can study changing process related to sudden and steady tensions and the relationship between changes in the tension and hull postures. They can see how changeable the part of the chain lying on the seabed is while a ship is swinging.

(5) Anchor movement orbit

External forces affecting to anchor and its chain, when stronger than their holding power, causes anchor to slide on the seabed. This window shows the locus of such a sliding anchor before it finally turns over and starts to drag. Students can observe the states of hull posture and chain tensions when an anchor starts to slide.

(6) Swinging movement display of three dimensions (viewpoint: bridge)

This gives the scene mariners have when standing on the bridge. Even a well-experienced seafarer can t easily have a clear perception of swinging movement, because the ship movement is too slow. Thus, students must learn wind direction is essential source of information to know the swinging movement at anchor exactly.

(7) Swinging movement display of three dimensions (viewpoint: windward)

This window shows the relation between an anchor holding the seabed well and a hull moving regularly on the sea surface.

(8) Probability of anchor dragging and anchor_dragging risk index number

Authors have already proposed two parameters as the indices to quantify a probability: one is the probability of anchor dragging and the other is anchor dragging risk index number. These parameters let us know how the safety of a ship varies as time goes on and what factors can be to affect to the safety of a ship at anchor.

3. Educational Effect of the System

3.1 Experiments on the System s Educational Effect

When a lecture about the movement of a ship at anchor is given in the classroom, an explanation is often given with some figures drawn on a blackboard.

However, when talking about a dynamic phenomenon such as the swinging movement of a ship at anchor, it is important to note that various forces are inter-related. It is, therefore, not easy to make students aware of the relationship between such forces and figures drawn on the board.

To understand the dynamic movement of a ship at anchor, it is important to display the composite action. From this we can recognize that visual educational system, which can show graphically the movement in animation, is necessary. This integrated simulation system (ISS) was developed from this viewpoint.

The visual display windows of ISS make it easier for students to understand the movement regularity of a ship at anchor. They will also come to know the relation between wind direction and the hull s posture, as well as the relation between a hull s movement and the tension on the anchor. Through these windows, students will understand the whole process and the reasons why a ship changes her posture in wind, and how the anchor changes from holding well to dragging.

To verify the educational effect of the ISS, we conducted an experiment. It was performed with 20 students from the third grade of the nautical study course at Kobe University of Mercantile Marine. Each of them gained a score between 75 points and 80 points in the final test for a lecture on theory of ship handling.

The 20 students were divided into four groups of A, B, C and D, and took part in a two-day program. Each group had five students and each group s schedule was as follows:

The 1st day:

Group A: The group received only the usual lecture in a classroom.

Group B: The group received the usual lecture in a classroom first, and then received a lecture using ISS animation.

The 2nd day:

Group C: The group only received a lecture using ISS. No usual lecture was given in the classroom.

Group D: The group received a lecture using ISS first, and then a usual lecture in a classroom.

One instructor gave explanations to the four groups on the movements of a ship at anchor. After whole program of each group, a test shown in Figure 5 was given to the students on the swinging movement of a ship at anchor. The test results are shown in Table 1.

Table 1_ The test results of each group

Group	Lecture	Average Score
Group A	Only received lecture in classroom	78.5
Group B	Received lecture in classroom first and ISS lecture	90.6
Group C	Only received ISS lecture	90.0
Group D	Received ISS lecture first and a lecture in classroom	93.8

On Table 1, the average score column shows the average score of the test on every group. We found a large difference between groups A and groups B, C, D in their scores. Clearly, group A gained the lowest score, while groups B, C, D s comprehensive results were higher. This is understandable due to them receiving a lecture using ISS.

On the other hand, when comparing the scores of group A and group C, it can be said that the educational effect of ISS animation is impressive. It can deepen understanding of the complex phenomenon much better than having only a lecture in a classroom.

We also carried out the Levene statistical official approval using the SPSS software between each two groups A&B, A&C and A&D with every student s scores. It was examined in 95% of the reliability. In the Levene official approval of the same dispersion, each probability is 0.447, 0.524, and 0.817, and F value is 0.640, 0.444, and 0.057.It can be said that the ISS lecture is certainly effective according to these result.

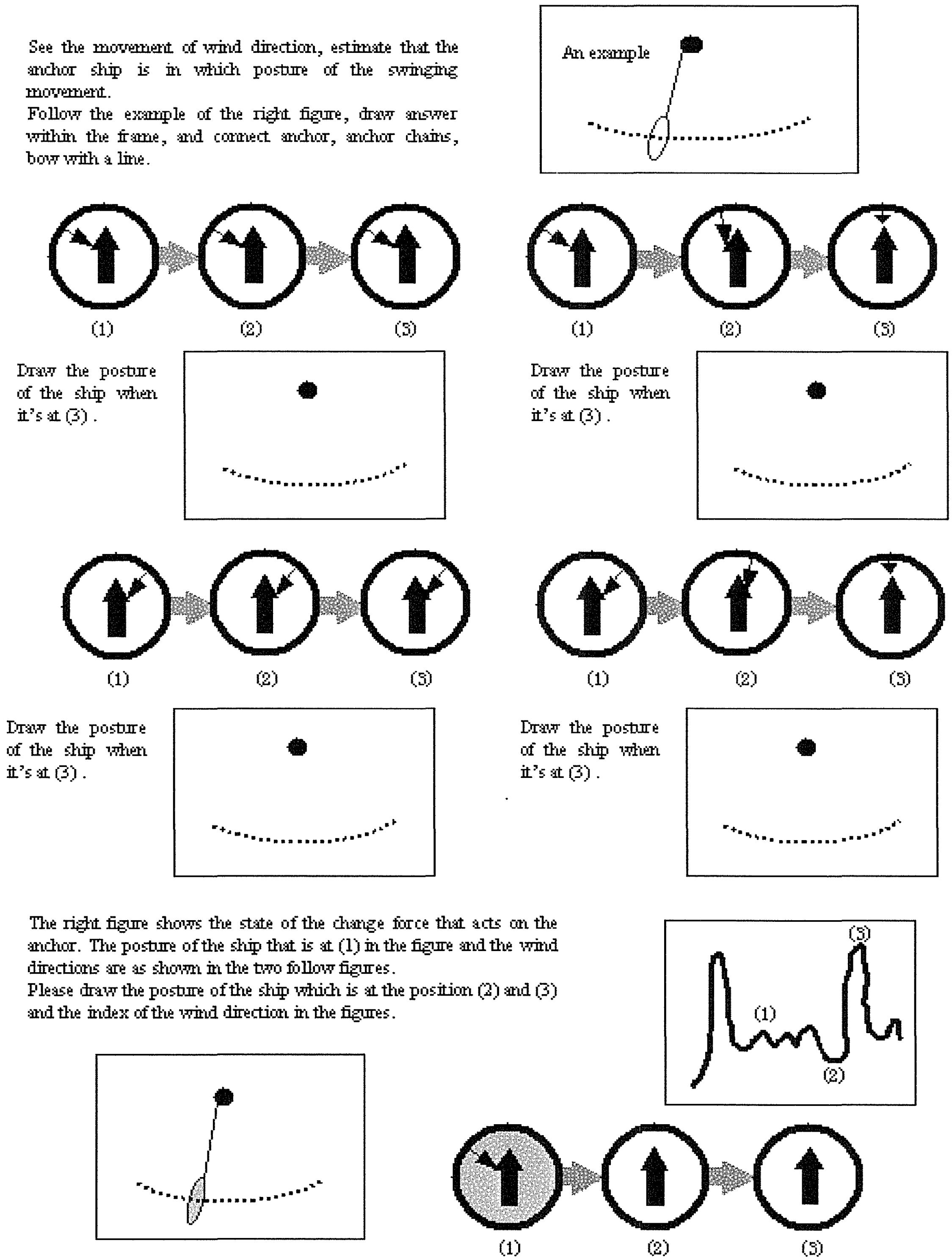

Fig. 5 The test of the swinging movement

3.2 Results of Questionnaire

Questionnaire was given to the students of groups B and D who received both lectures. Ten questionnaires were distributed and there were nine replies. The following are the results.

The questionnaire had four questions.

(1) Question "which lecture is more useful to you for understanding the swinging movement: the usual lecture or the animation-lecture using ISS? Why? Everyone chose the animation lecture and their feelings are recorded in Figure 6.

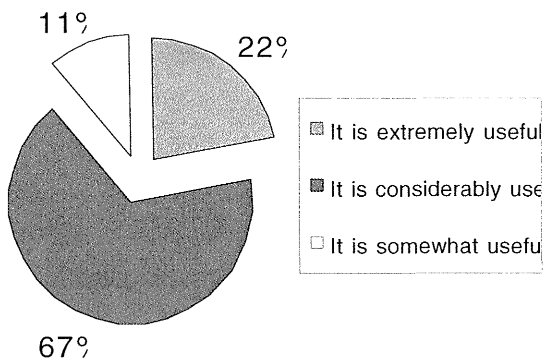

Fig. 6 Results of question one

(2) The results are shown in Figure 7 for the question "which point was most useful for you to understand the swinging movement in detail?"

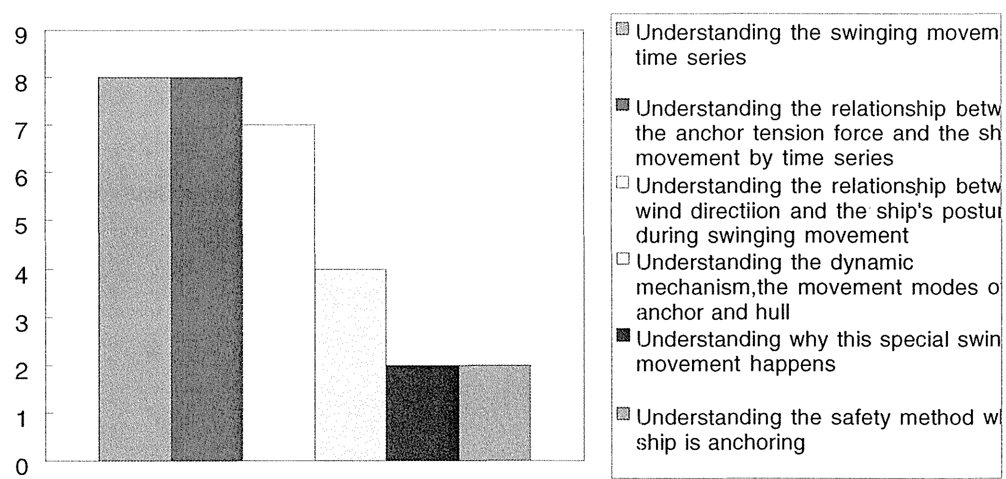

Fig.7 Results of question two

(3) The answers to the question "Would you prefer to receive the lecture with ISS animation first or the lecture in a classroom as usual first? Choose which you believe to be most effective" are shown in Figure 8.

(4) For the question of the two kinds of lecture, do you think that only one is enough or that both are necessary? the answers are shown in Figure 9.

Regarding the free answers in the questionnaire, five out of nine respondents gave the free answer. The results are shown in Table 2.

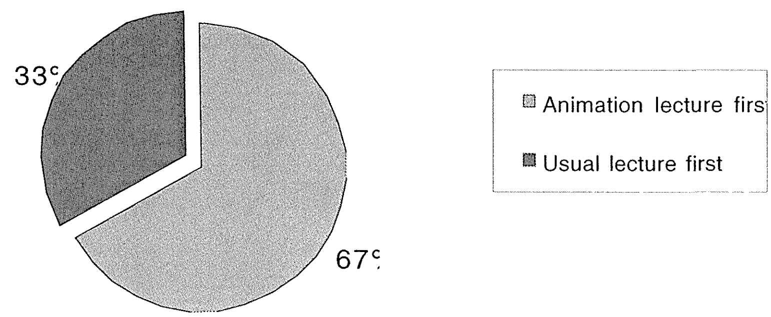

Fig.8 Results of question three

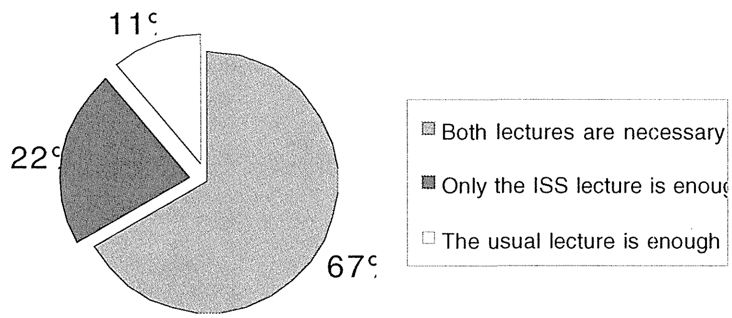

Fig.9 Results of question four

Table 2: The Results of free answers

Feel Positive, 3 persons	The lecture with ISS is easy to understand and believe that it is necessary; the ISS display the hull s movement very well.
Problems,1 person	In the lecture using ISS, there are no relevant documents. Maybe one could understand the explanation better when annotated on the blackboard.
Advice, 1 person	How about linking the lecture with ISS and the training-experiments on ship handling.

3.3 Investigation with Questionnaire

The better educational effect from studying the swinging movement of a ship at anchor was confirmed using the animations of ISS. As a visual resource, ISS and its animation can lead to a better understanding than a typical lecture in a classroom because of its simplicity.

Furthermore, it was effective to give an oral explanation when students see animations of ISS.

We also believe that it is important to combine other audio-visual aids such as videotape etc. However, since the auxiliary teaching materials according to the animation of ISS are still insufficient, it is now time to start to compile teaching-materials for our ISS.

Before students conduct practical experiments on ship anchoring aboard our training ship, maybe they should be given a lecture with the ISS animation. The students would feel more at ease and make fewer mistakes during such an on-board experiment, especially for those who have not prepared for ship training.

As mentioned above, we can see that ISS as a visual educational system, is useful for understanding the swinging movement of a ship at anchor, and is useful for deepening anchoring-safety knowledge.

4. Conclusions and Future Study Directions

This system can be positioned as an added-value application system of a ship-handling simulator.
The new ISS can analyze the swinging movement of a ship at anchor and impacts of forces on hull, anchor, anchor chains, etc. It cannot only be used for educational purposes, but also for assessing experiments on safety evaluation for a ship at anchor. Such a system may be useful to researchers in other field.
In the present paper, only the educational use of ISS was verified and now efforts are being made to increase its usefulness.

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PROPOSAL OF A MATHEMATICAL MODEL FOR OPTIMIZING RESOURCES IN MARINE SAR SERVICES

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ABSTRACT

When planners determine the dimensions of a means of transport, for example a regular shipping line that is going to join two or more ports, they estimate numerically the relation between the populations joined. This means that they must study and quantify the people and/or goods that are going to be moved from one point to another in accordance to certain parameters. Consequently, they will indicate to the Shipping Company the number of ships and frequency of sailings that must be established to offer an effective service and make the operation profitable. In the same way, it is possible to establish the relation between accidents and an efficient marine Search and Rescue service, according to a series of parameters determined beforehand. In this work an important population will consist of a zone where many serious accidents take place, and for that reason it will be necessary to give this area suitable coverage. Thus, the resources used for rescue must be located near the demand, considering that the means available are never limitless. This apparently simple problem becomes more complicated when we consider a number of different zones and take into account the different kinds of casualties that occur in each one, as well as the number and nature of the means to be employed. In this paper we propose a mathematical model that allows us to relocate SAR resources following the previous criteria. We have made use of gravity mod - els . These mo dels assess the alternative locations according to their proximity to or distance from the accidents, as well as using corrective coefficients that measure, among other things, the suitability of present infrastructures in the location at issue and the relevance of the casualties.

1. Introduction.

As Lee says, essentially, a model is a representation of the reality. It is usually a simplified and generalized statement of what seems to be the most important characteristics of a real world situation. It is an abstraction from reality which is used to gain conceptual clarity. The value of a model is that it can be used to improve our understanding of the ways in which a system behaves in circumstances where it is not possible to construct or experiment with a real world situation .

To formulate a model it is necessary to reduce a phenomenon to its fundamental lines. That is to say, we realized a simplified representation that, though it does not correspond in its entirety to the reality, allows us to translate the phenomenon into a symbolic - logical language by means of equations or statistical laws.

This way, for example, when a planner determines the dimensions of a regular line of passengers for joining two or more ports, he establishes the interrelationship among the united populations. It means that he is going to study and to establish the number of persons that are going to move every day from each port to the others, according to a few parameters. In consequence, he will indicate to the ship-owner the appropriate ships and schedules adapted to offer an effective service that makes profitable the exploitation of this line.

The same way, it is possible to investigate the interrelationship between the accidents and a SAR service. In this case, a planner must choose among alternative locations for the SAR ships and helicopters. In this model an important population will consist of a zone where place many and severe accidents take place, and for such reason it will be necessary to give her a suitable coverage. This way, SAR resources will be located where the interrelationship (attraction) between the accidents and the rescue resources is maximum, bearing in mind that the available means are never unlimited.

2. Gravity models.

Gravity models have probably been used in planning and transport studies more than any other form of mathematical model. Gravity models have been used during decades to analyze the interaction among several urban areas and they are named this way because the concept of human interaction can be assimilated to Newton's gravity concept. The simplest version of the gravity model can be represented mathematically this way:

$$I_{ij} = G \frac{P_i P_j}{d_{ij}^{b}} \qquad (1)$$

Where:

I_{ij} is the interaction between areas i and j.

P_i, P_j are the sizes of areas i and j.

d_{ij} is the distance between areas i and j.

b is a power or exponent applied to the distance between areas.

G is a constant, which is empirically determined, and is used to adjust the relationship to actual conditions. Once calculated, this constant expresses the intensity of the interaction amongst any of the areas in which the region object of study has been divided. This value of G depends on current conditions.

Therefore, gravity models allow estimating the interactions among the different areas in which the region object of study is divided. These models are also applied to the development of indicators that evaluate alternative locations, as the different situations for one bus stop or a station of train and, why not, indicators destined to compare the alternative locations of SAR resources.

3. The gravity models as models of location: problems and limitations.

This paper will center on the following points: Absence of a sound theoretical base; the need for disaggregating; the form of the distance function; the importance of zoning and the problem of calibration.

3.1 Lack of a theoretical solid base

Schneider affirms: There is no real kinship between a gravitational field and a trip generating system . Other authors have developed theoretical explanations of the gravity model using information theory and entropy maximizing methods, but we consider that are not adequate explanations of the gravity model in behavioral terms.

As the models of regression, the gravity models are capable of describing satisfactorily the interaction, but they do not explain it. Its attention does not center in what is happening, but in the result of what has happened, summarizing the information to describe the current situation.

Summarizing, it can be said that:

a) The results of the model are not acceptable when changes are produced in the system object of study.
b) Since the laws of the system are unknown, it is not possible to know whether it will change.

3.2 Disaggregating gravity models

It is obvious that these models were designed to account for the behavior of large groups of people, assuming that the behavior of large groups is predictable because the idiosyncrasy of the individuals tends to be cancelled out. The sample to which we apply the model has to be numerous and homogeneous. This way, the behavior of the population can be predictable on the basis of mathematical probability, being diluted the influence of the exceptional behaviors. In other way, the exceptional behaviors do not have to be representative in the set of the sample. When an exceptional behavior is sufficiently representative it is converted into a subgroup of population who must be treated apart from the rest.

When we deal with maritime accidents, it is evident that we must treat separately those fleets with accident rates related to homogeneous circumstances. One initial approximation to this question invites to treating separately the merchant fleet, from pleasure boats and fishing vessels. We can understand better this question with an example: The summer arrival produces an increase in the accidents of the pleasure fleet but not so on the others. Large SAR tugboats are not required to give assistance in incidents related to the pleasure fleet. The treatment of the information related to all three fleets together could lead to trying to keep operative during the summer a number of tugboats greater than necessary.

3.3 The distance function

The distance is used as the impedance variable. Nevertheless, it is evident that simple distance is not a sufficiently accurate measure of the effects of spatial separation. In case of maritime SAR, the time of arrival to the place of the disaster is a more significant variable than distance.

The exponent to be applied to the time factor needs to be changed for different salvage purposes, according to the cause of the assistance (It is not the same thing to be an hour late when human lives are in danger than when they are not). It is easily understood that the exponent not only has to change depending on the cause of the assistance, but also with the distance. This way, for example, we can consider a constant exponent until the radio of action of the SAR vehicle is reached. Once it has been surpassed, the value of the exponent would become infinite.

3.4 Zoning problems.

The use of spatial interaction and location models implies that the region under study has been divided in areas or zones. In practice, zoning systems are generally arbitrary, though the definition of zones is important for model performance.

The maritime accidents taking place in the same zone are grouped together as a unique entity (one weight and one location). That is to say, the model treats equally all the accidents grouped in the same zone.

A large number of zones (small areas) complicate calculations. A small number of zones (large areas) remove precision from the model, provided that it treats equally accidents with very different locations.

3.5 Problems of calibration.

Calibration is the process that allows finding the values of the parameters; it is to say, G and the exponents of the distances or times. These values provide the best adjustment between the model s performance and the fields measurements which gather the behavior of the real world system.

The most common evaluation consists of applying a method of comparisons with different values of the parameter and to select that one that facilitates the better adjustment . Here the problem of the predi ction arises. The parameters are correct for the current situation, but they do not have that to be in the future.

4. Hansen s gravity/potential model.

Hansen developed one of the earliest examples of the use of gravity models in planning situations. His model of location was designed to predict the settlement of population, and was based on the hypothesis that accessibility to employment is the principal factor that determines the above mentioned settlement of population. Hansen considers that the relationship between the increase of the population in the zone i and the present employment in the zone j can be expressed by means of an index of accessibility that would be calculated this way:

$$A_{ij} = \frac{E_j}{d_{ij}^b}$$

Where:
Aij is the accessibility index of zone i in relation to zone j.
Ej is the total employment of the zone j.
dij is the distance between zones i and j.
b is an exponent or power of dij.

This one is the expression of the accessibility of the zone i in relation to zone j. The general index for the

$$A_i = \sum_j \frac{E_j}{d_{ij}^b}$$

Hansen admits that, besides the accessibility, a fundamental factor exists in the fixation of the quantity of population who feels attracted by a certain area, this factor is the available area for residential uses. He called this the holding capacity of a zone and thinks that both factors can be combined calculating an index of development potential , which is obtained multiplying the index of accessibility by the hol ding capacity. The resultant index of a zone, Di, is therefore:

$$Di = Ai\ Hi$$

Where: Hi is the holding capacity of zone i. The development potential can considered to be a measurement of the attractiveness of a zone, based on access to employment and in the available area for housings. The population is distributed in zones of agreement with relative development potential of each one of them, that is to say, the development potential of each zone divided by the total potential:

$$\frac{A_i H_i}{\sum_i A_i H_i}$$

Hansen suggested that the share of total population growth, which will be obtained by each zone, is related to how attractive that zone is in relation to all the competing zones. If the total growth in population is Gi, then the amount of that growth going to any zone i will be:

$$G_i = G_t \frac{(A_i H_i)}{\sum_i A_i H_i}$$

This provides an instrument of assignment of the population which application is relatively easy. It can be used to test the effects of different hypotheses. The figure shows a flowchart that contains the sequence of calculations for the Hansen model..

5. Formulation of the model.

The problem dealt with by the authors of this paper tried to evaluate the spatial distribution of the maritime SAR resources which cover the coasts of Northern Spain. Therefore, we faced a wide maritime region and a large number of ports and alternative airports.

We elaborated a database with the location of the maritime accidents, information about the implied vessels, the type of incident, their causes, meteorological conditions, human and material loses, together with the means of salvage that were used, whether they belonged to the Spanish SAR Service (SASEMAR) or to neighbor countries.

Our work aimed to redistributing SAR means in an optimum way. To achieve this task, we evaluated different alternative locations.

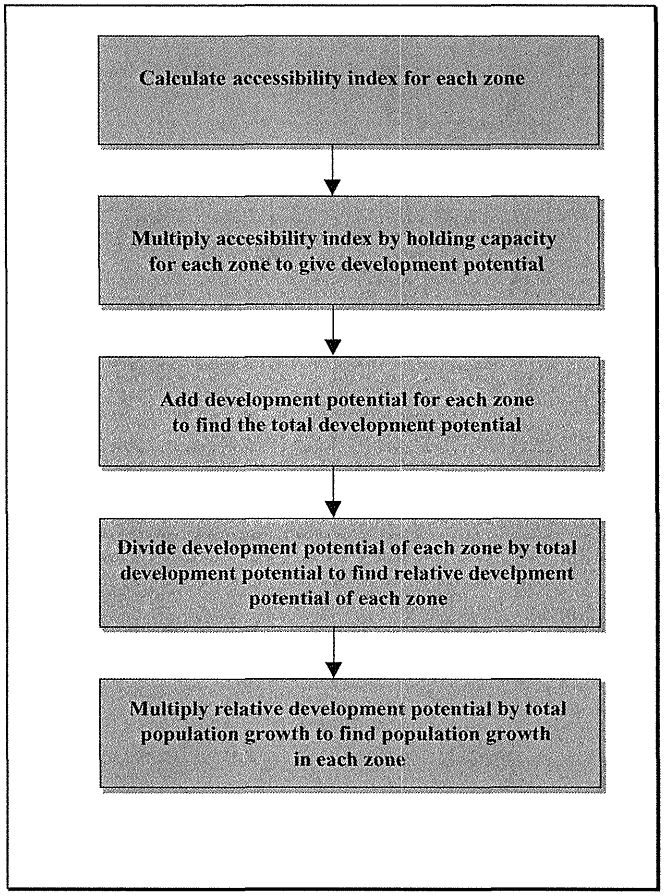

Fig. 1 - Flowchart for Hansen model

The model we propose is a modification of Hansen's model. Our model evaluates each of the resources separately (fast rescue boats, rescue tugboats and helicopters). This point of view is due to the fact that we can use different ports for the location of the different resources.

5.1 Assignment of weight

Maritime accidents were classified as belonging to four different types attending to their relevance: very serious, serious, moderate and slight. This information was stored in the database as an integer ranging from 1 to 5.

Relevance = f(no. deceased, no. injured, no. rescued, vessel value, cargo value)

In terms of gravity models, we assigned some weight to the accidents. Said otherwise, we are thinking that the intervention of the means of salvage is more valuable in some cases that in others.

The weight of the accidents has in our model a role equivalent to which the employment has in Hansen's model. The assignment of weight to the different accidents is carried out by means of an expression which arguments are included in the different fields of the database. In this article we do not include the detailed formula provided that we do not try to enter into such levels of concretion and, besides, we are quite sure that any reader will be able to obtain a number of different algorithms for such formula.

When every accident has been assigned a weight, we must distribute such weight between the different SAR resources: helicopters, tugs and fast rescue boats.

This distribution of fast rescue boats and helicopters is based in estimating the urgency in the intervention. The greater the urgency, the greater the weight assigned to the helicopter. Also the weight of the helicopter increases when the state of sea worsens or, for example, grounding has taken place in places inaccessible from the coast. This assignment is inverted in favor of the boats when the accident is placed

Large tugboats were only assigned a significant weight when towing vessels or extinguishing large fires that surpassed the capacity of the light crafts was required.

So that, to assign weights we employed the fields of the database, and placed the accidents, one by one, on the nautical chart.

5.2 Zoning.

The gravity model might be applied accident by accident. However, this way of proceeding would imply calculating distances between every accident and the different locations of the salvage resources. Calculations can be simplified if we divide in zones the waters object of study.

On the other hand, as we have seen above, the assignment of weight between the helicopter and the boat is dependent on their location. In this way, not all the accidents are treated equally in the model. It is, therefore, essential to delimit some zones. These zones must be composed by regions in which we can treat the accidents in a homogeneous way.

The accidents that took place in each of these zones were grouped in a super accident . The weight of this one was obtained adding those of the respective accidents. In the oceanic regions the situation of the super accident is calculated as a weighted average of the latitudes and longitudes corresponding to the accidents which took place in the area. In coastal waters we must analyze the weighted average and, if it is necessary, we must divide the zone. Super accidents which took place in ports or estuaries were located on the geographical center of such areas.

At open sea, zone sizes are greatest. Small zones lead to unnecessary calculations. On the other hand, too large zones lead to treating equally accidents that should be dealt with separately.

Maximum size of the oceanic zones depends on the type of SAR source. A zone must be a sea region with such a size to allow access to any of its points in homogeneous conditions. In other words, the size of the zone has to be small in comparison with the radio of action of the SAR vehicle.

For the application of our model we divided the coast of the Bay of Biscay and Galicia (Northern coast of Spain) in 207 zones for the fast rescue boats and 34 for the tugboats and helicopters.

We can apply regression analysis to forecast the future needs of salvage resources for each zone.

5.3 Accessibility.

Following the steps of Hansen's model, we may calculate accessibility now. With that in mind, let s place a SAR vehicle in a location i. The following expression evaluates the ability with which this SAR source gains access to the accident from the above mentioned location:

$$Ai = \sum_j \frac{Pj}{t_{ij}}$$

Ai is a coefficient that measures the value of a SAR vehicle placed in a certain location.
Pj is the weight of the super accident placed within reach of the above mentioned SAR resour ce.
tij is the time of arrival to the super accident .

The values of t will always be over a minimum that will depend on vehicle in question. This way, we limit the importance that the model grants to those mishaps that take place in the surroundings of location i.

Access time calculation is carried out using distances measured on the nautical chart and typical vehicle speeds. When these are maritime, way points are established along the coast in order to obtain credible tracks with a minimum of calculations.

5.4 The capacity of group and the potential of development.

The grouping capacity of Hansen's model is translated to our model as suitability factor . This factor, from 0 to 1, tries to evaluate the advantages and disadvantages of the infrastructures associated with the location at question. In case of the fast rescue boats, this factor takes into consideration the number of days when the port remains closed by bad weather, as well as the land traveling time up to a well equipped hospital.

For tugboats, the suitability factor depends on the days that the port remains closed due to bad weather and also its possible restrictions of draught. The autonomy of the tugboats allows them to go far out of their bases and tow the assisted vessel to any suitable port.

The bases proposed for the helicopters are all airports, with a suitability factor equal to one. Obviously, helicopters can take off from her bases and can land near the best hospital.

One we have obtained the suitability factors, a numeric estimation of the value of locating any SAR vehicle in i location is expressed by:

$$Di = f\,Ai$$

5.5 Assignment of the means of salvage to the different locations.

From this moment on, the nature of our problem requires us to separate our model from that of Hansen's. Hansen's model does not raise any restriction to the possibility that the population desert certain zones. In the case of maritime SAR, we can not accept that SAR resources be concentrated in zones with a greater number of casualties, while others are left unattended.

We also observe that the settlement of the population does not affect the distribution of the employment. Nevertheless, in the case of SAR, the assignment of a resource to a location supposes that several zones remain attended, and we must disregard these zones at the time of assigning the following source.

Our way of proceeding solves these questions. First, we calculate the *Di* values taking into consideration the totality of super accidents . A fast rescue boat, a rescue tugboat or a helicopter is assigned to those locations that clearly stand out of the set. The attended zones from these locations are removed from the sample, and the values of *Di* are calculated again. The process is repeated until all areas are attended.

When all zones are covered, the remaining salvage resources are assigned in accordance with the initial *Di*.

6. Conclusion.

Our model distinguished the merchant, fishing and pleasure fleet when the weight of the accident was distributed among the different salvage resources. It is evident that an accident of a merchant vessel does not need the same means than another accident in which only a light craft is involved.

We think that the model does not answer correctly to the seasonal variation of different factors. Fundamentally, it would be convenient that the model took into consideration the summer increase of the activity of pleasure boats and also that during summer time most ports remain open 100 % of the time (there exists, so, a seasonal variation of the suitability factor).

We recommend therefore that the model should be applied twice. Once for the summer time, and the other for the rest of the year. Our experience indicates that this way of proceeding leads to that in summer some fast rescue boats are moved toward minor ports. These ports are bad winter bases, but they allow better SAR operations to summer users.

We have revised the location of the SAR resources in the Northern coast of Spain, and we have concluded that there is a reasonable distribution of the means. We must only emphasize that the superposition of responsibilities leads to an accumulation of SAR resources at the main ports, which in many cases are redundant.

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Maritime Security Education and Training Needs Post-9/11: The Response of the United States Merchant Marine Academy

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ABSTRACT

The use of American commercial transportation carriers to carry out the terrorist attacks of 11 September 2001 provoked widespread recognition of manifold security vulnerabilities in the nation s port, maritime, and intermodal transportation systems. Effective deterrence of hostile action directed at merchant vessels, vehicles, and facilities and prevention of the utilization of cargo conveyances as a means of delivery for weapons and terrorists will require specific education, training, and research for those who must manage these threats. This paper characterizes the asymmetric warfare threat to the marine and intermodal transportation system, summarizes key personnel issues related thereto, and describes the education and training initiative developed by the U.S. Merchant Marine Academy in response to these threats.

1. Introduction

The terror attacks of 11 September 2001 prompted a large-scale assessment of the nation s vulnerabilities to terrorist acts and other types of asymmetric warfare. The transportation system, for obvious reasons, is of particular concern. While the security of the U.S. commercial aviation system was the natural initial focus of this scrutiny after 9/11, other modes and dimensions of transportation infrastructure are now being similarly examined. Unfortunately, our transportation system as a whole clearly offers both a target-rich environment and a potential means of access for those who seek to harm America through asymmetric warfare in general and terrorism in particular.

While all modes of transportation have specific vulnerabilities to asymmetric and terrorist attacks, perhaps no sector is more dangerously exposed and woefully under-protected than ports and the intermodal freight transportation systems to which they are connected. The insertion of Weapons of Mass Destruction (WMDs) into freight containers is a particularly acute risk in this context. A recent CIA analysis concludes that the delivery of WMDs to the United States via this mechanism is more likely than via ICBMs (CIA, 2001). Given the consequences of failure in the new era in which we now find ourselves, the current system of cargo security and contraband interdiction does not offer an acceptable degree of protection. The successful smuggling of illicit drugs, counterfeit fashion wear, or endangered animal products results in outcomes that though highly undesirable do not begin to approach in magnitude the potential effects of nuclear weapon detonation, biological agent dispersal, or chemical attack utilizing cargo containers as vehicles.

2. The Federal Response

The Federal government especially the U.S. Department of Transportation has moved rapidly to formulate new strategies and tactics to counter threats that before 11 September 2001 were perceived more as abstract possibilities than as imminent realities. Creation of the Transportation Security Administration (TSA), appointment of an Undersecretary of Transportation Security and an Associate Undersecretary for Maritime and Land Security, and the provision of grants for port security improvements are some examples of recent initiatives undertaken by DOT to this end.

Legislation on maritime anti-terrorism and port security has been passed in the U.S. Senate (S. 1214) and in the House of Representatives (H.R. 3983). Differences between these bills are presently being resolved in conference. The language of the legislation alludes to the need for maritime security education and training as an integral element of the national response to the events of 9/11.

Several federal agencies have moved to secure the containerized intermodal system against the threat of terrorism. The U.S. Coast Guard and the U.S. Customs Service have developed what are to some extent competing programs of international scope designed to provide point-of-origin to final destination visibility and control over containerized freight movements. Central to these initiatives is the accurate and timely flow of information on cargo and carrier movement and the identification of trusted shippers --those who demonstrate a degree of control over their loading facilities, personnel, and supply chains sufficient to justify characterization of their shipments as low risk.

The U.S. Coast Guard has also presented a 15-point proposal on port and maritime security to the International Maritime Organization (IMO) in London. The IMO is currently discussing the creation of a shipboard Security Officer, the duties of which position have yet to be defined.

An important demonstration project intended to show that international supply chains involving containerized freight can be managed to provide a high level of security against terrorist threats is Operation Safe Commerce (OSC). OSC relies on existing technology and collaborative relationships among supply chain partners to ensure the integrity of container loading and transportation (McHugh, 2002).

Dawning awareness of the fact that, in the war against terror, there are too many U.S. agencies possessing overlapping responsibilities and operating under unclear lines of authority has led to the White House plan for a cabinet-level Department of Homeland Security. The proposed department would incorporate the Transportation Security Administration, the U.S. Coast Guard, U.S. Customs, the Immigration and Naturalization Service, the Border Patrol, and other existing agencies into its structure. Presumably, the implementation of this plan will result in a more coherent and integrated use of federal agencies and resources that has been the case to date. While no comprehensive national strategy for education, training, and research in the context of transportation security has yet emerged, consolidation of diverse agencies with responsibilities for homeland security under one organizational umbrella can be expected to lend a more unified approach to the eventual development of such a plan.

It is apparent that if the United States is to protect and defend itself successfully against the dangers of terrorism and asymmetric warfare, an integrated strategy involving close cooperation among all relevant agencies and organizations will be required. Effective and efficient utilization of all available knowledge, experience, and personnel will be imperative if these threats are to be countered.

3. Nature of The Need

What are the personnel, education, and training implications of the above-described context? Stated simply, the emerging transportation security regime will require: (a) the hiring of a large number of personnel to perform security-related tasks, (b) the education and training of new personnel and the retraining of existing security personnel to provide them with the knowledge and skills needed for successful performance in the new environment, and (c) the development of new mindsets and innovative approaches to transportation security.

It is difficult to quantify the need for new hires and retraining in the transportation security realm. However, the example of the U.S. DOT Transportation Security Administration is instructive in this regard. By the end of 2002, TSA will need to hire and train over 30,000 employees for transportation security-related duties (primarily airline passenger baggage screening). In number of personnel, this recruitment will produce an agency that is larger than the FBI, Customs Service, and Border Patrol (as currently configured) combined (Peckenpaugh, 2002). Secretary of Transportation Norman Mineta has indicated that TSA will ultimately have a workforce of 67,000. Beyond TSA, numerous other federal, state, and local government agencies--including the Coast Guard, FBI, local police forces, Customs, and port authorities--will expand their organizations to include personnel having special expertise in transportation operations and security matters, or will provide existing personnel with appropriate training and education. To a limited extent, this will also be true of parties in the private sector, such as terminal operators, intermodal carriers, and industrial shippers.

The two primary--and complementary--domains in which most education and training for transportation security will likely take place are undergraduate academic curricula and post-graduate professional training programs. There are at present very few course offerings in either domain that focus on the specific challenges of global intermodal supply chain security. While several colleges and universities offer courses and programs in terrorism and national security, these tend to be oriented more towards high-level strategy and conceptual matters than towards the practical realities of managing transportation security.

Developing a full understanding of opportunities for terrorist and other asymmetric attacks upon--or using--the port and intermodal freight transportation system and evolving effective ways to counter those threats will require expertise that goes beyond the conventional security paradigm of gates, guns, and guards. As undergraduate and professional education and training programs develop, it seems important to recognize that while knowledge of security and counter-terrorism *per se* will be essential in this war, in-depth comprehension of port and intermodal system structure and operations in conjunction with an understanding of security principles will be of critical importance in stemming the tide of potential threats. Knowledge of global supply chain structure and operations is of crucial importance in this connection. Information technology will certainly be an important element of the emerging homeland security effort (Ham & Atkinson, 2002). An appreciation of the importance of information sharing and consciousness of what technology can and cannot do in this context are also essential. Awareness of potential win/win scenarios in supply chain management, in which security and efficiency are simultaneously furthered (such as described by Wolfe, 2002) is necessary. Successful prevention of terrorist actions involving port and transportation systems will ultimately depend to a large extent on the degree to which those responsible for security understand the dynamics and operational particulars of those systems and are therefore able to identify and control their vulnerabilities.

4. Institutional Capabilities

The United States Merchant Marine Academy began educating and training deck and engine officers for U.S.-flag merchant vessels at Kings Point, New York in 1942; it was formally dedicated by President Roosevelt in 1943. In the decades that followed, the Academy established a worldwide reputation for the rigor of its programs and the quality of its graduates. Operated by the U.S. Department of Transportation through the Maritime Administration (MARAD), USMMA has consistently provided highly qualified personnel to both industry and the military. Graduates receive a Bachelor of Science degree, a U.S. Coast Guard license as Third Mate or Third Assistant Engineer (depending on the academic major chosen), and a commission in the U.S. Naval Reserve.

The U.S. Merchant Marine Academy and its faculty, staff, midshipmen, and alumni are naturally positioned to become prominent contributors to strategy development, solution formulation, and law enforcement where port and intermodal security is concerned. In short, the Academy possesses specific capabilities that are impelling it to assume a national leadership role in this effort. These include:

1. A comprehensive undergraduate program in logistics, port operations and intermodal transportation focused on developing in midshipmen an international perspective and a hands-on, end-to-end understanding of port and containerized freight transportation management. The program includes the most heavily subscribed academic major at USMMA.

2. Faculty and staff members with practical experience in maritime, port, and transportation system operations, both commercial and military.

3. An active and interested alumni group that comprises a significant force in the management of carriers and transportation facilities.

4. Midshipmen with experience at sea, in ports, and in military practices and protocol.

5. The largest maritime and transportation continuing education program in the United States, with training capability in port operations, intermodal transportation, security, and related subjects.

6. Personnel with substantial consulting and applied research experience in port and terminal operations, logistics and intermodal transportation, and marine affairs.

5. Initiatives

Because of its focus on ports and global intermodal freight logistics, the U.S. Merchant Marine Academy s Logistics and Intermodal Transportation Program is the locus of the institution s response to the port and intermodal security crisis. Based on the capabilities of program personnel and the needs of the nation, the following initiatives are underway:

1. The Logistics and Intermodal Transportation Program curriculum and its supporting elements are being enhanced to focus directly on the pressing need for personnel able to address homeland security concerns related to ports and intermodal transportation.

2. Existing collaborative relationships with individuals and institutions possessing expertise in relevant security matters are being further developed.

3. The popular Logistics and Intermodal Transportation Guest Lecture Series is being used to provide midshipmen, faculty, and staff with exposure to qualified counter-terrorism and security experts from government, industry, and military sectors.

4. Outside experts of national and international stature are being engaged in the development of new courses focused on port and intermodal transportation security.

5. Securing the global containerized cargo system against terrorism was the theme of the capstone Logistics and Intermodal Seminar in the most recently concluded academic term. All First Class L&IT majors (approximately 65 midshipmen) were engaged in analysis of global intermodal supply chain operations with the objective of maximizing security while preserving the free flow of trade. Midshipmen, working in teams, generated written reports of their analyses and briefed senior government, military, and industry personnel on their work at the end of the term

6. An elective course in Port and Intermodal Security is in operation. The course enrollment consists of 28 Logistics and Intermodal Transportation majors. Topics include terrorism, Weapons of Mass Destruction, cargo theft, passenger vessel and terminal security, contraband smuggling, organized crime, and piracy.

7. Through an Academy alumnus, a relationship is being developed between the Logistics and Intermodal Transportation Program and personnel at the Monterey Institute of International Studies, who have been asked to provide guest lectures, possible assistance with course development, and midshipman research supervision on security topics. MIIS has also indicated willingness to offer special short courses for USMMA faculty and midshipmen in its areas of expertise. The Institute s Center for Nonproliferation Studies (CNS) is the largest nongovernmental organization in the world devoted to curbing the spread of WMDs.

8. Via introduction by the Academy s first Visiting Professor of Logistics and Intermodal Transportation, the prestigious Center for Strategic and International Studies (CSIS) in Washington has been approached to investigate potential synergies between USMMA and CSIS in the transportation security arena. The CSIS staff of 190 researchers and support personnel addresses the full spectrum of new challenges to national and international security.

9. A concerted effort is being made to communicate the capabilities of the enhanced L&IT program to internal and external audiences concerned with port and transportation security issues. Among other things, this involves faculty participation in panels and national conferences on transportation security.

10. The Academy is cooperating with a Baltimore company to stage the September 2002 ***U.S. Maritime Security Conference and Expo*** in New York City. This collaboration includes assistance with conference planning, developing recommendations for speakers, providing midshipmen as conference interns, and organization/facilitation of a conference workshop on supply chain security.

11. The capacity of Logistics and Intermodal Transportation Program faculty, staff, and midshipmen to conduct applied research on port and intermodal security issues and challenges is being organized to serve the needs of the nation in this realm.

12. Synergies are being pursued between the redefined undergraduate program and GMATS, which offers some security-related short courses and would be the natural site of a comprehensive program of continuing port and transportation security training. GMATS annually trains a large number of personnel from government, military, and private sector organizations in a wide variety of maritime, engineering, and transportation courses.

13. Opportunities for graduates of the Logistics and Intermodal Transportation Program are actively being sought in the Transportation Security Agency, Coast Guard Port Security detachments, and in other agencies and organizations that can benefit from the distinctive competencies of these Kings Pointers. The Maritime Administrator is personally involved in this effort. Interested midshipmen are being provided with assistance in obtaining job placement in port and intermodal security-related organizations.

6. Synergies and Value Added: An Example

A recent interaction with industry and other government agencies in the context of transportation security demonstrates the manner in which the Academy is supporting ongoing homeland security efforts.

A major conference on counter-terrorism was hosted at the U.S. Merchant Marine Academy in April 2001. Organized jointly by the U.S. Department of Energy National Nuclear Security Administration (NNSA) and the Academy s Global Maritime and Transportation School, this two-day event drew approximately 250 senior decision makers and subject matter experts. Presentations and conference sessions focused on dimensions of the current terrorist threat and strategies that might be employed to address it.

Approximately 60 USMMA midshipmen participated in the conference at various times. As the result of participant interaction with these students and a presentation on the capabilities of the Academy with respect to transportation security matters, representatives of NNSA headquarters and field units (specifically, the NNSA national research laboratories) expressed interest in the possibility of NNSA and USMMA engaging in some form of collaboration.

The ensuing discussions produced an agreement for a cooperative venture that would begin with a briefing by DOE/NNSA personnel for USMMA faculty and midshipmen who were already working on applied transportation security research in the capstone Logistics and Intermodal Seminar. This briefing consisted of a presentation on NNSA, its mission, and the capabilities of its national labs. At the conclusion of the briefing, NNSA personnel charged midshipmen with the task of analyzing how best to protect global intermodal freight systems against terrorist attack, with a corollary question being posed as to how the DOE/NNSA labs should best focus their efforts and resources toward this end.

These challenge questions were immediately integrated into research already underway and became a major focus for the 65 midshipmen who, working in teams, sought to develop creative and viable solutions to the pressing problems of global intermodal supply chain security.

The short-term culmination of this process was the oral presentation of results by selected groups to a visiting panel of VIPs. The panel included representatives of DOE/NNSA, the Council on Foreign Relations, MARAD, a major transportation consulting firm, and the steamship line/intermodal sector. Before the panel and a large audience, four groups delivered formal briefings on their recommendations for enhancement of container system security, followed by commentary by each of the panelists. The event was fully successful and served to provide midshipmen with valuable feedback on their work and a sense that their research and proposed solutions had genuine merit, while at the same time conveying to the panelists innovative and informed ideas for addressing transportation security challenges.

7. Conclusion

The terror attacks of 11 September 2001 brought to light a troubling array of vulnerabilities in our nation s critical infrastructure and global transportation systems. The country s failure to properly organize and adequately fund the agencies responsible for filtering the good from the bad at ports and borders was also brought into sharp focus. As Flynn (2002) notes: For years U.S. policymakers, trade negotiators, and business leaders have operated on the na ve assumption that there was no downside to building frictionless global networks of international trade and travel. Facilitation was the order of the day. Inspectors and agents with responsibility for policing the flow of people and goods passing through those networks were seen as nuisances at best and at worst, as barriers to competitiveness who should be marginalized, privatized, or eliminated wherever possible.

The time has clearly come to quickly reverse this state of affairs. For the indefinite future, there will be a critical need for transportation security personnel who understand the nation s global intermodal supply chains at an operational level, who are able to think in terms of improving security while at the same time enhancing customer service and efficiency, who appreciate the overarching importance of information and information sharing in security management, who recognize the capabilities and limitations of technology, and whose focus is whole systems and not functional silos and organizational stovepipes.

As a federal institution of higher education and training, the U.S. Merchant Marine Academy offers unique resources for the development of such personnel that are being marshaled to support what will clearly be a long-term struggle to prevent attacks upon, or using, the nation s ports and intermodal transportation systems. With their military training, their seagoing experience, and their education and training in port operations, intermodal transportation, and global logistics management, graduates of the Academy s Logistics and Intermodal Transportation Program bring a unique combination of knowledge, skills, and abilities to this campaign.

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Augmented Reality:
A New Tool to Increase Safety in Maritime Navigation

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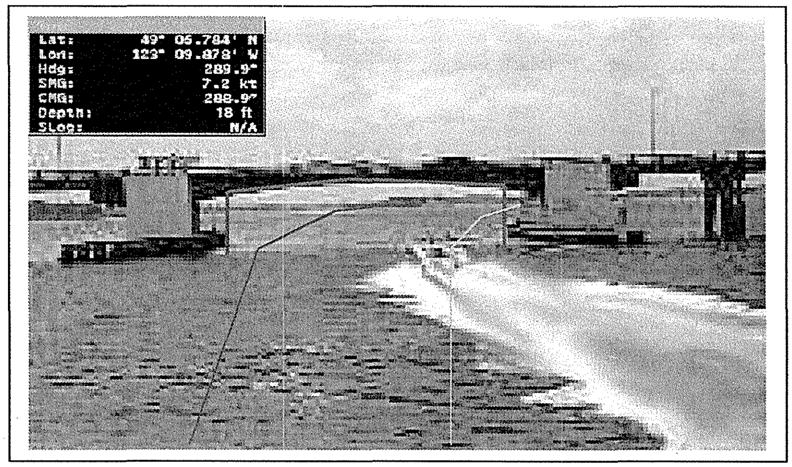
ABSTRACT

Augmented Reality (AR) is a visualization technique in which computer generated graphics are superimposed over one's view of the real world. This paper reports results of recent studies in which navigation data was superimposed into a ship pilot's field of view, including a system recently installed on the US military s High Speed Catamaran Joint Venture (HSV-X1). The system displays both navigational and tactical data on a bridge mounted display. The AR capability is achieved by merging a camera input with computer generated data. The system has demonstrated an unprecedented ability to enhance operator situational awareness, increase safety, and aid in ship navigation. The system's intuitively understood presentation of navigational data provides a clear benefit in low visibility and nighttime conditions. Ongoing efforts include transition of AR capability to the amphibious environment. This system will be installed on an LCAC (Air Cushioned Landing Craft) and an AAV (Amphibious Assault Vehicle).

1. Introduction

Augmented Reality (AR) is an emerging technology in which computer generated imagery is superimposed over a real-world image. The adjoining figure (which is notional and was developed by the USCG using Powerpoint) shows the initial goal of this effort, which was to provide channel markings electronically. During 2001 a system was developed that provided this capability. The system was implemented using a wearable computer, head mount display, plus DGPS and orientation sensors.



Subsequent efforts focused on examining the impact that Augmented Reality (AR) has on an operator's cognitive capabilities under high workload conditions. A system was created that augmented a boat operator s view with navigational information, and also introduced secondary tasks to enable measurement of the operator's residual attention capacity when performing the primary task of navigation under various conditions. We hypothesized that AR may be of minor consequence under low stress situations, but might significantly augment operator cognitive abilities during a high stress, high workload situation.

Finally, the system was upgraded for installation upon the Joint Venture (HSV-X1), a 96 meter high speed catamaran being evaluated by the Navy and Army under a two year lease. This generation system is commonly known as the ARVCOP system (Augmented Reality Visualization of the Common Operational Picture). The system was installed upon the Joint Venture during November, and tested at the Naval Warfare Development Center s Limited Operational Experiment (LOE) #2, held off Panama City, Florida during late November and early December 2001. The system was modified to enable importation of data from the Mine Environment Data Acquisition Library (MEDAL), which is part of the Navy s GCCS-M system (Global Command and Control System — Maritime).

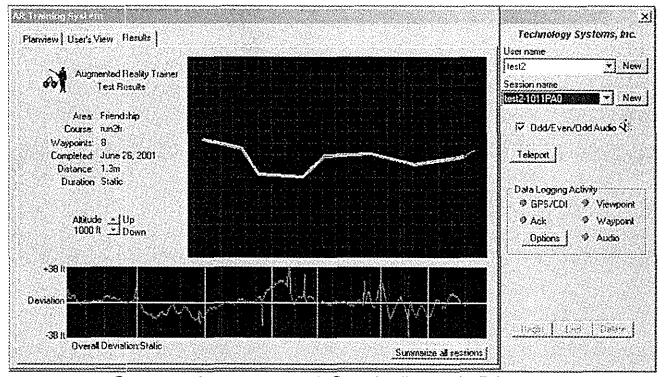
2. Cognitive Studies

2.1 Cognitive Study Overview

Initial test results indicated a 342% increase in operator performance using AR. Further test results demonstrated that operator residual cognitive capacity significantly benefited from the introduction of AR for what we term Display Adept subjects, but not the Display Na ve subjects. This implies that AR has strong potential, but that display format and user training may be a major variable in AR effectiveness. Significant human factors oriented data relating to the fielding of AR systems were also collected and are being incorporated into future designs. The implications of the initial effort were that: AR potential to enhance cognitive performance is demonstrated, the side-load task used to measure residual cognitive capacity and NASA TLX workload assessment methodologies were robust and valid, and that display form factor and content are a major variables in AR cognitive impact.

2.2 Cognitive Study Details

The AR prototype was evaluated using a control condition (CON) of no AR display, plus three different display modes: course deviation indicator (CDI) display, plan-view display (PVD), and forward pathway display (FPD). Research trials consisted of navigating a pre-set course, which had seven legs totaling 1.2 miles. Course changes varied from 30 to 60 degrees and overall course was symmetrical (providing the same course regardless of the run s direction).



Course Layout and Study Result Display

The research design was a two factor repeated measures design (4 treatments by 2 workload conditions by subjects) with the following dependent variables: perpendicular error from desired track centerline taken at 1 Hz, maximum excursion from centerline per leg of the course, time to complete the course, and subjective workload evaluation using the NASA TLX (task load index) instrument. Additionally, under the high workload condition the number of correct odd-even-odd sequences detected and the number of false alarms was recorded.

Our intent was to capture repeatable measures of human performance while navigating using varying display methodologies. We implemented this by introducing a secondary side load task that provides an indication of the operator s residual cognitive capacity. Since the AR capability is fundamentally a visual task, we did not want the secondary task to directly interfere with the information processing channel of the primary task (i.e. the secondary task should not be visual). Koonce, Gold and Moroze (1986) utilized an aural secondary task of digit monitoring to assess pilots abilities with three different types of visual flight displays (one traditional head-down display and two different head-up displays) with great success. Although the pilots performed adequately with the display types under normal workload conditions, using the aural secondary task they demonstrated a significant difference in performance between the two different types of head-up displays. We developed a similar capability to support future assessment of different Augmented Reality (AR) displays, along with traditional navigational displays (e.g. heads down equipment) in navigating a boat over a standardized path.

> The NASA TLX (Task Load Index) ascertains the operator s subjective estimate of workload on six scales. The scales are:
>
> The mental demand of the activity,
> The physical activity required,
> The degree of time pressure or temporal demand,
> How hard he had to work (mentally and physically) to accomplish the task,
> How satisfied the operator was with his performance, and
> The frustration level experienced.
>
> Thus, beyond the primary objective measures of performance, we obtain a measure of the subjective workload experienced while using the system.

Subjects —the minimum research design needed a minimum of four experienced boat operators and four novices to evaluate the display systems. Additional participants were desirable, however weather and scheduling issues resulted in only five persons completing a full set of trials using all four navigational systems. The five subjects were all male and ranged in age from early the 20s to mid 60s. Each operator was introduced to the course to be navigated, briefed on the AR system and the types of displays to be used, and introduced to the workload task.

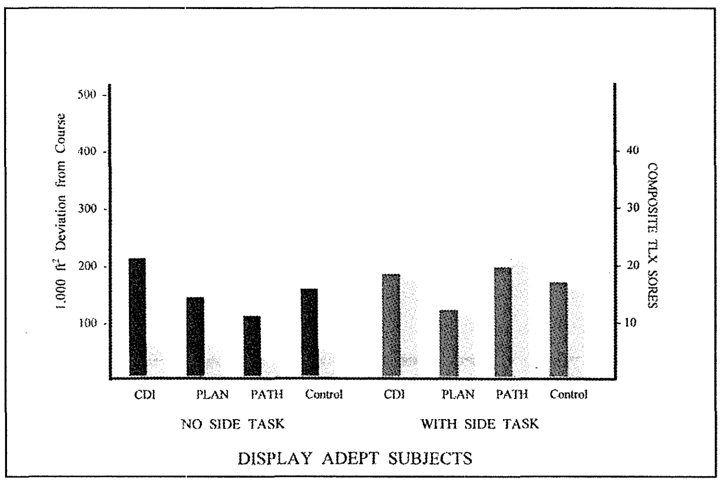
Equipment - The AR system used was based upon the VIA II wearable computer system, enhanced with D-GPS, an orientation sensor, and an HMD, plus supporting electronics. The eyewear used was the Sony RA-100, coupled to an orientation sensor manufactured by Precision Navigation. This subsystem is accurate to 0.5 degrees, with a resolution of 0.1 degrees. It provides tilt information (0.2 degree accuracy) from an electrolytic fluid based tilt sensor. The Differential GPS selected is that used by the majority of the commercial pilots, manufactured by Starlink Corporation. The unit includes an integrated GPS and differential antenna system, and provides an industry standard NMEA 183 output.

A variety of test platforms provided by the Maine Maritime Academy were used in the cognitive studies evaluation of the AR system, along with 40-foot cabin-class diesel powered boat.

2.3 Cognitive Study Results

Due to the small sample size (N=5), plus very large individual differences in performance with the different display types, parametric statistical tests could not detect any significant differences in the display types in terms of RMS error scores. However, there was an increase in error scores between the performance with no secondary task and that when the secondary task was present, and as expected, there was a significant difference between subjects.

Looking at the subjects ability to handle the secondary task while performing the primary task of navigating with the four different display types, we noted that some subjects seemed to handle the secondary task well while others could detect only a small proportion of the target digit sequences. Those who detected a large number of the target sequences in the secondary task had had prior experience with aircraft flight displays and some even had experience in using head mounted displays. We subsequently called those subjects display adept subjects. Those who had difficulty in detecting the digit sequences while performing the primary task had no prior experience in the use of wearable visual displays or with airplane navigational course displays. We called those subjects display na ve subjects. The same pattern of performance of the two groups noted under the workload condition was also clearly present under the no workload condition. That is, there were no significant differences in performance with the four displays for the display adept subjects, and the display na ve subjects performed much worse using the CDI or the Pathway displays than with the more traditional Plan-view or Control displays.

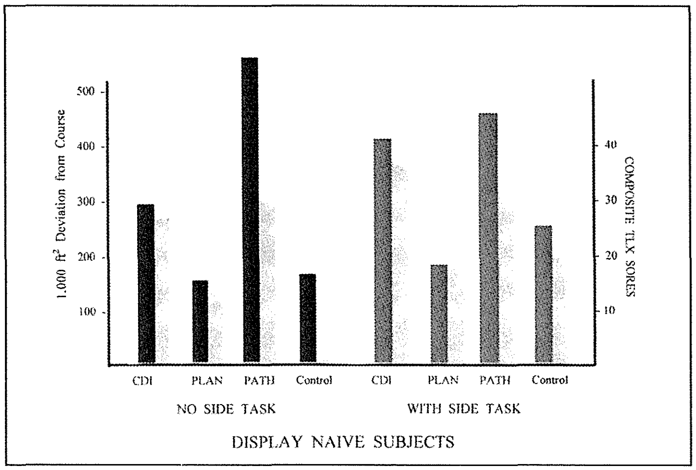


The display na ve subjects were nearly fully task-loaded with the primary task and did not have much residual capacity to attend to the secondary task, detecting only 25% of the target digit sequences. The display adept subjects were able to detect about 65% of the target digit sequences.

Separating the subjects into display adept and display na ve , there was no significant difference between the performance of the display adept subjects under no workload and workload conditions, and no significant difference between the display types under either workload condition.

The display adept subjects performance under the no workload condition exhibited the trend noted earlier from the preliminary study; that is, the CDI was the most difficult and the pathway easiest for the subjects.

The display na ve subjects, on the other hand, performed worst using the CDI and the Pathway displays than when using the Plan-view or the Control displays. On the trials where the secondary workload task was present, these subjects performed best with the Plan-view display, and the CDI and Pathway performance had the most error.



The subjects reported workload seemed to track rather closely with the actual vehicle performance. Over all of the subjects, the composite NASA Task Load Index (TLX) scores showed an increase in perceived workload when the secondary task was present. In terms of TLX scores, the display adept subjects reported much less overall workload than the display na ve subjects under no workload and workload conditions.

Combining all of the subjects, there was no significant difference in composite TLX scores between the Plan-view and the Control displays and no difference between the composite TLX scores on the CDI and Pathway displays.

2.4 Discussion

2.4.1 Environmental factors
Due to costs and the variability of environmental conditions, real-world data collection was very constrained. Besides heavy pitching seas and rain and fog, the availability of an appropriate vessel to conduct the trials, the availability of subjects for the length of time required, and numerous equipment adjustments that had to be made all adversely affected the costs and length of time to conduct the study. For example, one subject s trials were conducted with winds of 25-30 knots and a 3 knot current, and in the middle of one of the runs the wind blew the GPS antenna off of the top of the cabin into the water! The environmental conditions tended to contribute such great.variability to the performance that statistical differences in the display types would be most difficult to obtain. With the variability experienced in this study, a power analysis suggests that a sample size of near one hundred subjects would be necessary to detect any statistically significant differences between the displays.

An alternative is to perform studies in a controlled environment, such as a simulator. However, this would eliminate the benefit of operating in a real world setting, which would produce practical solutions viable in the real world environment.

2.4.2 HMD Issues
The limited display brightness of the HMD was unable to generate luminance visible in the ambient light of a sunny day. This resulted in difficulty seeing the AR image, which was even further exacerbated when turning toward or away from the light source (e.g. into or away from the sun).

The HMD used in this study had a 22 degree field of view. In practice, this was not sufficient to support maritime operations without the addition of various display cueing mechanisms that negatively impacted the objective of the effort, which was to provide an intuitively understood visual aid.

The optical focal length of the image presented in an AR display must be the same as the focal distance of the real world being viewed, or the images will not merge. The commercially affordable displays available provide a focal length of 15-20 feet, which presented another limitation.

2.4.3 Training and Display Format
The principal researcher noted that some people have trouble getting used to the path display while others have no trouble at all. It was felt that some would need an entire day of practice with the displays before being able to

perform reasonably well with them, but the project did not have the time or the resources to provide such familiarization training. The difficulty in transitioning to new types of displays experienced by some of the subjects, but not others, is not unique. Such has been experienced in aviation, however, extensive training is generally provided to the pilots to ensure their smooth transition to the new displays.

Some subjects were enthusiastic about the new, different displays, and saw all sorts of possibilities for them. They were eager to try out the AR system, regardless of the display type. But, other subjects were quite confused and seemed to not feel comfortable trying to navigate the boat with the head-mounted displays, especially the CDI and Pathway displays. After a trial using the pathway display, one subject asked So Where am I in this display? Even after his trials, he seemed to not understanding the CDI or Pathway displays at all. The Control and Plan-view displays were more similar to what these subjects were accustomed to using and thus were more acceptable and provided considerably better performance.

A key question that has not been explored in any detail is the degree to which display content should range along a continuum of concrete to abstract. Concrete information is representational of how the information is perceived in the real world, while abstract information uses symbols to represent objects or characteristics of objects or variables in the real world. The symbols used in abstract presentations do not have any inherent meaning relevant to that which it represents. Thus, the user must learn just what the abstract symbol means or represents. In processing abstract information, the user must utilize higher level resources to lend information (meaning) to the symbols before he can understand them. After training and extensive practice, many operators learn to respond to the abstract presentation of information rather automatically (automatic processing). But, when under high workload or the influence of other stressors, the automaticity of responding to the abstract symbols often breaks down and the user is faced with the task of engaging higher-level processors to interpret the meaning of the symbols used in the display.

2.4.4 Use of Secondary Task

The side task used the aural channel to minimize conflict with the visual-perceptual-motor activities of the primary task. Because of the potential hazards of channel buoys and markers, lobster pot buoys, random debris in the water, and other boats moving or stationary in the real world , the boat s helmsman cannot simply ignore the primary task in order to accomplish the side task. This secondary task (side task) was most helpful in classifying subjects as display adept or display na ve based upon their residual attention capacity to devote to the secondary task while performing the primary task of navigating the course.

2.5 Cognitive Study Summary

Overall, the study demonstrated the effectiveness of the research methodology, specifically the use of side load tasking and TLX measurements. The major shortfall of the study design was the low number of subjects for which data was collected.

The use of HMDs for AR is not warranted at this time, the technical shortcomings of current designs preclude real world use. We are currently exploring different form factors for merged image presentation.

The test results indicate that a key element in AR effectiveness is the user s familiarity with computer driven display systems. Users that are adept at using these types of displays clearly benefit from AR, which is demonstrated by their higher residual cognitive capabilities while under stress. Users not adept at using this type of display were clearly cognitively saturated regardless of display format.

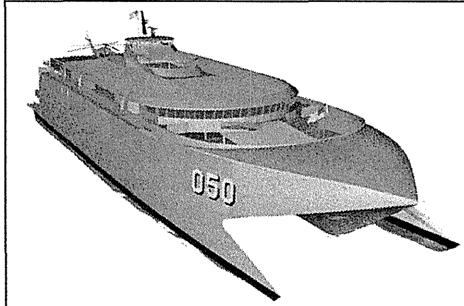
Future AR designs should pay attention to form factor and display content. User training is an area that needs to be explored, and which parallels other AR implementations such as those used in aircraft HUDs. Finally, environmental factors play a major role in the ability to collect study data, and need to be factored into future study designs.

2.6 Augmented Reality Visualization of the Common Operational Picture (ARVCOP)

2.6.1 ARVCOP Overview

Following this effort effort, The Naval Warfare Development Center funded creation of a next generation system to support Mine Countermeasure (MCM) operations. This system and work has been titled Augmented Reality Visualization of the Common Operational Picture (ARVCOP).

The ARVCOP system was developed for installation upon the Joint Venture (HSV-X1), a 96 meter high speed catamaran being evaluated by the Navy and Army under a two year lease. The ARVCOP system uses a fixed camera and display monitor to present the augmented reality image. This has resolved many of the problems associated with the original prototype.



Joint Venture (HSV-X1)

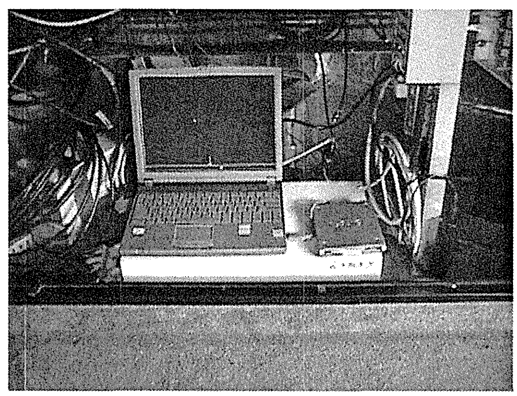
The system was installed upon the Joint Venture during November, and tested at NWDC s Limited Operational Experiment (LOE) #2, held off Panama City, Florida during late November and early December 2001. The system was modified to enable importation of data from the Mine Environment Data Acquisition Library (MEDAL), which is part of the Navy s GCCS-M system (Global Command and Control System — Maritime).

Bridge Mounted ARVCOP Display

2.6.1 ARVCOP Results

The following summarizes experiment results and is copied directly from the Navy s Quicklook Report summarizing LOE#2 results.

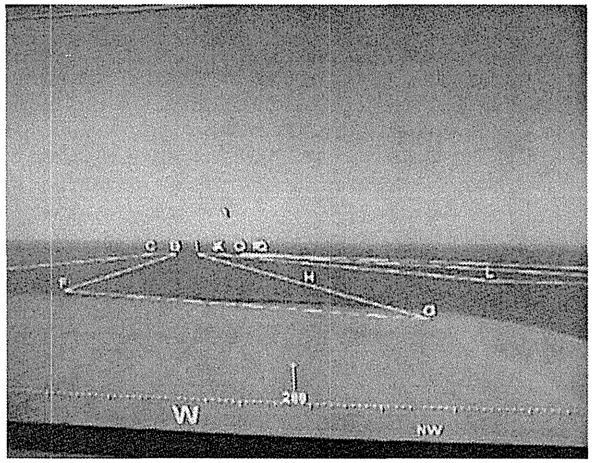
ARVCOP provided a visual overlay of navigation aids during the transit from port to sea. Correlation of real world navaids to ARVCOP generated counterparts was observed to be less than 50 yards. The ARVCOP display was viable during daytime, with various sun angles. Display clarity was adequate, but could be improved if a fully digital augmentation process were used. D-GPS capabliity performed as expected, however the digital gyro interface was occasionally down due to an electro-mechanical failure (>95% uptime). The current design has eliminated all image jitter issues observed in earlier trials. Icons and text provided in the ARVCOP image became cluttered at far distances. Some method for determining depth perception of the images is recommended. Higher camera position (such as on top of the bridge), camera tilt angles and/or filters to manage visual clutter are possible alternatives. Transfer of data from medal (via floppy disk) was achieved, but needs to be improved to support timely operations. The system provides a 90 degree forward looking field of view, and it is desireable that this be expanded to 360 degrees to enable ARVCOP visualization of AUV, EOD, and similar operations supported from the ship bridge. It is recommended that the camera be mounted centerline on top of the bridge. The bow of the vessel must be in the forward field of view, and the stern in the after field of view. Use of a high resolution digital camera will allow the use of a wide angle lens without their typical warped image. The display should be mounted center line into the forward overhead panel for the forward view and on the aft table top for the aft view. ARVCOP provided visualization of the BPAUV route, including the end waypoint used for BPAUV retrieval. A night palette is required to support operations in low light. Night runs were conducted at 40 knots along a q-route to support drop of 4 BXP sensors. ARVCOP provided a clear visualization of the q-route (both centerlane and boundaries), along with a circular indication of each BXP drop point. All data was imported from MEDAL. ARVCOP accuracy was at least equivalent to the other bridge systems and provided a very intuitive



ARVCOP Electronics

indication of relative lane position during operations. The next morning ARVCOP supported VEMS tests onboard Joint Venture, and provided visualization of the transit route along with the actual location of the individual VEMS as reported via medal. Position accuracy correlated with both the bridge systems and the additional D-GPS navigation system brought on board by VEMS test personnel. MEDAL data was transferred via disc to the ARVCOP computer. It is recommended that a network interface be developed to receive MEDAL data real-time.

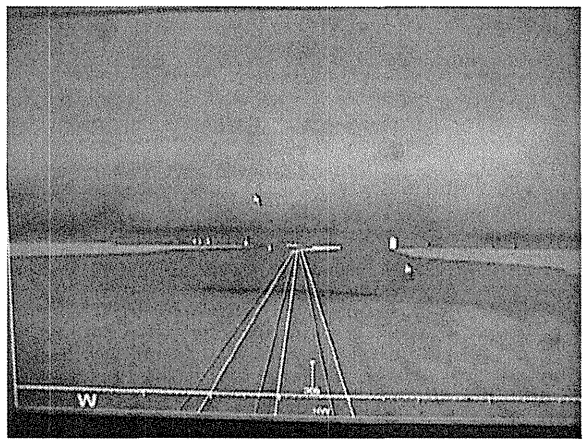
During late January ARVCOP was used in an exercise held of Morehead City, NC. The system was evaluated as an Aid to Navigation and displayed the channel boundares for the harbor entrance with high accuracy. Included in the display were electronic buoys, channel markings, and land masses.



ARVCOP Image of BPAUV route

The system was also used in night approach to both Morehead City,NC and Little Creek, VA. Its ability to clearly define the channel location against the backdrop of shore lights was highly effective in increasing operational safety.

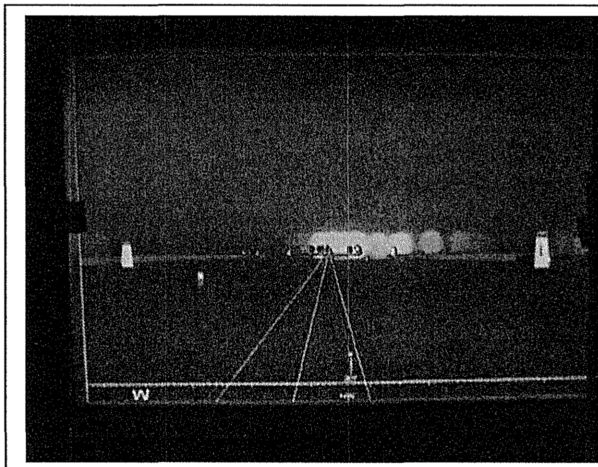
Finally, the system was used in low visibility and provided an effective navigational image while channel markers and the shoreline were obscured.



Entrance to Morehead City, NC

2.6.3 ARVCOP Summary

This generation of AR device has resolved the shortcomings of previous prototypes by incorporating a fixed mount camera, electronic image integration, stabilized orientation sensing, and a traditional display monitor to achieve functionality that has been demonstrated to be effective and easily used in the ship bridge environment. The ARVCOP capability has been demonstrated to be effective in a range of applications including mine countermeasures and ship navigation at night and during periods of low visibility. Numerous concepts for additional system enhancements have been identified.



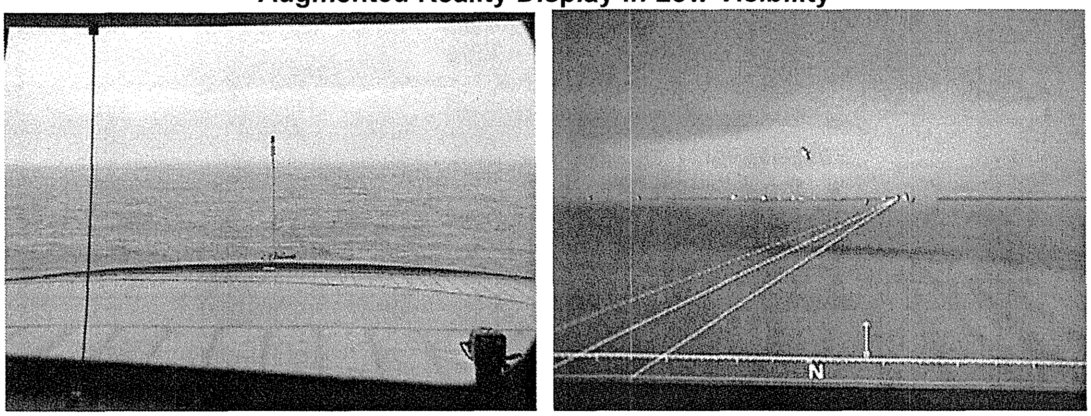
ARVCOP use at night

2.7 Next Steps

The ARVCOP system has been identified by the ONR EDSS (Expeditionary Decision Support System) as a system worthy of additional R&D. Funding is anticipated that will support the EDSS effort by providing prototype Augmented Reality (AR) capabilities upon LCACs and AAVs. Included is development of a fully digital AR system (including EDSS compatibility), creation of LCAC and AAV specific variants, support for testing and demonstrations, and delivery of additional systems for multi-vehicle experimentation. The objectives of this effort are:

To create a fully digital ARVCOP capability
To install ARVCOP on an LCAC
To install ARVCOP on an AAV
To experiment with ARVCOP as a visualization device for EDSS data
To gain real-world experience with ARVCOP through testing during amphibious warfare at-sea training operations.

Augmented Reality Display in Low Visibility



(Real World) (AR Enhanced)

3.0 Summary

The digital ARVCOP capability represents a significant next step in the maturation of this technology. By creating a fully digital system, a system with sufficient image resolution and flexibility will be developed that will be capable of meeting the challenges of the amphibious environment.

Session VIII — WG 1

Chair: Mr. H. Yamamoto

Probing Into the Acquisition and Maintenance of High Quality Seafarers
Kong Fan Cun and Ruan Wei
Shanghai Maritime University

Shipboard Training for the Efficient Maritime Education
Chung Do Nam
Korea Maritime University

Fire Fighting Training for Officers and Captains: A Problem Based Learning Approach
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The Ethical and Professional Obligations of Academic Staff Towards Technological Development of Students
Capt. Mohye Eldin Mahmoud El-Ashmawy and Dr. Sayed Abdel Galil
Arab Academy for Science, Technology and Maritime Transport (AASTMT)

Probing into the acquisition and maintenance of high quality seafarers

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ABSTRACT

The current status of crew-manning market needs to be paid with more attention. To acquire and maintain sufficient and stable high quality seafarers are becoming more and more difficult. Statistics reveals that the number of the seafarers is difficult to meet the needs of world fleet, and the further study indicates that the number of those who truly meet all the requirements set by the international shipping market is less than the statistics revealed. Furthermore such a number is dropping remarkably. It is adverse for the sustainable development of shipping industry. Therefore, the necessity arises for the maritime industry to probe into the acquisition and maintenance of high quality seafarers.

This paper analyzes major difficulties in acquiring and maintaining high quality seafarers confronted by major partners in shipping industry, and then introduces some practices and attempts having been made for the solution of those difficulties. Finally the paper brings forward some suggestions to different parties in shipping industry.

Key words:
Seafarer, Manning, Maritime Education Training, Shipping Industry, Ship-owner, and Quality Seafarer

1. Introduction

The problems that the international crew-manning market is confronting can be summarized as follows: Most of European maritime countries are facing with the shortage of seafarers, while other man-supply countries such as the South-East Asia countries are facing with the concerns on quality of their seafarers. The shortage of seafarers in the worldwide is obvious, particularly in the aspect of high quality seafarers.

The estimation of supply and demand of world seafarers table - 1

District	In the year of 2005				In the year of 2010			
	Senior officers		Ratings		Senior officers		Ratings	
	Demand		Supply		Demand		Supply	
OECD	162000	231000	129000	169000	166000	233000	113000	150000
East Europe	36000	40000	62000	122000	37000	40000	62000	138000
Africa/ Latin America	131000	157000	39000	95000	134000	156000	44000	102000
Far east	89000	148000	134000	332000	91000	147000	140000	342000
Indian Sub-continental	15000	26000	35000	115000	15000	26000	39000	127000
Total	432000	602000	399000	832000	443000	603000	397000	858000

Source: BIMCO/ISF 2000

Balance of supply and demand in future Table - 2

	In the year of 2000		In the year of 2010	
Senior officer	- 16000	- 4%	- 46000	- 12%
Ratings	+224000	+27%	+255000	+30%

Source: BIMCO/ISF 2000

The gap between the demand and supply is not so big (see table—2). However,the in-depth analysis reveals that the number of high quality seafarers truly meeting the requirements of crew-manning market is in sharply shortage. The reasons of which are complicated.

2. The understandings on high quality

Before looking into the shortage of high quality seafarers, full understandings shall be given to the term High Quality . The concept of Competency introduced by STCW 95 convention is hereby helpful for such understanding.

The essay deems that full understandings on the term shall be based on the latest development of shipping industry and navigation profession. Today, the trends in shipping industry are faster ships, larger ships, more automation technologies applied onboard, stressing more on management, and the navigation professionalism. These require correspondingly the operators of oceangoing vessels:

a) Shall be equipped with the traditional and modern navigation technologies, safety management technologies, and computer operating skills;
b) Shall master supporting techniques or skills such as communication/language, leadership, management, human relationship, etc,.
c) Shall possess the quality derived from navigation professionalism, i.e., the seafarers being with profound seagoing experience, career commitment, profession ethics, etc,.

So to sum up, the High Quality means in the essay that fully meets the requirements of STCW 95, possessing the knowledge and skills in respects of navigation technology, computer, English, management, and navigation professionalism.

3. The difficulties in acquiring high quality seafarers

3.1 The Mobility of high quality seafarers

Undoubtedly, those seafarers with quality as defined above possess a combination of theoretical knowledge and practical skills, which is very much competitive for working ashore. If the basic equivalency cannot be achieved when comparing with the posts onboard other vessels or the similar jobs ashore in respects of salary, welfares, etc., the mobility then exists.

With the aim to educate and train high quality seafarers, the maritime universities in China promoted the standards of MET, more than 1400 graduates being awarded with Bachelor degree every year. However, the following-up problem is that up to 60% of those graduates left navigation in a period of around five years after their graduation, seeking opportunity of working ashore. The high quality given enables them to be easily employed in shipping business like cargo forwarding, ship agency, ship management ashore, and even maritime insurance, for which the shipowners feel quite unsatisfied.

There are different views on such mobility in maritime industry. For MET institutions, particularly those aiming to educate and train high quality seafarers, the mobility of human resource is normal and beneficial to the industry, because it is first of all not controlled by a certain entity. Secondly, it helps to balance the interests of the seafarers and shipowners in respects of salary and welfare etc. And thirdly, it helps to form a positive circulation of MET resources, and to promote and maintain higher quality human resources for the industry, which finally constructs an advantage and competitiveness over other modes of transportation.

For the shipowners, a modern vessel with more than 5000 TEUs represents more than hundreds of millions of USD. The quality of seafarers is particularly important for the operation and management of such a big value, and for the competitiveness of the shipowners. Realizing the importance, the shipowners usually invest in certain forms for the formation and acquisition of high quality seafarers. As a business rule, the shipowners require certainly profits yielding from such an investment in a way of making use of the seafarers. Therefore, the shipowners make effort to avoid the mobility of high quality seafarers. Unfortunately, such efforts include sometimes the reduction or degrading of MET standards.

3.2 The difference in understanding MET Standards

Although the STCW 95 has set down the minimum standards for the competency of seafarers, in the reality most of international shipowners use in more occasions the standards by their understandings. This is so-called Market-oriented standards in which the types of ships, the nationality of seafarers, the salary of seafarers etc., are taken into account comprehensively. Apparently, such standards are flexible and high. To comply with them, the seafarers shall not only meet the requirements set in STCW 95 as competency , but also possess the knowledge and skills on shipping management, shipping economics, profession ethics, culture of enterprises, etc. Thus the quality of seafarers under the market-oriented standard is a kind of high quality.

The MET institutions also agree with the role of market-oriented standards leading to high quality of seafarers. But they argue that they are not in a position to be responsible fully for the MET in compliance with the Market-oriented standards due to the shortcomings of shore-based MET. Instead the MET would like to equip the seafarers with adequate navigation or Engineering knowledge, practical skills as much as possible, and the commitment to career, etc. The shipowners are obliged to provide further education and training for the seafarers particularly in respect of practical skills (including culture of enterprises).

But from the point-of-view of many shipowners, the standards or the requirements set by the shipowners are the supreme standards for MET activities, and meanwhile the graduates or trainees shall be able to put into practical use right after graduation. In other words, the shipowners take the view that the MET institutions shall undertake full or the vast majority of responsibility for the formation of high quality.

It can be concluded that both the MET institutions and shipowners agree with the market-oriented standards ,which shall be followed up firstly and importantly. Surely it is right. But the question is that there must be matters that they shall place emphasis on respectively and adequate co-operations between those two in the progress of seeking for high quality.

3.3 Problems existing in the MET

The MET undertakes no doubt the unshiftable responsibility in the formation of high quality seafarers. Although the MET institutions are implementing the STCW 95, the problems that MET institutions are facing with are: on the one hand, the development of MET has to follow up with the latest navigation technology (generally the rule is that the practices accumulated form knowledge or theory, and then disseminated); on the other hand, the shipowners put forward more requirements on MET according to the fast changes of the market.

The problems of MET internally are those related to the enrolment of new students, quality control, funding, instructors, and various resources, etc,.

3.4 The problems of shipowners

There is still a lack of smooth communication between the shipowners and MET institutions as to the MET standards.

Some shipowners do not pay enough attention to the further training or motivation or promotion of the graduates employed, which may lead to the running-off the high quality seafarers.

4. The acquisition of high quality seafarers ---- some meaningful practices

The whole MET consists of in a systematic point-of-view the software, the hardware and the management schemes related thereto. The acquisition and maintenance of high quality seafarers are actually a question of the whole system, and are the product of successful operation of the system. In such a system, positive circulations in respects of human resources, funds, and other resources are particularly important.

The SMU did many practices for the resolution of the above questions and problems encountered in seeking for high quality seafarers, and for the way of utilizing adequately the human resources, funds, and various resources provided by different partners in the shipping industry.

4.1 Full co-operation with large shipowners for course running

The NYK lines is co-operating with the SMU for a course running. Starting from the Oct. of 2002, a new project is introduced to educate and train high quality seafarers. The concept of this is that three parties (the shipowners, the manning agency, and the SMU) jointly operate and manage two classes of students (one for Navigation, and the other for Engineering). The project will take three years, featuring with the full involvement of the shipowner and MET including the selections of students in different phases, the formulation of curriculum, the arrangement of onboard training, and the practical instructing etc. the advantages of the project are to overcome the problems occurred in MET and the understandings on training and education standards, and to use the strengths of each party in forming high quality seafarers.

The scheme attracts more large shipping companies. COSCO follows soon with a contract of another two classes.

4.2 Partly participation of the shipowners in course running

It means a small part of the lectures or training items are conducted by the shipowners after the entry into the contract. This is not so much used in SMU, mainly in some short courses.

4.3 Little participation of the shipowners in course running

The scheme has been operated for about five years. It means that the shipowners are involved little into the practical teaching and management after contracting, such as the contract entered into between the SMU and Shanghai Harbor Authority.

5. The maintenance of high quality seafarers

The generality between the acquisition and maintenance of high quality seafarers is that they are both the contribution of the whole maritime industry, while the difference is that different parties may function differently in the system. In the maintenance of high quality seafarers, the administration and shipowners shall assume more responsibility.

Particularly, the strategy of maintaining high quality seafarers by the industry (mainly the administration and shipowners) can be:

a) The policies based on an attitude of motivation or protection
b) The policies of educating and training large number of seafarers, but leave out (1)
c) The policies balancing (1) and (2)

According to the (1), the shipping industry or even the society promotes the navigation profession in respects of salary, welfares, and social status, to be equivalent to or above the similar profession ashore. The profession will thus become attractive to more people, and the high quality seafarers are then maintained. While in case of (2), the manning market will become competitive because of the unbalance between the demands and supply of seafarers. It sounds good. But further questions are firstly the difficulty of large enrolment of new seafarers, secondly the pressure to be put on MET resources, particularly because of the costly MET, and thirdly the possible large unemployment. The (3) is advisable for its more practicability by balancing the quality, quantity, and the promotion of seafarers salary and social welfare as the rule of social developments..

6. The solutions

6.1 The efforts to be made by the MET institutions

a) To improve the quality and adequate number of new enrolments

Many MET institutions and shipping companies have made attempts. In China, such attempts include the establishment of human resource bases in under-development areas. This is proven to be a useful way of absorbing high quality enrolments, and eliminating the mobility of high quality seafarers.

b) To enhance the education on the servicing consciousness, profession ethics, and commitment to career.

The curriculum shall include such education, and for this purpose the communication with the shipowners is necessary, combining the education of the culture of the companies.

c) To conduct MET based on STCW 95, aiming at the market-oriented standards

The MET shall endeavor to meet the needs of the shipowners and market. Necessary communication and co-operations between the MET institutions and shipowners shall be carried out for the detailed MET activities.

d) To optimize the MET activities internally

The MET shall investigate itself internally in respects of curriculum designing, instruction methods, etc, to keep pace with the development of navigation technologies and meet the needs of shipowners.

6.2 Efforts to be made by the shipowners

a) To communicate with the MET institutions for the detailed MET, taking active participation in MET.
b) To pay attention to the following-up training of high quality seafarers
c) To motivate high quality seafarers

63 Efforts to be made by the administrations

a) To take measures to facilitate the adequate number of high quality enrolment
b) To regulate by reasonable legislation the mobility of human resources

c) To promulgate the shipping industry
d) To support actively and adequately the MET in respects of funding, policies and management

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Shipboard Training for the Efficient Maritime Education

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Abstract

Marine of ficers should ha ve crisis control ability because ship operation needs not only highly specialized information, but also functional capability due to the fact that there always exist dangers at sea, which are different from those at shore.

Therefore, marine officers should be trained on the related specialized information under the systematical educational system including shipboard training. Their training is also based on the strong spiritual power and physical strength through the strict training process.

In order to ha ve these v ocational personalities, dormitory life training and shipboard training course s seem to be essential processes, which are required of maritime education.

The introduction of automatic system into the ship as a result of the recent development of technology brings decrease of the full number of crew. Consequently, marine officers are increasingly under heavy burden, and should have more ship operation capabilities than before.

Maine of ficers should have not only specialized information which dif fers from that at shore, b ut also vocational adaptability which can reasonably tackle with all the problems which exist on the spot and are obstacles to individual, spiritual, physical, natural, and social demands.

There are many areas to deal with as extra curricula, which are unique characteristics of the education for marine officers. These vocational adaptabilities are based on the spiritual characteristics, such as self-developmental education, responsibility, meticulous care, attentiveness, voluntary, planning, readiness, spontaneity, accuracy, self-denial, obedience, leadership, and etc.

Furthermore, duty officers are solely responsible for the safety of their crew's lives and properties, they should train their students every day with safety supervision through the training process to cultivate vocational personality of marine officers for the safety control and economical operation of the ship.

1. Introduction

For the last several years, there have been big domestic changes around environment of KMU, for example, educational reformation of the university for the enforcement of national competitive power, requirement of the society based of knowledge according to the new educational process, structural change of population, an evasion and secession tendency of science and engineering communities of the student, conversion of the social cultural paradigm, a change of vocational view, and an environmental change in seamen power etc., and it has been also to be strengthened STCW convention internationally for it's performance for marine safety and protection of marine environment.

On the part of the shipping industry, as the goods change to make into compact from the 1st industrial products, shipping has been transferred to the type of container ship, LPG vessel, LNG vessel and etc. of which are added and technical intensive one.

At the other side of engineering part, it has been changed to automatic, to make into high power and maintenance free, so it is required the more expert skill for the marine engineer.

For the present it is found that 7700 TEU container vessel are under operation, and 15000 TEU container ship will be at the examine step for it's design

As the shipping industry needs various knowledge and technique and sea experience for the safe and economical ship operation, though it is weighted to the theoretical, spiritual side, to meet high technical development on the shipping industry, sea service working is required (needed) responsibility, self confidence, a self-denying spirit and etc. due to an unexpected case. It is essential that seamen are practical exercise and discipline for the education and training.

Therefore, all intelligence, justice and the body together should be cultivated in order to train a technical expert performing his duty effectively.

And so, all views of intelligence, justice and the body should be considered in human education.

Since the basic object of training in a training ship is to cultivate the power of execution and adaptation, it is important to possess the active will always for its acquirement.

Consequently, though the mental and physical power should be trained in order to possess the power of execution, navigational technology can be achieved by the various methods such as repetitive practice, experience, memorization and understanding and so on.

In a viewpoint that the students in a training ship are educated with living in a limited space, the education method is different from education at school, that is, just 24-hour education itself.

Therefore, only technical education should not be concentrated in a training ship, but it must be trained on a basis of living education.

2. Characteristics of the Maritime Education

2-1. Characteristics of the Sea Service Environment

The sea service environment on board is inferior to the shore one. The typical characteristics of the sea service environment are as follows:

1) The attitude of provision against a disaster at sea is required since the ship at sea is always exposed to danger of collision, stranding, sinking, and a fire and so on.
2) An absent-mindedness and a trifling error can not be unpardonable generally to the officer on duty of a ship because he has a heavy responsibility for the maintenance and the management of the precious life and the important property.
3) When an accident happens on ship, it must be treated separately without external assistance. And also the exact and proper treatment according to the circumstances is required in an emergency.
4) The seaman is easy to be under stress mentally and also to be tired physically due to a restrictive life in a limited place, which is a ship, isolated from a community and home.
5) The professional knowledge and the skill in a high degree are required to the economical navigation management because a ship is a composition plant integrated with various techniques of the different fields.
6) The seaman must follow the instructions of his boss in a sea service and obey the order of his boss absolutely in case of emergency.
7) The seaman must know the relevant facts well about the international law and the environment preservation since his ship calls at the international ports.

2-2. A Talent and Ability of a Marine Officer

A talent and ability, which a seaman must have as a manager in order to perform his duty faithfully, are as follows:

1) A high professional knowledge necessary to the ship operation management and a technical skill through the repeated field training
2) Precaution and carefulness against potential of danger and an ability of its treatment when an accident happens.
3) Collaboration and leadership through living in a group
4) Neatness, arrangement and responsibility through moderate life under critical regulations
5) Time observance through leading a regular life
6) Strong mind and physical power through the various repeated training
7) Courtesy and education in human relationships.

2-3. A Feature of Maritime Education

In order to train marine officers of talent and capacity required in a sea service, maritime education has characteristics as follows:

1) Completion of various courses necessary to the ship operation management: basic science, applied science, social science, and language etc..
2) Completion of courses necessary to obtain standard qualification: various basic educations provided by the international convention.
3) Adaptation, self-restraint and leadership in a specific environment through organizing billet living and systematic training, and also cultivation of seamanship through developing a healthy sense of values
4) Field education through embarkation training
5) Cultivation of treatment ability against danger in an emergency through training

3. Shipboard Training Education

3-1. A Purpose of Shipboard Training Education

In order to train basic knowledge and skill required of the seaman, the purpose of shipboard training education is to cultivate both theory and practical business in harmony with practical embarkation training, and also to train ability and adaptation necessary to conducting business given in peculiar environment.

It is described in detail as follows:

1) It is to increase understanding of professional knowledge and to promote its ability to use through practical experience.
2) It is to prepare for danger all the time, to encourage his responsibility based on continuous attention and precaution for safe navigation, and to cultivate management ability for economical operation management of a ship.
3) It is to cultivate treatment ability of an accident without confusion in an emergency after grasping its situation immediately and exactly.
4) It is to learn efficient operation, safety management and repair techniques of equipments.
5) It is to grasp overviews related to shipping industries and to cultivate his ability as a manager in a practical ship in future by being directly in contact with the officials in charge of the shipping companies, the agencies and the related enterprises.
6) It is to make him possess a good heart and morals as a manager through living on board a ship, and also to broaden his international sense in a management aspect by understanding the culture of the country when he calls at the other foreign ports.

3-2. Types of shipboard training education

Shipboard training education can be classified according to its execution method and time as follows.

3-2-1. Classification of shipboard training education

There are two methods of shipboard training education in which one method is to use an exclusive training ship and the other is to contract a commercial shipping company for training. The respective features are described as follows.

(1) Training education in an exclusive training ship

1) It is possible to be linked with a regular schooling and to train by the exclusive training professor systematically and organically.
2) It is possible to cultivate a fellow feeling, cooperative spirit and respect for law through group life and

regulation.

3) It is impossible to train car go navigation and dif ficult to train disassembly service of v arious kinds of equipments.

4) It is dif ficult to accumulate practical e xperience and to ha ve self-conf idence because of insuf ficient practical opportunity due to group training.

(2) Training education by contract with a commercial shipping company

1) It is possible to apply kno wledge obtained by practical training to a practical b usiness immediately because of field training, and to cultivate self-confidence.

2) It is possible to learn training assignment immediately and understand each system and v arious equipments wide because many training opportunities are given to each trainee.

3) It is impossible to be linked with a re gular school education, and there is a great dif ference of training effect according to enthusiasm and ability of field seaman trainer and also depending on human relationship.

4) Systematic education such as group training and so on is impossible and there are no op portunities of cultivating seamanship through such education.

3-2-2. Classification of training time

Training time can be classified as a multi-step completion type and a continuation type.

1) A multi-step completion type

It is possible to increase the education ef fect by di viding regular training period on board a ship (usually one year), and then by training basic education necessary to seamanship and shore education according to progress stage to various different functions. There is more-or-less difficulty in practical use of a method and a curriculum adopted from the developed countries such as England, France, USA and Japan.

2) A continuation type

The practical use of a curriculum is easy as a method of completion of embarkation training continuously at one time. Republic of Korea, Philippines and Taiwan adopt this method, and training on board a ship is required after graduation in Taiwan and Philippines.

3-3. The present state and problems of shipboard training education

By the STCW regulation navigation department trainees should have one-year shipboard training experience, and engineering trainees should have six-month experience. So training ship "Hanara" was placed for the students of navigation department of KMU since 1994, and the old training ship "Hanbada" was placed only for the students of maritime transportation department and engineering department. The students of engineering department are trained at machine factory for one semester between spring semester and autumn one as replace of shore service training for 6 months. The fact is that the training education is not effective due to insufficiency of training equipments. In spite of two training ships in service, the education in the training ship also is not effective due to the limits of accommodation (accommodation capacity: Hanbada-174 students, Hanara-152 students). Therefore, in order to improve the training effect, the number of students in the training ship must maintain at optimum level by taking a share in commission training companies, simulation training introduced in future and training at machine factory must proceed together properly and consistently.

3-3-1. The problems of commission training by a contract shipping company

Before entering a training ship "Hanara" in service, the commission company trains some students due to insufficiency of accommodations of an existing training ship, accordingly there happen various problems such as training conditions including expenses and indemnity in an accident. After all, shore training of half of the students in machine department alternately at machine room during one semester and accommodations of two training ships have solved the commission training problems by external companies. However, in view of overpopulated training education in a field, it can be considered that commission training of some students by external companies should be resumed gradually in order to bring practical training effects.

Judging from pre vious e xperiences, training condition is much dif ferent according to circumstances of each company. Generally speaking, the large companies have much interest in trainees. Some companies install education facilities on the newest ship in service and provide some students on summer vacation with training opportunities as well as self-education. However, it seems that systematic and organic training is not given by other companies except some large ones.

The problems in previous commission training by external companies are classified as follows:

1) It is difficult to train effectively on basis of theory because of no preparation of sufficient professional knowledge.
2) No sufficient time is given to trainees in making a training report.
3) It is difficult to set the student's time to the schedule of a ship since the training period is 6 months usually. And also it is difficult to say that six-month training is enough to get practical knowledge.
4) It is difficult to evaluate each trainee in all training considering only the submitted assignments, and impossible to give a grade if there is a mail delivery accident.
5) It is impossible to give an instruction by university.
6) Costs in safety training necessary to embarkation are a burden.

3-3-2. The present state and problems of training education in training ship

In training curriculum, after a basic living course is taken in the first one week, the education period is divided into coastal navigation training and overseas navigation training. Coastal navigation is given by nearly 6 times a year, and the essentials in navigation are achieved through navigation of national coast monthly in 3 or 4 days at the beginning of the week. After some basic training is achieved through several times of coast navigation training, overseas navigation training begins. In navigation training, 4 groups of navigation on duty are arranged together with students in navigation department and machine department. 3 groups of them are placed in navigation training and the other groups are placed in day-work, accordingly they can experience and learn duty services and working methods practically. Anchorage training is given during about a month after finishing basic training course and the other period except navigation training, and consists of education in a classroom and field training in each course.

The problems in training on board a training ship are as follows:

1) It is difficult for a trainee to operate equipments directly and sufficiently for training purpose during navigation.
2) The quality of education and training efficiency decrease and personal training opportunity is insufficient because many students are accommodated in a small space.
3) The education tends to be disconnected due to short period of navigation.
4) Students are apt to be passive because of lack of reality.

4. The improvement methods of training education

4-1. In case of commission training in a commercial ship

No problems yet, ho wever, a training manual according to the ship s type being referred in a f ield must be developed in case of resumption of commission training in near future. At one time, a training manual published by professors in both navigation and engineering departments was used for trainees. But the system and the content of the manual are somewhat different from practical aspect in a field, moreover, it became useless by students because training assignments were referred to the other materials.

In case of commission training by e xternal companies, school makes an ef fort in cooperation with them for the training managers to teach students effectively after grasping the training purpose completely.

In case of training e valuation, there happened some confusion at one time due to the absence of the training manager in a training ship but by professor in shore education. Moreover, there is some difficulty in proper evaluation of practical training results because it can't help but evaluate the results by referring only to the submitted assignments. Therefore, it should be considered that an effective training manual needs to be developed by introducing the system of training management professor and also the proper system is needed to evaluate the training results effectively.

4-2. In case of training in a school training ship

In case of no training by the e xternal commission companies b ut training in two training ship s, there are no formal problems even in the present system. However, it is not easy to train too many students at the same time and also effective training can not be expected. Therefore, it is highly effective to entrust a commission company with excessive students except accommodations suitable to train in two training ships. And also training effect can be achieved by installing simulators and equipments on shore since operation of navigation system, handling method of cargo, and disassembly and maintenance of various equipments are difficult to handle in a real ship for training.

4-3. In case of commission training in a contract shipping company after some periods of training in a training ship

A complementary method to solve the training problems, as described in sections 3-4, both in a training ship and in the external commission companies is to complete training by the external commission companies after training in a training ship in some period. The effective training can be expected by this method.

5. Conclusion

Shipboard training system that is currently being operated is considered to be quite problematic in itself in spite of the fact that lots of improvements have been made so far. In order to solve these problems, all the people in charge are required to continue their research and studies hard.

Shipboard training occupies a large part of quality education. However, there are lots of things that have to be improved and reformed especially in the area consisting of three inevitable elements in training; cadets, lecturers, environment, shipboard training. First of all, shipboard training must create the proper surroundings that encourage students to commit themselves to learning and mastering the knowledge and academic achievements very effectively through providing a good education. To do this, people in charge of training are surely required to create the learning environment for better academic advancements and its systematic changes should be followed subsequently.

In addition, when dealing with the matters of shipboard training education, improvements of training environment are urgently needed and its effectiveness is useless without any budget expansion and developments of equipment and facilities that can be available during anchorage.

For further development of model for shipboard training education, we should further study and research things that follow.

1. How to operate the training ships
2. To make changes for multi-level based system regarding training periods and times
3. Parallel management of training ship training and merchant ship training
4. Systematic training method of courses and curriculum tailored to each department.
5. Development of training guideline.

Academic affairs that have been managed by Ministry of Education so far, as a part of education reform plan under the government policy, now appear to be revised in the near future, which will secure less restricted and more tailored academic policy depending on the circumstances of each school in terms of the credit rule, credits needed to graduation, taking credits per a term, standard of distribution for cultural studies.

University regulation, in the case of college of Maritime Science, stated that required minimum credits for graduation are 160 and in fact it has not had a good influence on students because they have not been able to stay away from machine shop practice and formula of the education in the lecture room. From now on it is considered to be quite necessary that credit system be balanced with lots of leading universities of home and abroad in order to diversify students' way long before graduation and if possible, we should adjust the relevant regulation increasing completing credits and reducing total credits needed to graduation at least in the area of quality education. In order words, through introducing PASS, we will be able to have On-the-job based training so that we can achieve more effective education.

With the introduction of multi-level training system designed to provide students in each grade with shipboard training for about 2 months a year, we are able to make up for the weak points of continuous type and achieve more flexibility on managing the regulations of total required credits for graduation.

We can further achieve mutual-supplemented system of training ships and materials needed to practice through developing various training systems that offer simulated situation such as ship handling practice, backup capabilities under blackout and emergency case, all of which do not actually often take place.

We also promote safety program by making preventive measures against any dangerous elements on board and give practical opportunities to manipulate and work with various kinds of equipment and facilities, which ultimately encourage them to understand what they are learning better and grow their confidence and commitment to this field.

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Fire Fighting Training for Officers and Captains: A Problem Based Learning Approach

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Abstract

Problem based learning (PBL) is a new and more effective method of training compared to traditional education systems, which has been applied in different types of disciplines with a great success. Previous academic research has found out that the candidates trained with PBL have higher curiosity for learning objectives, greater gained abilities, a longer time of remembrance also with sustainability of learning all through their work life.

In maritime academic training, PBL is not a commonly used training method. With all its well worthy properties, which will be described through this paper, PBL can match maritime training consistently. For this purpose Dokuz Eylül University, School of Maritime Business and Management is working on matching PBL in maritime training program with STCW 78/95.

Emergency procedures, which are one of the core subjects of maritime training, require specific methods and equipment according to SOLAS. Especially fire fighting course for officers and captains should be designed and held with diligence. As SMBM we have developed a new curriculum and a special LEARNING RESOURCES LABORATORY for fire fighting training in accordance with STCW 95 Section A-VI /1-2 "Fire Prevention and Fire Fighting" and Section A-VI /3 "Advanced Fire Fighting".

This paper describes our new Fire Fighting Training System complied with PBL, specifications of our Learning Resources Laboratory for Fire Fighting Training, and the methods used for learner satisfaction measurement.

1. Introduction

Every seafarer who have worked onboard knows very well that, shiplife is always full of problems which requires immediate solutions. Problems are variable depending on the seafarer's education, experience and organisational culture. Forwarding the existence of the problem, to identify the problem and to find solutions for the problem are the most important skills to gain for a future deck officer. As they graduate from the school they instantly become `decision makers`. After they commence their jobs professionally, they will not be given any chance to make wrong or bad decisions.

However, statistics on marine casualties indicate that a common "signature"--that of human error--is present in most maritime disasters. To address this problem, the marine industry must strive to minimize poor human decisions that contribute--directly or indirectly--to a casualty or pollution incident. Education and ***training*** are an effective way to achieve this goal [Wang, J & Zhang S.M. 2000]. According to Nutt [1990] primary reasons of bad decisions of a decision maker are described as; core problems are often taken for granted, and premature commitments to action are made without any clear notion of what is provoking the need to act. Solution can displace problems, symptomatic signals can be considered, and urgency can be misinterpreted. Under these circumstances, accurate and fast decision making is said to be a necessary skill to be gained education should be aimed at training students how to deal with problems in the future, preparing themselves to become active, independent learners and problem solvers, rather than more or less passive recipients of information. [Dolmans & Schmidt 1996].

What does maritime training aim? Todays maritime training founded on the basis of traditional education methods, have became unconscious because of the past and new standards. At this process of fast changes, educational systems, which are open systems, must be more sensitive to all changes. Education systems have two chances : adopt themselves to the process or become a pioneer of process. There is only one other way, which must not be considered, that is to fall behind and rut in a process called `entropy`. The education systems that have changed and keep changing, started to force marine education which is a part of the open system.

A lot of expert seeking for developments at maritime education declare that marine education is in need of changing. Mokhtar (2000) indicates that ISD model and IMO model courses bring system approach to marine education, while Ruan (2002) highlights "enhancing practical skills" and "flexibility of curriculum" problems.

Lewran (2002) indicates that lots of universities have been changed and commenced to apply new educational methods. Lewran also mentions that if maritime education and training providers want to survive and grow, it is essential to participate in these changes now. All of these approaches are pointing us that a change is inevitable for maritime training. For these reasons, Dokuz Eylül University, School of Maritime Business and Management is working on matching Problem Based Learning in maritime training program with STCW 78/95.

2. Definition of PBL

Problem-based learning is an instructional method that is said to provide students with knowledge suitable for problem solving. [Schmid 1983]. While founding the structure of PBL , firstly the target objectives of

- Knowledge
- Skills
- Attitudes

are determined, than the suitable training for this purpose is planned. All the objectives are put in order and the yearly learning targets appear through the process. Planned and sequenced learning objectives are presented to students as a problem in a scenario. Principles for prepared scenarios are as below.[Dolmans 1997]

- The contents of case should adapt well to student' prior knowledge.
- A case should contain several cues that stimulate students to elaborate.
- Preferably present a case in a context that is relevant to future profession.
- Present relevant basic science concepts in the context of a ...... problem to encourage integration of knowledge.
- A case should stimulate self-directed learning by encouraging students to generate learning issues and conduct literature searches.
- A case should enhance students interest in the subject-mater, by sustaining discussion about possible solution and facilitating students to explore alternatives.
- A case should match one or more of the faculty objectives.

A scenario based on above principles takes around two weeks, consisting of 4 sessions about 3 hours each. The sessions are held with small groups consisting of maximum 8 persons each; determine the learning objectives themselves depending on the problems presented in the scenario. Until the next meeting, students use their free learning periods and study on the objectives, which they have derived themselves. When they meet again the students share their knowledge, which they have gained individually and elaborate on the problem applying the new knowledge they have gained. All through the process, between the meetings, laboratory applications, Learning Resources Laboratory practices, simulator training, presentations, field study and supporting educational activities will be carried on by expert lecturers, based on the predetermined skills and attitude achievement objectives planned within the scenario.

In PBL curriculum there are no particular classes such as navigation, compass, emergency procedures etc. A deck officer, an engineer, a captain who is supposed to be decision maker should not decided sticking work to single dimensional aspects, because every operations' macro environmental factors such as low-politics, economic, technologic, social-cultural, environmental, demographic and also micro environmental factors must be considered. To do this he /she has to integrate all the knowledge and use all of them together. This approach puts the maritime training into a multi-discipliner form.

The scenarios of PBL should be modified in accordance with feed-back of the system every year, so the curriculum can be developed and new learning objectives can be inserted into the system easily and this makes the PBL an alive system. The problems, such as, the unachieved objectives can be fixed easily trough the flexibility of the curriculum. At PBL system an intensive control and corrective actions must be carried out. Besides, system administrators should not be afraid to make mistakes, because the learners themselves will force and correct the system with their well-gained skills of researching and curiosity.

Dokuz Eylül University, School of Maritime Business and Management has been working on PBL system for 18 months and will commence the system at 2002-2003 semester. Some call this change "a transformation" while some call "reengineering and even some may call " metamorphosis". What ever you name it if you complain about the present system you have to keep changing not to suffer entropy.

3. Fire Fighting Training

Emergency procedures, which are one of the core subjects of maritime training, require specific methods and equipment according to SOLAS. Especially fire fighting courses for officers and captains should be designed and held with diligence. IMO have declared the standards of the prementioned trainings in accordance with STCW 95

Section A-VI /1-2 "Fire Prevention and Fire Fighting" and Section A-VI /3 "Advanced Fire Fighting" and curriculum of the training is recommended at "Fire Prevention And Basic Fire Fighting (Model Course 1.20)" and "Advanced Fire Fighting (Model Course 2.03)" . Almost all of the curriculum are prepared as reactive based training and focuses on mainly fire fighting fundamentals instead of fire extinction principles that should be the core issue of fire training for decision makers who are expected to assess, get rid of or minimise the potentials of fires before they occur. Are the decision maker officers supposed to be fire fighters or fire preventers? It is beyond arguments that fire fighting techniques is an essential part of training but it should be considered only as an ability to gain.

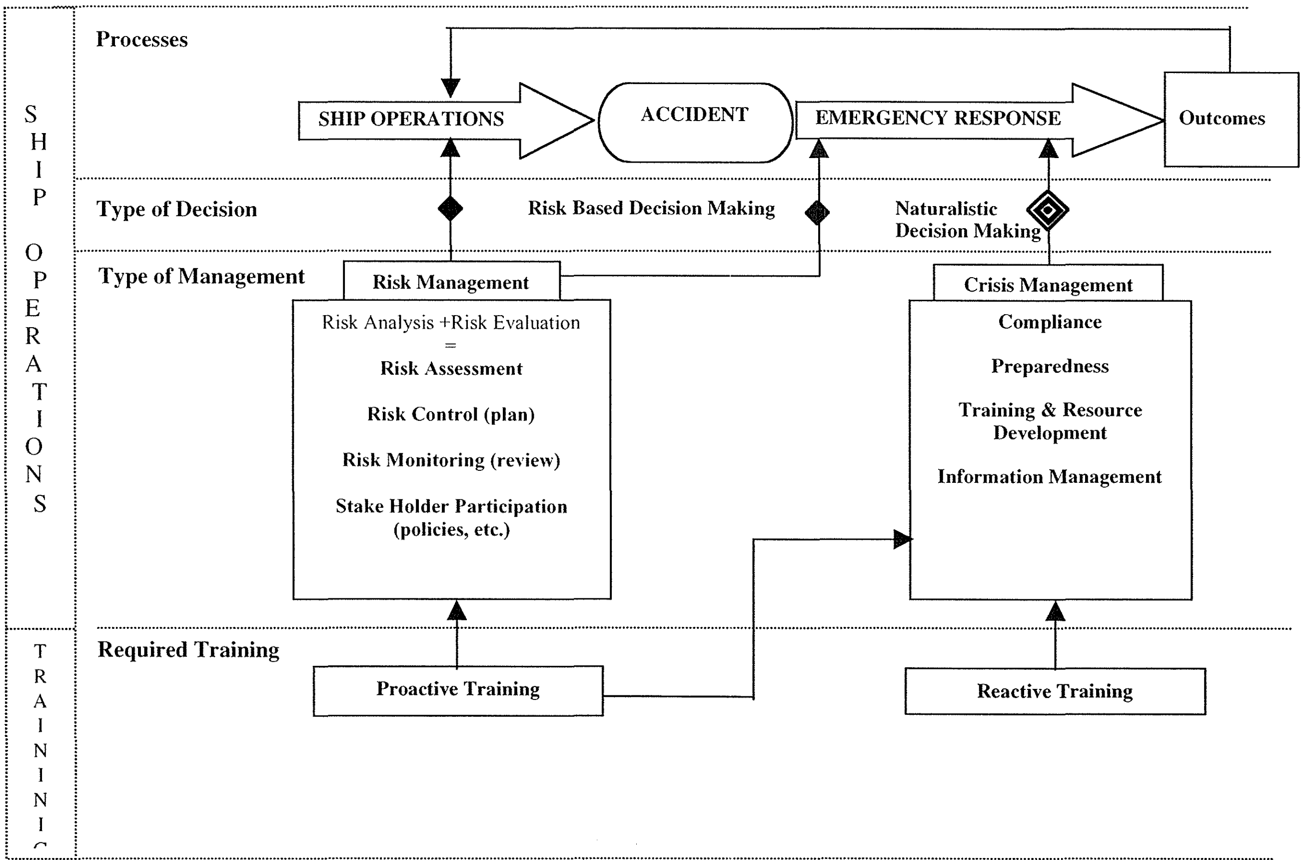

Figure 1 The Role of Training in Ship Operations.

All of the shipboard operations have a risk of fire. Some of the operations, which are carried out at the same time, creates synergy and increases the risk. The important point is each one of the decision maker's ability to risk determine the risk while considering the whole operation as shown **Figure 1.** Risk-based decision making asks the following questions and uses the answers in the decision-making process:[Bert M.]

- What can go wrong?
- How likely are the potential problems to occur?
- How severe might the potential problems be?
- Is the risk of potential problems tolerable?
- What can/should be done to lessen the risk?

Risk based decision maker needs proactive training methods for developing safety culture on board. Extinguishing operations are, one of the operations, which require risk management and crisis management have appropriate learning objectives that is maintain with reactive training methods. And in this situation, decision maker applies naturalistic decision' techniques.

Fire Fighting Training System, which is complied with PBL well fit to constitute safety culture. Because Every safety matter can be integrated with the scenarios. Thus proactive training can be developed easily by PBL. Practical skills, which are required for fire fighting reactive training, can be enhanced by special Learning Resources Laboratory for fire fighting training. A Special Learning Resources Laboratory for Fire Training Courses is proposed to be consisting of following items:

- 40' container with fixed fire pumps.
- 30 cubic meters closed space to use closed space fire, includes,
    - Fire glass, Fixed CO_2 system, Fixed Foam system, Sky Lights, Cowl, Fixed oil line
    - Fire Detectors, Fire Station, CO_2 Box, Sprinkler, etc.
- 4 square meters fire pool to use for open air fire.
- Fixed deck foam gun.
- Other fire fighting equipment
- 8 cubic meters holds model which is equipped fixed CO_2 system.
- Model of life boat manoeuvring pool.

4. Objective

The purpose of this study is to measure the perceptions of the deck officers and the engineers who work as decision makers onboard. The cause of the ship fire and the views of the respondents about maritime fire training have been questioned. The perception differences of deck officers and engineers who are in charge of different operations will be used to highlight Fire Fighting Training System compiled with PBL.

5. Hypothesis

The main hypothesis is developed to test the objectives built on the comparative analysis of the populations:

H_1 : Causes of ship fires are perceived different by deck and engine officers.

The main hypothesis, considering the perceptions on the causes of ship fires is given in **Figure 2**. To support **H_1**, the following sub-hypotheses are stated applying both for the Engine and Deck Officers.

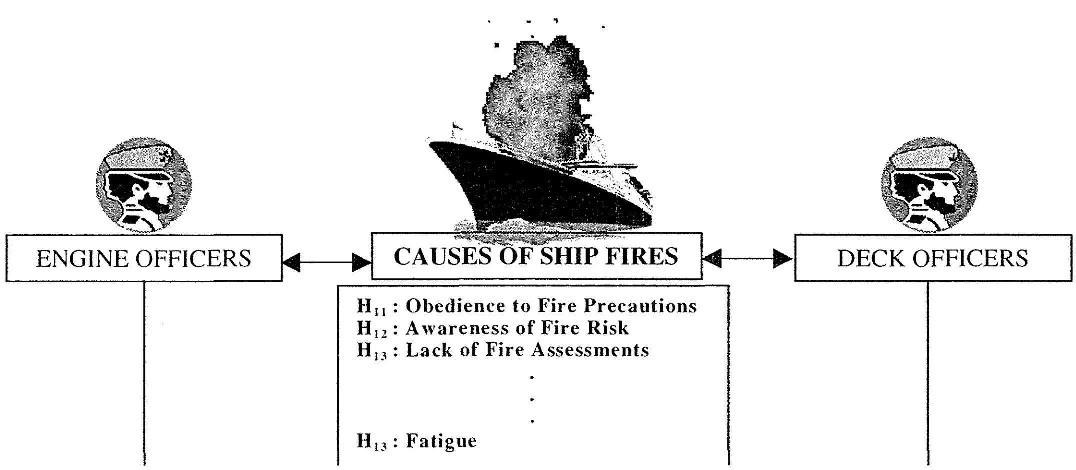

Fig. 2 Comparative Analysis for Perception of Causes of Ship Fires

6. Methodology

6.1. Questionnaire Development

To test the hypotheses of the research, a questionnaire consisting of 4 different parts is developed. The first part covers 5 open-ended and multiple-choice questions on the general information about the officer, for the purpose of profile establishment. The second part covers 6 questions on the fire risk on the board. . The third part covers 9 questions on the fire risk in the engine room. The fourth parts focus on the causes of ship fires measures stated in **Figure2.**

A set of totally 20 statements is formed on a 5-point Likert-scale (1= completely disagree, 5= completely agree) and the opinions of the respondents are proposed to be collected.

6.2. Sample

the sample is chosen among the trainees who have received STCW 95 section A-V1/3 advanced fire fighting courses. The respondents are the trainees who attended the Advanced Fire Fighting course at Dokuz Eylül University, School of Maritime Business and Management., totalling 72, which are all have been working as an officer (deck and engine). All of the respondents nationality is Turkish. The courses were realized during the interval from 15.05.2002 from 15.05.2002 to 26.07.2002. The questionnaires were collected at the beginning of the cources. Participants' profiles are given in **Table 1**. The 30 trainees are deck officers or captains. Others are engineers or chief engineers.

Table 1. Profiles of Respondents

	Age	Experiences (year)	Level of Education		Officer & Engineer & Captain	
			Bellow HE.	HE.*	Deck	Engine
N of Valid	72	69	40	32	30	42
Missing	0	3	0	0	0	0
Mean / Percent	37,93	13,32	55,6%	44,4%	41,7%	58,3%

HE* : Higher Education

6.3. Data Analysis Procedures

The research covers a comparative hypothesis. The questionnaire consists of different types of statements, Data processing is maintained by the SPSS (Statistical Package for the Social Sciences) Program. The hypothesis that is based on Likert-scale questions, ending in interval data, are comparatively analysed for perceptions of ship fire causes for Engine officers and deck officers using t-tests. Means for the sample sizes and the standard deviations are also calculated to support the t-tests. The results of the t-tests are used as a basis for the factor analysis, a factor analysis on couses as ship fires is accomplished and, finally, to test the reliability of the factor groupings reliability analysis is applied.

7. Evaluation and Results

The perceptions of the fire risk on the board is measured by the second part of questionnaire as shown **table 2.**

Table 2. Fire Risk on The Board

	Engine	Accommodation	Bridge	Holds	Deck	Galley
N of Valid	71	69	65	68	67	70
Missing	1	3	7	4	5	2
Mean*	**4,5352**	3,4348	**2,1692**	3,4853	2,4328	4,2286

* 5-point Likert scale- 1: Completely Disagree, 5 : Completely Agree

The perceptions of the fire risk in the engine room is measured by the third part of questionnaire as shown **table3.**

Table 3. Fire Risk in The Engine Room

	Workshop	Generator	Boiler Boiler Room	Bilge	Funnel	Exhaust valves and manifold	Main Engine Space	Engine Cont. Room
N of Valid	65	65	66	68	68	69	67	68
Missing	7	7	6	4	4	3	5	4
Mean*	3,0000	3,0000	3,8182	3,7059	3,8676	3,9565	3,3582	2,4412

*5-point Likert scale- 1: Completely Disagree, 5 : Completely Agree

7.1. Results of the Hypotheses Tests

The main hypothesis of the study aimed searching for the causes of ship fire with respect to differing approaches in the complete populations of the Engine Officers and the Deck Officers.

Tests for H_1 :
The hypothesis, $\mathbf{H_1}$ was based on the comparison between perceptions of the Engine Officers and the Deck Officers considering causes of ship fires. The results of the tests are summarized in **Table 4.**

Table 4. Comparative Analysis of Perceptions Measures for the Cause of Ship Fire by the Engine and Deck Officers: Results of the Hypothesis Tests for H_1

Hypothesis	Method of Analysis	Support
$\mathbf{H_{11}}$: Lack of obedience to fire precautions is perceived different for cause of ship fire by Engine and deck officers.	t-test	Not supported
$\mathbf{H_{12}}$: Lack of awareness of fire risk is perceived different for cause of ship fire by Engine and deck officers.	t-test	Supported $t=2,6372$ $p<0.05$
$\mathbf{H_{13}}$: Lack of officers training on assessment of fire risks is perceived different for cause of ship fire by Engine and deck officers.	t-test	Not supported
$\mathbf{H_{14}}$: Failure of the ship owner is perceived different for cause of ship fire by Engine and deck officers.	t-test	Not supported
$\mathbf{H_{15}}$: Lack of information on fire causes is perceived different for cause of ship fire by Engine and deck officers.	t-test	Supported $t=3,3004$ $p<0.05$
$\mathbf{H_{16}}$: Lack of regular maintenances on board is perceived different for cause of ship fire by Engine and deck officers.	t-test	Not supported
$\mathbf{H_{17}}$: Carelessness by dissatisfactions is perceived different for cause of ship fire by Engine and deck officers.	t-test	Supported $t=2.0730$ $p<0.05$
$\mathbf{H_{18}}$: Lack of ratings training on assessment of fire risks is perceived different for cause of ship fire by Engine and deck officers.	t-test	Not supported
$\mathbf{H_{19}}$: Lack of proficient in operations is perceived different for cause of ship fire by Engine and deck officers.	t-test	Supported $t=2.5661$ $p<0.05$

H_{110}: Focusing only on fire fighting not causes of fire is perceived different for cause of ship fire by Engine and deck officers.	t-test	Not supported
H_{111}: Non-compliance with SMS is perceived differently for cause of ship fire by Engine and deck officers.	t-test	Not supported
H_{112}: Fatalistic Approach is perceived differently for cause of ship fire by Engine and deck officers.	t-test	Not supported
H_{113}: No evaluation of the fire evidences is perceived differently for cause of ship fire by Engine and deck officers.	t-test	Not supported
H_{114}: Lack of training on causes of fire is perceived differently for cause of ship fire by Engine and deck officers.	t-test	Not supported
H_{115}: Lack of tidiness and cleanliness is perceived differently for cause of ship fire by Engine and deck officers.	t-test	Supported $t=2.1471$ $p<0.05$
H_{116}: Owner pressures for risky operations is perceived differently for cause of ship fire by Engine and deck officers.	t-test	Supported $t=2.9338$ $p<0.05$
H_{117}: Keeping some evidence operations is perceived different for cause of ship fire by Engine and deck officers.	t-test	Not supported
H_{118}: Unawareness of Cargo Risks is perceived different for cause of ship fire by Engine and deck officers.	t-test	Not supported
H_{119}: Unrecognised the fire risks in the ship operations is perceived different for cause of ship fire by Engine and deck officers.	t-test	Not supported
H_{120}: Fatigue is perceived different for cause of ship fire by Engine and deck officers.	t-test	Not supported

7.2. Factor Analysis

Reliability coefficient which is measured causes of ship fire is 0,8569. **Table 5** analyzes the six sets of factors obtained for the causes of ship fires through the factor analysis. The six factor groupings in the order of their reliability are respectively (1) lack of training and lack of fire risk assessment, (2) Human Element, (3) Management Failure, (4) Operational Failure (5) Owner Failure, (6) Tidiness and Cleanliness.

Highest factor loadings are:

In terms of the frequencies of the responses given to the Likert-type statements, Non-obedience to precautions (4,4028) emerge as the most important cause of ship fires. The second most important Cause of ship fire is unawareness of cargo risks (4,2754) followed by the lack of training on causes of fire (4,2286), Non-compliance with SMS (4,2254) and lack of ratings training on assessment of fire risks (4,1127). As can be noticed, statements relating to lack of training and lack of risk assessment in general have received the highest attributes.

Tablo 5 : Factor Analysis in Causes of Ship Fire

Factors				Factor Loading					
CAUSES OF SHIP FIRE	**Alpha**	**Mean*[1]**	**SD*[2]**	**I**	**II**	**III**	**IV**	**V**	**VI**
	0,8569								
LOT*[3] & FRA*[4]	**0,8543**								
LOT Officers on FRA		3,8889	1,3006	**0,6408**					
Fire Causes & Precautions		4,0833	1,2190	**0,5929**					
Lack of Regular Maintenances		3,7917	1,1979	**0,6219**					
Carelessness by Dissatisfactions		3,7222	1,3132	**0,4802**					
LOT Ratings on FRA		4,1127	1,0630	**0,8055**					
Lack of Proficient in Operations		3,8857	1,2688	**0,8094**					
Focusing Only on Fire Fighting		3,8592	1,17468	**0,4493**					
LOT on Fire Causes		4,2286	1,8710	**0,8502**					
Human Element	**0,7442**								
Fatalistic Approach		3,1549	1,6958		**0,6026**				

Keeping some evidence		3,3380	1,2789	**0,4964**				
Unrecognised fire risks		3,6056	1,1146	**0,8229**				
Fatigue		3,4507	1,2281	**0,7965**				
Management Failure	**0,5051**							
Non-compliance with SMS		4,2254	1,0447		**0,6665**			
Unawareness of Cargo Risks		4,2754	0,9983		**0,8265**			
Operational Failure	**0,5533**							
Non-obedience to Precautions		4,4028	0,8502			**0,7189**		
Unrecognised Risks of Operation		3,8194	1,2256			**0,7787**		
No evaluation of the Evidences		3,8873	0,9706			**0,4624**		
Owner Failure	**0,4127**							
Responsibility of Owner		3,3333	1,3531				**0,7263**	
Owner pressure for risky opera.		3,4783	1,2789				**0,6813**	
Tidiness and Cleanliness								
Tidiness and Cleanliness		3,8873	1,7636					**0,8011**

*[1] 5-point Likert scale- 1: Completely Disagree, 5 : Completely Agree *[2]Standard Deviation
*[3] LOT : Lack of Training *[4] FRA : Fire Risks Assessment

8. Conclusion

Some hypothesis which are Lack of awareness of fire risk ($\mathbf{H}_{12}$), Lack of information on fire causes ($\mathbf{H}_{15}$), Carelessness by dissatisfactions ($\mathbf{H}_{17}$), Lack of proficient in operations ($\mathbf{H}_{19}$), Lack of tidiness and cleanliness ($\mathbf{H}_{115}$), Owner pressures for risky operations ($\mathbf{H}_{116}$) are perceived different for cause of ship fires by Engine and deck officers. According to factor analysis, statements, which are "lack of training" and "fire risk assessment", are grouped in the first factor, which is the highest loading factor. Considering deck officers and engineers are responsible and in charge of different operations, risk management must be held separately for each operation and also methods of fire training should differ. The differences may be applied to the training of the operations, which the learners are going to be responsible for. All the training related to shipboard operations must contain risk management. Contemporary training methods should be based on trainee based proactive training with multi-disciplined applications instead of trainer based reactive training with single-disciplined applications, which are the basics of the traditional educational system. Problem Based Learning seems to be an ideal tool for the achievement of such radical changes.

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IAMU 3rd GENERAL ASSEMBLY PAPER
APPLICATION & ADDRESSING

The Ethical and Professional Obligations of Academic Staff Towards Technological Development of Students

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ABSTRACT

This paper focuses on an important aspect of education and training, namely orienting both education and training towards the promotion of ethical standards in the educational process that it might result in improving the quality of the seafarers towards the next century.
The common obligations of the academic staff comprises the general regulations which regulates the work in the universities and academies. While the articles of these regulations are known to the academic staff, who work in the educational and training fields, some of whom may not be fully conversant with all the academic ethical and professional obligations.
These obligations are not only limited to the process of education and training, whether at the level of basic studies, and upgrading studies or even postgraduates, but should also be the focus of attention in the daily activities in all academic institutions. Moreover the promotion of the said obligations to cope with the fast technological developments which greatly affect the graduates of maritime industry and academies who will have to cope with modern technologies on board modern ships, and their impact on social and psychological affairs.
The relation between academic education, scientific research and technological development is an interactive relation. It is the solid foundation of maritime education that creates future researchers and seafarers.
The introduction of sophisticated computer and advanced equipment will definitely play an important role not only in communication but also in academic research and the development of social life at sea.
The academies and universities contribute to the development of human resources, badly needed in the shipping industry by virtue of the fast technological development, which typify the shipping industry. The Arab Academy for Science and Technology and Maritime Transport recognized the importance of these aspects and has taken major steps towards these important fields.
The paper focuses on the educational and training techniques and activities, which help achieve the said objective.

N.B: The views represented in this paper reflect the author all views and not necessarily the Academy s view.

Part I
By Capt. El Ashmawy

1. Introduction

Education is the normal entrance to the developed world, and the basis which the principal infrastructure of human bases on.
The university, or any academy, is the place for consultation which leads the society to change, progress and development. This is simply the role one expects from such academic institutions, i.e., coping with the developments taking place in society and aiming at progress. Therefore, the preparation of the Faculty

Member requires inculcation of the values and ethical standards he is expected to inculcate in his students. Education of all types and at all levels aims at enabling the learner, who is the would be graduate, to deal with the realities of life in such a way that makes of him a good citizen who can effectively contribute to the development of his community. In other words, a basic function of educational institutions is to inculcate in the learner the ethical standards required for leading a good and useful life.

2. The Process of Achieving the Ethical Standard

2.1 Developing the learner s personality that he may be able to adapt to the new society he is going to live in, and shoulder whatever responsibility may be entrusted to him as a good citizen. This can only be achieved through interacting with all the available resources in an exemplary manner. Her should be prepared to accept the variables and constants of the society he is going to lie in.

2.2 Giving great care to the social, cultural and educational activities of the student. Only in such a way can students make good use of their leisure and get over the boredom of a life full of work and no play. Moreover, learning how to benefit from time is a condition of success in life.

2.3 Preparing a new generation of leaders through identifying those who have leadership traits, which can only be done through monitoring students while interacting in seminars and the other miscellaneous academic activities. Caring for such would-be leaders is essential. Within this context, it is also essential to identify those who lack such traits, identify the causes of such deficiency, and help them acquire the proper attitude.

2.4 Faculty members are expected to improve their professional performance up to the highest possible standards that they may be able to inculcate the proper attitudes in their students. This can be achieved through citing examples of commitment to the students and making them aware of the value of what they learn. Furthermore, the staff members are required to use modern educational techniques and update the textbooks used in the educational process. Only in this way can the staff member repay his society and academic institution.

2.5 Participation of Faculty members in planning, preparing and implementing the methods and techniques of training graduates, in addition to their commitment to the realization of the principle of continuation of learning through seminars and workshops at all levels.

2.6 The Faculty member has a commitment towards the varied cadres in the universities or the Academy. This applies to newly appointed lecturers as well as old hands. Faculty members could actively help in procuring academic scholarships and missions and holding international workshops and seminars to enhance exchange of experience which is essential to effective learning.

2.7 The Faculty member should be dedicated to enhance academic research, especially research which is related to the problems of his community. He has an obligation towards finding effective solutions to these problems. He is expected to find genuine solutions.

2.8 Self-assessment is crucial to Faculty members. All Faculty members are expected to undergo this experience that they may evaluate their own methods and techniques of teaching.

2.9 The Faculty member has an obligation towards activating and enhancing group work. This can be achieved by engaging in joint researches and projects. This obligations comprises two parts: The first is related to his daily educational activities; the second part is related to whatever is of concern to any member of his work team.

2.10 The Faculty member is expected to actively participate in whatever is of importance to academies and universities, e.g., systems, bylaws, etc.

3. Professional Obligations Towards Technological Development

With respect to the professional obligations of Faculty members towards technological development, it is advisable that the targeted objectives should be determined through education with its varied sectors, especially in this era of globalization and interactive strategies.

Faculty members are called upon to exert all possible efforts to base education and training on the findings of academic researches and to monitor all educational and training processes. They are expected to be aware of the importance of basic sciences, without which no success can be achieved in applied sciences.

This is of special importance to postgraduate students who are expected to be fully aware of the laws of basic sciences.
It is of special importance that distinguished students should be identified early in the educational process that they may be given ample opportunities to develop their skills and attitudes through involving them in exchange-of-ideas experiences.
Education in universities and academies should cope with the continuously changing social and academic environment, as well as changes in instructional techniques, which requires continuous modification and updating of educational syllabuses and teaching techniques in a manner that befits both technological development and the varied aptitudes of students at all educational levels.
Academic education and training should qualify the students to use information technology and all the related skills. Implementing graduation projects is an invaluable chance for the students to make the fullest possible use of information technology.

4. Student Personality Development

Meeting the challenges of the third millennium is a major commitment of all Academies. The preparation of a new generation is not an easy task, especially in an age of fast technological and informational development.
The student is the focus of the educational process. Helping the student build an integrated personality is a major aim, together with enabling him to improve his observation and deduction abilities.
The student is an integral part of the educational process. He should be trained to be interactive, responsive and fully aware of his role.
The educational system prepares students to cope with the realities of the world, treat others humanely, welcome difference in opinion, and appreciate other cultures through active interaction with others.
Within this context, it is relevant to cite the words of the English author, William Butler: Education is not filling a bucket but lighting a candle . The educational system should strive to prepare such a new generation in fulfillment of its sacred mission, i.e., serving as a focal point for all specializations and schools of thought.

5. Arab Academy for Science and Technology and Maritime Transport

The Arab Academy for Science, Technology and Maritime Transport strives hard to develop an advanced educational system based on full utilization of all potentialities to cope with the requirements of the present era. A basic objective of the Academy is to achieve such a goal by employing highly experienced Faculty members and to employ them into internal auditing in appropriate intervals seeking excellency in performance.
The second part of this paper will throw some lights on these attempts.
As for enhancing the educational and research processes, the Academy aims at providing a more qualified academic staff and developing laboratories and facilities to preserve the privilege it enjoys. In addition the Academy is in the process of establishing a modern library equipped with the latest technology that reflects future horizons. The Academy s main objective is to provide a distinguished educational service for its community.
For a long time the standard by which the efficiency of the educational process was judged is the ratio of lecturers to students. However, another factor is now present, which is the ratio of computers to students.
The University has a sacred mission, i.e., serving as a focal point for all specializations and schools of thought.
The aptitudes and attitudes of students should be fully explored with a view to preparing a new generation that could cope with the requirements of the present era.
Is it possible to apply the foregoing educational and training principles under the current status of maritime universities and academies? In the spirit of the International Association of Maritime Universities IAMU , I propose the following:

1. Assessing the current status of maritime universities and academies through re-administering a carefully planned questionnaire that guarantees a high response rate.
2. The Association is to request universities and academies members of the Federation to submit a report

describing their actual educational and training processes, academic research methods, and the technique followed in upgrading and postgraduate studies.

3. Circulating the findings by a committee the members of which are to be selected from the Federation universities and academies. The bases of the work of the said committee are to be laid down.
4. The maritime academies and universities are to be classified into levels recognized by IAMU on the basis of the work of the committee with respect to the degrees awarded.
5. A council comprising a review team is to be established; the team is to review the fields of maritime education and training to check the integration of education and training and submit proposals.

6. Summary and Conclusion

The promotion of ethical standards process might result in improving the quality of the seafarers. The ethical obligations are not only limited to the process of education and training, but should also be the focus of attention in the daily activities.

The preparation of the Faculty member requires inculcation of the values and ethical standards he is expected to inculcate in his students.

The basic function of educational institutions is to inculcate in the learner the ethical standards required for leading a good and useful life.

Faculty members are called upon to exert all possible efforts to base education and training on the findings of academic researches and to monitor all educational and training processes.

Education in academies should cope with the continuously changing social and academic environment, it should qualify the students to use information technology and all the related skills.

The educational system prepares the students to cope with the realities of the world through active interaction with others.

In the spirit of the IAMU it is possible to apply the foregoing educational and training principles under the current status of maritime universities and academies.

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Part II

By Dr. Galil

1. Introduction

The Arab Academy for Science and technology and Maritime Transport (formerly Arab Maritime Academy) was established in ALAEXANDRIA, EGYPT in 1972, to provide modern maritime education and training for all Arab states. No wonder as maritime transport started in Egypt 6500 years ago at the time of King Senphro.

In modern history, at the beginning of the 18th century, the Egyptian fleet was the 4th power in the Mediterranean Sea[1].

In 1979 the Academy extended its services to the African countries as well. By 1992 the Academy provided education and maritime training opportunities to candidates from 52 countries world wide.

Establishment of high ethical standard among faculty members and rising the moral condition of students have always been a part of the prime targets of Academy s management. These targets were not easy when the Academy occupies one single-story building. Nowadays where the Academy operates from nine campuses, one of them 52 acres, it would be very difficult to keep high morality and ethical behaviour without the principle of total quality management. This paper describes two major research projects contributed to the development of the Arab Academy.

2. The First Major Research Project

Up to 1989, the organization structure of the Arab Academy was to have the same departmental approach of onboard ships. The academic departments of the Academy were:

1- Nautical Studies Department

2- Engineering Studies Department

3- Academic Studies Department

4- Maritime Transport Department

These departments were in addition to:

One- Port Training Center

Two- Seamen Training Center

Three- Catering Training Center

Four- Maritime Research and Consultation Center.

But by the end of the seventieth a new era of ship building technology emerged. In the early 80 s the world merchant fleet had rapid revolutionary changes in technology. Also, the extremely competitive nature of maritime industry have lead to development of many innovation and complex ship designs[2]. These ships demands an extremely high level of operational procedures and skilled man-power. It was clear from the beginning that technological changes and innovation in ship building coupled with shrinking number of crew members are continuously increasing. This will necessitate installation of more informatic and electronic systems. It was also clear that the trend in ship building may lead to fully automated or even intelligent ships.

The Arab Academy looking into the special demands posed by modern ships and decided that a totally new approach to efficient education and accredited systems are badly needed. It was recognized that the departmental approach of the Academy at that time cannot keep pace with new requirements of highly skilled and intelligent manpower who can safely operate fully automated ships and capable of fulfilling recognizable and satisfactory tasks.

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1 Maher. S. The Maritime in Islamic Egypt and its Effect. Egypt Ministry of Education.

2 Abdel-Galil Maritime Education for Intelligent Ship ERA, Journal of Arab Academy, Vol. 20 No. 40, July 1995, PP 10-19.

In 1986 a research project and a research team were established. In addition, the faculty members were requested to gather information on education and development systems world wide, during their normal scientific activities abroad[3].

As a result, a lot of information was available to the research team. Systems of education and maritime training in Australia, Canada, China, Germany, Holland, Japan, Korea, Singapore, Sweden, Yugoslavia, UK, USA and USSR were available. These information were analysed in 5 groups of knowledge as: (a) critical subjects, (b) pre-requisite, (c) enhancing, (d) Precautionary and (e) academic. Figure (1) shows an example of comparison between the systems of Japan, USA, China, kings points and the Arab Academy[4].

By 1989, a comprehensive report on the aforesaid project was distributed. Two seminars and 7 general meetings were attended by most of the faculty members and some distinguished professors from Egyptian Universities. The following issues were deeply discussed:

1- The continuous changes in ship automation, where the main drive in automation is towards the totally integrated ship, control center from which all functions of navigation, machinery and cargo handling can be supervised and controlled[5].
2- The need for multi-purpose, intelligent crews.
3- Aspiration of students, demand for academic accreditation and academic recognition.

The 11th item of the list was about the requirements of regional and international shipping for manning of future ships.

The formerly Arab Maritime Transport Academy, inspired by the conclusion reached from the aforementioned research project decided to change its organization structure from departmental approach to faculty approach. Since 1990, the organization structure of the academy has been changed into:

- College of Maritime Transport and Technology
- College of Engineering and Technology
- College of Management and Technology
- Maritime Research and Consultation Center.

3. The Second Major Research Project

From 1990 to 2002, the Arab Academy for Science and Technology and Maritime Transport considerably expanded in terms of size, functions, activities and locations.

The College of Engineering and Technology, for example, started in 1990 with 3 main departments, In the year 2000, this college comprises 10 departments, functioning from three remoted sites, several hundred kilometers apart.

The Maritime Transport College and the College of Management and Technology expanded in large scales. The branches of each college are outside Alexandria town, and some located in other Arab countries. Larger number of students and faculty members been recruited every year. They are from different parts of the country and/or other countries. It worth mentioning that a new specialized institute entitled Productivity and Quality Institute was established in November 1994 after being certified for ISO 9001, as a comprehensive and flexible provider of specialist services. The fundamental element of thinking in this institute is that the Ethical and moral quality is never an accident, it requires always a good intelligent effort. This institute was assigned in a major research project to enhance quality assurance for the three main colleges and their departments, educational programs, maritime research and consultation center, in addition to, 4 institutes namely:

- Sea Training Institute
- Advanced Management Institute
- Port Training Institute
- Integrated Simulators Center.

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[3] Abdel-Galil Maritime Training and Education for the Next Century, Paper 26, Impact of New Technology on the Marine Industries, Southampton, UK, 1993.

[4] Salama A.H Future Education Strategy, 2nd Seminar of ACAD 2000 Project, March 1989.

[5] Alam M.Z. Training and Seafarers, International Manning and Training Conference, Oct. 1992, Singapore.

The research project was to cover the work of other five deaneries that enhance the educational and research processes, namely:

- The Deanery of Academic Affairs
- The Deanery of Students Affairs
- The Deanery of Admission and Registration
- The Deanery of Educational Resources
- The Deanery of Community Services & Programmes.

Due to its concern about the students, the Academy established the Deanery of Student Affairs, which supervises social activities, especially the nautical and engineering students, who are required to stay for 2 years in the Academy s hostels. This requirement is due to the fact that service on board ships demands high standard of ethical behaviour, discipline and a sense of leadership[6]. The Academy aims at enhancing the sense of responsibility, devotion to work and pride in profession among the seafaring students.

Although the institute of productivity and quality was relatively a new branch, but it has a very good start which may be indicated from figure (2). This figure shows 40 consultation projects that have been executed by the institute[7].

4. The Project Procedures and Aims

Although the Arab Academy used on having internal management auditing every single year and management external auditing on short intervals, the aforesaid project was extremely different. Approximately every faculty member was engaged in this project by one way or another for almost 3 years. It was requested from each teacher to review the contents of his/her course file and to suggest any modification required. The team leader of each subject will discuss the necessary adjustments required with subject teachers and to executed within a reasonable time. The objectives of each subject course are to be known to staff and students.

The deanery of each college is to review with heads of departments that the teaching methodologies are well planned, with clear links between curriculum content and teaching methods.

Programmes are also subject to regularly and systematically reviewed to assess their suitability. Teaching effectiveness is to be monitored in relation to stated objectives and to be evaluated regularly including students evaluation among others.

The deaneries of academic and students affairs are to develop documentation for the services been provided to students. These documents include but not limited to frequent reports to students on their academic progress, and accumulated record of attainment. The procedures should detect at an early stage if a student is in academic difficulty.

After two years of documentary procedures, two meetings between faculty members in one hand and representatives from institute of productivity and quality were held. In the first, a project plan towards AASTMT s ISO 9001 QMS Certification was presented and discussed.

The project plan started with a requirement from Quality Management System (QMS) of approval on the time table of December 98. The last item, number 12, is of a third party assessment on July 1999. The times and contents agreed upon by management of AASTMT and the faculty members.

Table (1) shows the time table and the functions included.

A week later, the second meeting attended by selected representatives for quality assurance. Figures (3) and (4) are samples of the Quality Management System (QMS), organization and document structure. The project ended on July 1999 by a successful third party assessment. A certificate of ISO 9001 was issued in Rotterdam on 4 September 1999. Figure (5) shows the ISO Certificate.

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6 Dr. Gamal Mokhtar President of the Arab Academy for Science and Technology and Maritime Transport, Catalogue of 2000-2002, Page 11.

7 Dr. Sherif El-Araby The Productivity and Quality Institute Catalogue 2002, Page 9.

5. Conclusion

The Arab Academy for Science and Technology and Maritime Transport has grown in size and activities by almost ten folds since 1990, expanded outwards in sites and locations. Some branches are located outside Egypt. Therefore, the management of the Academy looked for quality assurance as a necessary measurement of control.

From the management point of view, the most important part of the quality assurance is how to achieve consistency in methodology and contents of curriculum all round the head quarters and branches of the Arab Academy.

The Arab Academy has had good repetition, nationally and internationally, which raise morals among students and lecturers. On the other hand, the Academy seeks, all the time, to identify and meet customers requirements. This goal better achiever by coordination with international standards organization. This time the international organization made the third party assessment and the issue of ISO certificate.

Nowadays, every subject matter of a teaching course in every curriculum is well defined in detailed document, every subject matter will be delivered in any branch in same method and content as in the head-quarter site.

Frustration among lecturers and/or students in a remote branch is not to exist. On the contrary, the management was more able and has created a culture of continuous improvement in every aspect of teaching and training.

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7- Dr. Sherif El-Araby, The Productivity and Quality Institute Catalogue 2002, Page 9.

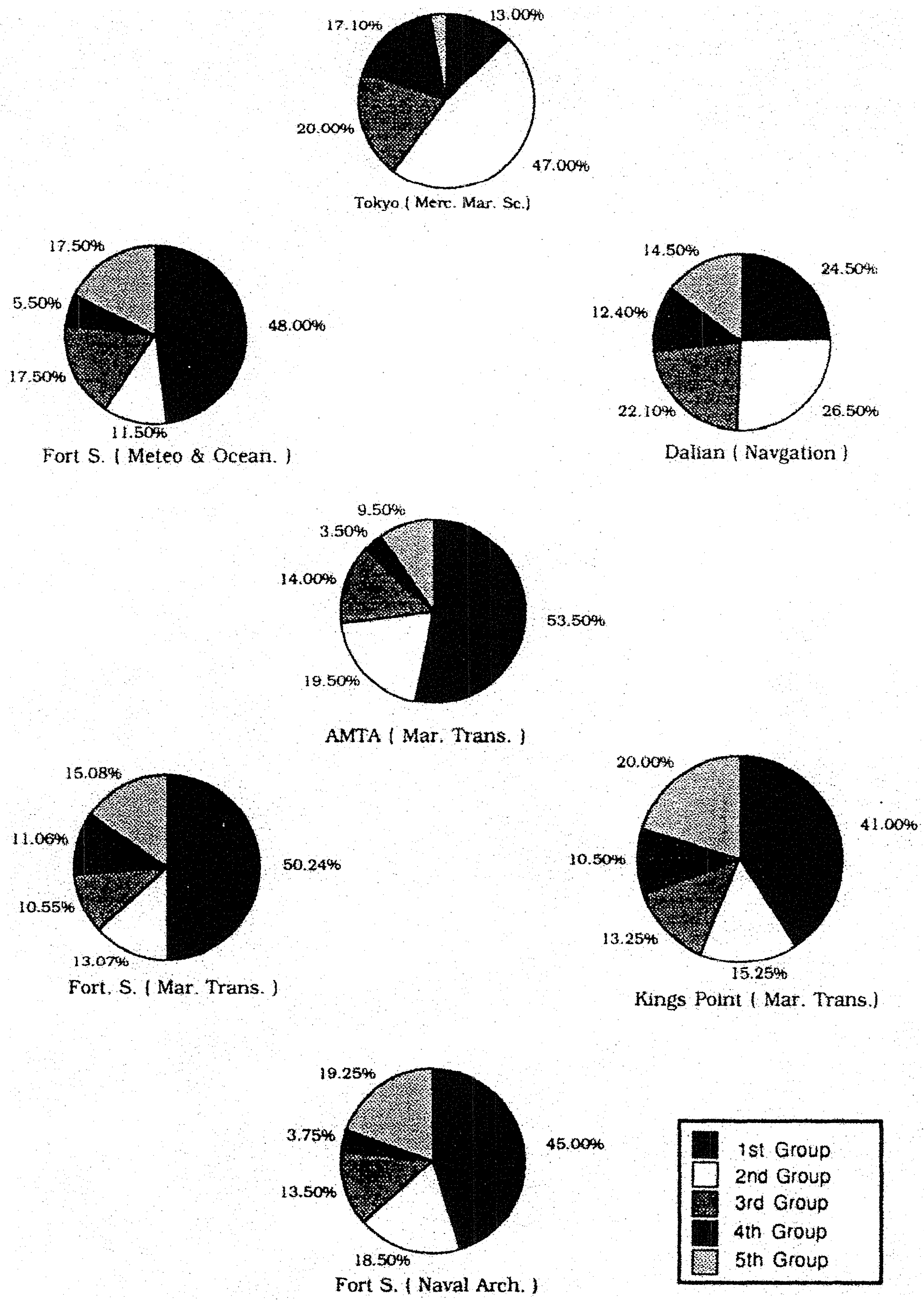
17.10%
13.00%
20.00%
47.00%
Tokyo (Merc. Mar. Sc.)
17.50%
5.50%
48.00%
17.50%
11.50%
Fort S. (Meteo & Ocean.)
14.50%
24.50%
12.40%
22.10%
26.50%
Dalian (Navgation)
9.50%
3.50%
14.00%
53.50%
19.50%
AMTA (Mar. Trans.)
15.08%
11.06%
50.24%
10.55%
13.07%
Fort. S. (Mar. Trans.)
20.00%
41.00%
10.50%
13.25%
15.25%
Kings Point (Mar. Trans.)
19.25%
3.75%
45.00%
13.50%
18.50%
Fort S. (Naval Arch.)
1st Group
2nd Group
3rd Group
4th Group
5th Group

Figure No. (1)

We have successfully Implemented and guided a numerous number of companies towards Quality/Environmental System certifications:

- Alex Tire Company
- Queen Interiors for furnishing
- El-Nasr Tanning
- The International Company for Industrial Development (Devco)
- Sika Egypt for chemical construction materials
- Itag
- Memphis, Amoun, Abu-Simbel and Tiba
- The Egyptian Warehouse
- El-Nahas Company
- Nile Textures Company
- The Arab United Company for Shipping
- The Egyptian Company for Importing
- El-Golan Jeansware
- Teefour for printing
- Seeza Adidas Clothing
- Unifarma for pharmaceutical products
- Tariq El-Harir for Tourism
- Tarq Bin Ziad for publishing
- Fire Extinguishers Company
- El Wadi for exporting Agriculture products
- Suez Canal for Constructing
- Suez Canal Agencies
- Misr for chemical manufacturing
- Egyptian company for ship building and repair
- General Motors Egypt (GME)
- Port Said Containers Handling
- Damietta for Container Handling
- Sornaga Porcelain Company
- International Navigation Agencies Company
- RACTA for Paper Manufacturing
- Mido for Paints Manufacture
- Maritime Company for Navigation Works
- Africa Storing Company
- El-Madina El-Menawarw Estate Investment Company
- Red Naf Navigation Company
- Misr Fire Extinguisher Company
- Tymor Language School
- Atlas Agencies Company
- Sea Gull Agencies Company
- Red Mar Agencies Company
- Arab Academy for Science and Technology and Maritime Transport

.... and many more

Figure No. (2)

Project Plan	
Approve Project Plan	December 98
Train Quality Representatives	December 98
Develop Quality Plans	January - March 99
Agree Procedures	January 99
Develop Procedures	January - March 99
Implement System	January-March 99
Conduct Internal Audits	May - July 99
Implement Corrective Actions	May - July 99
Conduct Mock Assessment	June 99
Management Status Meetings	Monthly
Management Review Meeting	June 99
Third Party Assessment	July 99

Table No. (1): The Time Table for AASTMT s ISO 9001 QMS

QMS Organization

♦ **President**

Responsible for articulating the Academy's overall strategy and monitoring and approving associated policies and plans.

♦ **Management Representative (MR) :**

Responsible for ensuring that the Quality Management System is implemented effectively, throughout the Academy and for reporting on its effectiveness to senior management through the Management Review process, The Deputy for Executive Affairs is the nominated Management Representative.

QMS Organization continued

♦ **Academy Quality Representative (AQR)**

Responsible for coordinating the implementation and maintenance of the Quality Management System on behalf of the Management Representative and for liaising with the departmental Quality Representatives. The Dean of the Productivity and Quality Institute is the nominated AQR .

♦ **Quality Representative (QR)**

The owner of each Quality Plan appoints a local Quality Representative who is responsible for the maintenance of the Quality System within the unit(s) covered by the plan.

***Figure** No. (3)*

Documentation Structure

♦ **Management System Manual**

This document contains the Academy's policy and objectives for quality. It defines the key responsibilities of those who manage the various functions within the Academy and gives a summary of the core business and supporting processes which enable it to meet its business objectives.

♦ **Quality Plans**

These documents contain further detail as to the Organization and services provided by units within the Academy (e.g. Colleges, Institutes). They also contain a matrix of the applicable Management Procedures.

Documentation Structure continued

♦ **Management Procedures**

These documents describe the key processes within the Academy. They define responsibilities and methods of control and ensure compliance with ISO 9001. They fall into three categories: Core Business, Business Support, ISO support.

♦ **Work Instructions**

These documents supplement Management Procedures and are developed when there is a need to provide prescriptive detail in order to ensure consistency in the performance of a task,

Figure No. (4)

DNV

DET NORSKE VERITAS

QUALITY SYSTEM CERTIFICATE

Certificate No. QSC - 3935

This is to certify that
the Quality System
of

ARAB ACADEMY FOR SCIENCE, TECHNOLOGY
AND MARITIME TRANSPORT

at
Alexandria, Egypt

has been found to conform to the Quality System Standard:

ISO 9001:1994

This Certificate is valid for the following product or service ranges:

DEVELOPMENT AND DELIVERY OF PROGRAMS OF STUDY
LEADING TO BACHELOR DEGREES IN
MARITIME TRANSPORT, ENGINEERING AND BUSINESS ADMINISTRATION

Place and date:
Rotterdam, 4 September, 1999

for the Accredited Unit:
DNV CERTIFICATION B.V.,
THE NETHERLANDS

Ron J. Meijer
Management Representative

Accredited
by the RvA

This Certificate is valid until:
4 September, 2002

Original Certification date:
4 September, 1999

Sherif Mekkawy
Lead Auditor

Lack of fulfilment of conditions as set out in the Appendix may render this Certificate invalid.

Figure No. (5)

Course FIle Summary:

ME (151) Engineering Drawing and Descriptive Geometry

Course Information :

Course Title:	Engineering Drawing & Descriptive Geometry.		
Code:	ME 151 .		
Hours	Lecture:3	Tutorial:3	Credit:2
Prerequisites:	None.		
Lecturer:			
Assistants:			
Room:			

Grading :

Class Performance / Attendance	10%
Midterm # 1/ Assignments : (7th week)	30%
Midterm # 2/ Assignments : (12th week)	20%
Final Exam	40%

Course Description:

(a) Engineering drawing introduction, types of lines, Sizes of drawing papers, Layouts of drawing sheets, Graphics instruments, scales, Geometrical construction, Orthographic projection, Sectioning, Dimensioning, pictorial drawing, Conventions.

(b) Descriptive geometry locus of a point, Monge's projection, Straight line (particular positions), The plane, Auxiliary planes, The positional problems, The projections of a circle, Curved surfaces, Intersection of surfaces of revolution, Helix – Helical surfaces, Perspective projection.

Text Books :

- (a) Engineering Drawing Book, prepared and edited from several related books .
- (b) Descriptive Geometry Book, prepared and edited from several related books

Reference Books:

- (a) BOGOLYULOV S. A. Voinor, *Engineering drawing.* Latest edition Mir publishers Thomas E. French *Engineering Drawing and Graphics Techniques,* Latest edition, Mc Graw – Hill.
- (b) GORDON V.O. and SEMENTSOBV M.A. *A Course in Descriptive Geometry.* Moscow Mir Pub., 1980.
- TIZZARD Rew, *An Introduction to computer aided Engineering. N.Y:, 1994.*
- **Books available in the AAST Library.**

Course Aim:

(a) To give the student the ability to communicate by means of Engineering Drawing, and to relate the applications of drawing techniques to mechanical engineering practice.

(b) identify the fundamentals of Descriptive Geometry. To develop three- dimensional imagination of forms and methods of presenting them in the plane. To acquire the skill of dealing with complex figures and study their geometrical properties.

Course Objectives:

(a) To provide the basic information for engineering drawing and to gain practice in drawing, as well as knowing the different types for drawing, such as sectioning, pictorial drawing...etc.

(b) To provide the basic information of practical geometry for students and to develop their three dimensional imagination. The graphic solutions enhance the ability of student to deal with complex figures and visualize their relative positions in space, hence, study their geometrical properties .

Course Outline:

(a) Engineering Drawing:

Week No.1:
Introduction to engineering drawing and geometrical construction

Week No.2:
Geometrical constructions

Week No.3-4:
Three views projection

Week No. 5-6:
Third view projection

Week No.7:
Quiz

Week No.8:
Third view projection

Week No.9-10-11:
Sectioning.

Week No.12:
Quiz

Week No.13-14:
Pictorial (Isometric) **Drawing**

Week No.15:
General revision or any pending.

Week No.16:
Final Exam

(b) Descriptive Geometry:

Week No.1:
Mongean Projection (Projection of a point)

Week No.2:
Projection / traces of a straight line

Week No.3:
Particular positions of straight lines

Week No.4:
Projection of a plane

Week No. 5:
Particular positions of planes

Week No.6:
Auxiliary planes: True length of an oblgue line

Week No.7:
Edge view of an oblique plane

Week No.8:
Positional problems pt. of int. of line and plans

Week No.9:
Pt. On plane, two parallel planes.

Week No.10:
Projection of a circle.

Week No.11:
Surfaces of Revolution.

Week No.12:
Intersection of two surfaces

Week No.13-14:
Perspective

Week No.15:
Perspective and model exams.

Week No.16:
Final Exam

Figure No. (6)