INTERNATIONAL ASSOCIATION OF MARITIME UNIVERSITIES

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AUSTRALIAN MARITIME COLLEGE

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The Nippon Foundation

ADVANCES IN INTERNATIONAL MARITIME RESEARCH

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FORWARD

The International Association of Maritime Universities (IAMU) has developed significantly since its establishment in 1999. Through the hard work of its members and the generous support of The Nippon Foundation, IAMU has expanded its membership and activities to the point that it is now recognised as an authoritative organisation for maritime educational issues. The Annual General Assemblies have been a highlight of each year since IAMU's inception and the Australian Maritime College (AMC) is proud to be hosting the 5th Annual General Assembly in Launceston in November 2004.

The theme of this year's Assembly is:

'Advances in International Maritime Research'

Research is one of the features that distinguish IAMU members from other training and education providers for the maritime industry. Through collaborative research amongst IAMU members, there is a good opportunity to introduce 'cutting edge' technologies and systems to assist the improvements in maritime safety, education systems and developments in standardised approaches throughout the world.

The papers contained in these Proceedings have been through a peer review process and reflect a range of important research activity which is being undertaken to extend the boundaries of knowledge in key fields associated with the objectives of IAMU. I commend these papers to the reader and encourage your involvement in the work of IAMU.

Dr Neil Otway
CEO/Principal of the Australian Maritime College, and
Senior Vice-Chair, IAMU

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Application Of Modern Teaching Methods To Study Of Navigation And Marine Engineering Technology

Jin Jianguo, Assistant Professor, Deputy Dean
Wu Jianhua, Ph D. Professor, Dean
Han Jiaying, MD. Lecture
Zhao Xin, Lecture
Tianjin University of Technology, P.R. China 300191

ABSTRACT

This paper introduces modern teaching methods that are used in maritime technology and marine education in Tianjin University of Technology. Modern teaching methods include multi-media teaching method, cases teaching method, VR (virtual reality) technology application, maritime simulators application, bilingual education in specialty education, academic seminar in school education activity, keeping in touch with International Maritime Safety Authority and Maritime Safety Authority of China, and student science activities. The excellent results are achieved by practice.

Key Words: Application, modern teaching method, study

Foreword

With the development of modern navigation technology more and more navigators and marine engineers are needed. The questions of how to train them as well as our students, how to organize their education and help them to catch up to the demands of modern navigation and marine engineering technology as quickly as possible, have been explored by colleges around the world, and valuable results in many aspects have been obtained. Colleges of the international community conducted beneficial research in many ways and obtained the valuable results. Our school has done the relevant exploration and research into these aspects according to our current equipment and teachers. We also have got good results in the training of the advanced engineers of Chinese navigation and marine technology fields.

Current problem

The Chinese higher education system pays attention to theorization teaching in general, that is embodied in the following aspects:

1) The quantity in the theorization courses arrangement is larger, accounting for more than 80% of total teaching hours.

2) Results of teaching are tested by theorization examination and the training and testing to their ability of practice are neglected.

3) Teachers usually explain the theories, deduce the formula, calculate the example and repeat what the book says. They seldom recommend the worthy reference books to their students. They also infrequently explain and analyze practice examples related to the theory when they teach the students. At the same

time, teachers are lack communication with each other, so many overlapping contents in different courses are not being explained clearly and the key contents are difficult for students to master. As a result students, who have no practical experience, are inclined to view the courses as dull and lack motivation to study positively.

4) The students are using Chinese examination education mode, so they recite all concepts and formulas before they take part in the examination. They will forget nearly all the things not long after the examination because their knowledge is unilateral and they have not understood the key contents of the courses.

What we do

In view of Chinese education method and our school s practice, in order to help our students adapt to the development of navigation and marine engineering technology and keep up with the level of navigation and marine engineering technology in the world, we have put emphasis on education and teaching work in following areas:

1) Employ multi-media teaching method using modern teaching technology. We encourage our teachers to apply the multi-media courseware in their teaching as it can not only explain a greater volume of information to the students in a short time, but it can also solve the problem of out of date books being used. The teachers enrich the contents of the courseware annually according to new technology and application in maritime teaching and ensure that the students learn the latest in technical development and application.

2) Because courses in navigation and marine engineering technology include both theory and practice, we adopt case teaching to enrich teaching content, integrate bald theories with navigation practice. At the same, we have adjusted the teaching project. The rate of theory and practice is from 80:20 to 65:35. We have increased some manipulation courses, such as GMDSS, APRA, advanced fire fighting, and so on. Case teaching means explaining the theory according to what has happened in navigation practice so it can attract the eyes and hearts of the students and deepen their comprehension of theories. There is also a lot of practical work for our students. Before the major classes start, our teachers often organize the students to visit the ship factory to learn the equipment. After all the classes are finished, they have chance to practice in the ship to improve their skills for their future work.

3) All kinds of maritime simulators used in teaching make possible things that could not be realized in the past. The navigation simulator is used for training navigators. In front of the navigation simulator, we have the feeling that the ship is moving as we are driving it. We can see the fog, clouds, beach and so on, in front of us. It is so vivid in the view of the scene, and has such a broad range of function that students can practice such things as drawing out the sea route, driving the ship and securing sailors. The engine simulator provides the maritime engineer the chance of practice. It involves almost all of the automatic equipment in the engine room. For instance generation system, main engine system, auxiliary engine system, pipe system. The students can control the engines and learn how to eliminate the fault. These simulators attract the interest of the students and by using these simulators the students learn the skills necessary to control the ship.

4) The VR technology is used in teaching. Now we pay more attention to the visual disassembly of ship that designed by CAD. We have finished some parts disassembly system by software technology. The application of virtual reality disassembly system makes the disassembly work

simple and can be grasped easily. There are qualities of equipment in the ship, without the virtual technology, teachers can never show so much equipment's disassembly progress to the students in the class. With the help of the LAN, in the virtual disassembly environment every student can have a computer to practice the disassembly and assembly of the equipment that solves the problem in the past that one played the practice and the others were only audiences. By the virtual disassembly system, the students can not only disassemble the assembly, but also learn its principles and grasp the key contents. And it is important to improve the students capability to take advantage of their brain and hand.

5) In order to improve our students level of English, we encourage our teachers to put bilingual education into their teaching practice and appoint foreign teachers to teach our students oral English. As the manipulator of an international ocean ship our students will need not only solid professional knowledge, but also a high level of foreign language in order to communicate information and professional knowledge or technology with colleagues, and to understand all kinds of instructions spoken in different accents.

6) We develop academic communication work periodically in our school. In order to change teaching contents singularity, our teachers communicate with each other periodically in academic seminars. Marine technology includes so much integrative knowledge that every teacher needs to introduce his new teaching method or update study to all teachers of the whole school. In this way, our teachers could keep on with their own study, as well as exchange and/or share their research achievements with others. And we can effectively avoid the problem of teaching content not being connective across our courses.

7) We have paid a close attention to strengthening contact with relevant navigation schools around the world, with a view to enhancing academic communication. In order to master updated technology and knowledge, we take an active part in translating and sorting relevant international navigation profession education or training information that is published by the International Maritime Safety Authority, the Maritime Safety Authority of China and local MSA of Tianjin. We implement our teaching quality guideline, putting a teaching quality control and evaluation system into practice. By means of communication, we continuously study others education methods to improve our education level. We pay much attention to education, improve the students responsibility to the career and help them to become qualified for their jobs.

8) We organize and guide our students to participate in science activities that are relevant to their professional knowledge, and will enrich their lives after class. One of the students science activities that we organized last year was the solar energy lifeboat concept design. Around this theme, students studied about the solar energy principle and solar energy battery board themselves. Students combined the new knowledge with the knowledge of body craftwork, hydrodynamics, ship design and so on what they have learned in the classroom. They finished the drawing design and modeling design with the help of their tutor. The solar energy lifeboat was awarded the bronze prize in the national competition of all undergraduates with Challenge Cup in 2002. This activity inspired students positivity.

Practices results

Through these practices over the last few years, we have acquired many benefits that can be embodied in the following:

1) Our students attended the seaman qualification certificate that is organized by the Ministry of Communications of the People s Republic of China and came out top of the relevant national colleges in the percentage of passed students.

2) Our students employment percentage, including the percentage of those that passed the entrance exam of graduated students, kept on 100 percent, which was more than other schools of our university.

3) The percentage of qualifier is higher. Our school s spot check of 62 graduates showed: the percentage of those who were employed or entered for entrance exam of graduate student and passed was 100 percent. Of the 14 graduates who are engaged by an enterprise, 10 graduates passed the international famous ship-owner written examination and interview, and got better grades.

4) The students of our school have such a strong dependability and such good achievement in the job that our school has received a lot of good feedback from their companies. The relevant companies plan to employ more students from our school in the next year.

Conclusion

Navigation and marine engineering specialty attach importance to both theory and practice. You can even say that they are related to safety of life at sea and pollution from ships. So we must build up students commitment to ocean shipping, make them take an active part in their education through a progressive teaching process, enabling them to feel that they have benefited from the education in the end. In the last few years we have achieved a good deal by the application of modern teaching methods. With the development of technology and the improvement of education level, we are confident that we can do even better in the future.

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BIOGRAPHY

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Study on Efficient Ways to Improve the Quality of Onboard Training System of Training Ships in the Section of Maritime Engineering

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Student Presentation

SUMMARY

The mandate of onboard training systems as a preparation procedure for working on trading vessels is assumed to be a positive step towards enhancing duty abilities that are technical and practical by conferring opportunities of actual on the spot experiences and disciplines stemming from the basis of theoretical knowledge that students have studied since their sophomore years.

However, the current situation is moving away from its original concept. Students have been relegated to a bystander level, as well; they have been completely excluded in joint practical work, which is fundamental to the original concept of practical learning. These problems are the main culprits of a student's incompetence on the criteria of spot working experiences.

A series of short engineering exercises and design projects are created to help students learn to apply abstract knowledge to physical experiences with hardware (Brereton, Margot Felicity, 1999). However, engineers in charge of training vessels do not have thorough obligations to, or little interest in, educating the trainees for acquiring knowledge from practical work. In addition, no classes related to overhauling processes or video interaction analyses are allocated. These processes, and more, need to be altered so that onboard training systems and programs are efficient and effective.

Currently, improving the quality of maritime personnel training has been a critical issue. Thus, key to coping with the aforementioned problems lies in how well the trainees can maximize their use of training ships

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Using Emerging Technologies in Online Course Delivery: A Course Showcase and Lessons Learned

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ABSTRACT

In response to the growing demand for flexible educational programming, the Marine Institute of Memorial University of Newfoundland has developed a number of post-secondary courses from our degree, diploma, and professional certification programmes for online delivery. The Internet, communications tools, learning technologies, and course specific CD-ROMs are integrated into courses where they are best suited in terms of instructional design. The audience for these courses has included full time, part time, in-house and virtual adult learners.

This paper will illustrate how the Marine Institute is adapting to the changing landscape of education with its efforts for providing alternate educational options to accommodate the schedules and circumstances of our clientele. In particular we will showcase both the instructional design and developmental process, and final delivery of a fully online course for offshore fishers entitled *Navigation and Stability*. A description of the uses of the new technologies employed in our course design will be explained and discussed. Experiences and lessons learned concerning asynchronous and real-time features of technologies will be addressed. Logistical and technical considerations will also be noted along with an opportunity to view the components of the course. To conclude, the changing demand for learning opportunities and the enhancement of post-secondary maritime education will be discussed.

1. Introduction

Traditionally, seafarers returned from sea time to spend time with family, leisure and other interests before returning to sea for a duration of time that could last from 3 weeks to 6 months depending on the company and/or their position on the vessel. When advancement or upgrading in a certificate was necessary, mariners would be required to set up residence in the location of the Marine Institute from rural areas or other provinces. As training became more frequent due to progress in systems, regulations and retiring personnel, advancements in educational technologies were noted, with the possibilities for companies and individual students. Inquiries about taking advantage of educational opportunities using technology for their own gain were being made to Marine Institute. It would decrease training costs for both individual and company, and allow for less time away from work, and more time on land for family and other interests.

As the knowledge economy took root, diploma graduates from 3-year technical college programmes were looking to advance into degree programmes. The online Bachelor of Technology degree programme was developed in response to this demand and it is now marketed internationally. The online Bachelor of Maritime Studies and Master of Marine Studies programmes have since followed.

At the **Marine Institute of Memorial University of Newfoundland (MI),** the delivery of online distance education programmes is a relatively new initiative, since 1998. In 1995, a learning technologies team was formed to develop educational products with a view to distance education. Several CD-ROM products were developed between 1995-1998, without a standardized systematic approach for the development of technology projects. In

September 1998, MI started to formalize the planning processes and procedures used in the development of technology projects regarding project management, instructional design, development and delivery. Eventually, logistics were devised and implemented that attempted to push delivery into the mainstream of programme delivery, and processes and procedures were documented and implemented for course design, development and delivery.

One of our particular strategies, the Bachelor of Maritime Studies (BMS) programme, has been steadily growing in the international Maritime community with respect to both reputation and student interest. It is Canada's only degree programme in maritime studies approved by Transport Canada (TC) as meeting or exceeding STCW standards. There are thirteen required courses including a project and a report, all of which can be fully completed via distance.

The programme accepts a range of graduates from disciplines such as nautical science, marine engineering, naval architecture, and marine systems design. The overall goal is to add an academic component to their existing technical education while exposing them to contemporary organizational and human resource management ideas, and to provide insight into economics and social sciences in the global context. The target clientele is mariners who have the desire for further education but cannot commit to the inflexibility of the traditional classroom. Furthermore, the ability to learn using the internet has made this programme such a success in the international maritime community that enrolment has doubled since September 2002.

The next section will highlight the approach that Marine Institute presently employs for its courses and projects. The systematic process ensures that institute-wide planning processes and procedures are integrated to result in quality educational products and services for Marine Institute students. As well an individual course, *Navigation & Stability*, which is scheduled for pilot delivery this September, will be analyzed in terms of its chosen elements and the logic behind the instructional design selections.

2. Instructional Design Processes and Procedures

2.1 The Team

A team-based approach to projects for designing, developing and delivering online programmes is used at Marine Institute. The significant pieces of the puzzle are seen to be these that Figure 1 illustrates: project management, instructional design and content development, technology design and integration of content, delivery logistics and learner services.

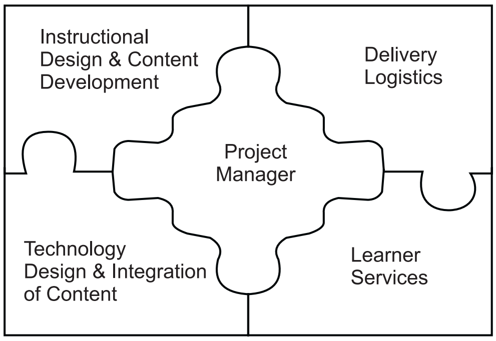

Figure 1. The integrated themes necessary for successful online learning.

The members of the team are identified and their roles defined. The team consists of a project manager, subject matter expert(s), an instructional designer/project manager, a graphic artist, a multimedia developer(s), a computer programmer and an editor(s) (Figure 2). The project utilizes resources of each member, where appropriate, for areas such as content, administration, technical, processing and layout. Some of the team members may have dual roles.

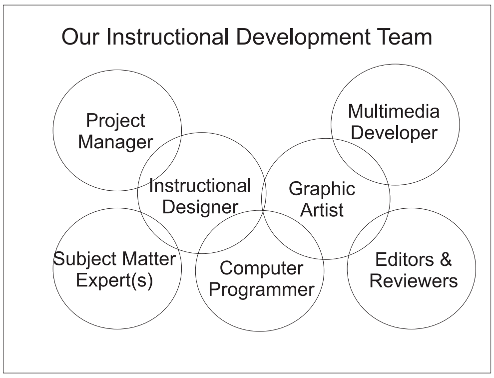

Figure 2. The team composition for designand development.

2.2 Project Management

The instructional designer/project manager begins the development process by working with the creative design team (internal or external) to produce a design template.

The team then produces a prototype that represents a fully functional subset of the project. The prototype is reviewed and revised by the team as well as other personnel, as necessary. Required changes are incorporated into the prototype and the remaining modules are produced. The final draft is presented initially to internal auditors and subsequently to external examiners. Edits resulting from these reviews are incorporated into the project. At this point an instructional designers report is generated and distributed to the team members to provide the initial focus (see Appendix A).

2.3 Tasks

Prior to the first planning meeting, a project task analysis, time line and role responsibility is charted by the project leader. The team works toward its goals by using a continuous quality improvement tool such as the Plan, Do, Check, and Act (P-D-C-A) Cycle as described by Brassard and Ritter, 1994 (p. 115). PLAN what you want to accomplish over a period of time and what you need to do to get there. DO what you planned on doing. Start on a small scale! CHECK the results of what you did to see if the objective was achieved. ACT on the information. If the cycle is successful, standardize the plan, otherwise continue in the cycle to plan for further improvement. This is a problem-solving process that is integrated in the individual work of team members and in the overall effort of the project.

A chart is used to track progress and offers a time line for the tasks, duties and deadlines for each role. The chart provides a view of role relationships and interdependence and provides a plan of action for each member. For tasks that require more than one team member, scheduling is negotiated by those involved in the tasks in accordance with the overall schedule. Progress meetings are established and a distribution list is used for group communication.

During the initial meeting the project scope is defined in relation to the needs assessment. The process for the project is presented. Tasks are presented to the group; input is invited and the tasks are revised, if necessary. The time line is presented in relation to tasks; input is invited and the time line is revised accordingly. The schedule and format for progress meetings is set, and dates for full team meetings and sign-off deadlines are determined. The format of progress meetings generally includes:

- preparation for meeting;
- agenda circulation;
- an update of activities to team members;
- highlights of issues for action;
- problem solving and troubleshooting;
- proceedings documentation and distribution.

2.4 Development

The instructional designer and the subject matter expert work closely to establish a design and a learning strategy for the content. The learning technology and media choices are carefully planned. Course management tools and learner tools are identified to fit the design of the course. The instructional designer then produces storyboards and a media matrix outlining the media requirements. For the purpose of this paper, the attributes or the work associated with each have been separated even though the design and development are integrated or non-linear.

Today's educational philosophy focuses on the students as active learners. The lessons should help them build on previous knowledge (the theory of constructivism), use authentic examples and encourage collaboration and interactivity to master the course material.

An opportunity for learning in each phase of the cycle should occur in the presentation of the content. The learning domain most applicable to the subject matter is determined, whether it is the affective domain, psychomotor or the cognitive domain. Each domain has various levels of
objectives and a collection of associated verbs. The different styles of learning and opportunities for learning preferred by each style are considered as espoused by Kolb's theory of learning styles (Hartman, 1995).

Learning theories that the team members might advocate influence much of the development and design. A bent toward collaborative and constructivist teaching and learning models is emerging, nonetheless an eclectic approach is, generally, applied. Selected media and tools are used to endorse an interactive instructional and graphic design with authentic examples and exercises. Mechanisms for student practices and feedback are provided throughout the course and at the end an overall course feedback survey is administered. Navigation is given attention and lifestyle and flexibility issues are considered and appropriately addressed in the design.

Learning objectives for the course and each section are developed and outlined. Learning paths or guideposts that help students navigate though the course in chunks and on time are made available. Texts and reference materials are identified, accessible and associated with respective parts of the course. Recommended and required readings are delineated. A variety of individual and or group assignments, tests and activities and answer keys are produced. Copyright authorization is sought for any sources that do not fall under the CANCOPY agreement, Canada's copyright authority. A copyright officer is available to assist with obtaining copyright and a log form is used to track the authorization contract. To guide this development process the instructional designer follows the essential elements outlined in Appendix B.

3. Course Showcase

3.1 The Project Background

The Marine Institute of Memorial University of Newfoundland (MI) and The Irish Sea Fisheries Board (BIM) have partnered to design and develop a fully contained online course called Navigation and Stability for small boat fishers. There will be a set date for the students to start and complete the course, the students will move through the password-protected course as a group, and the course would be facilitated by an instructor.

To enter this site as a student, go to http: //webct1.lyit.ie and enter the following information:Username : Bim.Guest
Password : iascaigh

The strategy is to have the final e-learning product made accessible by entering the learning technology login page. The learner will be directed to this entry page where they will be asked to enter a username and password which they would have received previously via email when they registered for the course. This password protected site, managed by Letterkilkenny University, would accommodate the completed course. The course would be developed and reside inside of WebCT version 4.0, a learning management system. This software allows for various levels of permission such as administrator, teacher, and student. The administrator and teacher would both be able to track students progress, review the chat logs, view all incoming and outgoing messages, assign and view all student grades, and modify course content or settings as desired.

3.2 Course Elements and Justification

In the case of the *Navigation and Stability* course for onshore fishers, course information will be presented to the learner through approximately ten different icons or zones, as figure 3 illustrates:

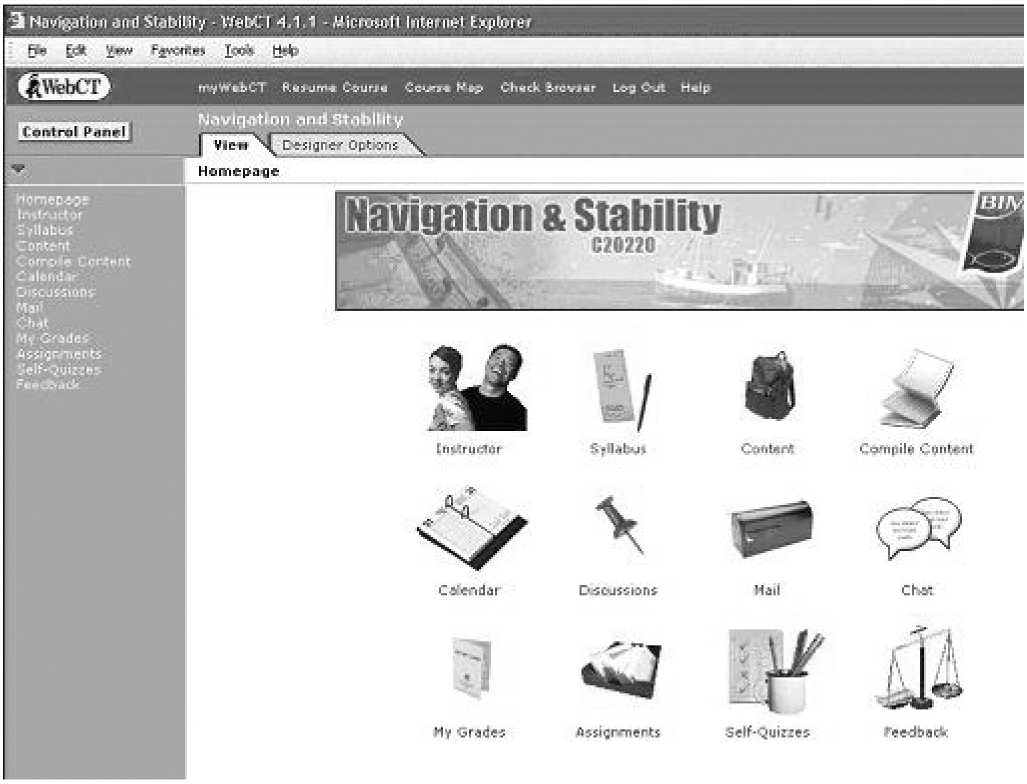

Figure 3. The Navigation and Stability WebCT course front page.

"This research and conversations with students and faculty suggest that the more interactions the better. As an administrator of a fairly large online programme [7500 student enrolments in 2004 academic year], I never have received a student complaint which states there was too much communication." Students expect interaction to occur in distance education with the advancements in technologies. They

The students would have a variety of communication tools at their disposal such as a bulletin board divided into corresponding chapter areas; private email inside of WebCT where they could email either their teacher or other students – not outside addresses; and synchronous chat rooms in which electronic logs are kept for the teacher if need be. The goal of these elements would be to decrease the isolation and intimidation many students experience during online courses. Steven Tello (as cited Lorenzetti, 2004) comments, see this as supporting the development of a community of inquiry and critical thinking skills.

The most important zone, the "content" icon, would contain the bulk of the course notes and offer features such as the ability to compile the online notes for printing purposes and to search for key words. Some teachers use this area to post course notes, as they traditionally would on the chalkboard to supplement the notes from the textbook. Others work with the instructional designer and multimedia team to create self-contained, course notes complete with various integrated media such as images, streaming audio, video and animations.

The "syllabus" icon would contain the overall learning objectives of the course, course details and the evaluation scheme. This serves to keep the students on track and keep them aware of the scope of information they are responsible to learn. The "calendar" icon would serve as a learning guide to help the students both budget their time and view at a glance what would be required of them and corresponding deadlines. We had initially devalued the importance of this element but the course feedback forms made us realize that the students felt more in control and were more academically successful with detailed learning guides. Shotsberger (1997) advises that learners should be given the opportunity to interact, to reflect, and to apply their learning experientially, but it is unreasonable to expect these kinds of outcomes without clear guidance.

Depending on the course and the preference of the teacher, the assessment could be integrated into the course content as links to self tests, exercises, assignments or tests as applicable and would also be compiled and available under the "assessment" icon. The students would receive instant feedback from any WebCT designed self-tests and a "my grades" icon would give them the ability to view only their individual grades inserted by a teacher.

The teacher facilitating the course would be available through an "instructor" icon which normally contains a personal narration and welcoming message from the instructor along with a photograph and at least three convenient ways to contact him/her. The students would be encouraged to start off the course by posting a parallel introduction about themselves. This gives them a chance to get to know their classmates and find friends with similar interests. The students need to feel secure that there is someone there guiding them, concerned about their success, and is available to answer their questions and concerns in a timely manner.

3.3 Hardware and Software Options

There are an array of hardware and software options at the disposal of any media team including various brands of streaming audio and video, animations and graphics software and hardware. The following comparison sites are a great way to make informed decisions.

- Yahoo's Multimedia Software Comparison:
  http://dir.yahoo.com/Business_and_Economy/Business_to_Business/Computers/Multimedia/Software/

- Comprehensive Course Management Comparison:
  http://www.edutools.info/course/compare/all.jsp

In addition, there are publisher driven courselets or "e-packs". These are sets of customisable online course materials developed and formatted by educational publishers. They usually compliment a set of online course content and/or correspond to a textbook. From this array of choices, an instructional designer has to be able to select the most educationally worthwhile preference depending on the curriculum, overall educational payoff and the technology available to the learner. The design also has to be adaptable to imminent technology movements.

Many people believe that the future of e-learning lies in m-learning (mobile learning). Basically, m-learning is an collection of existing learning experiences: e-learning, PDAs (personal digit assistants), wireless networks, and cellular communication. At this point, the infrastructure and tools are currently in place for m-learning. The next two obstacles are course content creation and social acceptance.

4. Educational Considerations

Obviously, there are many levels of lessons to be learned when designing for the online medium. The following information provides key points to be cognisant of during the process of designing, developing and delivering online courses.

4.1 Lessons Learned

4.1.1 During the Design Phase

- **Hire a instructional designer**. The ID should also be a project manager who is allowed control over the media team, budget, timeline and educational strategy. George Siemens (2002) remarks, “The growth and success of elearning is closely linked to the design of quality learning, enabled through the use of technology. Instructional designers play the pivotal role of bringing together these disparate fields - for the benefit of students, instructors, and organizations. Many of the concerns of online learning drop out rates, learner resistance, and poor learner performance can be addressed through a structured design process. The resulting benefits - reduced design costs, consistent look and feel, transparency, quality control, standardization - make organizational investment in ID a simple decision.”
- **Know your audience**. There should be a through needs assessment conducted by a marketing expert to determine the demographic of the target learner, the general level of computer skills to be expected and the anticipated access to a functional media equipped computer. For instance, if you plan to market to mariners who spend weeks and months aboard ships you will need to know what computer hardware and software they generally will be working with.
- **Plan to create a set of courses**. Students are constantly asking for a suite of courses that would constitute a programme. Often times, their employers will pay for the course in this scenario but will not fund random single courses that will not build towards a credential of some sort.
- **Introduce a project plan**. The art and science of project management and scheduling needs to be emphasized to all members of the team but in particular the instructional designer. The instructional designer has to lead the team and keep everyone on time and on budget (see Appendix B).

4.1.2 During the Development Stage

- **Require committed content experts**. Persistently instructional designers complain about their subject matter experts (SMEs) and are often left feeling like pests. SMEs are often overwhelmed by the amount of work it takes to prepare a course for online delivery, the instructional design process and the seemingly constant timelines (see Appendix B). The SMEs need to be informed about the process and committed to the project.
- **Keep it simple and worthwhile.** With the array of hardware and software choices available, instructional designers need to be able to select the most trouble-free, worthy solution to the problem while keeping the consistency of the teaching and learning experience. Often times a more simpler approach is the more successful one.
- **Deal with copyright upfront.** Each country has their own rules and regulations concerning copyright and these laws must be abided by or legal action could result. When publishers/ authors are informed that the requester works for an educational institution, has no desire to repackage their material for their own commercial gain, and the content will reside under a password protected site, they usually readily agree to copyright permission – provided they are appropriately credited.
- **Create an early prototype.** The subject matter expert, the instructional designer and the graphic designer need to work together to produce and agree upon the initial template. Either a course shell or the first chapter should

be produced, circulated and edits discussed. After the team concurs on the course's form and function, they should agree to move forward without further major style changes.

4.1.3 During the Delivery Stage

- **Teach the teachers**. Both before the start of the course and during the course pilot, the online teacher needs to be supported and guided by an online expert. This person could be the instructional designer or an experienced online teacher who would act as a mentor. As George Siemens (2002) notes, "Teaching online involves acquiring a new set of beliefs about what it means to be a teacher".
- **Connect with the students.** The students will need to know that there is someone on the other end of this experience who is concerned about their success. The instructor has to make them feel comfortable, secure and part of the online community. Without these considerations, failure and attrition rates soar.
- **Prepare for distance logistics.** The registration department at your particular institutions needs to invent a plan of action to provide online registration, payment of fees, and student support as required - all via distance.
- **Provide technical support.** Today's students expect and demand technical assistance. There should be an online student web portal to answer frequently asked questions, address issues such as etiquette, the role of the student and teacher, and an array to ways to contact a technical help assistant. The user should be guaranteed a response in 24 hours.
- **Encourage continuous student feed-back.** Students should be encouraged to fill out the anonymous, online feedback form - not just at the end but also during the course. This gives the instructor time to reflect and improve the course in the same term.

5. Conclusion

New teaching and learning models are continually emerging and critical features are surfacing as being necessary for success. To create an organizational structure that fosters and facilitates the use and development of online education and systems that promote efficiency for e-learning you will need: an experienced instructional designer and multimedia team; a thorough needs analysis to determine the demographic of the target learner; a systematic course design, development and delivery plan; committed, prepared and supported content experts and instructors; a distance education logistic strategy for delivery; a team environment where continuous improvement is the goal; and a clear, institute wide, e-learning vision.

In the world today, the integration of new technologies and online learning is inevitable in all post-secondary education. The marine education sector holds its own particular challenges with respect to content creation, international quality standards, and client needs. To be an educational leader in this field, an institution will need to strongly encourage an organizational cultural change where a commitment to excellence in marine teaching and learning, professional development, and emerging e-learning technologies leads the way.

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BIOGRAPHY

Corinne Breen B.Sc., B.Ed, M.Ed. (Curriculum and Instruction)

Corinne Breen is an experienced instructional designer involved in the design, development and delivery of multimedia learning packages and distance education courseware. She provides a range of professional development for instructors including learning technology software and online facilitation, and is responsible for both WebCT design support and delivery logistics.

Ms. Breen has practical experience regarding innovative teaching strategies both for large groups and tutoring individual students. This is supplemented by the knowledge gained during her Masters of Education programme involving the implementation of educational technologies in a post secondary environment.

Appendix A

Division of Degree Studies and Research

Instructional Design Report

for distributed learning courses

Course Name and Number: ______________________
School/Unit: ______________________
Media Partner: ______________________
Date of first contact meeting: ______________________
Projected Target Date: ______________________

Content Developer(s):
Name: ____________________ ____________________
Phone: ____________________ ____________________
E-mail: ____________________ ____________________

Primary Mode of Delivery:

On-site	___	Correspondence	___
CD-ROM	___	Teleconference	___
www	___	Videoconference	___

Media Component Forecast:

Print:	Textbook(s):	___	______________________________
	Course Manual:	___	______________________________
	Resources:	___	______________________________
Teleconferencing:		___	______________________________
Videoconferencing:		___	______________________________
Graphics:		___	______________________________
Video:		___	______________________________
Audio:		___	______________________________
CD-ROM:		___	______________________________
Library research:		___	______________________________
Web:	Course Notes:	___	______________________________
	Communications:	___	______________________________
	Programming:	___	______________________________
	Applications:	___	______________________________

Minimum design requirements for CD-ROM or Web development:

___ The ability to compile and print the entire content or assignments or activities.
___ Video clips must be accompanied by controls i.e. stop, pause, play, etc.
___ Navigation must be consistent and available on every page.
___ The ability to resume your session where you left off.
___ The ability to save assignments/activities to your own directory.
___ All fonts used should be available in the default settings
___ All courses in a common programme should have a consistent look and feel.
___ The font size should be no smaller than 12 point.
___ The development should be prepared using a 800 x 600 resolution.

Assessment Plan:

Additional Notes:

Signed: ______________________________ **Date:** ____________________

______________________________ ____________________

______________________________ ____________________

______________________________ ____________________

Appendix B

Division of Degree Studies and Research

Development Checklist

A. Curriculum Development & Planning Phase

1. Review Other Online Offerings of Similar Courses ❑
2. Develop:
   - proposed learning objectives; ❑
   - topic/concept map (i.e., learning path); ❑
   - structure and organization (via lesson plans); ❑
   - draft (or loose) course schedule; ❑
   - student assessment strategy (e.g., assignments, exams, etc.) ❑
   - content information present in sufficient form ❑
   - interactive content & activities suitable for an online environment ❑
   - potential media resources associated with topics/concepts; ❑
   - possible third-party copyright requirements (and associated details); ❑
   - potential media requirements; and ❑
   - a target date for initial (pilot) offering. ❑

B. Instructional Design/Development Phase

1. Conduct a team meeting outlining the project: ❑
   - Define Scope of project ❑
   - Devise and Discuss Project Process ❑
   - Present Proposed Timeline ❑
   - Invite Input for Task Breakdown ❑
   - Set Monitoring and / or Progress meetings ❑
   - Establish Progress Meeting Format ❑

2. Team Brainstorming / Establish Design Concepts and Instructional Methodologies ❑
3. Completion of Instructional Design Report (incl. team sign-off) ❑
4. Generate Activities, Self Tests, Answer Keys ❑
5. Copy-edit all "raw" content ❑

6. Identify Media Requirements ❑
7. Identify Audio / Video / Animations / Photos / Graphics / etc. ❑
8. Generate a Project Media Matrix ❑
9. Document Any/All Copyright Permission Requirements ❑
10. Identify Sequence and Structure for Media and content Integration ❑
11. Develop Storyboards (applicable to ALL technologies) ❑
12. Develop Blueprint Design ❑
13. Adapt Assignments ❑
14. Seek Copyright Permission for Third-Party Material ❑
15. Acquire Identified Media and Materials ❑
    *Ensure release forms are signed for "home-grown" media products involving human subjects.
16. Develop Prototype(s) ❑
17. Review and Edit (as necessary) ❑
18. Revise Accordingly ❑
19. Develop "Alpha" Product(s) ❑
20. Review and Edit (as necessary) ❑
21. Copy-edit all "new" content and product related instructions ❑
22. Internal Review ❑
23. Revise Accordingly ❑
24. Develop "Beta" Product(s) ❑
25. External Review ("Pilot-Offering" or "Beta Test") ❑
26. Revision of Final Product ❑

The Implications Of Shipping Laws And Practices Upon Onboard Operations - An Aspect Of Life-Long Learning For Seafarers

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ABSTRACT
The maritime education and training system generally educates and trains seafarers in respect of maritime safety and pollution prevention conventions, seamanship practices, and navigational instrument operations, etc. However, many maritime disputes arise due to seafarers' insufficient knowledge and experience in observing shipping laws and practices. From the point-of-view of a shipowner, they are the equivalent of "an accident".

It should be realized that the performance of various shipping contracts and the observance of merchant shipping conventions, laws, and rules, and practices binding the carriers relies greatly on the seafarers onboard, particularly the shipmaster. Thus it can be expected that gaining this body of knowledge will become an aspect of life-long learning for seafarers as required by quality shipping.

This essay discusses some key points in shipping laws and practices based on maritime insurance, salvage, chartering, etc,. and their influences upon practical onboard operations, briefing the roles of ship crewmembers in the shipping business, and attempting to illuminate another way of safety management and pollution prevention.

Introduction

Today, the maritime industry makes many efforts to achieve better safety and pollution prevention by means of better technologies and higher safety standards and requirements. Those technologies, higher standards and requirements are transferred to the crewmembers onboard by various management systems. However, efforts could be made for other ways of transference, i.e., affecting the activities of shipowners and carriers by shipping laws and practices, who will affect shipboard operations based on their labor relationship with crewmembers. On the other hand, in view of the position and roles of crewmembers in fulfilling the responsibilities of their employers, they should be familiar with key points of those shipping laws and practices.

1. The significance of maritime insurance upon shipboard operations

The reasons why the significance of maritime insurance upon shipboard operations should be emphasized are: firstly, because the control of the subject matter and the performance of the insurance contracts rely greatly on the crewmembers onboard. Ships always sail away from their homeland and their owners. Only when the crewmembers know of the key points of maritime insurance can they perform their duties well onboard, protect the interests of their owners, and minimize damages and losses at sea finally. Secondly, because the objective of maritime insurance is to deal with risks at sea, which is also dealt with by the risk management currently being actively introduced into maritime circles. Although there are differences between these two.

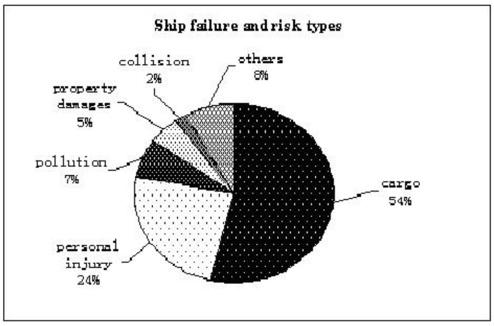
The former prevents maritime accidents by means of permitting ships to be operated within acceptable risks and the scheme of indemnity and compensation, while the latter uses risk management techniques such as risk management analysis and risk decision-making to handle risks. Thirdly, in mutual insurance, P&I clubs themselves are involved directly in safety management onboard through activities like ship visits, issuing various loss prevention reports, publishing operational guidance and booklets, etc.

1.1 Direct involvement in safety management

The P&I clubs are very experienced in handling maritime disputes and claims. Benefiting from their good communication network, their professional experience enables them to provide shipowners with good recommendations and technical guidance on safety management, emergency-handling, and legal assistance, etc. For instance, one of the largest clubs, the UK P&I club, has 7 offices and 13 representatives in Asia and more than 400 correspondents worldwide. It owns a strong professional team, keeping watch 24 hours a day to handle various emergencies in which its shipowners may be involved.

The P&I clubs pay more attention than hull underwriters to the daily operations of the ships entered, and thus conduct many activities such as executing ship visits, publishing loss prevention bulletins and videos (shipboard emergency plans, hatch cover maintenance, human factor analysis, ship survey reports, etc,.), making seafarers' health reports, and providing statistics on the emergencies and accidents that involved its members. For instance, the UK P&I Club generated statistics for all damages and losses which were suffered by its members' ships of different sizes, tonnages, ages and flags. All this information is valuable for better safety management onboard (see table-1 as follows for the typical statistics).

Table-1 Ship failure and risk types



Source: UK P&I Club, 1999

Currently, the most important activity affecting shipboard operations is the ship visit, for which the ship and crewmembers should provide full co-operation. P&I UK launched the program in 1989/1990 with the aim to maintain high quality of the ships entered, to target sub-standard ships, to inspect the operations of ships entered, and to encourage the adoption of higher standards, etc,. More than 6000 visits have been executed since its first introduction. Meanwhile, more than 500 ship visits are taking place each year, enabling the club to effectively monitor the condition and performance of the ships entered.

Ship visits can normally be carried out in three steps:

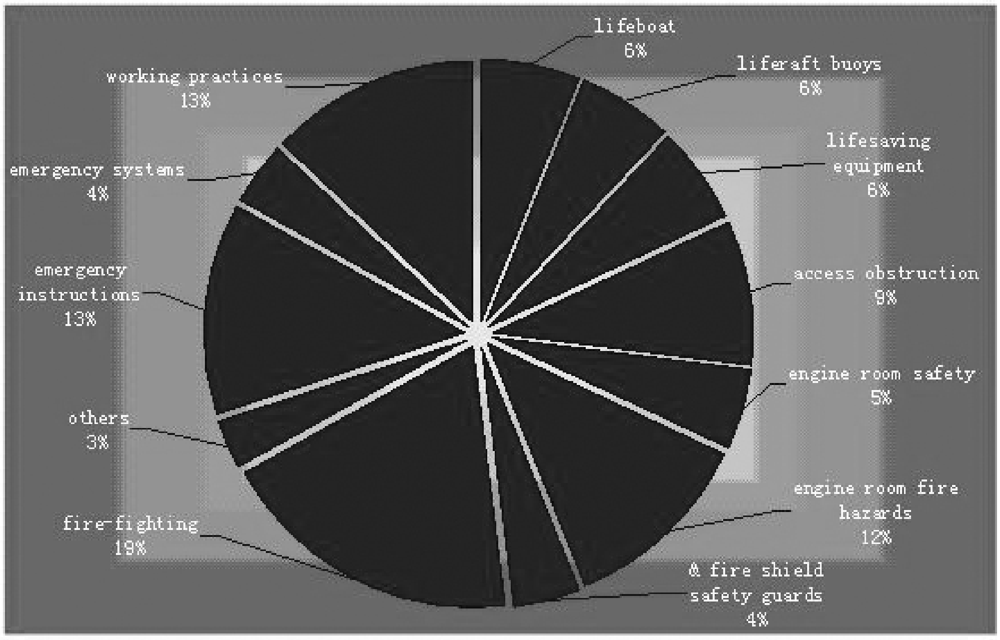
- Education: let crewmembers know the roles of the club, causes of maritime accidents and usual ways to handle them;
- Loss prevention: discuss and analyze claims in the past and at present, reduce and prevent future claims by means of providing recommendations;
- Inspection: independent surveyors will inspect the ships and assess the cargo-worthiness, safe manning, services and maintenance, safety standards (particularly the crewmembers' safety experiences), pollution prevention measures, and operational performance of the ship.

Through such activities, individual shipowners can make comparisons with other members in respect of safety levels. The observations, recommendations and assessments following up the survey are divided into major items and minor items. The former gives rise to the attention of all members in the club while the latter deals only with crewmembers. A final report of such a survey is made showing the outcomes as Table-2 and circulated to members to raise their attention. Usually, the visit takes about 4 hours. But in case the surveyor thinks it necessary to conduct a more detailed inspection for the ship in question, the club could decide on a sound condition survey. Additionally, the port state control inspector and the surveyors engaging in routine cargo inspections could initiate such a visit as well.

duty of disclosure, description and warranty, etc. The former two are relatively simple - simply disclose all information to the insurer that the assured know or should know. But it is worthwhile to discuss the warranty, which relates closely to shipboard operations.

Warranty of seaworthiness is one of the most important warranties, and should be observed through the whole period of insurance. In the 1906 English Marine Insurance Act, seaworthiness should be warranted implicitly for voyage insurance. In case of time insurance, it should be kept at the time when she is insured.

Table-2 Shortcomings in safety standards and equipment



Source: Ship survey report, 1995, UK P&I Club

1.2 The impacts of key principles of maritime insurance

There are some important principles defined by the influential 1906 English Marine Insurance Act. One of them is the Utmost Good Faith principle. It requires each party involved in the maritime insurance contract to perform most faithfully in the whole period starting from the first stage of entering into the contract to its completion. In detail, it includes

As to the details of seaworthiness, the 1924 Hague rule illustrates:*"…b). Properly man, equip and supply the ship; c). Make the hold, refrigerating and cool chambers, and all other parts of the ship in which goods are carried, fit and safe for their reception, carriage and preservation – 1924, Hague rule, article 3".*

The shipmasters' responsibility in keeping seaworthiness is incorporated into some national maritime laws, such as the article 513 of the Maritime Code of Germany. *The rules of Chinese Seafarers* to be issued also attempts to cover such a responsibility. In practice, shipmasters and officers should realize the importance of seaworthiness, know of the type of insurance (voyage or time), be familiar with the detailed requirements of seaworthiness, and record all measures taken for the maintenance of seaworthiness as stipulated by the SMS onboard.

For shipboard operations, another important warranty is the warranty of a ship's class. Ship's class indicates technical conditions, furthermore the capability of a ship coping with risks at sea, which the hull insurers and clubs stress as critical. All crewmembers, including the master, shall perform correctly such warranty. The case *"The Caribbean Sea" (Lloyd's Rep.338, 1980)* indicates the importance of observing such warranty. Vessel *"Caribbean Sea"* (classed by BV, the French classification society) grounded slightly during her voyage from port A to B, and then sank several days after leaving port B. According to the BV regulations, she was deemed to have lost her class at the moment of grounding even though it was just a slight touching, but she was allowed to maintain her class until arriving at port B. To maintain her as classed by the society and covered by the insurer in and after port B, the shipmaster in this case should invite surveyors of the society to inspect the ship and obtain a seaworthiness certificate. Luckily the master of the *"Caribbean Sea"* did so.

The problem is that many masters and senior officers pay little attention in reality to their society regulations, even those relating to the suspension, termination, or withdrawal of the ship's class. This may cause them to be unable to respond properly to accidents, and correspondingly may impose on their owners great risks of failure to be compensated for damages and losses sustained. A further question is that they may be unwilling sometimes to take the above-mentioned remedies even when they know the regulations, when they call at small ports where classification society surveyors are not easily available and the damages to the ship are very small.

1.3 The impacts of stipulations on on-scene accident handling

The aforesaid are the efforts made by the insurers (including clubs) to prevent maritime accidents. Additionally, certain maritime insurance clauses stipulate the responsibilities of the insured in respect of accident handling, which are meaningful to shipboard operations. It could be summed up based on the above that the insured usually owe duties to the insurers and the clubs the duty of notification when risks increase, the duty of notification when dangers are incurred, and the duty of sue and labor. Although there are no express regulations requiring crewmembers onboard be held directly responsible, the performance of those duties rely greatly on those crewmembers staying onboard in the same risks with the ship and cargoes. Additionally, the correct performance of the above is essential for P & I Clubs to make professional and instant decisions as to the handling of emergencies. The safety of ships can thus be secured. Therefore, it is very important for crewmembers to bear in mind those duties and perform them properly.

1.4 The impacts of stipulations relating to the handling of claims after an accident

For instance, the "tendering" clause requires the shipmasters and their crewmembers to behave diligently like "uninsured owner" during the whole ship-repairing period. Also the "obligation of claim" clause, the hull underwriters or P & I clubs may make further claims at a later stage after they have compensated the owner if a third party is liable for the accident. To enable this to be done successfully, the owner should provide assistance to the underwriters or clubs. He should at all times promptly notify these parties of any information, documents or reports in his or his agents' possession, any knowledge relevant to such casualty, event or matter…. He shall copy at the request of those parties all the relevant documents, and he shall facilitate the interviews conducted by those parties with all relevant personnel as well.

In a word, the underwriters and clubs have the right to use all the evidences collected by the owner. However, this relies on the crewmembers particularly the master and senior officers onboard. Theoretically, they have many advantages over other investigators such as the court and MSA officers to collect evidences properly, especially before and after the accident, because they are at the scene of the accident. This enables them to collect all kinds of evidence thoroughly in a professional and timely manner, as understood by the Nautical Institute "the master and senior officers onboard can play independent and decisive roles in collecting evidences." Furthermore, the process of handling a claim is usually very complicated. The formality relating most closely to shipboard operations is simple but important, i.e., the survey of the ship. It aims to ascertain the damages to or losses of the ship and cargo onboard. In detail, it includes the investigation of the extent of damages and/or losses, causes of the accident, salvage, sue and labor, collection of evidences, generating the survey report, etc,. All of these may affect the determination of the share of losses and responsibilities that each party shall take. Usually such a survey is carried out by the insurers or the club soon after receiving the notification from the owner, but in case of an accident occurring abroad, by the agent of insurer. The crewmembers shall co-operate in these efforts. However, due to the complexity of the international maritime legal and contractual relationship, the parties involved in an accident could be very complicated. For inspection purposes, many surveyors and investigators may present on behalf of different interests, such as salvage association surveyors, P&I surveyor, MSA officers, classification society surveyors, etc,. It is difficult in many cases for crewmembers onboard to identify who is who. This undoubtedly leads to difficulties and misunderstandings in claim handling. Well, in such cases the P&I Clubs are reliable for crewmembers in these cases since the clubs themselves are gathered by the owners voluntarily, and all decisions made are for the owners' benefits.

2. Chartering

The crewmembers are not involved in the negotiation and signing of C/P. But it is very important for them to know the details thereof since there are always many disputes in the chartering business and many clauses affect the shipboard operations. The following disputes arise frequently:

- Seaworthiness of the ship;
- Quality of fuel oil and the consumption thereof, and the speed;
- Safe port or safe berth;
- The rendering of Notice of Readiness (NOR);
- Reasonable deviation;
- The relationship between C/P and local practices in a particular port, etc.

One case well illustrates the importance of the shipmaster's knowledge in the chartering business. Before arriving at the port, the shipmaster compared carefully the clauses in the C/P and local practices as to the time for rendering the Notice of Readiness (NOR). He found a non-conformity there - the C/P stipulates that the NOR shall be rendered until the ship arrives at the pilot station, while the local practice says it could be tendered once she passes the boundary of the port. The competent master informed the shipowner of this non-conformity immediately. No disputes arose in that case.

It is really difficult to discuss fully the chartering business in relation to shipboard operations. But for the shipmaster and crewmember, it should always be kept in mind:

- Knowing of the C/P, at least those main parts;
- Clarify quickly any doubts and non-conformity with owners, agents, and ship management companies;

- Keep details and evidences of the operations.

3. Salvage and General Average

The obligation of salvage for shipmasters is defined in international conventions and national legislation. The problem is whether all masters can make correct decisions in contracting salvage services, particularly in case of emergency. One of the shipmasters of a large shipping company in China made a wrong decision when his vessel slightly grounded in the fairway of Port ROTTERDAM. He signed a salvage contract with a local towing company. But actually, the sea and the weather were then calm, and the fairway was clear. The right action would have been to employ a tug for refloating.

There are many cases like this. In 1978, Feb. vessel ABC sailed from Bremen to Said. A bearing of the cranked shaft of the main engine crashed. The ship thus lost propulsion. But the sea was then calm. So the master did not send a distress message and asked his agent to arrange a tug. The tug insisted on and requested to sign a “No-cure, No-pay” contract, but the master insisted on signing a contract based on employment. After negotiation, the owner paid a lump sum of 70,000 USD as a payment instead of salvage reward.

And also in 1978 Jan. vessel CDF dragged anchor in an Italian port due to heavy wind. The master requested pilot and tug as is customary to shift berth. After this, the tug company requested the master to sign a salvage contract. The excuse for this was the rough weather. The master signed without full consideration. Then the tug company resorted to the court for salvage on the basis of this contract.

Since salvage rewards are normally contributed by different parties, the rationality is the most important concern and is very often questioned by interested parties. In this regard, attention must be paid by the shipmaster onboard:

- The criteria of a “salvage”;
- The authority of a shipmaster in prohibiting salvage and signing a contract;
- The necessity of signing a salvage contract or the type of contract that should be signed;
- The actions to be taken after signing the contract, etc.

The general average is very much alike the above. The following doctrines must be observed: *“There is a general average act when, and only when, any extraordinary sacrifice or expenditure is intentionally and reasonably made or incurred for the common safety for the purpose of preserving from peril the property involved in a common maritime adventure.” - York-Antwerp Rules, 1974”.* Otherwise, the owner will have to face various defenses.

Additionally, shipmasters are authorized by international conventions and SMS documents of the company to use overriding authorities to handle emergencies. However, it’s difficult to decide the exact time to use those authorities. --- If the authority is used in an emergent case and there is no damage, the master may be questioned by the owner or other relevant parties of the necessity of taking such emergency measures, or vice versa, if he does not use the authority and there are some damages or even big losses, then he will be questioned as well. Therefore, for shipmasters, it is very important to inform the owner or other interest parties beforehand when he decides to use such authority if time permits, and to keep all the records when making decisions or taking actions.

4. Cargo transportation and the B/L

The fulfillment of the responsibility borne by the carrier relies on the shipboard operations as previously stated. The shipmaster and crewmembers should pay great attention to the following aspects:

- The inspection and compliance of seaworthiness. The requirements of seaworthiness should be fully understood, and special attention should be paid to problems such as hatch covers, refrigerating rooms, crew-manning, and readiness of the hatches for cargo transportation;

- The receipt, caring and management of cargoes during cargo transportation, seeing to the transportation of those cargoes with special requirements. If there is any doubt, inquiries should be made to the P&I club, owner or his agent;
- Issuance of B/L. The shipmaster should verify each item entered, particularly in case of the issuance of B/L under C/P, which requires careful comparisons between the two documents. A report should be sent to the owner in case of any non-conformity;
- The deviation. The master shall know adequately the clauses related to deviation;
- The settlement of non-conformities between C/P, B/L and local practices. The master can inquire of his P&I club, owner or his agent if he has any doubts.

5. Summarisation

The above describes the impacts of major aspects of shipping laws and practices on shipboard operations. The key point is that any mistake made in those aspects, even very slightly, will cause damages or losses or result in huge compensations. This could be as severe as the consequences of a collision or grounding. For shipboard personnel, another kind of pressure other than those coming from maritime safety legislation is based on the instructions or the considerations of shipowners, charterer, ship management company, etc., who require them to behave simultaneously for safety and economical profits. Therefore, and as required by higher quality shipping, shipboard personnel must realize the importance of understanding and observing those relevant shipping laws and practices. They shall put them in a central position linking various shipping parties and being responsible for them. Technically, the personnel onboard should keep close communication with shipowners and keep various evidences of operations.

Not all maritime education and training programs cover the above. But by investigation and analysis, the above contents are evidenced as very important for practical shipboard operations. So the training for the above should be recommended as one of the aspects of the seafarers' life-long study.

Yet, like the education and training on other subjects, some details should be taken in account when exercising such philosophy. For instance, the level and standards of such education and training should be determined, which may vary from masters to officers, or from a wide coverage to a very narrow topic. But the most important issue for this matter is that the education and training should focus on the fundamental parts of merchant shipping knowledge, particularly those elements closely related to shipboard operations.

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BIOGRAPHY

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Mr. Ruan Wei graduated from the Merchant Marine College of Shanghai Maritime University (SMMC), China in the year 1994. He sailed at sea for about one year and in 1998, he started his two-year postgraduate study in Maritime Education and Training Course in World Maritime University (WMU).

He works for the SMMC, giving lectures now for maritime students and trainees in respect of maritime safety management. But he is also actively involved in academic researches, such as "The strategies for the further development of Chinese MET", which was contracted with the Ministry of Communications of China, "Researches on the enhancement of Chinese crew-manning services in world market" entrusted by the Shanghai Municipal government, "Re-designing the maritime curriculum", and other research projects.

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Advanced Learning Solutions For Further Career Development And Enhancement Of Seagoing Professionals

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ABSTRACT

MET Institutions have experienced major changes in their structure and provision of services over the past three decades. These changes have come about partly due to national and international requirements concerned with the standards of competence of seafarers (e.g. STCW), and partly due to financial regimes under which these institutions are funded, forcing them to diversify into other areas and activities, such as consultancy, research, and shore based training programmes.

Today's seafarer is also markedly different to those who went to sea some 20 or 30 years ago. The differences in seafarers' attitude and approach to a seafaring career manifest themselves in a desire to spend less time at sea, and treat this as a stepping stone in their working life career. This is definitely true for developed nations, and becoming more and more the norm, even for the developing countries.

With above status in mind one can argue, that MET Institutions, and in particular the IAMU member Universities due to their superior standing and level of provision, have an excellent opportunity to provide a whole range of courses, and components of courses, which can be undertaken by seafarers to prepare them for their next stage of career.

Distance learning and web-based courses are now commonplace in many Higher Education institutions, and that technology can be easily transferred to the MET institutions. This paper will discuss some of the issues involved in web-based and distance learning, and use a recently completed distance-learning project, undertaken by the WMU for the IMO, to demonstrate some of the possibilities in this area.

1. Introduction

Training of seafarers (officers) has traditionally been a matter of national pride, and has evolved and matured in different countries, due to local (national) requirements and circumstances. For this reason, up until mid 1970s, training and education of seafarers in different countries was provided to a very varied set of standards that had developed over the years. These variations included both the content and structure of the training and educational programmes provided, which eventually led to the development of STCW78 and 95. It is also worth noting here at the outset that up until that time most developed countries manned their ships from nationals of their own countries, as well as providing qualified officers for the international fleet.

In terms of structure, some countries (mainly the Commonwealth members) followed the British model, where candidates entered the programme following their 'O' level studies at the age of 16 or 17. The courses provided were of “sandwich” nature where the training and educational programmes were interrupted by periods of sea service, at the end which candidates were qualified to sit for examinations conducted by the Maritime Administrations.

Other models, which were practiced, included the “front loaded” model where a candidate entered the programme after graduating from school, and spent 3 or 4 years in a college without any periods of sea service. These systems did not require seafarers to return to college for examination of higher certificates of competency.

Some courtiers also had a “dual purpose” or “polyvalent” certification schemes where candidates would go through a programme at the end of which they qualify to sail as both Deck and Engineering officers. In France for example this is taken to the extreme that successful individuals would be qualified to sail as Masters or Chief Engineers.

A series of events, some of which will be highlighted in this paper, caused these arrangements to be changed and forced a global and harmonised system of education and training to put in place (STCW). These changes have had an impact on the operation and running of MET systems, as well as seafarer’s attitudes and approach to life at sea. The central topics worth discussing on this subject are:

- What were the main reasons and drivers for changes in the global manning regime?
- What challenges and opportunities does this bring to the IAMU membership?

2. Changes in the Global Manning Regime

2.1 Flagging Out

The most remarkable change in the ship owning and management sector, over the past fifty years, is the way that shipowners and operators have changed their approach to registry (nationality) and flag of their vessels. The flag that ships fly has always been important, as ships, like people, are required by law to belong to a country, and to have their port of registration identified. There is nothing new about shipowners using flags that happen, for certain reasons suit their specific requirements. Looking back in history to a few centuries ago, one can note instances where shipowners changed their flags at times when their ships were in some sort of danger, or when trading in parts of the world where certain flags were not welcomed.

In recent times and around the period immediately following the Second World War, a mass migration of ship registries from the country of ownership to other flags took place. The main purpose for this revolved around commercial gains. Reputable owners have used FoC, or open registers for a variety of different reasons. They may well appreciate the freedom from bureaucracy in their own country, or wish to avoid paying heavy corporation taxes. They might wish to have more freedom over whom they employ on their ships, perhaps preferring crews of a certain nationality, or wish to avoid trade embargoes that apply to ships of their own nationality. International Transport Workers’ Federation (ITF, 2004) defines FoC as

“A flag of convenience ship is one that flies the flag of a country other than the country of ownership”

and gives the main reasons for this as cheap registration fees, low or no taxes, and freedom to employ cheap labour. In the same report a list of countries classed as FoC countries are also given together with some of the concerns that ITF has on FoCs which include:

- Treatment of seafarers: denial of basic human and trade union rights, low wages, poor onboard conditions, long contracts, inadequate training, etc.
- Unsafe Conditions
- Unprotected conditions
- Undervalued workforce

This has had major implications for countries, such as the United Kingdom, Germany, and the Netherlands, which have traditionally been major shipowning countries as well as supplier of officers not only for their own ships, but also for the international fleet.

2.2 Changes in sources of manpower
Seafaring as a profession was an attractive career for nationals of most developed countries as it provided a relatively high level of income; possibility of travelling and visiting foreign countries; and respect in the society. These primary reasons for choosing a seagoing career are no longer valid. The differential salary levels between shore based and seagoing professions have eroded over the years. The attraction of visiting foreign countries are also no longer valid, as transportation systems has become more widely and cheaply available that most school leavers don't consider this as an important issue, as well as the fact that port stays are much shorter than what they used to be. The life onboard has also changed, from small communities of 40 or 50 persons, to very small number of crew, perhaps less than 15, which does not allow social interactions, gatherings, and other activities. The respect in the society has also been eroded over the years, as the media highlighted the major maritime disasters such the Herald of Free Enterprise, and Exxon Valdes, giving the shipping industry a poor image in the society.

FoC, which were mentioned in the previous section, is the other driver for number of seafarers dropping dramatically from nationals of developed countries in recent years. Until early 1990s this was an observation that was made by most developed nations, without realising the full impact of the situation on the shore-based maritime sectors.

A series of classical and original studies that highlighted the global manning problem for the international shipping were sponsored by the BIMCO/ISF and reported to the community, in 1990 (BIMCO, 1990), and then updated by the same group in 1995, and 2000.

The 1990 and 1995 studies had pointed out the potential shortage of skilled labour in the maritime industry, and advised an increase in training in order to offset the losses due to retirement and wastage. The main purpose of the 2000 report was to build on the previous studies, describe the worldwide supply and demand of seafarers, and forecast the situation in 5 and 10 years time. The worldwide supply of seafarers was estimated at 404,000 officers and 823,000 ratings. Worldwide demand was estimated at 420,000 officers and 599,000 ratings, which gave a shortage of 16,000 officers and a surplus of 224,000 ratings. The trends indicated in the 2000 report were very similar to the 1995 update, including the serious reservations about the quality of training of the 'surplus' ratings.

The report indicated that by 2010, the ratings situation will not change significantly, but all the indications are that the shortage of officers will get worse, from a 4% deficit in 2000 to a 12% deficit in 2010.

Some pertinent points identified by ITF from the 2000 report, some of which could be the **basis of future IAMU research work** are listed below:

- Lack of reliable sources (national, regional, global) of data on the numbers of active seafarers;
- Manning levels on ships are not likely to decrease further;
- Back-up levels are likely to increase, thus increasing the demand for crew;
- If a cadet was placed on each ship in the world fleet, there would soon be a surplus of officers;
- Training ratios, cadets to officers: 1 to 13 in 1995; 1 to 10 in 2000; needs to go to 1 to 7 to reduce the predicted deficit;
- Training has increased and altered: OECD trainees have doubled since 1995; Eastern European trainees have halved since 1995;
- About 30% of trainees fail to qualify;
- The world fleet is too dependent on an ageing population of OECD senior officers;

- Among OECD officers, 48% are over 50 years old and 18% over 55;
- Among senior officers, 49% of deck and 43% of engineers are OECD nationals;
- Eastern European and Indian officers have been taking the place of OECD officers;
- Few Asian officers stay at sea beyond the age of 50.

The content of these reports (1990, 1995, and 2000) were noted and analysed by national governments, and the upshot is that most developed nations do not seem to be concerned about the nationality of seafarers supporting their shipboard requirements, as they have accepted the hard fact there is not enough nationals for these jobs. What seems to be the main cause of anxiety in these countries is the realisation that in the near future, some of the sensitive shore-based jobs (such maritime administrations, classification societies, pilotage, etc), which have traditionally been filled by ex seafarers from these countries, will now either remains unfilled, or foreign nationals should be considered for these posts.

Taking the United Kingdom as an example, Tarver and Pourzanjani (2003) reported their findings and analysis on the measures taken by the UK government to deal with this issue. These included introduction in 1997 of "Tonnage Tax" which replaced the normal corporation tax for UK ship owners. This system, based upon a Netherlands scheme, is aimed to provide a level playing field for UK owners and to encourage an increase in UK ship registrations. Although not intended to be a panacea for all the industry's ills, the Government intended that the tonnage tax would also have some positive effect on the recruitment levels of cadets. It was thought that an increase in UK ship registrations would provide greater opportunities for UK officers; increase the numbers of cadet officers being recruited and provide more training berths available on UK registered ships. It therefore made it a condition of an individual shipowner's re-registration that for every 15 officers employed on their UK vessels, there must be a minimum of one trainee officer. Furthermore, the Government also promised a set of initiatives to aid recruitment.
The industry, shipowners, shore based institutions, unions, and some philanthropic bodies have also put into place their own initiatives to boost training of officer cadets. These efforts have led to some success: the UK register of shipping increased in size by 20% in tonnage terms in the months following the announcement of the tonnage tax. Recruitment of cadets has increased but is still half the number that is required to sustain numbers into the future.

Similar studies have been conducted for other countries examples are the "Maritime Skills Availability Study" in Australia (Thompson Clarke Shipping Pty Ltd, 2002), and "Foreign Flag Crewing Practice" for non-US vessels calling at US ports (US Maritime Administration, 2003).

At a regional level, the European Commission considered the issue of the declining number of EU seafarers, in particular the shortage of well-qualified officers, in its Communication to the Council of Ministers and the European Parliament, adopted in April 2001 (COM (2001) 188 final). This report provided an update on the shortage of seafarers on the basis, in particular, of the 1998 FST and ECSA Joint Study (FST/ECSA, 1998). The general interest in the dramatic decline in EU seafarer numbers is also reflected in a number of other studies, research projects, and Network of Experts including some funded by the EC, such as METHAR and METNET. In its conclusions on improving the image of EU shipping and attracting young people to the seafaring profession, adopted on 5 June 2003, the Council invited the EC to continue monitoring the evolution of the training and recruitment of seafarers on the basis of data provided by the Member States.

3. Opportunities and Challenges for IAMU membership

3.1. Impact on Maritime Education and Training Institutions

Maritime Training and Education Institutions (including schools, colleges, faculties and universities) have traditionally been setup due to the needs of the industry and funded through regional or central government funding mechanisms. Courses provided by these organisations had to have the approval of their Ministry of Transport who are responsible for issuing the CoC, and in addition in some countries the Ministry of Education if these courses also provided an educational certification (e.g. BSc, or MSc). Introduction of STCW 78 and 95 had little effect on this arrangement. Events mentioned in previous sections, however, have had a major impact in some countries, where the demand for national seafarers has dropped dramatically, causing some of these Institutions to close down. In the United Kingdom, for example, up to the late 60s and early 70s there were more than 20 nautical colleges, each having 3 or 4 intakes per year. This has now been reduced to three main colleges, with some arguing, that only two would suffice.

In recent years we have observed in most countries a move from the old State funded regime, to a more privatised and independent institutional regimes, where Institutes have to compete to get enough students to make them viable. In some countries the State funding continues, but there is more accountability is required from the Institutions, where they need to demonstrate that they are providing a service, which meet a minimum set of standards. Introduction of QA and QE requirements in some countries (e.g. UK, Australia), which is also part of the STCW 95, is one example of how institutions are required to demonstrate how they achieve some set standards, and what systems they have in place to enhance quality of their provision.

A system, which seems to be unique to the United Kingdom and very few other countries, and have had excellent results, is the participation of the shipping companies in education and training of seafarers. Potential candidates are interviewed and assessed by shipping companies, and introduced to colleges who will provide the educational element. As part of this collaborative effort shipping companies provide the opportunity for sea service, as well as covering part of costs incurred by colleges. It is surprising that other countries have not picked this practice, which have resulted in almost zero dropout rates.

Main issues, which need to be addressed and are frequently asked by those funding these Institutions are:

- Is there demand for services provided?
- Is the Institution financially viable?
- Is the subject area “academic” or “vocational”?

In responding to the first issue, some institutions have diversified into other non-maritime subject areas (management, engineering, etc), as well as other activities such as research, consultancy, short courses, etc.

In raising the second issue, and what makes it difficult particularly for Institutions which are part of a bigger organisation (e.g. a faculty as part of a University) a comparison is made between Maritime subject area and other disciplines. Maritime departments are intrinsically expensive to run and manage. They are different from humanities departments, where there is a high demand and most teaching and learning is classroom based in large groups.

The last issue of “Maritime” being an academic or vocational subject is also an important one, and should be defended strongly, as if this subject area is classified as a purely vocational subject area, there is a danger of high level work not being funded.

3.2 Role of the IAMU members

We have, so far established some facts, which need to be further considered on opportunities that they provide for IAMU membership.

The most important issue is the period of sea service. It is now accepted that most seafarers from developed countries have a short span of service at sea. METHAR and METNET results indicate that for EU seafarers this is about seven year. Other studies from the seafarer supply countries (Philippines, China, etc) also indicate that for different reasons, nationals from these countries also don't have a lifetime ambition of working at sea, and their length of service is around 10 years.

So, what actually happens to this large population of workforce when they finish their seagoing career? The answer is simple; they come ashore and get shore-based jobs. The challenge and opportunity for IAMU membership, is to redefine their services more in line with the needs of current seafarers. As IAMU membership is made up of the best MET institutions around the globe, they also have a responsibility, in ensuring that future managers and leaders of the industry are well educated and prepared to take the industry further.

The EC funded network of experts on MET, METNET, concluded by making a series of recommendations to the EC some of which are equally applicable to IAMU membership. These included:

- Making the seagoing profession more attractive, through: improving the image of shipping industry; developing a career path in the maritime industry where sea service is an element,
- Enhancement of the current courses leading to seagoing certification, through identification and provision of subject areas which would benefit the seafarers, both at sea and ashore,
- Provision of PG courses, specifically designed for ex-seafarers to work in the shore based maritime industries (maritime cluster).

3.3 Identifying the Maritime Cluster

Various sectors of the maritime industry, which put together form what is known in some countries as the Maritime Cluster, are probably the most divers and varied within transportation systems. Most of the sectors within the cluster benefited in the past from an inflow of well educated, disciplined, practitioners, who after serving at sea for a number of years, would come and take shore-based positions. Previous studies (Pourzanjani, 2002, Pourzanjani et al, 2002, Pourzanjani et al 2003) have identified the shore-based maritime sectors that traditionally used to benefit from an inflow of ex seafarers as follows:

- ❑ Ports sector: Port authorities; Terminal operators; Stevedore companies; Contract labour suppliers; Ferry companies; Pilotage organizations; VTS
- ❑ Marine equipment supplies and manufacturers;
- ❑ Commercial maritime and insurance; Loss adjusters
- ❑ Regulatory authorities; Maritime Administrations
- ❑ Education and training;
- ❑ Ship management;
- ❑ Ports and related services;
- ❑ Dredging and hydrographic services;
- ❑ Surveying, Classification Societies;
- ❑ Shipbuilding
- ❑ Maritime Law
- ❑ Coast Guards
- ❑ Offshore (oil and gas)
- ❑ Yachting and Recreational Craft
- ❑ Fishing and aquaculture

In addition to technical subjects that employers identified as essential for their sector, they also identified a number of core skills that they regarded as important for their staff:

- ❑ Organisational / analytical skills
- ❑ Marketing and PR skills
- ❑ Customer awareness
- ❑ Communication and interpersonal skills
- ❑ HR expertise
- ❑ Environmental awareness
- ❑ Safety
- ❑ Leadership and Teamwork
- ❑ Communications (written and oral)
- ❑ Numeracy and problem solving
- ❑ Advanced IT and e-commerce
- ❑ Engineering skills

4. New developments in Distance Learning and Web based Education

We have witnessed an explosion of new ideas and approaches to new way of learning, following the global acceptance of "Life Long Learning" as a concept, as well as technological advances in information and communication technologies providing new routes and tools for delivery and management of learning.

Distance learning has been increasingly considered by institutions as an economical way of expanding their activities, widening opportunities for students around the world, and making effective use of the new technologies that are rapidly emerging. What is most important in making such provision is an assurance that rigorous quality assurance systems to be in place, as well as a well founded reasoning and justification that the usual ways of 'on-campus' provision are not necessarily appropriate or possible in the current context.

These are particularly important and relevant to the IAMU membership, when considering provision of courses for shore-based destinations, where at least part the programme can be delivered through distance learning, either due to lack of on-campus resources, or availability of seafarers to attend courses.

Distance learning is defined by the UK Quality Assurance Agency for Higher Education as *"provision of higher education that involves the transfer to the student's location of the materials that form the main basis of study, rather than the student moving to the location of the resource provider",* Where they also outline four dimensions of distance learning as follows:

"Materials-based learning*. This dimension of a system of distance learning refers to all the learning resource materials made available by the programme provider to students studying at a distance. The range and diversity of materials provided can be great. It may include printed, audio or audio-visual material, experimental equipment and material on the World Wide Web and other electronic or computer-based resources. Materials forming the basis of study may also be drawn from local public providers or resources accessible locally – as with local libraries, local book suppliers or information on the World Wide Web.*

Programme components delivered by travelling teachers. *This dimension refers to staff of the providing institution travelling on a periodic basis to the location of the student to deliver components of the programme. The delivery may be concentrated into a period of intensive classroom-based study for a group of students or be arranged on a scheduled basis for an individual student. The scope of the functions carried out by travelling teachers may include initial orientation; delivery of learning materials; intensive teaching of the programme; tutorial support; student development and guidance; assessment; and gathering feedback.*

Learning supported locally*. This dimension involves the providing institution employing persons specifically to undertake certain defined functions for the local support of students following the programme. It may involve administrative tasks for which a local agent is contracted and/or specified teaching functions for which a local tutor is engaged. An example of the latter might be the provision of residential weekend workshops or the like.*

Learning supported from the providing institution remotely from the student. *This dimension refers to defined support and specified components of teaching provided remotely for individual distant students by a tutor from the providing institution. The forms of communication between the tutor and student may include postal correspondence in print or by audio or videocassette, telephone, fax, email and the Internet. It may be solely between tutor and individual student or may include voice, video or computer-based conferencing.*

All of these are relevant and appropriate for future developments of IAMU courses, where potentially more than one Institution will be involved.

World Maritime University was awarded a contract by the IMO in 2002, to develop a DL course for "Casualty Investigators". The course is a self-paced study programme, which is developed in HTML (can be delivered through internet), but for a variety of reasons, is provided on CDs. The content of the course is not relevant to the current discussion, but the structure, experienced gained, and lesson learnt from the experience are.

Through this development programme, WMU has gathered information and expertise on the latest innovations and techniques in distance learning including appropriate assessment methods, and available off the shelf IT packages. The most important lesson learnt through this exercise is the realization that conversion from classroom based lessons to electronic and DL mode, takes much longer than anticipated by the academics involved. Although WMU has excellent in-house expertise in web based development methods, it was decided to bring in external experts, who have been involved in similar projects in the past.

The development team has also been experimenting with various types of "Internet Based Video/Audio Conferencing" hardware and software, which can be used as parts of the delivery and discussion method for distance learning purposes. The major difficulties identified here are the time difference between different regions, for a true global provision, and some technical issues on Audio if loudspeakers are used instead of headphones.

5. Summary and Conclusions

This paper has examined the underlying reasons for changes in supply and demand of human resource in the shipping industry. In doing so a number of issues have been discussed and some fundamental facts established. These include:

- There still exist a deficit in the number of officers for the international fleet;
- Regardless of their nationality, there is a desire by almost all seafarers to spend less time at sea;
- MET Institutions are under pressure to diversify into new activities;
- Current MET courses based on STCW do not equip the seafarers for shore-based position;
- There is a lack of PG courses, specifically designed for ex-seafarers;

Changes in MET Institutions have also been discussed, indicating that most MET Institutions should prepare themselves to diversify into other areas of activity in order to remain viable.

What can be concluded from the above is the opportunity that this gives to IAMU members to provide better undergraduate courses, as well as new PG opportunities to satisfy the shore-based industries HR needs, as well as the needs of today's seafarers. So what is being proposed here is that IAMU membership should consider:

"Doing Things Better, and
Doing Better Things."

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BIOGRAPHY

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Professor Pourzanjani was trained as a deck officer by Y-ARD of Glasgow and served on Merchant ships for ten years.

In 1980 he left the merchant navy to read for a BSc (Hons) in Maritime Technology at the University of Wales followed by a PhD at Exeter University. He stayed on as a lecturer in Marine and Systems Dynamics at Exeter University until he joined Southampton Institute in 1991 as a Principal Lecturer in Maritime Technology, leading to Professor and Dean of the Maritime Faculty from 1996 to 2001.

Professor Pourzanjani's main area of interest is maritime safety which spans the whole spectrum of ship design and operation, in particular education and training and Human factor issues. He has been the lead investigator on many Research Council and EC-funded projects and has published extensively in this area.

He is a Chartered Engineer an active member of professional institutions and serves on the H-10 committee of the Society of Naval Architects and Marine Engineers (SNAME). He is also a member of the Marine Technical Committee of the International Federation of Automatic Control (IFAC) and the Founder of the Manoeuvring and Control of Marine Craft (MCMC) series of conferences now run by the IFAC.

He has in the past worked as a consultant to the Canadian Government, and the International Maritime Organisation. He currently holds the INMARSAT Chair in Maritime Education and Training at the World Maritime University, where he has been a resident Professor since January 2003.

Design Strategy of Enhanced Educational Functions in MET

(Theme 1. Quality assurance in a time of change: mariti me education & research)
(Theme 3. New technologies for seafarers' education & research)

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Student Presentaton

ABSTRACT

This study set off one simple question that how efficiently "Enhanced Educational Functions" can be applied to the current education system. Whereas the importance of "Enhanced Educational Functions" is discussed, the research for its tangible measures has not been carried out so far. The educational significance of this study is to feedback its results to maritime universities and institutions and to improve the educational function of each as well as IAMU itself.

To obtain the valuable data, several questions are made to all the IAMU member universities and institutions. The results reflect the current educational situation in each university and institution and are undertaken a through diagnosis from the perspective of both teachers and students.

IAMU has potential capability of enhancing educational functions in MET. Implementation of specific and effective measures is presented through intensive study on four essential feasibilities: Educational feasibility, Environmental feasibility, Economical feasibility and System feasibility.

Based on the findings of the study, "Design Strategy of Enhanced Educational Functions in MET" is proposed. It can be achieved by managing and utilizing the highest possible resources and intelligence of maritime universities and institutions.

To enhance educational functions of each university and institution through tangible activities of IAMU is the utilization of the resources and intelligence of the member universities in common. For instance, educational facilities, teaching staffs and educational know-how etc.

This perspective sees consistency with the aiming of goal of IAMU. In conclusion, we give our views on the next generation type of educational system in the international maritime society and the roles of maritime universities and IAMU.

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Challenges of the Columbia River Bar Pilots

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Summary
Throughout maritime history, pilots have played an essential role in maintaining vessel safety. The Columbia River Bar Pilots guide ships across an eighteen-mile passage, ranked one of the most dangerous and challenging pilotages in the world. Each day these bar pilots encounter adverse weather, challenging jetties and sand bars, fishing traffic, a constantly changing channel, as well as tides and currents. This pilotage is located on the northwestern coast of the continental United States and is known as the “Graveyard of the Pacific.” Due to the extreme conditions that bar pilots experience, they have been one of the first pilot associations to integrate helicopters for pilot transportation as well as state-of-the-art, self-righting pilot boats.

Because of simulator training, students at maritime academies are provided with the educational foundation to become skilled mariners; however, they lack the maritime experience of someone who rose from within the ranks. Merchant Marine cadets routinely demonstrate metacognitive skills during bridge team training. These students are thinking about thinking. They perform complex tasks, execute precise communications, and manage intricate situations. (Teel, 1999) Simulators offer near to real-life situations in a classroom setting. Based on the career of a Columbia River Bar Pilot, my research will explore the significance of simulator training while attending a maritime academy. The numerous contributions of the Columbia River Bar Pilots in the field of maritime safety were brought to my attention in July 2003, when I had the opportunity to ride along with a bar pilot. I will illustrate the demand for continual simulator training and constant awareness, which these pilots need to have in order to navigate the ever-changing channel as a result of dredging and coastal erosion. I will look into the United States Coast Guard coxswain training program, located at the mouth of the Columbia River, to provide extreme condition training for boat coxswains. My paper will explain the dangers of the Columbia River Bar and demonstrate the need for educated, competent bar pilots.

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Novel Approach For Assessing The Results Of Radar - ARPA Simulator Training

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ABSTRACT
The ultimate purpose of this study is to develop one novel approach for assessing and analysing the results of the Radar and ARPA simulator training as it is improved by each maritime university and institute in the world. There are many different kinds of Maritime Education and Training (MET) simulator in the maritime training universities/institutes all over the worlds. These MET simulators are going to be one of a major training facility in maritime universities/institutes. These MET simulators include Radar-ARPA, GMDSS, Ship handling, Cargo handling and Engine room simulator and so on.

The Standard Training Certificate and Watch keeping (STCW 95) have additional standards for Radar and ARPA simulators as simulating the operational capabilities. The instructor should not only consider the capabilities of simulator facility but also take into account the ability to assess the results of training for MET. Then we had some experiments for assessing the results of Radar and ARPA simulator training. There were four scenarios. The first scenario has one own ship and one target ship. These ships get sufficient distances in head-on situation. There are one own ship and two target ships on the second scenario. The first target ship comes from the port side and the other came from starboard side in three ways stand off situation. The third scenario has one own ship and three target ships. All target ships are crossing in a row ahead of own ship. The last scenario has a total of seven vessels, one of them is own vessel, and the other six are target vessels. In these experiments, three different groups of student were chosen for experimental subjects to analyse the results. The first group of students was second year students who had had no lessons on this Radar and ARPA simulator training. The second group was third year students who had had the lessons on the Radar and ARPA simulator training. The third group fourth year students who had finished the long term on board training and they understand how to use operate the Radar and ARPA equipment. Each group consists of ten students.

Consequently authors analyzed the results of these experiments, compared these experimental results of different academic year students and show the efficiency and effectiveness with the training and lesson about Radar and ARPA. Finally authors propose one novel approach for assessing the results of Radar and ARPA simulator training based on these experimental results and some recommendations for future MET training.

1. Introduction

Radar and Automatic Radar Plotting Aids (ARPA) simulator training are compulsory training for maritime universities and institutes. STCW 95 has standards for Radar and ARPA Simulation:

"Radar simulation equipment shall be capable of simulating the operational capabilities of navigational equipment which meets all applicable performance standards adopted by the Organization and incorporate facilities to:

1. Operate in the stabilized relative motion mode and sea and ground stabilized true motion modes,
2. Model weather, tidal streams, current, shadow sectors, spurious echoes and other propagation effects, and generate coastlines, navigational buoys and search and rescue transponders; and
3. Create a real time operating environmental incorporating at least two own-ship stations with ability to change own ship's course and speed, and include parameters for at least 20 targets ships and appropriate communication facilities.

ARPA simulator equipments shall be capable of simulating the operational capabilities of ARPAs which meet all applicable performance standards adopted by the Organization, and shall incorporate the facilities for:

1. manual and automatic target acquisition,
2. past track information,
3. use of exclusion areas,
4. vector/graphic time-scale and data display, and
5. trial manoeuvres" (STCW, 1995).

Authors decided to development for the Radar and ARPA simulator training. Authors prepared two steps for experiments. In the first step they prepared three different scenarios, which were open sea and have one to six targets. In second step, authors divided ten students each class except first year students. Each selected student passed all scenarios. After all experiments, they analyzed results of the experiment.

2. Experimental Facility

2.1 Radar and ARPA Simulator in I.T.U. Maritime Faculty

The Radar and ARPA Simulator in ITUMF is shown in Fig. 1, which includes 2 own ship's bridges equipped with different navigational instruments. This simulator is predominantly used as radar booths, but is each equipped with a visual display system. Each of visual views, which has 60 degree's horizontal field, is generated with a highly efficient virtual image generation system (Sindel Vision 6000). The acoustic effect that are the sounded from outside vehicles or from the vessel's own engine is generated with a corresponding acoustic generator.

Each of the bridges includes following components:

- 2 consoles with Radar and ARPA unit (two Sperry, and two generic display)
- steering-stand console
- chart table with navigational instruments such as Loran, Omega, GPS, DGPS, Echo sounder
- Visual Generator with LCD Projectors

Fig. 1 Bridge of the ARPA-Radar Simulator in ITUMF

2.2 Experimental scenarios

This experiment has four different and typical scenarios. The first scenario is a **"head on situation"**, second one is a **"three-way stand off"**, third one is a **"multiple crossing situations"** and fourth scenario is a "**continuous crossing situation".**

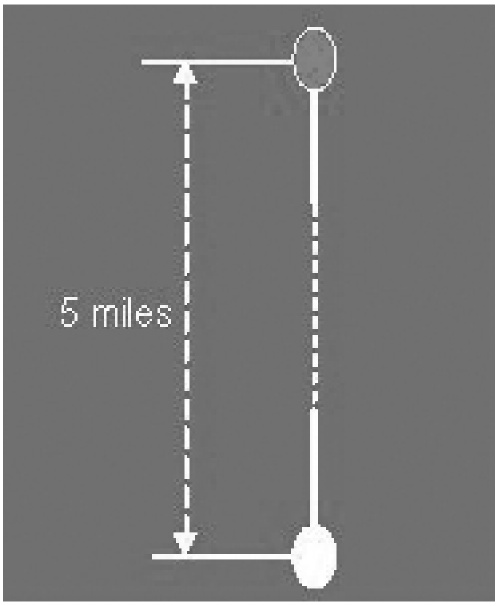

Fig. 2 Head on situation (Scenario 1)

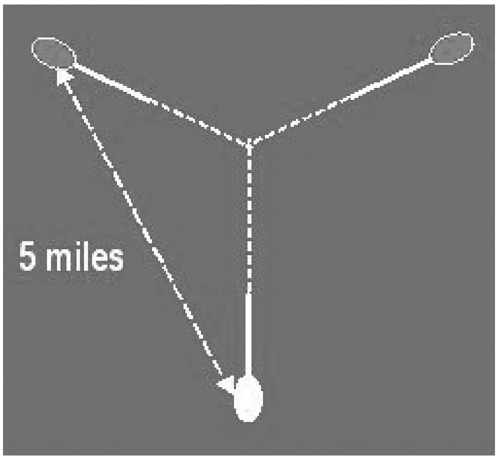

Fig. 3 Three-way stands off (Scenario 2)

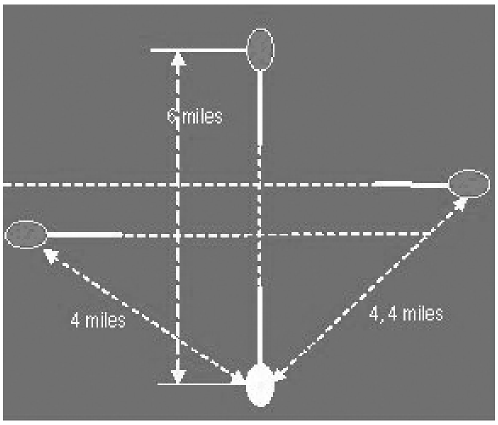

Fig. 4 Multiple crossing situations (Scenario 3)

Fig. 2 shows the first scenario that has only two vessels. One vessel is an own vessel, and the other vessel is a target vessel. The own vessel's course is 000˚, the target's one is 180˚, and so two vessels have opposite course but same speed. The experimental subjects (students) can select various actions (manoeuvring by using-ordering course and/or speed) to avoid a collision with target vessel.

Fig. 3 shows the second scenario that has three vessels. One is own vessel, the others are target vessels. One target vessel has takes a course on 245˚ and speed in 18.0 knots, the course of another target vessel is 115˚ and speed is 18.0 knots. Own ship's course is set default value on 000˚.

Fig. 4 shows the third scenario (Scenario 3) has four vessels all together, one is own

Fig. 5 Continuous crossing situations (Scenario 4)

vessel, and another three vessels are target vessels. Own vessel's course is 000˚, the first target vessel's course is 270˚, the second vessel's course is 180˚ and the last target vessel's course is 090˚; all target ships' speed are 18.0 knots. Fourth scenario (Scenario 4) has total seven vessels, one of them is own vessel, and the other six are target vessels, as displayed by Fig.5. Own ship's course is 000˚, target ships' course on 270˚ and speed in18 knots. The distance among internal of all target ships are 3 miles.

2.3 Subjective Risk of Collision (SRC) Level

During the experiment, the all experiment subjects (students) must answer the SRC values every one-minute. It is defined that a navigator cognises Subjectively the Risk of Collision (Umatani, 2001). It was used to make a quantitative assessment of the risk of collision at 5 levels. Level 1 is the first level which a navigator never feels an existence of the risk of collision. Level 2 is the second level which a navigator rarely feels an existence of the risk of collision. Level 3 is the third level which a navigator usually feels an existence of the risk of collision. Level 4 is the fourth level which a navigator strongly feels an existence of the risk of collision. Level 5 is the maximum level which a navigator extremely feels an existence of the risk of collision. Fig. 6 shows S.R.C. Sheet that is used in this study to analyse as follows.

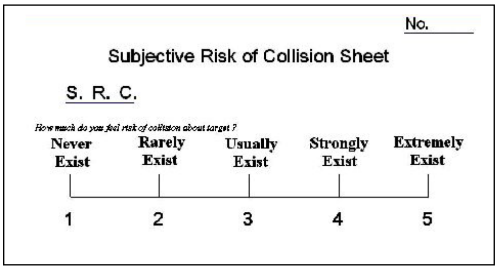

Fig. 6 Subjective Risk of Collision – SRC

2.4 Heart Rate Monitor-HRM

The Heart Rate Monitor is equipment that consists of a watch, a heart belt and software, can measure heartbeats. This model of the heart rate monitor made by POLAR Co. Ltd. is called S 810 shows as Fig.7. Professional and amateurs athletes have been relying on the information provided by the heart rate monitor as follows,

- A heart rate monitor is like a rev counter, giving a precise measurement of exercise intensity,
- Training at ideal pace is made possible with a heart rate monitor,
- Direct measurement of heart rate during exercise is the most accurate way to gauge performance,
- Progress can be monitored and measured, increasing motivation,
- It introduces objective observation,
- It is a tool for regulating frequency and intensity of workouts.

Fig. 7 Heart Rate Monitor – HRM

3. Results and Discussions

Authors' main aim is to find the effective Radar and ARPA simulator training method and is to develop the assessing method for Maritime Simulator Training. In the first step of this study, one method and one experimental result to quantify the maritime training results with using simulator are shown clearly. At the end of the first step of this study, three results are as follows,

(1) It is necessary to combine the subjective assessment and the objective one, and so all trainees should use above two results to assess the training.

(2) Before the training, all trainees must make good use of all nautical instruments.

(3) There are three indexes of goodness to assess the subjective results of training,

but it is difficult that two indexes of goodness for collecting and cognizing information are verified in the middle of training, because these two indexes of goodness depend on the level of proficiency about ARPA and Radar. Accordingly these two indexes of goodness should be assessed before this training.

(4) The S.R.C. helps a trainee to assess goodness for judgment and decision-making.

In the first step of study authors used scenario 1, 2 and 4 with student except first class year, but second step they used scenario 1, 2 and 3 with different students except first class year. Authors used new equipment, that is a Heart Rate Monitor, with subjective risk of collision (SRC) at the second step, and have four interesting and significant results as follows:

(1) After analysing, the heart rate and subjective risk of collision (SRC) have no correlations other.

(2) The SRC value has non-linear relation with four parameters [the distance from own vessel to targets, relative bearing, closest point of approach (CPA) and time of closest point of approach (TCPA)], but heart rate has shown no correlation with four parameters, according to relation between the risk of collision and four parameters; distance from own vessel to targets, CPA and TCPA obtained a strong correlation between each other.

(3) The physiological factors are physiological factors, physical factors, pathological factors and pharmaceutical factors. The psychological factors are psychological and psycho-social factors. The SRC is one psychological index, but heart rate is a physical factor. The combination of the subjective risk of collision and the heart rate is one of the human factors.

(4) The authors found the characteristics of the non-linearity between the SRC and four parameters. This relation, which has resulted from the regression analysis which is Microsoft excel program, used by authors, could be used in a special case and if it was implemented to general case, but it had a significant results. For future studies, authors believe that the knowledge about internal and/or external human factors can be used heart rate monitor by a specific model.

Scenario 1, 2 and 3 are used in the third step of study. In this step authors used statistical software (SPSS 11.5) for analyzing data by regression analysis. The most effective and variable explanation on the SRC was DISTANCE as the first element where students were concerned about assessing the risk of collision. CPA was less important for students to avoid the collision. The similar relation was between CPA and DISTANCE. Lecturers/operators for Radar and ARPA simulator training should prepare specific scenarios for only using ARPA information such as CPA and TCPA for improving the using Radar and ARPA functions.

Authors finished three steps their study. Authors analyzed results of steps by using six criteria. These criteria are Knowledge, Methodology, Human Factor, Facility Factor, Environmental Factor and Management Factor. These criteria are divided into two parts. One part is Knowledge and Methodology as internal factors; other part is human, facility, environmental and management factor as external factors. Authors compared results using six criteria shown as table 1.

	KNOWLEDGE	METHODOLOGY	HUMAN FACTORS	FACILITY FACTOR	ENVIRONMENTAL FACTOR	MANAGEMENT FACTOR
1.STEP	X			X		
2.STEP		X	X		X	
3.STEP	X			X	X	X

Table.1 Results of three steps of study

Authors developed environmental approach model for enhancing scenarios by results of these studies shown as Fig 8. First step is *Aim* at the model; instructor must decide to aim for scenario and to put objectives for this aim. Second step is *Facility*; every MET have Radar and ARPA simulator that's why instructor must care for facility of simulator such as what kind of facilities which are day or night and fog, rain and heavy wave, can be used in scenarios. Environmental factor affects facility and it is relevant to aim of scenario. Third step of the model is *Methodology*. Institutes designate the general methodology of training in their policy and also they should use the guidelines of STCW Convention for making this methodology. On the other hand instructor may affect methodology while putting it into practice. Instructor who is the person makes to implement the scenarios by using these internal factors. Student is mainly important item due to they implement scenarios which is prepared for them. The success level of students in scenarios is affected by knowledge and human factor. Student's knowledge is depending by class. Human factor effect is varying by students. Some students can be nervous; some of them can be ease in the scenarios. Finally when all above items are combined in harmonization, the best scenario can be obtained for purpose of the training.

Authors prepared a *Questionnaire*, which used the Environmental Approach Model, displayed in table 2. It helps instructors for evaluating their best scenarios.

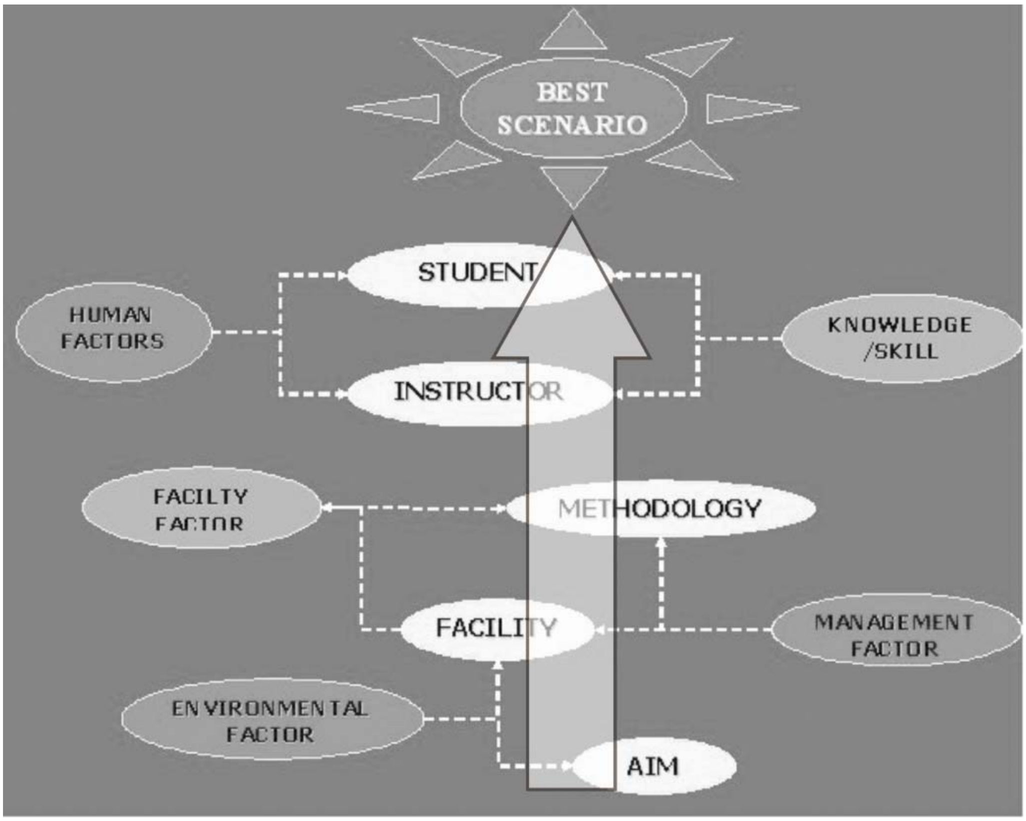

Fig. 8 Environmental Approach Model for the best scenario

NO	*ITEM*	-2 Strongly Disagree	-1 Disagree	0 Neutral	1 Agree	2 Strongly Agree
1	The scenario's time is enough	☐	☐	☐	☐	☐
2	I think scenario was difficult for me					
3	I understand my role of the bridge team					
4	I could use navigation equipment during scenario					
5	I lost target ships because of night (If scenario is night)					
6	I lost our ship manoeuvrability after fog (If scenario has fog)					
7	I lost our ship manoeuvrability after rain (If scenario has rain)					
8	I think scenario was easy for me					
9	I could plot to target ships on the ARPA-Radar screen					
10	Bridge was crowded					
11	I think we get aim of the scenario explained briefing section					
12	I think the traffic situation in scenario is too complex					
13	Communication in the bridge team is good					
14	Everybody knows their task in the bridge team					
15	I think no need to be a team					
16	I deeply treat what my task in the scenario					
17	Briefing explanation is enough to understand scenario objectives					
18	De-briefing material in an interesting way					
19	The objectives of scenario are more subjective					
20	The objectives of scenario are more objective					
21	Lecturer should interfere to scenario					
22	Before briefing section some texts should be given about scenario					
23	My knowledge of the subject has increased after scenario					
24	I think we never get a real situation like as this scenario					
25	I clearly understood the assessment requirements for main aim of the scenario					
26	The assessment method were effective					
27	The relationship between this scenario and other scenarios in the lesson is well understood					
28	I think this scenario should be repeated one more time					

Table 2. Frame of the Questionnaire

4. Conclusion

The final purpose of this study's authors was to develop one novel approach for assessing and analysing the results of Radar and ARPA training as it is improved by maritime universities and institutes around the world. The main aim of the study is to create a new model for Radar-ARPA training. The authors came to the following conclusions:

1 To propose the novel Environmental Approach Model for the best scenario.

2 To prepare the Frame of the Questionnaire for assessing students and developing scenarios by using the novel Environmental Approach Model.

3 To propose how to consider the scenario before for making and after for evaluating by using above the Questionnaire.

Acknowledgements

The authors gratefully acknowledge financial support by Japan International Cooperation.

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BIOGRAPHY

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Tanzer is research assistant at the Deck Department of the Istanbul Technical University Maritime Faculty since 1997. He was previously officer, chief officer and captain of the different type of vessel between 1990 and 1997. He is responsible lecturer of the Radar-ARPA and Ship Handling Simulator. He lectures some advanced STCW Courses (Bridge Resource Management, Ship-Company and Port Facility Security Officer and VTS Training). He started PhD in 2001 and research subject is “Marine Pollution and Reception Facility”.

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Serdar Kum is currently research assistant at the Deck Department of the Istanbul Technical University Maritime Faculty since 2002. He graduated from Istanbul Technical University Maritime Faculty in 2001. He had on board experience in different type of vessels. He lectures all basic STCW Courses and some advanced (Advanced Marine Fire Fighting, Bridge Resource Management, Ship-Company and Port Facility Security Officer and VTS Training) courses. He started post graduate at ITUMF in Maritime Transportation Engineering Programme in 2003. His research subject is “Risk Analysis on Tankers”.

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Masao Furusho is a long term expert of JICA (Japan International Cooperative Agency) Project on improving maritime research activities. He graduated from the Department of Nautical Science, Kobe University of Mercantile Marine in 1978. He holds the First Grade Maritime Officer (Navigation) in 1986, Doctor of Psychology from Chukyo University in 2000. He is a specialist on Traffic Psychology at Sea, on Maritime Safety Management, and on Visual Perception at sea. His research interests are lookout, visual performance and human factors in maritime traffic system. His main educational contents and teaching subjects are ship safety management and good seamanship in maritime traffic system, safety and maintenance of ships.

Development Of An Innovative Radiation Detector For Marine Use

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Student Presentaton

SUMMARY

During sea transportation, radioactive materials are stored in radiation-shield containers. Radiation leakage from such containers is continuously monitored with conventional radiation detectors. However, extreme conditions encountered at sea, for example, ship movements, high or low temperatures, and salt in the air can damage onboard detectors. Thus, development of more stable radiation detectors is essential for safe sea transportation of radioactive materials.

Currently, I am developing a new radiation detector using radiation induced surface activation (RISA). This phenomenon was first discovered by our research team at Tokyo University of Marine Science and Technology. When radioactive rays are irradiated against oxidized metal, cathodic and anodic reactions are induced. The current produced by RISA can be used to measure radiation intensity. Since RISA occurs with β-, γ-, and X-rays, applications in various fields not only in engineering but also in physics and medicine are possible.

A prototype radiation detector we developed uses a sensor that consists of a rutile TiO_2 film backed by an Al_2O_3 layer (Figure 1). This sensor is very light and small (Fig. 2), enabling a compact design of the overall detector, a feature suitable for marine applications. A series of tests with this detector reveled that it has many advantages over conventional detectors (Table 1). It is stable both chemically and physically, easy to handle, and low in cost. The robustness under strong radiation makes it possible to measure radiation intensity for several months. Furthermore, using several layers of backing plates coated with TiO_2 is found to enhance sensitivity. These advantages suggest the possibility that the RISA radiation detector will have wide applications in radiation measurement.

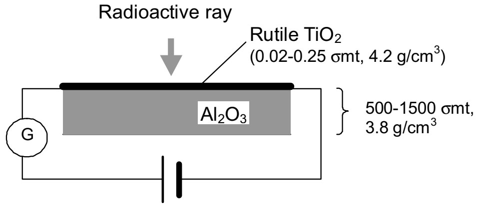

Fig. 1 RISA radiation detector

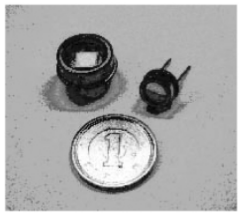

Fig. 2 Small sensors
(The coin is 2cm in diameter)

Table 1 Advantages of RISA detector

	Conveni-ence	Robust-ness	Strong radiation measurements	IC	Simpli-city	Response	Range	Cost
Ionization	△	×	○	×	○	△	○	○
GM tube	△	×	○	×	△	○	○	△
Scintillation	△	×	○	×	△	○	○	△
Film badge	◎	◎	◎	△	○	×	△	○ Once
Thermal luminescence	◎	△	○	×	○	×	△	○
Semi conductor	○	△	×	△	×	◎	△	△
RISA detector	◎	◎	◎	◎	◎	◎	◎	◎

◎ Excellent ○ Good △ Average × Poor

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International Maritime Environmental And Safety Legislation, A Case Study Of Implementation Of The ISM Code

In Gdynia Maritime University

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ABSTRACT
The requirements for safety management at sea are established by IMO conventions (STCW Convention, Solas). ISM Code (Solas Convention, Ch.IX) specifies that every shipping company should develop, implement and maintain Safety Management System which includes and relates to environmental protection policy in compliance with relevant international and flag State legislation. The Code also establishes that the shipping company should clearly define and document the owner's responsibility with regard to implementing the safety and environmental protection policy of the company.

ISM Code requirements are obligatory for Gdynia Maritime University as the owner of training vessels: s.v. "Dar Młodzieży" and m.v. "Horyzont II". ISM Code implementation was made through establishment of the University policy for safety and pollution prevention and through issuance of safety management manual and introduction of documented procedures: operational and emergency. Also the responsibilities and communication links were documented. Staff and students' trainings and audits necessary for the system implementation were provided together with corrective and preventive actions, management reviews and certification process.

Despite some relatively low costs connected with the implementation of the ISM Code in GMU, there are a lot of benefits of this process, i.e. compliance with IMO conventions, better control and prevention of potential accidents, costs saving as regards possible fines.

GMU - by implementation of the ISM Code on its training vessels - is in compliance with international maritime environmental and safety legislation. Thus, GMU contributes to safe sea operation.

1. Introduction

The evolution of international maritime environmental and safety legislation was made throughout establishment by International Maritime Organisation of Load Line Convention, Safety of Life at Sea Convention (SOLAS), Marine Pollution Prevention Convention (Marpol), Safety Management (ISM Code), STCW Convention and other. The European Union is also seeking to strengthen environmental protection through different regulations and directives (Council Directive 79/115/EEC, Council Regulation (EC) No. 3051/95).

In particular, technical progress, incidents at sea resulted in development of standards for ship and her supervision. The requirements for safety management at sea are established by IMO conventions (STCW Convention, ISM Code). Seafarers play a crucial role in safe operation at sea, the protection of marine environment. Also staff members of maritime institutions and administrations and other operators or managers are often in charge of marine pollution prevention and response [Przybylowski 2001].

Gdynia Maritime University as the owner of two training vessels: 'Dar Młodzieży' and 'Horyzont II' implemented ISM Code in order to be in compliance with international maritime legislation and to ensure safe sea operation. This aim was achieved by introduction of documentation and ISM Code surveillance system and proper students training.

The implementation of the system, despite some relatively low costs, gives numerous benefits and may be an example to be followed by other maritime universities.

2. ISM Code requirements

The ISM Code (SOLAS Convention, Ch. IX) is based on a new approach to safety, because it sets out to provide a management system which will anticipate possible contingencies and focuses on the unique characteristics of ships as marine vehicles and the need to protect the marine environment [SOLAS, Ch. IX].

The purpose of this mandatory code is to stimulate and encourage the development of a safety based culture in the maritime sector. William A O'Neil, Secretary-General of IMO said:

> '[…] the ISM Code aims at contributing to safer shipping and cleaner oceans by laying down requirements for a clear link between shore and sea staff of a company and for a designated person to strengthen that link. A key aspect of the ISM Code is that companies must have a verifiable safety management system in place. For the system to be effectively implemented there must be a commitment from the top, responsibilities assigned and measures in place to remedy deficiencies […] the ISM Code represents a component of invaluable importance and significance in IMO's strive to improve safety at sea and preserve the marine environment from pollutions by ships.' (Chauvel, 1997).

The above statement shows how important the ISM Code is for safe operations at sea.

Also in this respect F. Lorentzen, President of BIMCO added :

> '[…] the mandatory nature of the ISM Code will ensure that no shipping company will be able to escape the process. ISM will accentuate the positive aspects of the Safety Management System and everyone in the company can benefit from the enhancement of safe practices in ship operations. Reduced damage, improved safety consciousness, greater professionalism and improved morale are likely to bring genuine cost savings and better efficiency…' (Chauvel, 1997).

ISM Code establishes that every shipping company should develop, implement and maintain Safety Management System which includes and relates to safety and environmental protection policy in compliance with relevant international and flag State legislation. The Code also establishes that the shipping company should clearly define and document the master's responsibility with regard to implementing the safety and the environmental protection policy of the company.

3. ISM Code implementation in Gdynia Maritime University

3.1 ISM Code implementation on GMU's training vessels

ISM Code requirements are obligatory for GMU as the owner of training vessels: SV "Dar Młodzieży" and MV "Horyzont II". As both ships are bigger than 500gt, ISM Code implementation was compulsory by July 2002. This process was commenced in 1999 by the establishment of the owner policy for safety and pollution prevention which is defined as follows: 'To ensure safety of trainees and passengers and also health protection and safe work conditions for all employees and protection of the environment' [Szymoński 2001]. The implementation of the Code was also made by issuing of safety management manual and by introduction of documented procedures for company and for ships (operational and emergency).

Also the responsibilities and communication links were documented. Trainings and audits necessary for system implementation were provided together with corrective and preventive actions, management reviews and certification process. The Company Department directly under Vice Rector for Maritime Matters plays

Type of training	Company's employees	Crew of "Dar Młodzieży"	Crew of "Horyzont II"	Internal auditors
General concerning ISM Code	X	X	X	X
Concerning company's policy	X	X	X	X
Related to drafting documentation on safety management system	X	X	X	
Training of internal auditors				X
Knowledge of implemented documentation and responsibilities aspiring from ISM Code	X	X	X	X
Related to changes in documentation	X	X	X	X

Table 1. Training while implementing safety management system in Company's Department of GMU and on training vessels.

a very important role in implementation of the system. It makes communication link between shore side and the ships effective and efficient. To achieve this aim, the Designated Person having a direct access to Executive Board of the University was appointed.
This person is responsible for:

- effective implementation of safety management system
- assurance of shore side back up in case of emergency or accident on board
- analysis of the lack of compliance reported by ships and employees of the Company
- identification of necessary resources and training needs for crew members and shore side personnel

For the implementation of the system a number of training were carried out for all crewmembers of both ships and for shore side employees (table 1).

The Vice Rector for Maritime Matters, acting on Designated Person's advice, nominates

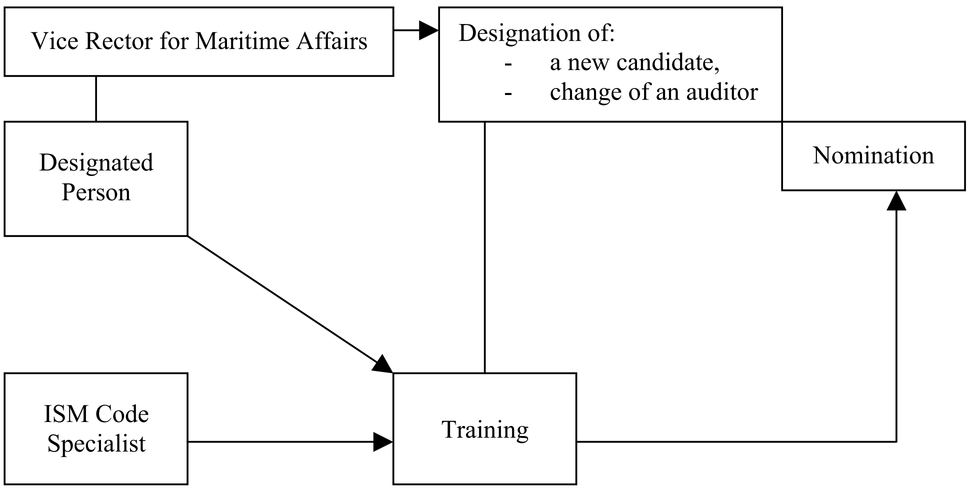

Fig.1 SMS Auditors Training

candidates for internal auditors. Seven persons have been trained by the Designated Person and ISM Code Specialist (fig. 1 below).

As far as training is concerned, it specifically covered knowledge related to:

- ISM Code,
- Safety Management Manual,
- Internal audit process steps,
- Methods and techniques of inspection,
- Documents and notes necessary to conduct audits,
- Methods of control list filling and documents recognition,
- Internal audit procedure [Piglowski and Pawlowska (2001)].

Internal audits may concern: the Rector, Vice Rector for Maritime Affairs, Head of Company Department, Designated Person, ISM Code Specialist, Head of Human Resources Department and Technical Inspector.

An auditor may control if:

- SMS documents are in compliance with ISM Code requirements,
- SMS documents are in compliance with other requirements (SOLAS, MARPOL, etc.),
- Notes are in compliance with SMS documents,
- Training is in compliance with SMS documents,
- Training is in compliance with notes,
- Training is in compliance in relation to SMS.

  In case of noncompliance with any of the above factors, corrective and preventive acts must be undertaken by heads of departments no later than three weeks after the audit.

3.2 ISM Code documentation

ISM Code requires a Company to implement a documented safety management system. After having completed training about ISM Code and company's policy, the Safety Management Manual (SMM) containing company's policy, procedures and instructions was then drafted to document the system (fig. 2).

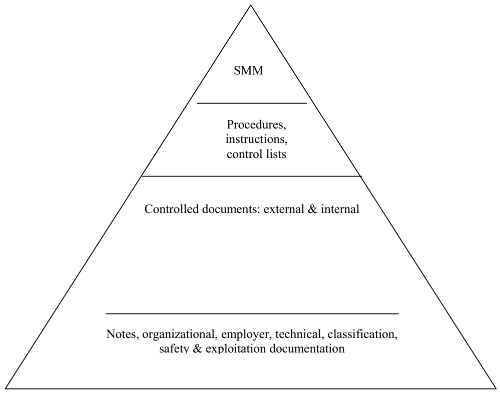

Fig.2 Components documentation of safety management system

As far as procedures are concerned, they are divided into 2 groups:

- companies
- ships: operational and emergency

Company procedures define:

- ship maintenance rules,
- how to react while different emergency situations,
- Company's Emergency Team's composition and working rules; its duties and responsibility of all its members, way of calling them up and mobilizing them,
- communication methods with ships in emergency,
- kinds, frequency and scope of emergency training
- internal control of the system (internal audits) and management review by directors.

Ship procedures contain:

- operational ones which describe basic actions allowing safe sea operation, ship operation and protection of the environment

- emergency describing potential threats, duties of crew members and measures of reaction (emergency training)

To evaluate if the system has been correctly implemented, internal audits and external ones made by PRS have been carried out [Szymoński 2001].

3.3 ISM Code surveillance

In order to maintain and develop the system, training for shore side employees and crewmembers is carried out [Szymoński 2001]. To maintain best technical ship condition and to ensure exploitation needs, safety and PSC requirements and also crew and ship's expectations, inspections are carried out (see below).

Certification process of the Safety Management System is presented on the figure 3:

The certification process covered:

- The Company Department – Document of Compliance was issued;
- Two ships – two Safety Management Certificates were issued [Piglowski and Pawlowska (2001)].

Kind of inspection	Periods	Person responsible
Technical	Min. 4 times a year	Technical Inspector
Safety of work, fire prevention	Once a year	Inspector for fire prevention Inspector for work safety
Company's	As to the needs	Rector, Vice-rector for Maritime Affairs, Head of Company's Department, Designated Person, Specialist For ISM Code
PRS, Maritime Office	As to the needs	Coordinated by Technical Inspector
PSC	According to external requirements	Coordinated by: - Captain - Chief Eng.

Table 2. Inspections and periods of their execution

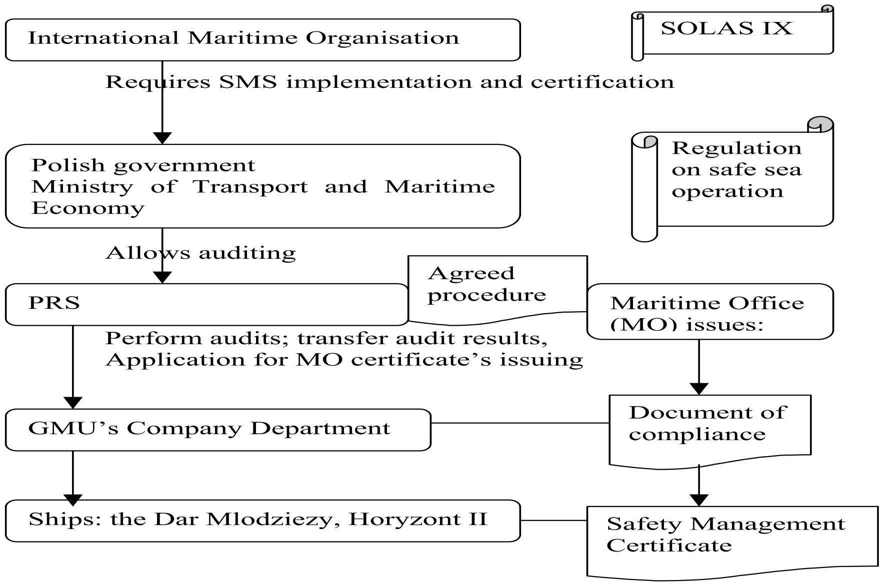

Fig. 3 Compulsory certification of the Safety Management System in GMU

3.4 Student safety education & training

Gdynia Maritime University provides also students with knowledge related to the requirements of STCW Convention and ISM Code. Engineering Faculty students study Safety Management of Ship: 2 months of the II semester on the training vessels and 6-8 months of the VIII semester as a motorman or cadet while having training on ships in compliance with program in Training Record Book and also while having lectures and tutorials on the X semester [Tarnowski 2001]. In 1998, Engineering Faculty had gained certificate of compliance with ISO 9001:1994, according to Regulation I/8 STCW 78/95.

Students are brought to the training and merchant ship to participate in so-called exploitation practice according to Training Record Book. The successful completion of the program is approved by the signature of the Chief Engineer. Students deal with alarm and get knowledge about responsibilities while alarm on board. They also get accustomed to placement of safety, fire and first aid medical equipment. Equally, students must know functioning of closing emergency exits. In addition, they follow the execution of operational or alarm procedure according to ISM Code procedure, SOPEP and learn how to draft plans of alarm and environmental devices.

On the last (10th) semester students have 15 hours of lectures and 15 hours of tutorials. Below, a detailed list of subjects of the program is presented.
So GMU integrates the SMS with education on Safety Management of Ship for students by:

- implementation of ISM Code on training vessels (since 1999),
- basic training for students on training vessels using ISM procedures,
- implementation of ISM requirements as a part of Training Record Book (fulfilled on training vessel and on sea practice under Chief Engineer supervision),
- lectures and tutorials on last semester of education (using ISM Code documentation). [Przybylowski 2002].

Additionally, before sea practice students have passed in the University four basic trainings required for each crewmember (fire, medical, rescue and social responsibility). Also records about familiarization with ships are provided in Training Record Book.

4. Costs and benefits related to implementation of the ISM Code in GMU

Costs related to implementation of the ISM Code in GMU can be divided into four categories:

Subject	Lectures	Tutorials
Safe ship operations conventions and regulations.	1	1
Ship’s technical condition and equipment surveillance. Legitimate, classification and safety documentation.	1	1
Crew’s qualifications and membership surveillance.	1	1
Safe sailing and rescue surveillance.	1	1
Quality, safe ship operation and environmental management in maritime economy. ISO and IMO requirements.	3	3
ISM Code and STCW requirements	6	6
Company’s responsibilities.	1	1
Crew members’ responsibilities according to ISM Code and other ...	1	1

Table 3. Safety Management of Ship program

- certification audits,
- functioning of the Company Department,
- training and
- literature.

The most expensive enterprises were audits of the Company Department, audits for training vessels and certificates issued by Maritime Administration. All costs were around 7500 Euro.

Benefits of the implementation of the ISM Code are numerous:

- compliance with IMO conventions,
- better control and prevention of potential accidents,
- cost saving as regards possible fines and also
- training onboard for students using established procedures on training vessels while having practice in compliance with program in Training Record Book.

GMU authorities have always been taking a great care of being in compliance with IMO convention. It is also the case of the ISM Code implementation.
The prevention of potential accidents is achieved through the regular trainings. For example, crewmembers and students must have trainings about alarm procedures within 48 hours and passengers within 24 hours. The captain designs a person responsible for the training.
As far as the emergency procedures are concerned, the crew must be trained two times a year. The scope of student and passenger training is determined by the captain.
In case of SOPEP training for the crewmembers, it is made two times a year under the supervision of the chief.

Conclusion
In conclusion, the GMU - by implementation of the ISM Code on its training vessels - is in compliance with international maritime environmental and safety legislation.
The ISM Code requires implementation of safety management system on ships. GMU, as the owner of two training vessels: ‘Dar Młodzieży’ and ‘Horyzont II’, was obliged to implement the ISM Code. This aim was achieved by introduction of documentation and ISM Code surveillance system and proper staff and students training.
Despite some relatively low costs connected with implementation of the ISM Code in GMU, there are a lot of benefits of this process like costs savings,

for example.

Thus, by implementation of the ISM Code, GMU prepare staff for safe sea operation and is in compliance with international environmental and safety legislation.

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BIOGRAPHY

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Adam Przybylowski graduated Adam Mickiewicz University in Poznan where he was studying international relations/European studies. Since 2001 he has worked as an assistant in Gdynia Maritime University in Business Administration Faculty. He is a member of Second Working Group within IAMU. He is preparing his PhD in economics (transport).

New Legislation on the Environmental Impact of Global Ballast

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Student Presentaton

SUMMARY
The Global Ballast Water Management Program is progressing to eliminate the dangers of harmful foreign aquatic organisms and pathogens, from being subjected to vulnerable ecosystems throughout the world. New suggested legislation could possibly require that individual ships maintain a ballast water and sediments management plan as well as conforming to specific ballast water management procedures and standards. Basic requirements of this legislature are that all ships will be required to implement ballast water exchange by a specific date, and incentives are provided for shippers to test future ballast water treatment technologies.

The primary areas of influence of this directive are the Great Lakes of the United States, as well as an initial testing site of the Port of Odessa located in the northwest part of the Black Sea. The reason for selection of these areas is the uniqueness of aquatic environment, and specifically for the Black Sea, the diversity of ships exchanging ballast water from all over the world.

The magnitude of the directive can be explained in the fact that it took more than forty national legislative acts to carry out the initial analysis. In order to effectively implement this plan several steps must take place. The primary influencing body of this directive is the IMO, (International Maritime Organization) and the co-ordination unit will be based at the IMO Headquarters. Additionally, there will be a Global Task Force comprised of stakeholder in the organization, and affected parties. This group will review the work plan, as well as amend the work plan when necessary. Separate Regional Task Forces will implement the plan in specific areas. The IMO will work closely with each separate body to overcome difficulties specific to each region as well as a list of potential partners including:

1) The United Nations Environment Programme (UNEP)
2) International Union for Conservation of Nature/Natural Resources (IUCN)
3) International Council for the Exploration of Sea (ICES)
4) Food and Agriculture Organization (FAO)

There have been proposals to limit the invasive nature of foreign ballast water released by traveling ships that involve both filtration of the ballast water, as well as neutralization of the affecting organisms by destruction of cell-membrane. The production model of this system is currently in the modular stage for efficient installation in current vessels. This method was decided upon in order to limit costs, as well as provide limited impact on the operations of the ship, and surrounding environment.

The application of study on this topic will depend on several variables. Support of legislation by specific nations is undoubtedly important. Proper management of the navigation of ships, in combination with the commitment to public health and environmental sanctity is also of up-most importance. Despite the extensive analysis of this plan, and steps to implement it, there are gray areas that will certainly arise in the future. Problems facing the shipping industry, that have not been evaluated or even encountered, and can only be overcome with constant improvement of systems created and ingenuity by the parties involved. The national management involved must be aware of deviations from the initial plan, and provide maximum effort as co-operation to ensure success.

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Feasibility Study on IAMU Corridor System in Maritime Management Field

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ABSTRACT
IAMU Corridor System is an idea to achieve a tangible result expected for IAMU activities, which is based on an international collaboration activity among IAMU member universities. IAMU Corridor System is a next generation type educational system utilizing IAMU-network of member universities.

The purpose of this idea is to attain the highest quality education in the maritime management field, which enables to foster the leader ship as maritime manager in the international maritime society as policy maker and social designer. To cover maritime management education field, a wide-ranging subject is necessary. The range of subjects spreads from scientific and technological management field to sociological management field. However, there is not enough qualified manpower in one institution, and it is difficult to offer all of the subjects at highest level in one institution.

From this point of view, in an idea of IAMU Corridor System by linking member universities to the corridor, several member universities of IAMU offer subjects according to their expertise. Students can obtain extensive knowledge and technologies on maritime management field by participating in prepared subjects of universities sequentially for one month term next by next, as if they were walking along a corridor.

In the present paper, to verify the feasibility of implementing this new type of education system, the ability, the possibility and the keenness of each member university for the participation to IAMU Corridor System are examined by means of questionnaires. And possible schemes of corridor are proposed based on the answers to the questionnaires.

1. Introduction

The establishment of a functional network system of maritime universities is a tangible result expected for IAMU activities. The educational system utilizing IAMU-network of member universities will be one of the next generation type MET system. In the present paper, IAMU Corridor System is proposed to realize the idea of implementing the maritime management education through the IAMU-network.

The purpose of this idea is to attain the highest quality education in the maritime management field, which enables to foster the leader ship in the international maritime community as policy designer or social designer.

To cover maritime management education field, a wide-ranging subject is necessary. The range of subjects spreads from scientific and technological management field to sociological management field. However, there is not enough qualified manpower in one institution, and it is difficult to offer all of the subjects at highest level in one institution.

From this point of view, in an idea of IAMU Corridor System by linking member universities to the corridor, several member universities of IAMU offer subjects according to their expertise. Students can obtain extensive knowledge and technologies on maritime management field by participating in prepared subjects of universities sequentially for one month term next by next, as if they were walking along a corridor.

In the present paper, to verify the feasibility of implementing this new type of education system, the ability, the possibility and the keenness of each member university for the participation to IAMU Corridor System were examined by means of questionnaires from the aspects of competent professors recommended, subjects offered and qualified students sent by each member university. The agreement on interchangeable credit units on each member university and the budget aspect are also discussed. And possible schemes of corridor are proposed based on the answers to the questionnaires.

2. IAMU Corridor System

As can be seen in Fig. 1, IAMU Corridor System is composed of such units as corridor universities, corridor lecturers, corridor students and corridor coordinators

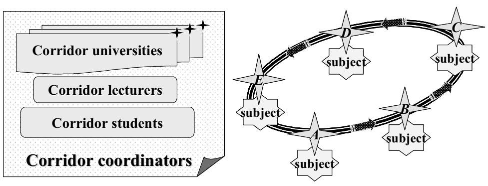

Fig. 1 IAMU Corridor System

2.1 Corridor Universities

The feature and the outline of the corridor university can be summarizes as follows.

(1) Basically courses are intended for post-graduate students.
(2) The language of lectures should be English.
(3) Students can take two credit units with an intensive course of 2 (hours/day)×15 (days).
(4) They move to another university for one month term next by next.
(5) Acquired credits are interchangeable among corridor universities.
(6) Universities in charge should, besides lectures, provide their own exchange programs, such as; student exchanges, cultural exchanges for understanding different cultures.

Corridor universities offer the subjects according to their expertise to foster the leader-ship in the international maritime community as policy designer or social designer.

Linking four member universities to the corridor, it is possible to offer lectures giving 8 credit units in 4 months (a semester). If each university runs a course twice a day, in the morning and in the afternoon, respectively, the corridor university can offer 16 credit units in 4 months (a semester).

Not so many credits are required to complete a master's course in general: about 20 credits in two-year coursework will be considered as a standard. Therefore, it can be said that the IAMU Corridor System is a very reasonable way for students to obtain credits from a minimum of 8 to a maximum of 16 state-of-the-art lectures in a semester.

To certify credits, which a student acquires in a foreign corridor university, as those of our own university's, a credit interchange agreement must be made among member corridor universities. The number of credits transferable should not be limited, although some universities actually set the maximum acceptable number of credits to be transferred. We propose this because it is a privilege for students to take the world's high-level lectures in the IAMU Corridor System.

The maritime community is international by its nature. The universities hosting the corridor university should provide students with such opportunities as student interchange and cultural exchange programs so that they can contribute to the international maritime society with a global view in the future. We emphasize this because the IAMU Corridor System includes an excellent educational benefit offering a great opportunity for nurturing international students. Students, participating in IAMU Corridor System, not only get to know other corridor students from all over the world, but can also interact with the local students of the country hosting the corridor university, and are exposed to its culture.

2.2 Corridor Lecturers

A competent professor recommended by each university offers a subject on maritime management field. A professor gives a lecture for two hours a day for three weeks, and certifies a credit from the results of examinations. Basically, IAMU approves and certifies his (her) professorship by examining the syllabus presented.

Although it is necessary to discuss further how to certify corridor lecturers, it would be appropriate for a special screening committee to select lecturers based upon established rules and standards.

The professors of a member university of IAMU offer top-level lectures in principle. However, if possible, or if necessary, lecturers can be invited from neighboring countries or business organizations to use external manpower other than that of IAMU member universities.

2.3 Corridor Students

A certain number of students recommended by member universities of IAMU are qualified as corridor students.

Although it is preferable to select candidates from the corridor universities' students in the initial stage of the IAMU Corridor System, it is necessary to discuss further how to select corridor students in the future. However, It is considered that it appropriate to basically choose corridor students in a special committee to be set up in IAMU based upon rules and standards in the same way as corridor lecturers are chosen.

3. Feasibility Study of IAMU Corridor System

3.1 Survey by means of questionnaire

The questionnaires were distributed to all the IAMU member universities (36 universities) to verify the feasibility of implementing this new type of education system, from the aspect of the ability, the possibility and the keenness of each member university for the participation to IAMU Corridor System.

We had received responses from 18 out of 36 universities by June 2004. We have to note that all of the responses are based on individual understandings of each respondent in charge and do not reflect the policy of the university.

Figure 2 shows the geographical distribution of the universities that responded to the questionnaire. The distribution is seen to be almost worldwide - Asia, Oceania, Americas, Europe and Eastern Europe.

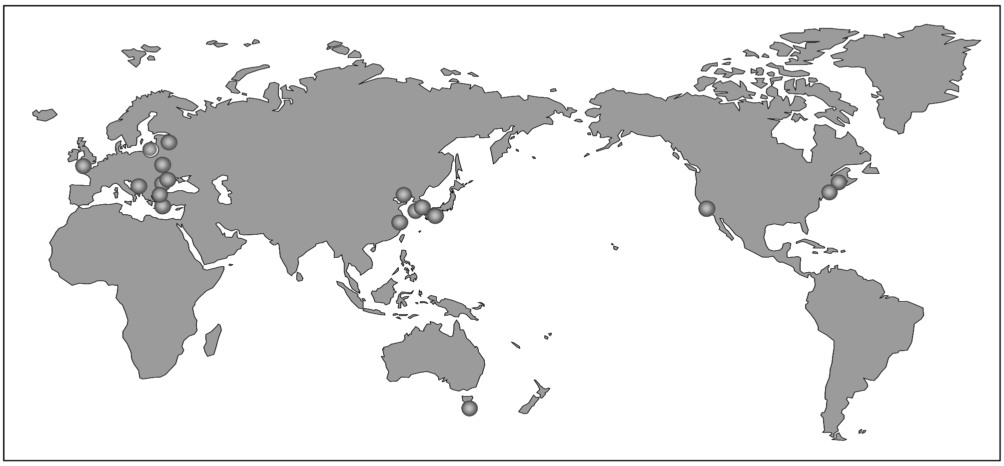

Fig. 2 Geographical distribution of respondent universities

3.2 The ability

(1) Current education system

Q.1

Does your university have post-graduate courses or programs in maritime management field?

If yes, please write the name of course or program.

Seventeen (17) of the 18 universities that responded to the questionnaires offer courses or programs in the maritime management field. The courses and programs are classified as follows.

a) Maritime transport management related to shipping, logistics and port management

This course is offered by 10 universities out of the 17 universities around the world, irrespective of area.

b) Maritime business administration in the shipping and maritime related field

This course is offered by 5 universities of the 17 universities in Asia, the Americas, and part of the Eastern Europe.

c) Maritime safety and technology system management

This course is offered by 4 universities of the 17 universities, in Asia, the Americas, and part of the Eastern Europe.

d) Management science and operation systems engineering

This course, which is a foundation course essentially to understand management philosophy, is offered in 3 of the 17 universities in Asia.

(2) Teaching staffs

Q.2

Does your university have a teacher who majors in education and research of maritime management field?

If yes, please specify who (if possible), his/her degree, the possibility of giving lectures in English and his/her research field or subjects:

Seventeen (17) of the 18 universities responded affirmatively that they have instructors who majored in education and research of maritime management field. One (1) has not responded.

Seventeen (17) universities listed 66 instructors whose majors are as follows.

a)	Maritime economics, marketing, business	14
b)	Logistics and transport	11
c)	Maritime safety and security	13
d)	Maritime policy, strategy, quality system	9
e)	Nautical techniques	6
f)	Management science	5
g)	Port operation and management	4
h)	Maritime law and convention	3
i)	Maritime environmental management	1

Almost all of the 66 instructors hold doctor degree and can give lecture in English.

Q.3

Even for undergraduate students, is your university able to offer those maritime management related lectures?

If yes, please specify who (if possible), his/her degree, the possibility of giving lectures in English and his/her research field or subjects:

The universities that offer maritime management courses in post-graduate school also offer them in the undergraduate school.

The subjects and the instructors in the undergraduate school are almost the same as in the post-graduate school.

Q4

If necessary, your university can arrange a lecturer from other universities, companies or industries etc?

Education and research on maritime management range widely from technical to social science areas, and from theoretical to practical approaches. Therefore, we may consider inviting external lecturers from universities other than IAMU ones or business organizations if we can identify them.

According to the results of the questionnaire, 14 universities can arrange external instructors from universities other than IAMU ones or business firms, while 2 universities cannot. One (1) has not responded.

The 14 affirmative universities do not provide details, but they seem to have some possible instructors outside the university.

3.3 The possibility

(1) Credits interchange

Q.5

Some universities have the agreement that allows their students who have obtained credits at other university or institution to have those credits authorized as their university credits. Do you have this kind of agreement with other university or institution?

> If you do, that agreement is: [Between two universities / Among group member universities (more than 3 universities) / Both two and group member universities]

In the IAMU Corridor System, it is crucial to make a credits interchange agreement among the corridor universities. The agreement should not be signed bilaterally between any two corridor universities, but multilaterally among all. Because several independent universities give credits and independent students of several universities earn them.
The multilateral credits interchange agreement will be signed by the member corridor universities only when each member university is convinced that the credits obtained in the IAMU Corridor System are acceptable for its post-graduate school in terms of quality and level, and also when each university approves the educational method proposed by IAMU Corridor System.

However, it is not necessary to worry about these aspects as the IAMU Corridor System tries to use the best-qualified educational potential.

In the questionnaire, we asked about the record of previous credits interchange systems in each university. According to the results, 14 universities already have a credits interchange agreement; three (3) universities do not have; and, one (1) has not answered.

All 14 universities have bilateral agreements, and 5 of 14 universities have a multilateral group agreement among more than three universities.

As a multilateral group agreement among more than three universities is nothing new and we see a proven record, it can be presumed that there is not a big problem with the multilateral credits interchange agreement among the Corridor universities.

(2) Cost and budget

Q.6

Suppose you are one of the Corridor universities, how much money do you expect to be cost for one international student to stay for one month in your university? And which expense may be able to be funded or aided by your university? (Tuition fee, Accommodation, Food)

Another problem in realizing the IAMU Corridor System is how to cover operating costs. In the questionnaire we asked how much it costs per person for a one-month stay in a Corridor university, and how much each university can bear of a student's costs.

Sixteen (16) of 18 universities responded to this questionnaire. Seven (7) of 16 universities think it is unnecessary to get paid tuition. For the purpose of reducing operating costs as much as possible, it is desirable to include a consensus on tuition that the Corridor universities do not collect tuition, in the multilateral credit interchange agreement

Lodging and food costs per month vary from country to country. Roughly, in the cheapest country they cost USD 100 while in the most expensive country they cost USD 1,000. On average, lodging and food costs are USD 600 – 650 per month.

Four (4) universities responded that they would be able to bear part of the lodging and food costs while many universities would not be. There was a comment that we should ask for grants.

In addition to lodging and food costs, there will be other costs such as airfares for corridor students to travel from their country to a corridor university and from the corridor university to the next one, and other operating costs for running the IAMU Corridor System. Other operating costs include those for coordinating students interchange and cultural exchange programs at each university.

In order to realize the IAMU Corridor System, the above-mentioned expenses have to be covered, and the maximum enrollment depends on budget scale. It is preferable to prepare a grants system for this activity to raise money to cover operating costs.

3.4 The keenness

(1) Recognition of the IAMU Corridor System

Q.7

Do you know the idea and concept of IAMU "Corridor System" which has been proposed at IAMU?

Realization of the IAMU Corridor System depends absolutely on the commitment of each of the IAMU member universities. Therefore, we asked a question about the recognition of the IAMU Corridor System. Sixteen (16) of 18 universities which answered the question with "Yes," while the remaining 2 universities said "No" and "Not fully familiar."

(2) Commitment to the IAMU Corridor System

Q.8

Do you wish to send your students to IAMU Corridor System?

We asked if member universities wish to send their students to the IAMU Corridor System. The eleven (11) of the 18 universities that answered the question said "Yes." Five (5) universities said "Do not yet know" and one (1)university said "No."

Q.9

Do you wish to accept international students as a Corridor university and provide high-level lectures and international cultural exchange opportunities at your university?

Next, we asked about the willingness to become a corridor university. Fourteen (14) of 18 universities that answered the question said "Yes." Two (2) said "Do not yet know," and one (1) said "No."

The majority of the respondents support the IAMU Corridor System. The universities that have instructors who can provide the top-level lectures necessary to carry out a new educational system in maritime management field show a high level of interest in participating in IAMU Corridor System: the fact is very significant to realize the next-generation education system using the IAMU network.

4. Proposal of Pilot Scheme (In lieu of Concluding Remarks)

After summarizing the results of the questionnaires we can propose a Corridor pilot scheme linking Oceania, Asia, Americas, and East/West Europe.

For example, we assume the following pilot scheme. Maritime Business Administration course is given in Oceania; Maritime Safety System and Management Science courses are given in Asia; Port Operation and Management is given in the Americas; and Maritime Logistics and Transport Management is given in East/West Europe.

The result of the questionnaires indicated the high potential of lectures and instructors with which and whom we can comprehensively cover the maritime management field. In the future, discussing more combinations of areas and lectures than what we have assumed in the above and new combinations of lectures from the broader maritime management fields, we expect to build a creative education system in the IAMU Corridor System.

BIOGRAPHY

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Kinzo INOUE

Dr. Kinzo Inoue is Professor of Kobe University, Faculty of Maritime Sciences, and is currently the Head, Division of Maritime Sciences, Graduate School of Science and Technology of Kobe University.

Dr. Kinzo Inoue holds a Bachelor of Nautical studies and a Master of Maritime Sciences from Kobe University of Mercantile Marine, and holds a Doctor degree in Engineering from University of Kyoto. He has worked at NYK Shipping Company as a deck officer from 1968, and came back to Kobe University of Mercantile Marine in 1973 to serve maritime education and training at his alma mater.

He was the Vice President of Kobe University of Mercantile Marine from 2000 to 2002. And he was the President of Japan Institute of Navigation from 2002 to 2004. He is currently honorary member of Japan Institute of navigation, and is also an Associate Fellow of Royal Institute of Navigation in UK.

His research interests are Ship-handling theory, Marine traffic engineering, Port and waterway design and around International maritime safety management. Regarding the establishment of IAMU, he contributed by proposing the philosophy and the design-concept of IAMU-activities.

Momoko MOTOHASHI

Momoko Motohashi is an undergraduate of the Nautical Science Course of Kobe University, Faculty of Maritime Sciences (KUMS). She used to work at the trading company and have lots of international experiences, such as the Japanese national leader of Ship for World Youth program 2000, the ambassador of World Youth for United Nations etc.

Since started her maritime education in Kobe, she has been playing a leading role of international activities both in KUMS and IAMUS. Her first thesis, "International cooperation against the pirates and armed robbery in Southeast Asia” won a prize in the 5th International Cooperation-related Thesis Contest for University Students, sponsored by JICA in 2002. She intends to extend her maritime research activity in Europe as a young Asian mariner after graduation.

Installing And Testing New Technologies On A Maritime Training Vessel

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ABSTRACT
The installation of new technologies; advanced, developed and being researched for use on board commercial or military vessels, on board a Maritime Training Vessel can result in very positive opportunities for the vessel, the institution, the manufacturer, and the eventual end user, but none benefits more than the student population. STATE OF MAINE has been involved in just such development, research and training for the past seven years. Our current involvement is expected to stretch into the future and we are continually on the lookout to research, procure and test new equipment and to partner with manufacturers and developers.

The enthusiasm generated amongst the students involved is exciting and our training cruises have proven to be a very effective defined time to collect data from some of the installed equipment. The recently released commercial and military versions of “LookSea” are an example of a training ship installation which allowed for an intense programming and problem solving hands on real ship trial and error involvement.

This paper details and explores the lessons learned and shares the failures as well as the successes. The knowledge garnered by the students involved whether the technology is a success or failure can equate to a well-trained seafarer who can recognize the factors involved in integrating equipments. The student can equally relate to the worth of the technology in enhancing the safety of the vessel or the benefit to its performance.

New technologies are vital to our industry and preparing our student population to interact with the emerging technological advances is a key mandate.

1. Introduction

Training Ship STATE OF MAINE was delivered (the vessel is owned by the United States Department of Transportation, Maritime Administration MARAD and is on loan to the State of Maine with MMA the custodian) to Maine Maritime Academy in the spring of 1997. The ship was constructed for and delivered to the U.S. Navy in 1990 and served as a Fast Oceanographic Research Vessel until 1993 when an engine casualty effectively removed it from Navy use. After a 3-year period of lying idle the ship was converted for use by Maine Maritime Academy as a training vessel for educating men and women to become officers in the merchant marine.

Because of the engine casualty it was necessary to completely strip the ship of her old propulsion engines and install another propulsion plant. In studies of plant types it eventually became obvious that some innovations in design could be easily accomplished while adhering to the strict budgetary restraints imposed on the project by lack of governmental agency funds.

The power plant installed is unique in a couple of ways. First, the tail shaft, intermediate shaft and propeller were modified or replaced without changing the stern tube bearing or structure. Second, the original (2) two engines, reduction gear and fixed propeller were replaced by a single used engine on the port side and an electric motor on the starboard side through the original gearbox and driving a controllable pitch propeller.

This in itself makes it a unique vessel in the world fleet today. The ship can be operated using the diesel engine dragging the electric motor and still accomplish speeds of around 16.5 knots. Alternatively the ship may be operated with the main diesel engine unclutched, all (3) three generators on line and the electric motor driving the ship via the original gearbox and controllable pitch propeller. Speed in the range of 6.5 knots is accomplished in this mode of operation.

So, we have a training ship that has a special design capable of teaching diesel mechanical propulsion along with diesel electric propulsion. The added advantage is that the electric motor adds emergency backup for the main propulsion plant enhancing the safety of the entire platform.

Lastly, this innovation in power plant design leads into our use of the training ship as a technology development platform. We have made every effort to stay up with technological innovations and, if possible, ahead of what will be the norm in ships in the immediate future, which will be the platforms our students will be sailing on after graduation.

2. Installation and testing of technology and associated applications

With the arrival of the converted training ship at Maine Maritime Academy it became very evident that insufficient funds were available to install and test new items of technology had they been commercially available. The Maritime Administration has been, and continues to be, very supportive of our independent endeavors to introduce new items to the platform for testing and teaching. Our affiliation with the Maritime Administration proves to be valuable in helping other government entities provide us with equipment and enhance our teaching technology. Some research datasets have been gathered by students, ship's crew and faculty for evaluation and submittal to the sponsoring agencies, notably the Office of Naval Research, NAVSEA, DARPA, and ISOpur Corp.

As with any endeavor there have been varying levels of success with some of our projects but without a doubt even the failed projects offered a great teaching and learning experience for all involved. For example, research into radio tagging components failed, while the concept of modular construction, and assembly using wearable computer generated instruction datasets certainly left the students with a much better understanding of the problem and invoked some interesting suggestions to fix the problem.

Table 1 below delineates the particulars of some of our projects to date, and the involvement of students, crew and faculty. In a university environment there are many opportunities to involve faculty and students with training ship platform initiatives that pique the curiosity, stimulate the interests and reward the individuals involved with a sense of pride and knowledge that they are at the leading edge of implementation in their field.

Project	Description	Student involvement	Crew involvement	Faculty involvement
RF tagging	DARPA[1] initiative for radio tagging components in the weapons handling design of CVX	Students located and assembled 'mock" weapons	Crew developed storage plan, and infrastructure	None
ISOpur Filter	Lube oil purification using coalescing and filtering technology.	Students helped install on multiple equipments. They operated and logged data	Designated and supervised operation, installation and data analysis and submittal	Oversight and instruction in the classroom
Augmented reality Navigational Aid	"LookSea" augmented reality overlay of a real time video picture.	Involved in wearing of original headset and operation of subsequent models	Design, comment and implementation assistance to developer.	Use and comment as a teaching tool. Possible integration with simulation
WiFi, WAP & WEBCAM technology aboard ship	Self developed for training ship specific use of 250+ terminals. Bridge and Engine room WebCams.	Installation of switches. Use at all times when living aboard.	Continuous development, trial and installation along with every day use.	Every day use when aboard
WiFi connection to shoreside networks	No direct cable connect yet allows shoreside integration to a LAN when at a port	Local MMA intranet as well as internet portal.	Local MMA intranet as well as internet portal.	Shoreside access to ship server
Bridge technologies	Integration and power requirements and design. Research into auto equipment redundancy switchover and system UPS design	Users	Users, designers, installers, implementers.	Users
Generator, breaker, metering wireless data transmission	New meters installed to store and wirelessly transmit data to ship's computers for load trending	Installation of meters and WAP's	Design, Installation and Implementation of meters and data downloads	Direct oversight and installation assistance. End point for data collected.
Marine Fuel Cell	ONR[2] funded fuel cell academic training course	None	Joint course development with faculty geared to shipboard training	Develop Marine operations course
Marine Fuel Cell	NAVSEA[3] shipboard test of unit	None yet	Ship platform integration study underway	Joint platform development with ship crew

[1] DARPA; Defense Advanced Research Projects Agency
[2] ONR, Office of Naval Research
[3] NAVSEA, Naval Sea Systems Command

Table 1. Projects

All of the above projects have made a noticeable impact on the way our students view technology. An interesting comment from a student was "Now I see why you keep stressing the basics. It enables me to realize when I am getting misleading or false information from my technology." So right this student was! In this particular case a stalled display had been giving static information for about nine minutes before the student had the gut feeling all was not right and figured out what the problem was.

3. Project descriptions

For the purpose of this paper I will describe our involvement with the first three items in table 1 which will give a representative look at our projects and allow a better understanding of the "value added" by Maine Maritime Academy, its students, faculty and the crew of the training ship.

3.1 RF Tagging

MMA (Maine Maritime Academy), TSSOM (Training ship STATE OF MAINE) was approached by Technology Systems Inc to partner in an effort to research designs and implementation of radio frequency tagging of weapons system components. This effort was part of a study sponsored by DARPA, which revolved around the design of the weapons system for the next generation of aircraft carrier.

Our effort involved designating several storerooms aboard the training ship to receive radio location antennas that were directionally stable and sensitive to distance. A mock weapon (one of our torpedo shaped oceanographic departments towed 'fish") which was disassembled into (6) six component parts each of which were radio tagged and then distributed to the storerooms. A central assembly area was designated and the entire system was networked with computers. Students involved in the project planning were designated to don a "wearable" computer, which alerted them to the specific type of weapon that was to be assembled, and led them to the storeroom with the proper component. They would retrieve the component; take it to the assembly area and go on to retrieve the remaining components. Finally the computer would instruct them on the sequence of assembly.

Running behind the scene in the background to this retrieval and assembly process was the fact that the computer was tracking parts usage and transmitting the data to the ship's server which in turn was preparing the order to be sent to the supply depot to replenish the expended parts. The computer was also tracking "custody" control of the items and "who" retrieved them. Ultimately we made a video of the entire process and except for the "RF" tags the project went remarkably well. The RF tags were problematic and our conclusion was that the technology was not quite ready for deployment at the time of the testing (circa 1999, 2000). It is interesting to note that since that time the giant retailer WalMart has notified all their suppliers that every single item they sell must be equipped with radio frequency tags by December 2005.

3.2 MAG Filter

MMA & TSSOM were tasked by Bath Iron Works to install and test an ISOpur MAG filter on one of our diesel generators and to operate it during our 60 day annual cruise. System pressures were to be tracked and filter media changed as necessary. The promise was that our old oil, which we would normally centrifuge, would be routed through this machine and after a period of time would approach specifications better than new virgin oil. This equipment is much simpler and less difficult to run and maintain than any purifier (centrifuge).

The students and ship's crew under the direction of the manufacturers representative installed the equipment and we operated the filter for an entire cruise, drawing samples at designated times and sending data and samples back to the manufacturer.

A full report of this trial and accompanying data is available to read at the following link:http://www.isopurfluid.com/Cases/CS-MARINE-0404-0.pdf

We have now had the unit for (4) four cruises and have moved it from Generator to Generator and also have had it installed on the Main Reduction Gear case and the Stern tube. In all instances the filter worked flawlessly and in fact lived up to the promises of the manufacturer. Original oil in each unit was in need of purification and after MAG filter use cleaned up to very shiny lean looking oil which when sent out for analysis proved to be free of contaminants of any sort and in fact “better than new”.

The original manufacturer has consented to let us retain the unit and we now use it as part of our ship’s equipment specifically used for trouble spots that we identify in our lube oil purification processes.

Student involvement in the multiple installations has made them acutely aware of the lube oil flow through various equipments because of their intimate involvement with insuring the proper pipes are tied in to the right place on the equipment

The filter has proven easy to operate and any of our students are now able to demonstrate the unit operations as well as explain it’s function and worth to them as an operating engineer.

Original ‘wearable computer” and goggles on left and redesigned unit on the right.

3.3 LookSea (Augmented Navigation)

LookSea is perhaps our most visible and rewarding development partnership to date. It started about (4) four years ago with MMA’s technology partner TSI (Technology Systems Inc). At that time video gaming virtual reality headsets were the vogue and the idea was to replicate that technology for use on the bridge of a ship to assist the navigator with a heads up view of the environment surrounding him with chart data overlays of real time views. The original system included a GPS mounted helmet with wearable computer and eyepiece. All entirely linked to an electronic charting system that allowed the navigational aids to be overlaid on the real picture as viewed. Bridge parallax as the person moved about the bridge was solved by precision radio tracking modules installed on the bridge and on the person.

The concept worked BUT was very cumbersome and we soon realized that wearing the unit was not the answer. In casual conversation we speculated that perhaps a fixed screen on the bridge would solve the restrictive wearing problem along with adding significantly to the safety of the bridge operations as viewed by the operator. From that casual conversation on the bridge of training ship STATE OF MAINE, **“LookSea”** was born…

(3) basic components. Screen, Camera and Computer Server

“**LookSea™ Pro** is the most advanced electronic chart system available and can also provide a focal point for your integrated bridge system. The LookSea system takes video data from an exterior camera, converts electronic

LookSea screen in reduced visibility

chart data into computer generated, 3D graphics and synchronizes those images with GPS and heading data to create an augmented view of your situation on a video monitor."

As with many items of technology, LookSea proved to be a natural addition to the bridge technology of various military vessels: minesweepers and landing craft air cushion to name a couple. These led to more robust military versions with more sophisticated "night vision" cameras and integrated to the military software that was mission designated.

The training ship has a professional version installed and during the recently completed cruise the crew and students did extensive testing of the various aspects of the equipment use and integration to our other NEMA compatible equipments signals, such as AIS. We are continuing our software upgrade tests as I write this paper.

I am happy to report that a cumbersome first edition piece of equipment has evolved into a sleek easily useable piece of equipment that will go a long way towards enhancing bridge safety.

3.3.1 Recent adaptation

During testing and operations aboard TSSOM the idea came up of sending the LookSea signal to the ship's local area network for possible remote site extraction. This became a reality about two thirds of he way through cruise so we were able to test and use the remote picture, for information purposes only, during the final days of this years voyage. The picture was remotely displayed in a lower passageway of the ship for any and all crewmembers to view. Additionally it was sent to the Engine room for display in the Engine Operating Console area of the control room. Suddenly the myriad persons in the crew, who never really saw where they were going, are now totally in the picture. Well informed as to the progress of the voyage and more importantly they can watch the ship's progress in docking and undocking. Again adding that one more layer of safety awareness should they be called on to respond to an emergency situation.

This added feature has proven to be extremely valuable to crew well-being and awareness. It adds one more level to total ship integration and awareness.

4. MMA/TSSOM "Value added"

Academia, partnering with Industry, and the sponsored government research adds value to the project at significantly reduced cost to the project. Our facilities, research methodology, and foremost our student population are key to being able to make this partnership work to everyone's advantage.

Students are extremely interested in technology. They are also weaned on the visual acuity of modern childhood games and are very quick learners. They tend to bypass "operations manuals" and often discover unusual ways to use the equipment. Some innovative and useful and others that show the need for sounder programming techniques. Regardless, that is what testing is all about and reinforces the worth of

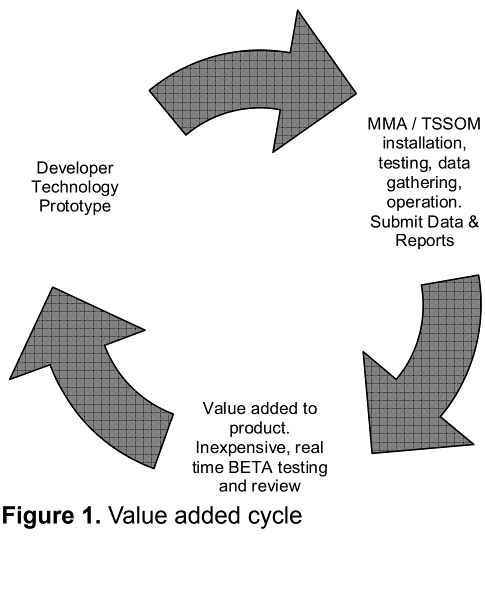

Figure 1. Value added cycle

this type of testing platform and venue.

One word of caution that is applicable…"they are eager to point and click, often without first thinking". Going to sea with 200 plus students simply means you are taking 2000 button pushing fingers with you.

5. Conclusions

Maine Maritime Academy and the Training Ship STATE OF MAINE recognize the value to *all* parties involved in an industry/academia partnership to test technology. Our technology partners have been pleased by our collaborative effort on their behalf. The longer we are involved and the more diverse the involvement the stronger our conviction is that this is a value to the institution, to the vessel and to our student population as much as it is to our partners. Whether or not the real time use of a product or idea is of current value to us, we certainly learn from our installation and testing. The seafarer of tomorrow will be surrounded by technology. Perhaps a test that he/she was involved in back in the training ship days will prove useful in a future situation allowing instant recognition of a failed piece of equipment or system malfunction.

I firmly believe the value of this technology to our cadets is paramount and an important part of their training at a maritime university. They must learn the inherent dangers and or distractions that will arise and they must learn how to effectively deal with the situation, which is dependent on their analytical skills as well as their intuitions. Technology testing adds immeasurably to these skills.

Collaboration is an easily initiated testing method that is relatively inexpensive, and reaps great benefits to all parties involved.

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BIOGRAPHY

Laurence V. Wade

Captain Larry Wade has been Master of the Maine Maritime Academy training ship STATE OF MAINE since 1996. Capt. Wade is also an adjunct Professor in the Department of Marine Operations and teaches various professional courses. He is involved in research endeavors in marine technology for private and government entities. He previously spent 30 years as a licensed officer in the U.S. Merchant Marine primarily as a Master on tankers. He also worked as a consultant and assistant port engineer during time at home from the ships.

Captain Wade is a 1964 graduate of Maine Maritime Academy where he earned a BS in Marine Science. He holds an Unlimited Masters License, 1st Class Pilot and STCW certificate along with numerous other professional certifications. He is a member of the Society of Naval Architects and Marine Engineers SNAME, The Boston Marine Society, the Council of American Master Mariners CAMM, and is a past President of The Kiwanis Club of Orono – Old Town Maine.

Analysis Of Human Error In Marine Engine Management

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ABSTRACT

In the whole industrial activities, although the people concerned have been making sustained efforts to prevent accidents and casualties, they have not been disappeared. Most of accidents have been caused by human errors. It can be said that human behavior and mind are not perfect and faultless, therefore, it should be recognized that human has to commit faults. The most important matter is making efforts to study existent human error and to prevent actualized danger. In order to decrease actual casualties, it is very important to dissolve unsafe acts or decisions and unsafe conditions hidden behind them, and to analyze and to investigate incidents that indicate a foretaste of actual casualties. However, the systematic accumulation and analysis of the marine incidents are not completed in the maritime industries. There are very few of information on the marine incidents, especially related to the marine engine management because they may include a lot of disadvantage information for mariners or shipping companies.

In this paper, marine accidents are investigated in order to grasp the actual circumstances of human errors in marine engine management. The information of objective marine accidents is collected from the judgments of Japan Marine Accident Inquiry Agency for the last 9 years. According to the IMO resolution A.884 (21), human behaviors are categorized into 3 modes, i.e., skill-, rule- and knowledge-based behaviors. Human errors and violation are classified into 4 modes, i.e., slip, lapse, mistake and violation. The background of error occurrence is assorted into 4 groups correlated with software, hardware, environment or liveware. And the location of the human error can be divided into organization onboard, on shore and both organizations. All of objective marine accidents are analyzed according to the above classification methods. Several deficiencies are revealed through the systematic investigation of actual accidents. The results of this paper realize the importance of marine incident analysis to aim the ultimate goal of marine safety.

1. Introduction

The very valuable morals for the industrial accident prevention were obtained from the industrial accident study conducted by H.W. Heinrich. They are "Prevent the accidents and there can be no injuries." and "Prevent the unsafe practices and unsafe conditions and there can be neither accidents nor injuries." In order to reduce the number of injuries and accidents, it is very important to dissolve the latent situations, which are unsafe practices and unsafe conditions. And it is essential to collect and analyze not only the information of actualized accidents and injuries but also the information of incident that can be considered as a foretaste of actualized one.

The aim of this study is to grasp the actual circumstances of human error in marine engine management. There are very few of information on the marine incidents, especially related to the marine engine management because they may include a lot of disadvantage information for mariners or shipping companies. In this paper, the marine accidents that are actualized phenomenon are taken as an object of investigation.

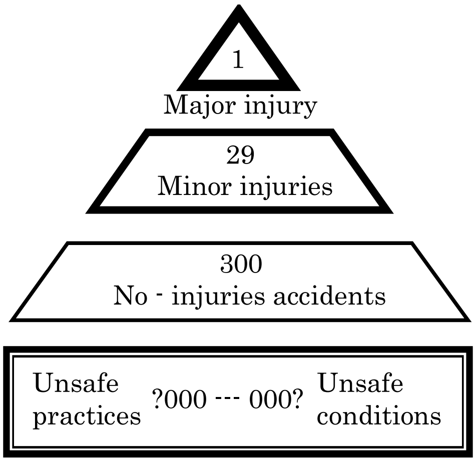

Fig. 1 Foundation of a major injury. (By H.W.Heinrich)

2. Objective data of marine accidents

The data of objective marine accidents is collected from the court's judgments of Japan Marine Accident Inquiry Agency for 9 years from 1995 to 2003. The marine accidents are classified into 16 categories in the judgments, namely, 1) collision, 2) collision (single), 3) grounding, 4) foundering, 5) flooding, 6) capsize, 7) missing, 8) multiple accident, 9) fire, 10) explosion, 11) machinery failure, 12) equipment damage, 13) facility damage, 14) death and injuries, 15) safety hindrance and 16) navigation hindrance. The marine accidents related to marine engine management are picked out from these all marine accidents. The total number of accident picked out is 887. In addition, the types of vessel involved are focused on merchant ships. In brief, the marine accidents involved with fishing boats or pleasure boats are eliminated. Consequently the number of objective data of marine accidents is finally 173 in this paper.

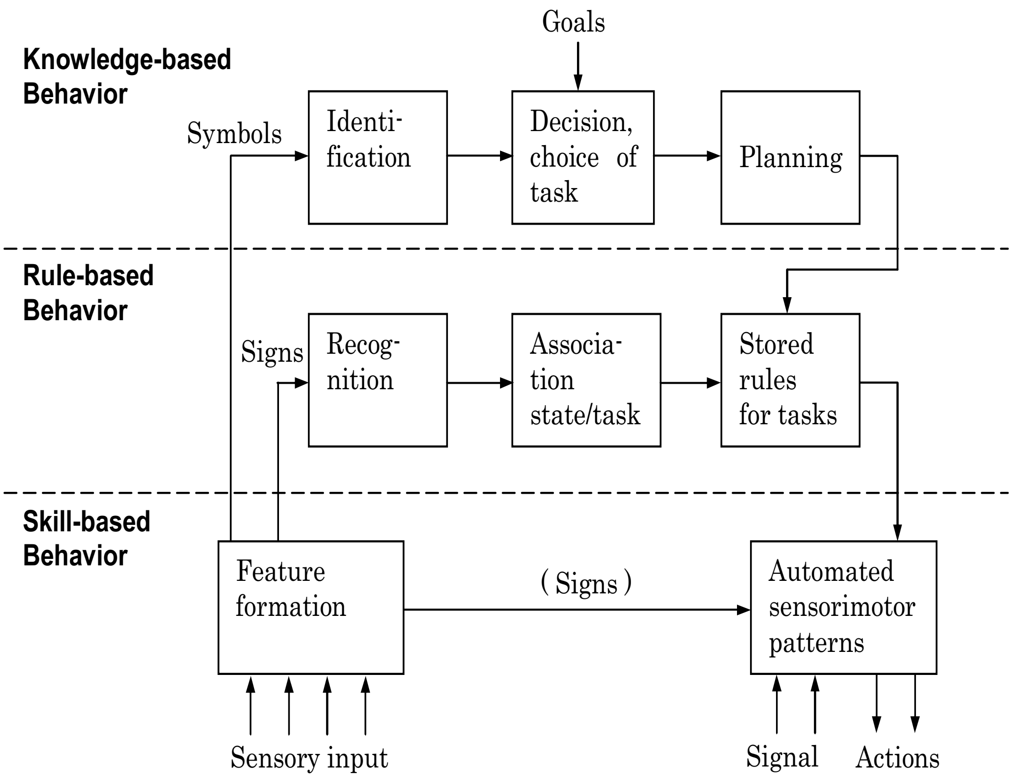

Fig. 2 SRK model : Simplified diagram of the three levels of control of human actions. (By Jens Rasmussen)

3. Analyzing models for the major factor in accidents

3.1 SRK model

Jens Rasmussen classified categories of human behavior into tree levels of performance : skill-, rule-, and knowledge-based performance. Simplified diagram of the three levels of control of human actions is shown in Fig. 2.

1) Skill-based behavior is automated and highly integrated patterns of behavior without conscious control represented by sensorimotor performance.
2) Rule-based behavior is typically consciously controlled by a stored rule or procedure that may have been derived empirically during previous occasions, communicated from other persons' know-how as an instruction, or it may be prepared on occasion by conscious problem solving and planning.
3) Knowledge-based behavior is controlled physically by trial and error, or conceptually by means of understanding of the functional properties of the environment and prediction of the effect of the plan considered in unfamiliar situations. In this situation, there are no know-how or rules to resolve subjects.

3.2 SLMV model (GEMS: A Generic Error-Modeling System)

James Reason devised a classification of unsafe acts into four types: slip, lapse, mistake and violation as shown in Fig. 3. The psychological varieties of unsafe acts are classified initially according to whether the act was intended or unintended and then errors are distinguished from violations.

1) **Slip :** A slip is an unintentional action where the failure involves attention.
2) **Lapse :** A lapse is an unintentional action where the failure involves memory.
3) **Mistake :** A mistake is an intentional action, but there is no deliberate decision to act against a rule or plan.
There are errors in planning.
4) **Violation :** A violation is a planning failure where a deliberate decision to act against a rule or plan has been made.

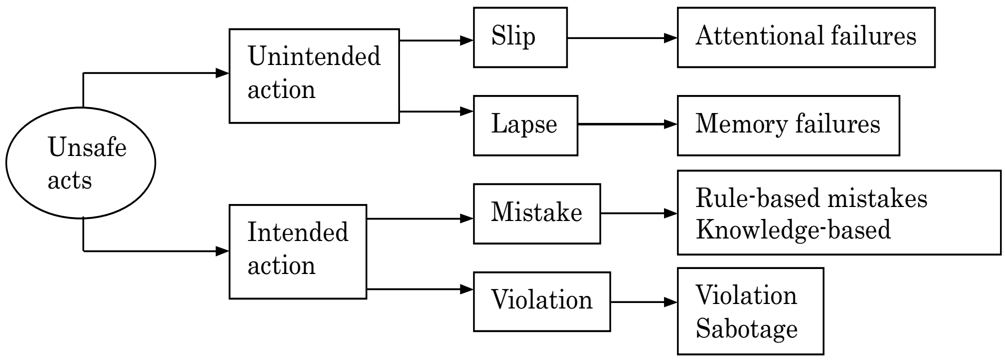

Fig. 3 SLMV model : A summary of the psychological varieties of unsafe acts. (By James Reason)

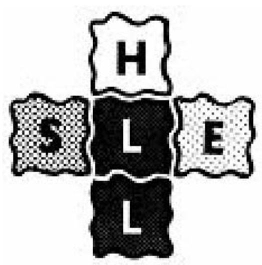

Fig. 4 SHEL model. (By Frank H. Hawkins)

3.3 SHEL model

The SHEL model was initially developed by Elwyn Edwards, with a modified diagram to illustrate the model developed by Frank H. Hawkins. The SHEL model categorize primary component concerned with occurrence of human errors into Software, Hardware, Environment or Liveware. The background of occurrence of human errors can be classified.

1) S - Software : Software is the non-physical part of the system including organizational policies, procedures, manuals, advisories, computer programs, etc.
2) H - Hardware : Hardware refers to the equipments and facilities. It includes the design of displays, controls, function of switch, etc.
3) E - Environment : Environment includes the internal and external climate, temperature and other factors. And, the broad political and economic constrains under which the system operates are sometimes included.
4) L - Liveware (central component) : The most valuable and flexible component in this system is the human element placed at the center of the model. The person under consideration interacts directly with each one of the four other elements.
L - Liveware (peripheral) : The peripheral liveware refers to the system's human-human interactions.

4. Analyzing procedures

4.1 Classification of human behavior and error

The classifications of human behavior by SRK model and human error by SLMV model are integrated as shown in Fig. 5.

An unsafe action is classified into intended or unintended action. The unintended action is classified into slip or lapse according to whether the aim of the action is appropriate or not. An intended action is classified into familiar or unfamiliar action. The familiar action is classified into mistake in rule-based action or violation according to whether the action is followed rules or not. An unsafe action in unfamiliar circumstance is classified into mistake in knowledge-based action. Mistake in rule- and knowledge-based action is represented as "Rule" and "Knowledge" respectively in tables and figures in this paper hereafter.

4.2 Major factor location of occurrences of human error

In the marine accidents concerned with marine engine operation and management, a major factor location of occurrence of human error is categorized into five patterns as followings.

1) Organization onboard
Human factor of only a chief engineer or crewmembers onboard is related to occurrence of marine accident.
2) Support organization on shore
Human factor of a member of shipping company, engine manufacturer or ship repair company, namely support

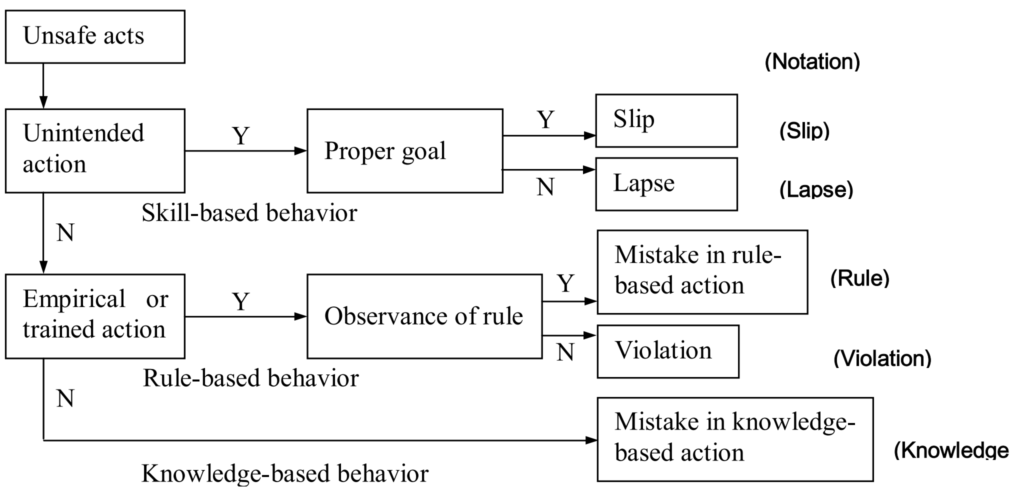

Fig. 5 Classification diagram for human behavior and human error.

organization on shore, is primary related to occurrence of marine accident. There are no human errors in an onboard organization.

3) Both (onboard)
Human factor of both parties onboard and on shore is related to occurrence of marine accident. Human factor of onboard organization affects occurrence of marine accident relatively more heavily than support organization's one.

4) Both (shore)
Human factor of both parties onboard and on shore is related to occurrence of marine accident as well as the above "Both (onboard)". Contrary to the above, human factor of support organization affects occurrence of marine accident relatively more heavy than onboard organization's one.

5) Unidentified
A cause of accident is unidentified, or human factor concerned to accidents is slightness and neglect able.

5. Analyzed results

5.1 Particulars of individual accident

The progresses of typical accident on marine engine management are analyzed and shown below with the categorized human behavior and human error regarding the marine accidents in complicated situation or complex background.

SHIP #1 (Ro- Pax Ferry 9,463gt)

Phenomenon	Action	Background SHEL C/E	Background SHEL 1/E	Behavior SRK	Error SLMV (GEMS)
	Ship management Co. Lack of instruction in emergency situation	Env. Educational env.	Env.	Ship management Co. Knowledge Needs of education	Mistake Decision
	Ship management Co. Nothing equipment of emergency stop by oil mist alarm	Hard. No equipment	Hard.	Ship management Co. Knowledge Effectiveness of equipments	Mistake Decision
Oil mist alarm on same type engine	Engine maker Co. Nothing information of the frequency oil mist alarm	Soft. Nothing report on occurrence	Soft.	Engine maker Co. Knowledge Value of information	Mistake Decision
	Engineer Nothing confirmation on talk of same type engine	–	Soft. Value of information	Engineer Knowledge Value of information	Mistake Decision
Oil mist alarm					
Nothing slow down and continuation of resolving by oneself	Engineer Nothing appropriate measure	–	Env. Educational env.	Engineer Knowledge Emergency procedure	Mistake Decision
Getting permission of M/E stop Nothing report on oil mist alarm	Engineer Nothing correct report to C/E	Soft. Lack of information	Soft. Value of information	Engineer Knowledge Value of information	Mistake Decision
Disconnection of S/G with normal procedure before M/E stop	Engineer Normal procedure to disconnect S/G	Env. Educational env.	Env.	Engineer Skill Disconnection of S/G	Lapse Work priority
M/E seized					
M/E tripped					

Table 1 Summary of accident, case 1.

1) Case 1
Ship type : Domestic ro-pax ferry, 9463gt.
Accident : Seizure of M/E piston with cylinder liner and break of cylinder liner.

The typical example of that both parties onboard and on shore were responsible for the accident is shown in Table 1.

In this case, after the oil mist alarm occurred, the first engineer on duty did not take appropriate measures such as slowing down of the engine or stopping of the engine in order to detect the source of the trouble and his report to the chief engineer was insufficient. And, when the first engineer tried to stop the main engine at final stage,

the disengagement of the shaft generator connected with the starboard side engine concerned was left after the handling of the port side engine that was under normal running, because he got the normal procedure customary to disengage the shaft generator. The piston and the cylinder liner of the starboard side engine were seized and the cylinder liner was cracked because the stopping work was delayed.

The most important factor in this accident was the watch keeping engineer's error of judgment in knowledge-based behavior when the alarm occurred. But, it was just one penetration of multiple protections. The serious factor related to expansion of the accident can be categorized into "Lapse" in skill-based action of the first engineer when he tried to stop main engines. It can be considered that a composite error caused severe damaged accident. If he stopped the starboard side engine ahead of the port side engine, the severe damage might be avoided. In addition, a background factor was considerably concerned with the occurrence of the accident. The shipping company had not carried out adequate education of operation and management in emergency situation to crewmembers. And, the engine manufacturer had not made the frequency of same type accidents known to users. The background factor based on the support organization on shore had a great influence on the engineer's behavior. And, the unsafe condition was induced.

The judgment of the marine accident inquiry must be considerable because the shipping company and the engine manufacturer didn't even get any punishment such as a recommendation due to taking counter measures to prevent a recurrence after the accident. On the other hand the first engineer got a punishment of reprimand due to his faults.

2) Case 2
Ship type : Ocean going crude oil tanker, 136,688gt.
Accident : Crack of M/E cylinder liner.

The typical example of that only one party on shore was responsible for the accident is shown in Table 2. When the corroded part of M/E cylinder liner was repaired by welding, the removal of residual stress was inadequate. The M/E cylinder liner was cracked at the welded part and some cooling fresh water flowed into the cylinder only one-day service after the repair.

Welding repair was adopted because it would take excessive days to get a new cylinder liner for replacement. After start of the repair works, it was came to light that the condition of cylinder corroded was worse than expectation. In spite of a recommendation from superintendent of shipping company to extend the term of repair, the welding agency rejected the recommendation and forced an original schedule. The main factor of this accident is a decision mistake of knowledge base and a violation of the rule base by the welding agency, which is the support organization on shore.

SHIP #16 (Oil tanker 136,688gt)

Phenomenon	Action	Background SHEL C/E	Behavior SRK	Error SLMV (GEMS)
Cylinder liner corrosion rapidly progressed				
Tracing survey by maker				
Rejection of repair by welding co. in Singapore	Ship management Co. Taking a lot of time for renewal of cylinder liner	Env. · Hard. Nothing of time margin Order made cylinder liner		
Decision of repair by low-temp. welding				
Planning of repair schedule				
Excessive corrosion	Repair service CO. Rejection of proposal to extend work term. Frocing of original schedule.	Env. First experience	Repair service CO. Knowledge Consideration on schedule	Mistake Decision
Lack of peening	Repair service CO. Workers rushed	Env. Impending of termination	Repair service CO. Rule Low-temp. welding needs long time.	Violation Violation
Occurrence of crack by residual stress				
M/E tripped				

Table 2 Summary of accident, case 2.

In this case, no body onboard organization got any punishment. And, the welding agency also did not get any punishment in the judgment of the marine accident inquiry due to taking counter measures to prevent a recurrence after the accident in spite of the court of the marine accident inquiry pointed out that the main cause of this accident was the inadequacy for the work schedule consideration by the welding agency.

5.2 General statistical analysis

The major factors in 173 all examined marine accidents related to the marine engine management are detected from the court's judgments of marine accident inquiry. The result of statistical analysis on the major factor location and the classified categories of human error is shown in Fig. 6.

The largest number of human error related to the marine accident on the marine engine management is the violation of crewmembers onboard and accounts for 45% of the whole. There are extremely a lot of cases that a well-skilled engineer who has abundant experiences relies on the experience and intuition too much and he dose not observes neither a basic procedure, the rule nor the standard. The second largest number is the knowledge-based mistake. The one by crewmembers accounts for 13% and the one by support organizations on shore accounts for 7.5% of the whole respectively. This indicates unquestionably that a person concerned lacks ability to cope an event of the first experience or an unknown trouble. The third largest number is the skill-based lapse. The one by crewmembers accounts for 9%. The many of these cases are following. A person concerned works carelessly same as usually or mistakes an object equipment to operate, in spite of that an equipment handling procedure at abnormal condition is different from usual. The skill-based slip and rule-based mistake are overall few.

On the major factor location, the organization onboard accounts for 2/3 or more of the whole. It is very important to improve environment in the viewpoint by which the education and training is refined and the unsafe condition is dissolved. The support organization on shore

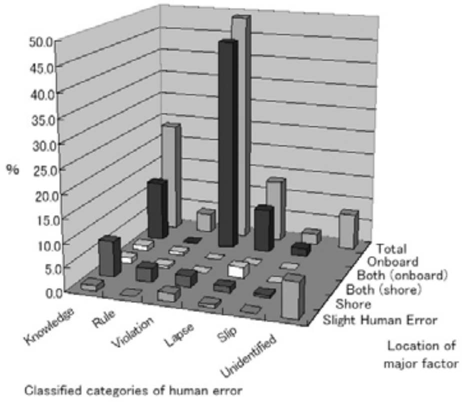

Fig. 6 The major factor location and the classified categories of human error.

accounts significantly for 14.5%. And, it is remarkable that many of prime factors are in support organization on shore when the both parties of onboard and on shore have accident generation factors. There are a lot of knowledge-based mistake accounted for 52% within the support organization on shore. When the repair and maintenance are ordered to the support organization on shore and they execute it, it is important that crewmembers pay attention substantially to the works.

6. Conclusions

As a means to grasp the actual circumstances of human error on marine engine management, the marine accidents on marine engine management are collected from the court's judgments of Japan Marine Accident Inquiry Agency and the analysis is carried out paying attention to the major factor location and the classification of human error.

According to the analyzed results, the following two matters are important in order to dissolve unsafe conditions to cause the occurrence of human errors, and to avoid actualization of accidents.

1) Improvements in environment to carry out education and training for exclusion of overconfidence based on empirical rule and making up for deficiency of knowledge and experience.
2) Improvements in standard for efficient operations and in safety environment conforming reasonably to real state on field.

An interesting result is obtained collaterally.

3) When both parties of the organization onboard and the support organization on shore had the accident factors, although administrative measures such as reprimand or suspension of duty were decided to engineers in many case, any administrative measure was not given to the support organization on shore because the relapse prevention measure was adopted after the occurrence of accident.

Finally, the challenge in the future should be taken is shown below.

4) The results are obtained from actualized marine accidents in this paper. The investigation on latent unsafe practices and unsafe conditions is essential for improvement of maritime safety. The marine incidents not accidents should be collected and analyzed.

5) In most human errors, the mismatch of the correlation with two or more people is one of important factors. The analysis and the improvement of mutual communications between participants in the marine engineering system are essential. That is, it is necessary to introduce the crew resource management also into the field of the marine engine operation and management.

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BIOGRAPHY

Analysis of Human Error in Marine Engine Management

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Dr Makoto Uchida is an associate professor in Faculty of Maritime Sciences, Kobe University. He has been working for marine engineering education for more than 20 years at Kobe University and the predecessor, namely Kobe University of mercantile Marine. He has been a visiting researcher at Australian Maritime College to study Engine Room Simulator for 10 months in 2000. He also worked for Istanbul Technical University, Maritime Faculty as a long-term expert of JICA project for one and half years between 2001 and 2003.

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On the Quality Ship System for Safety Inspection

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ABSTRACT
The purpose of the Quality Ship System is to establish a marine supervising management mechanism that is a combination of punishment and encouragement, positive and negative. In detail, it is to establish an inspection evaluation system, a hierarchical rewards and punishment system based on the innovation of modern controlling theory, by bringing into full play the advantages and functions of the Diagnostic Controlling System, the Trust Controlling System, the Forbidden Zone Controlling System and the Interactive Controlling System, so as to perfect the existing ship safety and supervision system.

In view of this, the essay analyzes the problems in present safety inspections, compares four different management controlling systems, then examines detailed descriptions on the systematic structure and the implement steps of Design of the Quality Ship System and Model for the Ship Safety Control.

1. Introduction

The severe marine disaster of the Chinese Ro-Ro Ferry in the Bohai Bay in China has not only aroused the astonishment of both domestic and overseas shipping industry, but also brought more concerns on the problems of safety management to Chinese maritime Industry. In recent years, although various measures have been taken by the executive and supervision departments of the Ministry of Communications maritime undertakings in China, maritime safety is far from satisfactory. There still remain many hidden troubles of bottlenecks and disasters. Besides, frequent severe maritime disasters still occur. Tracing its sources, four basic reasons can be identified - the disregard of cognition; the disquieting shipping status; the comparatively low educational level of the staff; and the unsatisfactory management and supervision. Going deep into these four basic safety factors, some important insights can be obtained as follows:

1.1 A frequent mistake in the idealistic realization

The improvement of management calls for the prospective cost, or vice versa, the enhancement of safety management means an increasing cost to meet the needs of the basic assurance of safety. Hence there is a dialectical relationship between safety and cost. The safety of shipping may be reliably assured with the improvement of safety management and the increase of cost. However, the increase of cost does not mean safety follows an invariable linearity. In other words, the increasing cost may never avoid the occurrence of accidents. Obviously, there is a critical area between safety and cost, i.e., the optimal safety assurance with a reasonable cost. For maritime safety management, it is an optimal conjoined point for relevant governmental authorities, trade supervisors and maritime undertakings to try to find this optimal critical area (See Fig.1). Therefore, it is worthwhile to study how to bring the

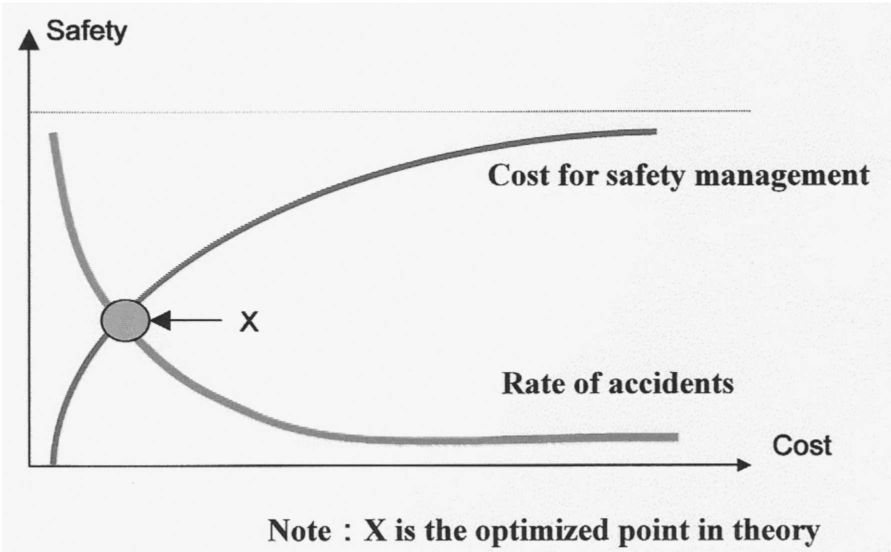

Fig 1 The relationship between cost for safety management and rate of accidents

enthusiasm of these three parties into full play and to exert necessary strong scientific managing methods.

1.2 Less strength and low efficiency of the safety inspections

Statistics shows that in 1999, 903 maritime accidents occurred in China, resulting in direct economic losses of 200 million Chinese Yuan (24 million USD). But how are safety inspections? The following statistics in 1999 can be referred to:

- Ships entering Chinese ports were 381,070, and ships leaving were 381,085.
- Ships that received safety inspections numbered 6,713, which constituted 1.8% of the ships both arriving and departing.
- Ships detained were 74 which made up 0.03% of the ships both arriving and departing

It seems the detention rate is low and the safety status of shipping is not so serious. However, if compared with the serious maritime accidents of over 900 ships, far more than 74 ships have hidden troubles and potential defects.

Probing into the characteristics of the potential defects and the situation of different shipping companies, it can be identified that:

- The main defects are the fire control and life-saving equipment. Next, safety precautions, certificate, pollution prevention, equipment and the loadline, etc.
- Those ships that belong to local or individual companies have more safety defects than those, which belong to national main maritime undertakings.

Several speculations and insights may be drawn from the above analysis:

- Less potency of safety management. On one hand, due to unsatisfactory safety management, maritime accidents frequently occur. Hence shipping companies should exert more pressure on safety management; On the other hand, the unsatisfactory safety inspection quality enables ships that are not on target to pass the inspection easily.
- Low efficiency of safety management. On one hand, the number of ships engaging in marine transportation is increasing quickly with the rapid development of China's economy. Meanwhile the hidden safety troubles are ubiquitous,

which cries for the strengthening of self-construction and external supervision; On the other hand, the limited scale of maritime safety inspections and the linear distribution of inspection results are in a less wide context and of a low proportion. Furthermore, the very same operations without consideration of the previous status of the shipping companies and the safety of the ships cause a low efficiency of safety inspections. The quality of maritime safety management is thus affected.

Accordingly, it is a pressing and arduous task to bring into existence a new virtuous circle of maritime safety management in an environment with limited resources, in order to smoothly develop the national maritime industry and ensure maritime safety.

2. New Ideas on Maritime Safety Management

It is a new problem faced by modern management science and cybernetics, i.e., how to exert enough control in a flexible and innovative environment. For maritime undertakings, this depends on the enthusiasm shown by the shipping managers in the shipping transportation field that may deal with hundreds of millions Yuan. They should try to find opportunities and give reactions to ensure the soundness of both ship and freight thus providing the lowest transport cost and highest transport efficiency. As for the government and supervising organizations, the problem is how to enable the smooth development of maritime safety and the national maritime economy by exercising an active and reasonable administrative and economic leverage.

2.1 Diagnostic Controlling System

Based on the mechanical bureaucratic mechanism, the traditional Diagnostic Controlling System is to avoid the occurrence of accidents by constant supervision, i.e., to ensure the realization of the preconcerted aims by premeditated inspections or inspection processes. For example, the navigating officer on duty should keep the index mark of various devices on the bridge in order to catch sight of any abnormal signs and keep the main manipulated variable under preconcerted control. The other example is that the officers from the Maritime Safety Administration, when carrying out the safety inspection, may take the examination of the differences between the maritime safety standards and the actual conditions of the ship, and may meet the standards by requesting the ship operators to correct the defects. However, this kind of Diagnostic Controlling System is only one side of the coin. The efficiency and intensity of control may be affected in a wider controlling context, numerous controlling factors or a complicated controlling environment. Practices show that Diagnostic Controlling System is not sufficient for efficient control. On the contrary, the execution thereof may cause the failure of environmental control due to the heterogeneous controlling compressive force, and a crisis may even appear.

2.2 Trust Controlling System

The Trust Controlling System is an active controlling system based on the core-conception which takes advantage of the concise, revelatory, and valuable moral concept and brings into full play the internal impetus and the potential creativity, so as to ensure the orderliness of the organized activity. For example, the maritime supervising organization may encourage maritime undertakings to perform management conforming to safety requirements by establishing a series of policies and regulations. With all these rational policies and regulations, the maritime undertakings try to seek a standard of both safety and efficiency of ship operations and management. Obviously, without the Trust Controlling System, employees cannot understand the kernel of the management and its relative position in a big scale and slack organization. Certainly the Trust Controlling System cannot serve as an independent controlling system, but only as a supplement. However, if displayed rationally, it may play an especially important role.

2.3 Forbidden Zone Controlling System

The Forbidden Zone Controlling System is based on the principle of "Power of Negative Thinking". The idea of this control is to warn the employees what not to do or there will be severe effects if they do so. Generally, the government tends to establish a set of rules and regulations, which are the frame of the forbidden zone and those who violate the rules will be punished. Standard operation rules and manuals should be set up within the undertakings in order to instruct their employees that what they do could destroy the development and efficiency of the undertakings and what the severe results of safety accidents could be. Different from the Diagnostic Controlling System and the Trust Controlling System, the Forbidden Zone Controlling System is obviously based on the negative effects and the lowest standards. Besides, it adopts punishment as a controlling method. As Prof. Robert Simons from the Harvard Business School said, ***"…can never be understood as giving a blank check to the underling and then let them do as they want."*** the Forbidden Zone Controlling System can effectively control those who attempt to dabble with the rules in certain conditions. Practices prove that an organic combination of the Forbidden Zone Controlling System and the Trust Controlling System can create an aggregation of the positive side and the negative side of dynamic pressure, thus creating a bi-directional dynamic pressure mechanism of both stimulus and punishment by the cold, darkness-limited negative pressure.

2.4 Interactive Controlling System

The Interactive Controlling System is an active controlling pattern based on mutual trust, intercommunication, co-action, and co-determination. With the extension of the maritime administration and the reinforcement of such a management, the absence of communication and co-action between the government and the undertakings may make safety management and supervision weak and powerless. The advantages of the Interactive Controlling System over the Diagnostic Controlling System are as follows:

- Various beneficial channels are established to remind the maritime administrators and operators of the undertakings of the new changes taking place in the safety production;
- Thanks to the active environment of co-action, great importance has been attached to the important information by maritime administrations, thus the undertakings may take active methods more voluntary to

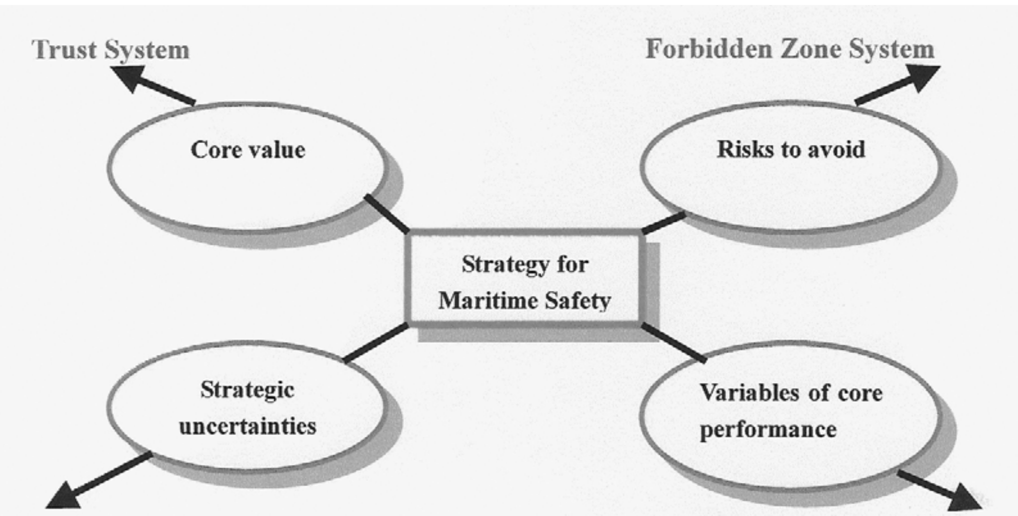

Fig 2. Strategic combination of four systems

ensure the safety at sea.
- Co-action communication is helpful for mutual understandings.

On the whole, an organic combination of these four controlling systems will definitely have a remarkable effect: The Diagnostic Controlling System ensures the realization of those important aims by controlling the variables of the core performance effectively. The Trust controlling system, by establishing the core-conception, passes the authority on to the "to be controlled" to encourage operators to self-inspire and innovate in management, thus the object may exert more potential to ensure the realization of the aims. The Forbidden Zone Controlling System avoids accidents and sets up a prediction of punishment by nailing down the rules and regulations. Lastly the Interactive Controlling System is helpful to establish a real information communication and find out the unknown field of the strategic decision-making so as to make appropriate compensation for the uncertainty of the strategy. The relationships between them are as in Fig 2

Existing maritime safety management and supervision is based on a combination of the traditional Diagnostic Controlling System and the Forbidden Zone Controlling System. It performed irreplaceable functions in the past. However, despite the efforts of shipping companies and the history of the safety of different ships, using all the same procedural practices and pre-arranged checks will, on the one hand, limit the thoroughness and deepness of the checks. Therefore, it will eliminate as well the activeness of those ships with a good reputation on the safety and operation, and those ships may have the regret of being tied together with those unqualified ships.

3. The Framework of the Quality Ship System

In order to strengthen supervision over the ships in respect of equipment and crewmembers, to ensure the safety of lives and possessions and to avoid the pollution of the sea, the Maritime Safety Administration (MSA) P.R.C established the *Rules on Ship Safety Inspection of PRC (1997)* in light of relevant International Conventions and the relevant clauses incorporated into the Tokyo Memorandum of Understandings (MOU). According to the rules, all the Chinese sea-going ships which have gross tonnage over 200 tons or main engine power over 750kw, inland waterway ships which have gross tonnage over 50 tons or main engine power over 36.8kw, and all foreign ships arriving or departing Chinese ports should receive safety inspections. The maximum frequency of such an inspection is six months, except those passenger ships, ro/ro vessels, bulk ships, crude oil carriers, LPG carriers, chemicals in bulk vessels and other carriers designed and used for special needs. The inspectors of MSA carry out inspections using 16 aspects of the rules. Once defects are found, the inspectors shall take necessary measures; for instance requesting in-port corrections for those defects, or detaining the ship.

Obviously this inspection and supervision system is a combination of the traditional Diagnostic Controlling System and the Forbidden Zone Controlling System. Communication between the inspectors and the party to be inspected is basically inactive and unilateral, from the inspectors to the party to be inspected. In such a system, the party to be inspected will always have a regular tendency of being inspected and lack of enough enthusiasm; and the control or punishment is negative.

The System of Quality Ship is to establish a marine supervising management mechanism that is a combination of punishment and encouragement, of positive and negative. In detail, it is about the establishment of an inspection evaluation system, a hierarchical reward and punishment system based on the innovation of modern controlling theory, by bringing into full play the advantages and functions of the Diagnostic Controlling System, the Trust Controlling System, the

Forbidden Zone Controlling System, and the Interactive Controlling System. The existing ship safety and supervision system can thus be promoted.

3.1 The Criteria of Quality Ship

The Quality Ship System means that in a well-functioning shipping company its underling ships are certified to have conformed to the safety standards, to have provided good shipping management records and to have been approved by the maritime supervising organizations. Therefore, the Quality Ship System requires maritime supervising organizations to establish uniform safety standards according to the particular requirements of International Conventions, national maritime laws and regulations and the general public. The following indexes should be taken into account as to how to establish such safety standards:

- During the past three years ships haven't been detained either in a domestic or foreign port by reason of non-conformity to the standards. (The reason why the period should be three years is that it is usually a statistical period in the international supervising and inspection system, and a comparatively long period is helpful for an unfeigned inspection of the ship's safety management level.)
- The ship has a good safety management system and has no record of violating the relevant prescriptions concerning maritime transportation safety.
- No severe marine accident was recorded in the past three years.
- The sailors have not, as individuals, any records of severe contraventions of safety regulations and other criminal records in the past three years.
- In the past three years, the shipping company has never appeared in the blacklist of the Port State Control (PSC) inspection, or the detention rate of the company is higher than the average rate of the previous three years.
- In a certain period of time (e.g. one year), the accumulative integral of the defects inspected in safety inspections does not exceed the stated accumulative integral by the Quality Ship System.

The above-mentioned indexes are all impersonal except the last one, which decides whether it accords with the qualifications. The last index is a variable beta function of integrated safety factors and it must be measured and accumulated by using a normative index system with appropriate weight co-efficiency, so as to take the quantified value out.

3.2 The Evaluation System of the Quality Ship System (Ship Safety Performance and Defect Index System)

The evaluation system of the Quality Ship System may use the hierarchy analytical method of the management study by regarding the above six basic indexes as factors on the first grade. Factors that can be logically estimated should not have the secondary index. As for the sixth index, a secondary index and even a tertiary one should be set in order to fix upon the quantified value. The index

A1	Detention of the ship
A2	Violation of the safety rules
A3	Maritime accident
A4	Violation of the safety management regulation as individual
A5	The resort rate of the shipping company
A6	The accumulative integral of defects

Table-1. The index system of the evaluation system of the Quality Ship on the first grade (Ship Safety Performance and Defect Index System)

The accumulative integral of defects (A6) can be further divided into the secondary and tertiary index according to the needs. According to *The Rules on Safety Inspection, 1997*, 16 secondary indexes can be set. (See table-2) Every secondary index may be followed by relevant tertiary index(C) in order to describe the meanings of the secondary index in details.

3.3 The Mathematic Model of the Valuation System of Quality Ship

A conclusion can be made from the characteristics of the above indexing system. That is, the valuation system of Quality Ship is a system made by the combination of the logical estimation grade (the first grade index A) and a series of hierarchy distributions (A6).

A6	B61 * W61	Ship's certificates and the relevant files and documents
	B62 * W62	Crew and equipment
	B63 * W63	Life-Saving Appliances
	B64 * W64	Fire fighting equipment
	B65 * W65	Presentations against accidents
	B66 * W66	Generic safety precautions
	B67 * W67	Alarm equipment
	B68 * W68	Stowage of goods and loading and unloading equipment
	B69 * W69	Loadline
	B610 * W610	Mooring equipment
	B611 * W611	Propelling and auxiliary machinery
	B612 * W712	Navigation equipment
	B613 * W613	Radio equipment
	B614 * W614	Anti-pollution equipment
	B615 * W615	Loading and unloading equipment of liquid goods
	B616 * W616	Relevant equipment of the post and manipulation ability of the crew

Table-2 The secondary indexes

B61	Ship's certificates and the relevant files and documents	C611 * W611	Nationality certificate
		C612 * W612	Copy of DOC
		C613 * W613	Ship's survey certificate
		C614 * W614	Certificate of minimum manning
		C615 * W615	Documents relating to the reliability and insurance of the oil pollution
		C616 * W616	Certificate of safe operation for high speed craft
		C617 * W617	Related documents, manual, instructions and materials
		C618 * W618	Inspection book of the cargo handling facilities
		C619 * W619	Ship endorsements
		C6110 * W6110	Ship Log and legal records

Table-3 The Tertiary indexes

The Quality Ship may be demonstrated by the following formula:

$$\mathbf{QS = — A_i}$$

The accumulative integral of the defects (A6) may be demonstrated as follows:

$$\begin{aligned}\mathbf{A6} &= \mathbf{B_{61} W_{61} + B_{62} W_{62} + \ldots\ldots + B_{615} W_{615} + A_{616} W_{616}} \\ &= \mathbf{B_{61} (\sum B_i W_i, \ \sum C_j W_j) W_1 + B_{62} (\sum B_i W_i, \ \sum C_j W_j) W_{61} + \ldots\ldots +} \\ &\quad \mathbf{B_{615} (\sum B_i W_i, \ \sum C_j W_j) W_{615} + B_{616} (\sum B_i W_i, \ \sum C_j W_j) W_{616}}\end{aligned}$$

Notes:

B61…B616 Stands for the secondary index of the accumulative integral of the defects.
Cj Stands for the tertiary index
Wij Stands for the secondary or tertiary weight.

3.4 The Establishment and Application of the Weight of Index

The first five indexes in the first layer can be estimated directly by the accumulated historical data, so it is comparatively easy to get a conclusion. However, the sixth index in the first layer (the accumulative integral of the defects) must be inspected on the spot and reach the conclusion taking the accumulation of the historical data into account. A correct and just inspection is the key-point of defining a quality ship. Practice shows that the three layers of indexes involved by the accumulative integral of the defects is of a contribution to the degree, extension and effectiveness for a given period of time of the safety of ships. Hence it is of significance to define the degree of contribution (i.e. weight coefficient) scientifically and it will be helpful to decide the criteria of Quality Ship accurately.

Generally, the Analytic Hierarchy Process (AHP) can be used to decide the Weight Valuation Index System of a hierarchy, which was first put forward by the American scholar in management, T.L.Saaty (1980). Its basic principle is to establish a matrix by gathering all the factors in the hierarchy and the independent expert will compare one factor with the other according to the nature and characteristics of every factor. The comparison is a relatively important discriminant that is based on the uniform and hierarchised judgment model. The Weight decided by a group of independent experts in order to get the Weight of every factor should be averagely. Once the Weight of the factors on every grade is explicit, all that is required is to type into the computer to get the inspection results of the ship's safety factor.

3.5 The Evaluation Criterion of the Index Value

There must be a fair and objective evaluation criteria for every index value. The national maritime organization has in the past several years established a complete set of inspection rules and criteria of the ship safety factors. And the foundation of the PSC system serves as a base for the establishment of a uniform evaluation criterion. For example, the inspecting procedure of *Tokyo MOU* and *A Handbook of the Safety Inspection of Ships along the Coast* are both valuable normalized models.

3.6 An Assumption of the Application for Quality Ship System

The establishment of the Quality Ship System is a systemic project and the practice work should be based upon justice, clarity and efficiency.

First of all, relevant management rules and regulations should be established by the national maritime organizations in charge. The kernel of the rules and regulations is to establish the Quality Ship System so as to carry out the safety inspection more strictly and the reward and punishment more trenchantly. On the one hand, it can further strengthen the inspection, especially for those ships with an unqualified safety records and a lot of hidden troubles; on the other hand, by carrying out the reward and punishment, it may encourage those shipping companies with good safety records and wholesome management systems to retain top-quality safety management. Those shipping companies conforming to the standards of Quality Ship may get a Quality Ship certificate awarded by a certain national maritime organization. During the period of validity of the certificate, the quality ship may enjoy various favorable policies and treatment.

The quality ships authenticated by the strict evaluation system of Quality Ship may have wide applications. The four controlling levels may bring their functions into full play through the strengthening of the system. As for positive stimulations, at least the following three can be done:

- Publicize in an open publication; for example publish in a newspaper or publicize on the Internet so as to encourage the Quality Ship to persist in good safety management. It has been already done in Europe.

- Trust those ships in the period of validity of the certificate so as to encourage the administrators to take measures to increase the efficiency of safety production.
- Encourage ports to give favorable treatment to the Quality Ship upon arrival, carrying out the operation and other relevant tasks and even provide a preferential price. That favorable treatment has been done in some countries and regions recently.

As for the punishment, those nonstandard ships (once been detained), or ships with a bad safety record or with accumulated defects lower than that of normal ships shall be punished so as to help the shipping company correct the defects. Based on the safety records, the ship's previous inspection notes and the accumulated integral defects, the following measures may be put into effect:

- Circulate a notice of criticism as a kind of warning for those ships.
- Increase the frequency of inspection, following a strict verification and monitoring in the network;
- Place necessary restrictive measures on the marine navigation;
- Institute necessary economic punishments.

4. The National Examiner System for Maritime Safety

The realization of the Quality Ship System calls for a group of examiners of high accomplishment who may conduct the inspection impersonally and justly. The construction of the maritime tipstaff should not only strengthen the leadership and management but also concentrate efforts on rules and regulations. China should construct a group of specialized maritime examiners of high accomplishment by using the popular international practices for reference. A national maritime examination system should be established through legislation and the establishment of relevant laws and regulations. These regulations nail down the education and training of the examiners, professional standards, the retraining system, the method of examination and the awarding of certificates. In the concrete, the maritime examiners should receive strict training recognized by the national government. The professional standards mean that the examiners should be competent for every professional level concerning the maritime inspections. For instance, necessary professional knowledge, experience at sea, practices of maritime inspection and upstanding professional ethics. The qualification of holding an office should be conferred through a special authorization procedure, thus the examiner may get a certificate of competence of maritime examiners. As for the management of the maritime examiners, firstly there should be a timely refreshment of knowledge and improvement of ability. Secondly, there should be a strict set of management systems including measures of reward and punishment.

5. The feasibility of the Quality Ship System and its Possible Problems

Although the Quality Ship System is a huge systematic Engineering, it is feasible with the establishment of China's maritime management system and its managing group with high ability, as well as improvement in the safety management of shipping undertakings.

The establishment of the Quality Ship System calls for the accumulation, transaction and exchange of a great amount of safety data. The data processing of computers and the development of modern communication technologies create the basic conditions for the establishment of the Quality Ship System.

The establishment and development of PSC system form an international recognizing index connotation for the establishment of the ideal model of the Quality Ship System, thus providing a universal criteria and evaluation method for the objective and just evaluation of the safety condition of ships.

The Quality Ship System should be constructed on the basis of a group of maritime examiners with comparatively high managerial ability. Therefore, the establishment of a group of maritime examiners with high accomplishment is not only the need of the national maritime safety management, but also necessary to create foundations for the establishment of a Quality Ship System.

According to the requirement of the "*Year of Safety Management of Marine Transport*" put forward by the Ministry of Communications, this is suggested to enhance the science and validity of maritime safety management. The Quality Ship System is an important embodiment of the science and validity of the maritime safety management. The Quality Ship System may be not only carried out on the ocean-going vessels, and also then extended to coastal and inland water vessels. Meanwhile, evaluating the experiences and lessons constantly is required to perfect the Quality Ship System.

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BIOGRAPHY

On the quality ship system for safety inspection

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Professor Gao De Yi graduated from the World Maritime University (Sweden), and is the vice-president of the Shanghai Maritime University. His specialty is maritime policy, maritime education and training, and maritime safety management.

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He also works for many international maritime organizations. He is one of the experts of IMO for technical consultancy and verification, the secretary of the International Maritime Lecturer's Association, member of maritime safety standard committee of the Ministry of Communication of China, etc.

Safety Culture in International Maritime Legislation

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Student Presentation

SUMMARY

Since the mid 1990's, the idea of a safety culture has not only taken effect, but indeed precedence, in international maritime environmental and safety legislation. A safety culture means that safe and proper methods of shipping and doing business in the maritime industry are not only economical, but a way of life. This idea is actually revolutionary in international maritime regulations, for this means that all parties and people are responsible for any casualties or accidents in shipping.

Realizing that transportation by oceangoing ships will continue to be a method of international trade for many years, regulatory bodies were set up to create and uphold standards for this industry. In the past few years, however, it has been realized that it is very difficult for companies and countries to adhere to all standards set by the IMO. A trend that has arisen is to make regulations more uniform worldwide. The driving force behind this new idea is the safety culture.

A new example of this is the Voluntary IMO Member State Audit Scheme, which has already been adopted by the 23rd IMO Assembly in 2003. This resolution is also known as A.946(23). The interesting aspect of this is that member states of the IMO voluntarily adhere to this policy of the IMO, which will provide them with advice on how to better their performance of safety for both the seafarer and the environment. This is the new way that international regulations are taking: countries have to take the initiative and implement greater standards. Companies are also taking this point of view, especially since it is much more expensive to deal with a casualty situation than to take preemptive measures of avoidance.

Another example of the safety culture taking effect is the new IMDG code becoming mandatory. This code was amended to SOLAS in January of 2004, and makes uniform global regulation of the shipping of dangerous goods. It regards packing, marking, labeling, storage, and segregation of dangerous goods.

There are other examples of the safety culture beginning to seriously become a driving force in international maritime legislature and regulations. Especially with terrorism becoming a grave concern, port state authority and security is strengthening. Classification

societies, such as Det Norske Veritas, are also beginning to implement new, uniform, and global standards in their regulations.

It is clear that the only way for international shipping governing councils and bodies to have successful implementation and realization of their goals is the work in uniform and a "safety culture" type of mentality with their member states, and training institutions.

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Identification and Inclusion of Shore-based and Near shore Activities associated with Maritime Operations into the Maritime Safety Management System (MSMS)

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Student Presentation

SUMMARY

The primary objective of this study is to identify all shore-based and near shore activities, which are associated with maritime operation, and to codify them into a Maritime Safety Management System (MSMS). This is the attempt to extend the currently existing ISM Code in order to complete the safety net in the maritime industry for the sake of ''safer shipping and cleaner oceans''.

The study is conducted through six stages with six reports as the outputs. The objectives of the first report, which was already completed, are to identify all shore-based and near-shore activities that are associated with maritime safety management system as well as other elements of the MSMS. These elements are named as main players in the shore-based and near shore activities, safety-related relationships among these players, key safety issues, related risks associated with these issues and contents and requirements for a good maritime safety plan. In order to produce the first report, a Focus Group interview was conducted with the participation of maritime professionals in Australia and New Zealand.

The first report of this study reveals important findings, as illustrated in the figure in the following page. These findings are essential since they provide a clear picture of how the MSMS is effectively constructed. They are also the background for further refinement of the study in the subsequent reports, where all elements of the MSMS are analysed and codified.

FOCUS GROUP PERCEPTIONS ON MSMS

MSMS

Activities

- Safe channel & basin management
- Pilotage
- Tug & towage
- Aids to navigation
- Stevedoring (cargo handling in all operation systems within port & terminal area)
- Ship berthing/unberthing
- VTS/AIS & general waterway management
- Port emergencies response
- Marine environmental management
- Shore-based security
- Ballast water exchange
- Safety surveying & consultancy

Main players

- Port authorities/Harbour Masters
- Port & terminal operators/Stevedoring companies
- Pilots
- Tug & towage providers
- VTS managers
- Marine surveyors & consultants
- Marine environmental managers
- Port worker union
- Independent contractors (mooring, security…)
- Regional councils
- Fishing industry
- Ship agencies

Safety-related Relationships

INTERNAL VS EXTERNAL

INTERNAL
- Pilot & Master/ship officers
- Master & Ship officers and Master/ship officers & crew

EXTERNAL
- Players onboard & port staff
- Players onboard & tugs
- Players onboard & VTS
- Players onboard & Harbour Master
- Port staff & independent contractors & visitors

OPERATIONAL VS MANAGEMENT LEVEL

OPERATIONAL LEVEL
- Operational staff

MANAGEMENT LEVEL
- Regulators/peak bodies

Key issues

- Role & commitment from senior management
- Paradigm shift and inclusion of the 'safety culture'
- Effective communication
- Commerciality versus safety
- Consistency of regulations & requirements
- Appropriate & workable legislation/working procedures involving safety

Related risks

- Over abundance of safety planning but ineffective implementation/monitoring
- Over reliance on paperwork
- Safety system being onerous
- Non-compliance culture/increased operating costs
- Unilateral approach towards safety
- Over focus on commerciality

Contents & requirements

CONTENTS
- Standards of operating systems for day-to-day operations
- Standards of emergencies responses procedures
- Environmental management plan
- OH & S management plan
- Security management plan

REQUIREMENTS
- Inculcation of 'safety culture'
- Recognition of the inevitability of operational errors & establishment of defences
- Accountability of management
- Employees' involvement
- Risk identification & reporting procedures
- Clear, concise, simple & appropriate procedures involvement risks control
- Simple & functional standards of operating procedures
- Procedures documented & training provided
- Concise deliverables & objectives
- Measurable, auditable & manageable outcomes/non-conformity
- Being legislative supported

The Likely Effects of ISPS Code on Turkish Shipping Industry

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Student Presentation

SUMMARY

The recent technological, social and economic changes in world trade have brought about various threats to the shipping industry. Such threats have involved the security issues as well. Although the security threats encountered in the 90's were almost the same as the ones in the 2000's, since then they have especially increased more and more, due to the recently rising terrorism. In fact the terrorist attacks suffered throughout the world history have caused a danger for the future. Thus various effortful struggles to solve such a critical problem have been adopted. The triggering event urging such proactive measures occurred in the USA on September 11, 2001. The mentioned tragic event, affected the shipping industry as a whole.

Hence the concept of the security has been considered as a serious problem all over the world. The first step taken towards the solution to this problem has been to identify the deficiencies in the procedures related with the security matters at ports, ships and shipping companies. From this point on the developments in ship designs, company policies, port facilities as well as super and infrastructure has become inevitable. In compliance with this requirement, IMO adopted ISPS Code to be implemented onward July 1, 2004. The purpose of this adoption was to correct and complete the missing points in the existing conventions regarding security.

This project aims at discussing organizational, financial, legal effects of ISPS Code on ships, ports and shipping companies in Turkey. The requirements of this code are of great importance for the security of the Turkish Ports and the ships calling these ports. First of all, the number of tourists to visit Turkey will increase in near future and this could mean that a lot of cruise ships are likely to call at Turkish Ports besides the Turkish straits, the strait of Istanbul and the strait of Çanakkale and encounter intensive ship traffic has a geopolitical position of great importance due to its function of linking the chaotic territories. Furthermore, the flow of container traffic is increasing in Turkey, so security measures are to be taken. Such major issues, however, are most likely to slow down the handling operations, which will in turn affect the parties and the Turkish economy as well. Moreover, the new restrictions of ISPS Code, the probability of detention of Turkish ships can be increased, which might bring about further impacts in Turkish foreign trade and the transit callings through Turkish waters.

Additionally, ISPS Code has a vital importance for the security of the hub storages of all Turkey's energy, which is mostly imported and stored at a few strategic points. In addition to these, as most of the ports are not specialized in any specific port service, instead providing integrated port services, taking security measures at these ports seems to be a challenge. The ISPS Code requirements are likely to affect the users of these ports.

These are some of the apparent prepositions regarding the likely effects of ISPS Code requirements on Turkish shipping industry. Through the method used for this study, more concrete views are expected to be gathered. The methods used in this study will cover interviews with the authorities of the relevant private or state shipping organizations such as ports, shippers, carriers and insurance companies, the governmental bodies and maritime related.

Methodical Experiences Gained During The Implementation Of Simulator Based Training Of Turkish VTS Operators

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ABSTRACT

The Turkish VTS System became operational for the Straits of Istanbul and Canakkale in December 2003. The Maritime Faculty of Istanbul Technical University (ITUMF) was appointed as the Training Institute for newly employed VTS Operators by Turkish Competent Authority. Pilots, nautical experts, hydrographers, salvage and legal experts have been closely consulted by the ITUMF, which has designed all the courses. ITUMF has also carried out the required training, using its own VTS and bridge simulators. All training courses for Turkish Straits-VTS personnel were based on IMO VTS Guidelines and VTS Manual of the International Association of Lighthouse Authorities.

This paper discusses experiences with process of simulator-based training of Turkish VTS Operators. The main parts of the paper cover in particular the following aspects:

- a brief description of the ‘operational framework’ of Turkish Straits VTS organization
- definition of training objectives and course development for VTS operators
- the design of effective VTS simulator Exercise
- differences between VTS simulator training and nautical simulator training
- evaluation of VTS operators (short time memory tests and eye mark movement records)
- feedback from VTS users in Turkish Straits

1. Introduction

Vessel Traffic Services (VTS) are shore-side systems that range from the provision of simple navigational information messages to ships (such as position of other traffic or meteorological warnings) to extensive management of traffic within a port or waterway. The International Convention for the Safety of Life at Sea (SOLAS) Chapter V on Safety of Navigation was adopted in December 2000, and entered into force on 1 July 2002. Regulation 12, Vessel Traffic Services states: “Vessel traffic services (VTS) contribute to safety of life at sea, safety and efficiency of navigation and protection of the marine environment, adjacent shore areas, work sites and offshore installations from possible adverse effects of maritime traffic”.International Association of Lighthouse Authorities (IALA) is a non-governmental association that brings together services and organizations concerned with the provision, maintenance and operation of marine aids to navigation. IALA cooperates closely with the IMO and International Telecommunication Union (ITU), which are both specialist agencies of the United Nations with regulatory powers. It was the IALA that took on the task of specifying VTS standards, and 1997 IMO adopted Resolution A.857(20) concerning the qualification of VTS operators. One of the objectives of the IMO Resolution A.857(20) is that; "The governments and authorities will need to establish a logical process for selecting and training of VTS operators in order to fulfill these requirements." The purpose of the IALA-Model Courses (V-103) is to provide a template against which training institutes are able to develop their training Programs for approval by National Competent Authorities. (IALA, 1998).

The concept of VTS has gained acceptance by Turkish Government as a means of advancing navigational safety by reducing the number and severity of vessel casualties in the Turkish Straits. The Under secretariat of Maritime Affairs of Turkey initiated to set up the VTS project in 1999. The Turkish Straits VTS (TS-VTS) was delivered to the under secretariat of Maritime Affairs on July 1st 2003, which is Turkish Cabotage and National Maritime day. Since then a number of acceptance tests had to be performed and the on the job training of all operators were carried out as a result of which TS-VTS became operational on 1st January 2004. The training of operators and supervisors was carried out by Istanbul Technical University, Maritime Faculty at Tuzla according to all International Regulations of IMO and Recommendations of IALA. The author of this paper has been involved in this training to a very large extent.

2. Operational Framework of the New VTS in the Turkish Straits

2.1 Characteristics of the Turkish Straits

The European and Asian part of Turkey is divided by a complex waterway that connects the Black Sea to the Sea of Marmara and the Aegean Sea, which leads to, Mediterranean Sea and the rest of the World. From the Black Sea to the Aegean Sea there is not any alternative route for shipping except passing through the Turkish Straits. The total length of Turkish Straits and Marmara Sea is 164 n. miles from the southern entrance of the Strait of Çanakkale to the northern exit of the Strait of Istanbul (Fig. 1).

These narrow and sharp waterways have difficulties and are dangerous while currents are 5-8 knots for the big vessels passage. Several sharp turns have to be executed under the influence of strong currents, counter-currents and crosscurrents. The Straits witnessed two major tanker accidents

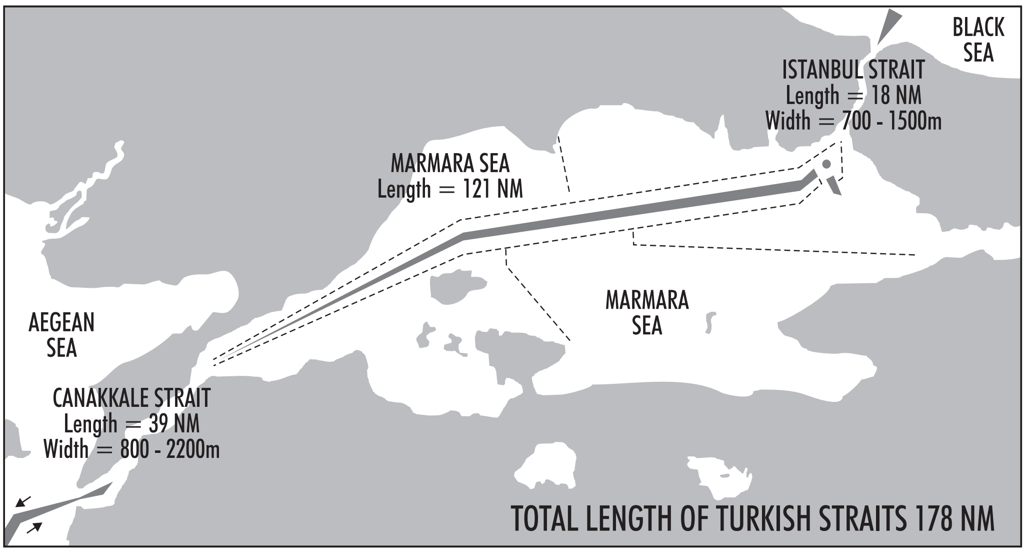

Figure.1 The Turkish Straits

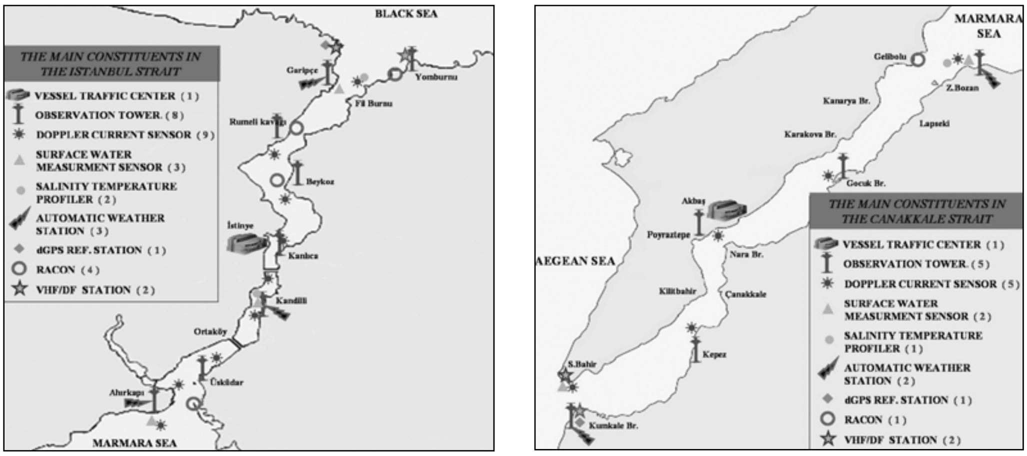

Figure 2: The Hardware for the Istanbul and Canakkale area

resulting in 125.000 tons of oil spilling into the sea during last decade. Based on a geometrical vessel casualty probability model which has been applied for 10 years specific real vessel casualty rates of ships shows the future casualty rate in the Istanbul strait to be 42 vessel collision and 37 grounding per 100,000 vessel transits. It is an established fact that the Turkish Straits are one of the most hazardous, crowded, difficult and potentially dangerous waterways in the world for marine traffic and consequently for the people living its borders. (Poyraz, 1999).

In 1994 Traffic Separation Schemes were also established in the Straits. These schemes have been adopted by IMO so that vessels using them must comply with Rule 10 of Collision Regulation. Since the introduction of the new rules in 1994 there has been a significant reduction in the number of the casualties occurring within the region.

2.2 Elements of the TS-VTS

VTS's have been established in ports and approaches all over the Black Sea area. The latest VTS to become operational was the Turkish Straits VTS. The TS-VTS is operated in accordance with the Turkish Straits Maritime Traffic Regulations, as promulgated in the Official Gazette no.23515 of 6 November 1998 together with the IMO Resolutions A.857 (20) and A.827 (19). The VTS is set up according to all internationally approved IMO and IALA documents and provides three services according to IMO resolution A.857(20):

- Information Service
- Navigational Assistance Service
- Traffic Organization Service

The TS-VTS covers two areas:

- Istanbul Strait plus northern and southern approaches
- Canakkale Strait plus northern and southern approaches.

Presently there are two VTS centers: Istanbul VTS center and Canakkale VTS center. At a later stage the Marmara Sea will be added to the VTS. It is expected that there will be two sectors in the Marmara Sea. The system is based on the various radar sensors, but more input to the system is provided via CCTV, AIS i.e. the various pieces of hardware for the Istanbul and Canakkale area are shown in Figure 2. The Straits are monitored 24 hours day from a single center in each strait. (Manual TS-VTS, 2003).

2.3 Authorities' Role and Manning of the TS-VTS

The Minister of Transport of the Turkish Republic is the Competent Authority of the VTS, while the General Manager of Coastal Safety and Salvage Administration (CSSA) is the VTS Authority. IALA Model Courses -V 103 are designed to foster universally common standards of training. They provide a basis for national VTS authority and training institutions to design and authorize the courses that they wish to offer to potential candidates.

A Department Head manages each TS-VTS Center. The Head of the VTS Department is responsible for the working schedules, vacations, substitutes in case of illness as well as the training of future operators. The VTS-supervisors are responsible for the work that is carried out by the operators. The VTS supervisors are responsible for the watches in the VTS Center to be carried out according to the internal procedures and any rules and regulations made by the Competent Authority and/or the VTS Authority or his/her substitute.
The Turkish Government decided that the operators of the TS-VTS should have the highest possible nautical qualification: master mariner. New personnel were recruited from the pool of Captains. In total, 80 operators are working in the VTS-Cs. TS-VTS- Centers provide a 24 hours duty with 2 watches, each 12 hours. In principle, the operators work behind the radar screen for not more than 2 hours in a row and are then relieved of duty by a colleague. During the 2 hours when they are not behind a radar screen, they are occupied with other non-radar related tasks.

3. Training of Turkish VTS Operators

3.1 Train the Trainer Program

In 2002, the work group 'Training of VTS Personnel' was founded in Istanbul Technical University- Maritime Faculty (ITUMF). The task of this work group was to develop a concept for position, tasks and training of future instructors. In the first phase, a special Train the trainer program was developed for a selected group of persons who would be involved in the actual training of the candidate VTS Operators for the new VTS in the Turkish Straits. A group of six people, four ITUMF lecturers and two future managers of the TS-VTS, accomplished this "Train the Trainer Program" in Maritime Simulation Rotterdam B.V. (MSR) to prepare them for their future job as VTS-trainers.

3.2 Accreditation of ITUMF as VTS Training Institute

One of the functions of the Competent Authority pursuant to IALA Recommendation V-103 is to

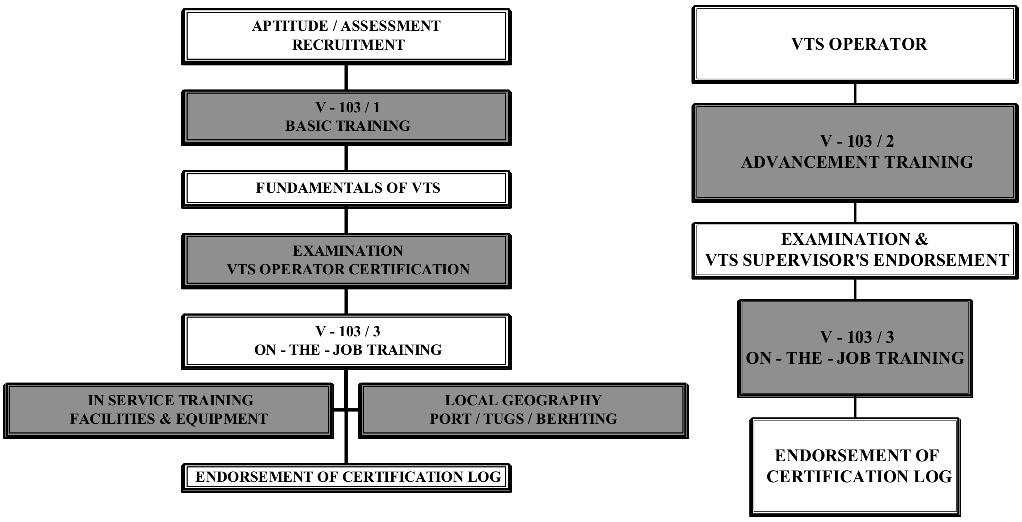

Figure 3: the Training Modules of the TS-VTS Operators

accredit VTS- training institutes. The aim of the IALA VTS Training Institute Accreditation Guidelines is to ensure conformance to the pertinent requirements of IALA Recommendation V-103, “Recommendation on Standards for Training and Certification of VTS Personnel” as applied to the provision of training for qualification of VTS Operators, VTS Supervisors and VTS Managers.

VTS Training Institutes that comply with IALA- Guidelines may receive a “Certificate of Conformity with IALA Recommendation V-103” issued by the Competent Authority of the country in which the VTS Training Institute is located, provided the organization responsible for the Competent Authority is a Member of IALA. The Figure 3 gives a summary of the different training modules within the framework of the TS-VTS training concept.

In this context, the Ministry of Transportation appointed the Coastal Safety and Salvage Administration for performing a formal accreditation assessment process. On 1 February 2003 ITUMF has been accredited by the Competent Authority based on the guidelines provided by IALA. However, Maritime Simulation Rotterdam (MSR) was formally requested to conduct the IALA accreditation process for ITU-MF on behalf of the Turkish Government.

3.3 Objectives of the Training and Task Analysis

In Turkish case, the operators and supervisors of this VTS are all master mariners. This was a choice of the Turkish Government that would shorten the training period considerably and increase automatically the mutual trust between the VTS and its customers. A very important item is also the acceptance of a VTS by the shipmaster and officers. However if his training is at least at the same level of a master, then a situation of mutual trust is easily established. But a VTS operator should never consider himself to be conducting the vessel; that is the task of the master.

At the beginning of the planning and preparation phase, the advantages and disadvantages of training master mariners as VTS operators and VTS supervisors became clear very quickly.
The advantages of this kind of training were:

- relatively short training period and low training costs for the VTS Authority
- customer-oriented view of VTS operators
- rather homogenous maritime experience of the candidates (easy to understand the maritime traffic risks)

The disadvantages were, in particular:

- inhomogeneous age spectrum
- low job satisfaction and less motivation of VTS operators
- prior learning of theory knowledge took place several years ago

A number of different organizations and organizational units such as Coastal Safety and Salvage Administration, agents, pilots, P&I Club representatives, maritime lawyers, coast guard officers were engaged in the planning, organization and implementation of VTS training.

This group of people prepared the curriculum for the theoretical part of the basic course. To make clear the level of knowledge and capability a person must possess to perform properly in his/her function or task; the working group executed a "Didactic Task Analysis"(DTA). DTA is the fundamental basis for a functional or task oriented training. Within the stipulated field of knowledge, a connection is made between the level of required Attitude, Skill and Knowledge (ASK methodology). This DTA reflects the IALA Recommendations V-103. At the end of the task analysis, the working group decided that objectives of VTS trainings rely on a proper interpretation of the radar image, correct identification of the traffic, and an adequate use of both radio communication procedures and standardized Maritime English with regard to internal and

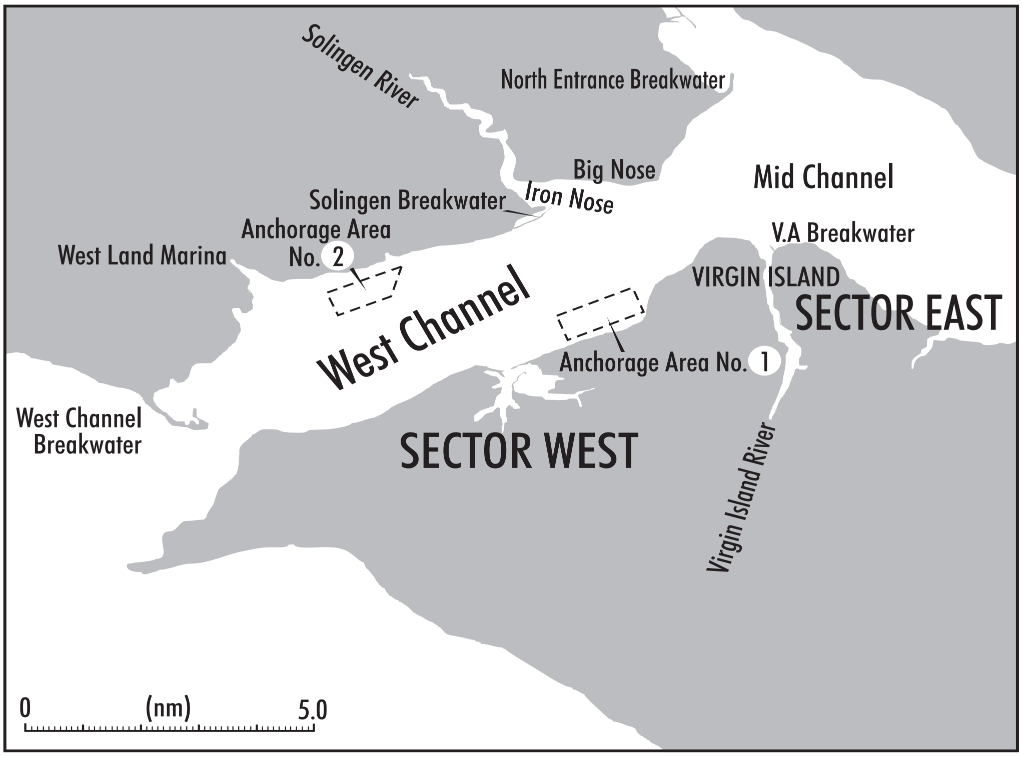

Figure 4: All scenarios were based on this generic area

external procedures of the TS-VTS. (Poyraz and Van t'Padje 2004)

3.4 Use of Simulators

IALA Recommendation V-103 on "Standards for Training and Certification of VTS Personnel" and its associated model courses, refer to the need for simulated training exercises in addition to lecture room presentations. Therefore ITUMF has carried out the required training, using its own VTS and bridge simulators.

The development of the simulator scenarios was the core task of instructors. As a result of the training objectives derived from the DTA and V-103, the development of training scenarios for the practical part on the VTS simulator was started. The ITUMF- VTS simulator is designed to train personnel in handling shore-based ship radio communication services as well as using radar and communication equipment by means of a computer simulation system. The simulator consists of three stations for the instructors/ship-operators by making use of parts of the radar simulators, three stations for trainees, one debriefing station stations. The stations for instructor/ship-operators and trainees are equipped with all essential radar, geographical electronic maps and communication means required to fulfill the training objectives. The instructors were able to train the operators in a one-to-one situation (1 instructor for 1 trainee). This set up was chosen to optimize the interaction between the student and the instructor, which results in a very steep learning curve. All scenarios were based on generic geographical area. Figure.4

The development of an exercise does not begin with the 'programming phase' at the simulator; instead, a VTS exercise requires a complete 'development process'. Therefore a collection of scenarios developed in the form of the 'building blocks' for future simulation exercises. Since the 'guest instructors', in most cases, did not take part in the development of the exercise itself, a comprehensive and standardized documentation of the exercise was provided. (Förster and Wismar, 2002)

Scenario	Training Objectives	Environment / Traffic
F	Familiarization equipment, topography of the area, message structure, standard communication procedures, using English language, take over shift, standard communication procedures (*SMCP-GENERAL*)	Good visibility 2 ships in the each sectors
1	standard phrases (*SMCP- VTS phrases, A1/6*), standard communication procedures, using English language, using message markers, using message markers, use of voice (*intonation*), radar observation	Good Visibility 4 ships in the each sector
2	standard phrases (*SMCP-external communication phrases, A1/1-A1/5*), standard phrases for identification, standard phrases for VTS sailing plans (link with MANOPS), combining traffic information, set/select priorities by radar observation, providing feedback (*is everybody informed?*), Handover procedures	Poor Visibility 4 ships in the each sector
3	Unknown vessels, vessels overtaking and approaching each other, passing/proceeding with caution and other arrangements, hydrological and meteorological reports, broadcast method and warnings	Good Visibility 5 ships in the each sector Diving operation by tugboat
4	Position information in latitude / longitude, position information in bearing/distance, position information relative to the fairway, position information including additional information, identification of targets	Good Visibility 5 ships in the each sector
5	Relay instruction from authority, Navigational Assistance Service, Instructions to vessels on the basis of rules and regulations	

Table 1. The List of Training Objectives of the Scenarios

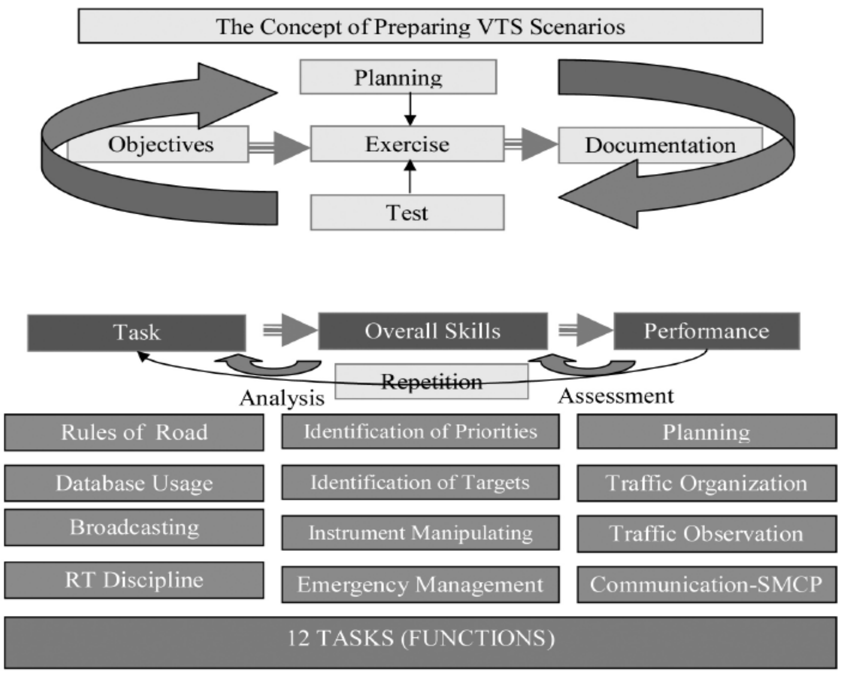

Figure 5: The Concept of Development of VTS Scenarios

As a result of above mentioned task analysis, the instructors created six scenarios. Events were planned in the scenarios to ensure all of the various tasks that were identified by Subject Matter Experts. Moreover, each task was developed into elemental techniques such as identification of targets, communication, instrument manipulating and etc. Figure 5. (Endo & Kobayashi, 2000)

Each simulator scenarios was prepared and validated based on concrete training objectives. For example, in the first scenario; the participants were given tuition on how and when to "Instruct", "Inform" and "Advice" vessels in an area, and the situations and the authority required for the different forms of assistance. In the fourth scenario VTS operators were trained on how to communicate effectively with ship officers for learning the ship's position in the VTS area. Table 1 shows the objectives of the scenarios

During the simulator training strong emphasize was laid on communication procedure. After the first draft of the Standard Maritime Communication Phrases (SMCP) was circulated by IMO as MSC Circular 794, relevant phrases have been incorporated into the syllabus used at the ITUMF for training TS-VTS Operators. A communicative approach or methodology, together with a VTS simulator was the main training tools used and these ensured that the phrases were taught in context with normal maritime operating procedures and practices.

More time was spent on the simulators, where most items learned could be practiced under almost real life circumstances. It might be interesting to mention that not only a VTS-simulator was used for training purposes, but also a full mission bridge-simulator. By doing this instructors were able to confront the shipmaster on the bridge-simulator with the behavior and attitude of the "VTS-operator". Once the shipmaster had to act as a VTS-operator he was very much aware that another attitude had to be adopted, as then he was "only" assisting in the decision making process on the bridge of the vessel concerned. This training combined with lectures about the possibilities of the VTS-operator to influence the decision making process in a pro-active way established a proper groundwork for the future. (Hofstee, 2004)

3.5 Assessment

All candidates were very motivated and enthusiastic. They worked hard to reach the required level of competence as stipulated in the objectives of the basic training for VTS Operator for the Turkish Straits. Without the dedication and enthusiasm of instruction team the candidates could never have reached this level in such a short time. Before and during training the operators were tested with regard to attitude and short-term memory capacity as well as their general proficiency in the English.

Before any test was administered, Instructors conducted a job analysis to identify the IALA requirements and operators' duties. Tests were chosen to measure aptitudes and abilities related to the jobs in VTS Centers. Assessment procedures were supported by the PC based software, which has been developed by our team.

The Instruction team provided a group of tests, which consist of cognitive, perceptual, and psychomotor ability tests, based on the result of this task analysis. Some of the tests are:

- Visual Pursuit Test: designed to measure the ability to make rapid scanning movements of the eyes without being distracted by other irrelevant visual stimulation.
- Verbal Reasoning Test; designed to measure the ability to analyze verbally stated facts and to make valid judgments on the basis of the logical implications of such facts; and thus, the ability to analyze available information in order to make practical decisions.
- Manual Speed and Accuracy Test: designed to measure the ability to

make rapid and precise movements with the hands and fingers. Also measures, according to the authors, the temperamental willingness to perform highly repetitive, routine, and monotonous work.

- Short-term Memory Test: A form of cognitive ability test that were exemplified by short-term memory tasks such as forward digit span and serial rote learning, which do not require mental manipulation of inputs in order to provide an output.

The aptitude of the TS-VTS operators can be divided into two stages: the expected attitude during the intake-process and observed aptitude during the training. When the training was started with various lectures, there were a number of future operators who had the idea that any training was hardly necessary for them. Within a period of two weeks, this attitude changed completely, especially once the training on the VTS-simulator started. In principal the aptitude observed during the training was in the majority of the cases high. Here we must stress that the debriefing should be more a kind of a moderated process, dealing not so much with 'right' or 'wrong' actions, but instead with 'possible' and 'good' actions. The performance of the trainee is evaluated by his/her peer group, while the instructor should play the role of the moderator in this process. (Förster and Wismar, 2002)

It might be interesting to mention that eye-movement recorder used in this field for first time, most notably scene perception and situation awareness, to study cognitive processing. The eye mark recorder is a head mounted, monocular eye tracking system that uses the corneal reflection method of tracking. The eye movement data of VTS operators will help us to understand how to maximize the efficiency of the human-machine interface. The result of this study could be the subject of an additional analysis.

4. Conclusion

The training of TS-VTS Operators was in most cases conducted on a "peer to peer" basis. By means of confronting the operator with his behavior on the two simulators (in one case as a shipmaster in control of his own vessel, and in the other case as a VTS-operator) we were able to make necessary adjustments quite naturally. The same was done during the lectures with regard to SMCP, procedures and liability aspects.

VTS simulation training shows that there are considerable differences between VTS simulator training and nautical simulator training. For VTS exercises there is a much higher need for the careful planning of the situation development over the whole run time. An 'effective' VTS scenario cannot be developed without careful planning. The development of an exercise does not begin with the 'programming phase' at the simulator; instead, a VTS exercise requires a complete 'development process. Learning objectives should be the 'starting point' of any exercise development.

Immediately after termination of a course the persons involved (lecturers, guest instructors, members of the work group) were requested to fill out questionnaires in which they could rate the training. On average all groups of training subjects score reasonably well. Definite conclusions with regard to the fact whether the operators and supervisors have been properly trained can only be established once the TS-VTS is operational for a specific amount of time.

Abbreviations

CSSA: Coastal Safety and Salvage Administration
DTA: Didactic Task Analysis
IALA: International Association of Lighthouse Authorities
ITU: International Telecommunication Union
ITUMF: Istanbul Technical University, Maritime Faculty
SMCP: Standard Maritime Communication Phrases
SOLAS: International Convention for the Safety of Life at Sea
TS: Turkish Straits
VTS: Vessel Traffic Services

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BIOGRAPHY

Methodical Experiences Gained During the Implementation of Simulator Based Training of Turkish VTS Operators

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Captain Dr. Özkan POYRAZ is currently the advisor to Undersecretary for Maritime Affairs in Turkey. He was previously employed by the Maritime Faculty of Istanbul Technical University (ITUMF) as the Director of the Simulators Centre. Dr. Poyraz holds a PhD in Maritime Transportation Engineering from Istanbul University in 1999 specializing in "Coastal Crisis Management Following Vessel Casualties and Application of this in the Turkish Straits". He also holds a Turkish Master Unlimited Certificate of Competency.

He has successfully completed the group-training course in Seafarer's Management System at Ministry of Transport, Maritime Technology and Safety Bureau and JICA in Japan (1997). Dr. POYRAZ has also successfully completed "the Ship Handling Practical Training Course for masters and chief mates of large ships" in Gdynia/Ilawa in Poland (1998) and VTS operator course at MSR in Holland (2002). He was a visiting scholar at U.S. Merchant Marine Academy.

Sea Service Equivalency For Full Mission Simulator Training

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ABSTRACT

The STCW 95 imposed a compulsory 12/6-month sea time service for deck/engineer cadets in order to be certified as Third Officers. All Maritime Authorities embraced this provision and put this stipulation in practice with no exceptions.

Computer technology and software capabilities have advanced 50 times over the state of art in 1995. This means that up-to-date full mission simulators can now (re)produce reality at least 15 to 20 times better than in 1995. As presented in the paper, the simulated bridges can include all modern navigation technologies; simulate all types of navigation conditions, breakdowns, emergencies, maritime areas and maneuvering situations.

On the other hand, the number of national flag vessels has decreased constantly, and year after year it is harder and harder to find owners willing to accept cadets on board their ships and able to organize an effective onboard training program.

We believe that the entire maritime academic community must begin sustained and focused actions to promote the official acceptance of simulator training as an equivalent for sea time service. A first step in this direction was already made by the United States Coast Guard (USCG), which grants a 1:6 ratio equivalency. IAMU has the power and duty to present such a point of view at the international level.

1. Introduction

Following the example of the aeronautic industry, the shipping industry made its first steps regarding maritime simulators in the early 80s. At that time, all the navigation equipment used for simulation was real equipment electrical and mechanical interconnected. The visual scene was very difficult to create and the movement of the ship was generated by mobile platforms. These two components entailed a lot of expensive equipment and space. Practically speaking, the owner of such a simulator first had to build a building large enough to accommodate the ship handling simulator components.

Consequently the costs were very high (millions of dollars) and no public or private maritime education institution could afford such an investment. Between 1980 and 1990, worldwide there were only a few ship handling simulation centers.

In the maritime education system, practical training was mainly based on training voyages onboard training ships owned by the maritime schools. At that time, the management and maintenance of a ship, even for a long period of time, was cheaper than a simulator. As a result, most of the maritime education institutions had their own training ship.

After 1990, this situation changed rapidly and dramatically under the pressure of three main factors:

- exponential development of computer capabilities;
- widespread usage of the Windows operation system;
- international regulation and constraints regarding ships' technical and personnel standards.

The first two factors lowered the maritime simulators price and increased their capabilities and performances. The third factor raised the running cost for training ship maintenance and implied substantial investments in new equipment, ship and crew management.

In addition, the STCW 95 provisions made compulsory the training of deck officers on radar simulators and underlined the importance of training using full mission simulators.

Statistics show that after 1995, the number of maritime simulators purchased by maritime education institutions increased rapidly and the number of traditional training ships decreased year after year.

2. State of art configuration for navigation simulators

From the beginning we have to underline that, in accordance with STCW requirements, the navigation training based on simulation is divided into two main parts:

- radar navigation and use of radar and ARPA;
- ship handling and bridge team management.

Starting from these training aspects, the navigation simulator market offers two main types of products:

- radar simulators;
- full mission ship handling simulators (FMSHS), also known as full mission bridge simulators (FMBS).

After 1997, simulator manufacturers used computer technology on a large scale in order to create virtual navigation equipment and ship handling controls. The main reason for this policy was the reduction of the price for the simulator systems and an easier way to reproduce all the parameters of the ships equipment using fully dedicated software. A combination of real equipment and virtual equipment remained an option for the buyer, but the actual trend is limitation of the real equipment to the steering console and auxiliary panels. This trend is also justified by the new generation of real ships with integrated bridge systems (IBS), where PCs, trackballs, keyboards and monitors replaced many of the traditional knob and push button panels.

Because the number of ships using IBS is still limited, there are many voices among students, deck officers and even instructors, who believe that a good bridge simulator must be a close copy of a traditional merchant ship bridge.

Today, from the manufacturer's point of view, a radar simulator is the cheapest version of a full mission bridge simulator, because, technically speaking, the major difference between these two simulators consists in the visualization system. In other words, a radar simulator with a visualization and projection system could be converted in a full bridge simulator, because the software that generates all the other main tasks is the same. Another important difference between these simulators consists in the complexity of the mathematical model used to generate the ship motion. Most manufacturers offer radar simulators with a three-degree of freedom (DOF) mathematical model for the ships. Six-DOF is a compulsory requirement for Class A FMBS only, in order to meet the IMO requirements for the Bridge Team Management Course (DNV, 2000).

The buyer knows that an affordable radar simulator consists of 2-8 working stations, each one with one, two or three displays, where all the ship's equipment and controls are virtual. In the two or three display configuration, the radar simulator workstation will have a visual channel with a 30^0-50^0 horizontal field of view and also the opportunity to display electronic navigation charts. In order to increase the realism of the simulation, the buyer could ask for a hands-on ship steering console, but this will increase the price of the radar simulator by at least 30%.

When a training institution has enough money to buy a FMBS, you expect a close mock-up of a real ship's bridge. A combination of virtual and hands-on navigation equipment is a must. The strongest point of the FMBS must be the visual system, which has the main responsibility for creating the realism of the simulated environment. The visual scene and the projection system must cover a 210^0-270^0 horizontal field of view (Cross, SJ; Olofsson M, 2000). Due to the increasing capabilities of video cards, video projectors and 3D image generation software, simulators with a 360^0 horizontal field of view are no longer actual, because the software can rotate the visual scene all around the horizon and change the position of the observer eye all around the ship.

The new generation of visual software engine and hardware projects the visual scene on a cylindrical screen, where the movement of the image is smoother than on a sided screen. More visual effects have been added (waves, whitecaps, sun or moon reflection on the water, stars, different types of clouds, etc.). Another important achievement of the 3D software is the visual generation of the ship movement. This feature contributed to the reduction of the necessary space for simulator installation and offered a much cheaper alternative to the moving platforms.

Realism of the visual scene and realistic ship handling behavior in different environmental conditions are the key aspects for a good FMBS and these requirements are fulfilled by the main simulator manufacturers. Harbour pilots, deck officers and masters who perform voyages on similar ships in the same maritime areas being simulated could very well assess these characteristics. Their positive opinions would be the most valuable quality certificate for the shiphandling simulator being evaluated.

3. What can the new generation of navigation simulators do?

To answer this question we have to compare the STCW 95 training and professional skill requirements with the objectives and tasks posed to the trainee by a FMBS scenario.
The most detailed list of tasks that could be achieved using a FMSHS was found in the EU FP 4 project called MASSTER (Maritime Standardised Simulator Training Exercises Register). This project was finalized in 1998 but we think that most of the conclusions stated there are still valid in 2004.

In accordance with the MASSTER authors, there are at least 140 tasks at operational level and 160 tasks at managerial level that could be taught and assessed using a FMBS class A. These tasks start from basic navigation and deck watch procedures, include voyage planning and ship maneuvering in confined waters, and end with communication procedures, use of maritime English, SAR and emergency navigation. As a result it will be easier to discuss *which training task could not be achieved and which competencies could not be demonstrated using a FMBS*.

In accordance with STCW, examination and assessment of competence for masters, chief mates and officers, regarding navigation at operational and management level (tables AII/1 and AII/2), is based on evidence obtained from one or more of the following:

- approved in-service experience
- approved training ship experience
- approved simulator training, where appropriate
- approved laboratory equipment training.

From the STCW navigation competences category, the following tasks cannot be theoretically carried-out using only the capabilities of most FMBS:

1. celestial navigation
2. proper keeping of different kinds of log in port
3. starting of the gyro-compass and the minimization of settling time
4. forecast weather and oceanographic conditions
5. send and receive Morse signals by flashing light
6. send and receive a message by using the international code flags

7. use of an anchor to dredge down with a current.
8. assessment of damage and post-event actions in case of navigational emergencies
9. use of the emergency steering
10. take on board survivors from rescue boats and survival craft
11. general operation techniques of marine power plants.

I said theoretically, because on some simulators, some of the above tasks could be performed or with some imagination the instructors could find a way to teach these procedures. As a result, from the above list, at operational level, only items 1, 3, 7, 8, and 10 imply sea service experience.

For celestial navigation, sea experience is required in order to acquire practical skills in celestial bodies' altitude measurement. The damage assessment, post-event actions and taking survivors on board are actions that actually happen after an emergency event. The probability that a cadet will experience a real distress situation in the 12-month compulsory on board training period, is under 0.5%. As a result, training for these emergencies procedures is also theoretical, with participation at drills along with the ship's crew.

Of course, other competencies imposed by the STCW cannot be achieved by the cadets without a sea-service period. These training objectives strictly related to the on board training were included in the following STCW competence categories:

- Monitor the loading, stowage, securing and unloading of cargoes and their care during the voyage
- Ensure compliance with pollution prevention requirements
- Maintain seaworthiness of the ship
- Prevent, control and fight fires on board
- Operate life-saving appliances

One the other hand, most of the training aims from the above list are covered by the mandatory IMO courses that each cadet had to accomplish before he could enlist for the Third deck officer certification exam.

Another aspect that has the same importance as the FMBS technical capabilities is the quality and realism of the simulation scenario. You could have the most expensive and up to date simulator on the market, but without well-designed simulation scenarios, the training aims will not be achieved at the desired level of performance.

We must emphasize that in this paper we are discussing the training of students and cadets using the navigation simulators. There is a great difference in terms of design and preparation between a scenario arranged for students and a scenario that must be accomplished by already certified deck officers.

In our opinion, in order to obtain a good training scenario for students, the instructor's team must have a well-balanced structure. The scenario design team must include:

- teachers of nautical science, who are well aware of the theoretical level of knowledge of the trainees;
- certified deck officers, sea going experience, who know the practical requirements and responsibilities that must be carried out during the navigation watch;
- personnel with a deep knowledge of the technical capabilities of the simulator and the facilities offered by the simulation software in terms of scenario creation and exercise monitoring.

The ideal solution is to have teachers who meet all this three descriptions and we are convinced that all IAMU members have this kind of teacher-instructor staff for their navigation simulation facilities.

We practice the first contact of the students with the FMBS in the second semester of the second year of study (in accordance with our curricula), after they have finished all the theoretical courses related to seamanship, coastal navigation and piloting, basic navigation equipment, and had minimal knowledge of navigation watch procedures.

What can be done in FMBS with so little theoretical knowledge?

The most important thing is familiarization with the real time navigation process. Additionally:

- hand steering of the ship on an imposed track;
- visual identification of navigation landmarks and floating navigation aids;
- taking visual bearings;
- reading gyro, compass, soundings, wind, current data;
- feeling different type of ships behavior on various weather conditions ;
- familiarization with distance perception at sea and day and night conditions;

are also very important tasks and skills that could be achieved at that beginning stage.

After that, in the third and fourth year of study, all the other objectives and tasks could be performed on the simulator: radar and electronic navigation, passage planning, ship maneuvering, radio communications, bridge procedures, watch team management, etc.

The realism of a scenario is also very important in training students with no previous sea going experience, even considering that they do not have yet a clear scale for comparing the virtual environment with the real one. We could count at least four reasons in support of this statement:

1. Skills and competences achieved during simulator exercises will be more accurate if the simulation environment is realistic.
2. Once on board a ship the student will be more confident in his actions realizing the similarity between the virtual and the real maritime environment.
3. If the student has a chance to be on board a ship that has similar characteristics as one of the simulated models, or if he will pass through a maritime area that was used as simulation area, he will perform his duties very well, based on the deja vu feeling.
4. After a sea service period the student/cadet will better appreciate the importance of simulator training and once back in school or training center, he will be more focused and involved in resolving the tasks imposed by the simulation scenarios.

I think that I have the consent of most FMBS instructors, when, in conclusion, I state that based on the new generation of full mission simulators capabilities, we can perform almost all tasks required by STCW in the navigation competencies chapter for operational level.

4. Sea service equivalency for Full Mission Simulators training

As we all know, STCW 95 introduced a compulsory 12-month seagoing service for every candidate for certification as deck watch officer (operational level). At least six months of this period the cadet must perform bridge watchkeeping duties under the supervision of a qualified bridge watchkeeping officer (IMO, 1995). The cadet's achievements during onboard training programs must be documented in an approved training record book.

There were two areas where maritime administrations rushed to implement ad-literam the new STCW requirements: seagoing service periods and IMO compulsory courses.

This one-year sea service period for our cadets raised a lot of logistic problems for our university. The first one was a substantial reorganization of curricula, in order to clear of courses from the entire fifth year of study and to allocate this last year of study entirely for on board training. Even so, it is a very tight schedule, due to the fact that the graduation exam must take place at the end of July.

More than that, the students lose the contact with the university for almost 12 months, and they have to prepare their graduation thesis without periodical tuition and supervision by the teachers.

From the point of view of the university, the main logistic problem lies in finding owners and ships for almost 200 cadets each year. This problem is amplified by the lack of Romanian flagships and the total non-implication of the Romanian Maritime Administration and Ministry of Transport in this matter.

Consequently, every year, we had to sign agreements with various international crewing companies and we managed to embark more than 80% of our cadets. The main problem of this solution is that the cadets are on board international flagships with multicultural crews, and of course multinational officer staff. In accordance with ship-owner policy regarding cadets' training, we experienced many cases where the cadets had access to the bridge and performed watchkeeping duties for only 2-3 months. The rest of the period they worked as helmsman or in most case as AB.

There were also some discriminatory or preferential attitudes towards the cadets due to the nationality of master/officers/cadet.

From our 8-year experience, we identified only 4-5 big ship-owners that had a coherent onboard training programme with the deck officers, were seriously involved in the cadets' training activities.

In conclusion, after the 12- month sea training period, we assessed great differences between the cadets regarding the competences and professional skills achieved.

In a study undertaken by Warsash Maritime Centre (Habberley et al., 2001) regarding the use of simulators for training in emergency situations, the authors run a questionnaire among various shipping companies, shipping organizations and maritime education institution, regarding different aspects of training using full mission ship simulators. One of the questions was related to the preferred method of training of deck officers for routine watchkeeping situations. The answers received are illustrated in Graph no.1. As we can see, there are some differences between the opinions of maritime education institutions and the shipping industry.

The shipping companies prefer the onboard training associated with the sea service experience. The maritime training institutions consider FMBS as the primary tool for routine training of deck officers. It is also interesting that:

- apparently, the shipping industry has more confidence in video training tapes than in simulator training;
- maritime education institutions consider lectures and textbooks less suitable as methods of training, but these methods are suitable for the shipping industry.

In my opinion, the answers given by the maritime training institutions are in accordance with the actual trends in MET and reflect the increasing confidence in simulation and simulator as tools for efficient training. I think that the opinions expressed by the shipping companies reflect their predisposition to minimize the cost of training. Otherwise we could not explain why an owner could consider that lectures are almost equal in efficiency to FMBS training, regarding achievement of practical watchkeeping skills. This assumption is based also on the answers given by the shipping industry to the question regarding preferred means for training in bridge team management (graph no.2). On this subject, maritime education institutions and the shipping industry share the same opinion concerning onboard and simulator training as methods for working out bridge team management procedures. Because the Bridge Team Management IMO model course became compulsory for deck officers at management level, the shipping companies had to pay for the training of their staff. The IMO standard for this course implies the use of a full mission simulator. The paradox is that at least 60% of this course deals with routine situations, so when you have no alternative for a cheaper training, everyone agrees that simulation is the best way to do it.

Only Maritime Administrations are apparently reluctant to embrace this means of training as an alternative to sea service time. With the exception of the USCG (CSBST, 1996), I do not know any other maritime authority that established an equivalency between on board training and FMBS training. The USCG decisions to grant remission of sea time in ratios, such as 6 to 1, have been based on achievement of licensing objectives, based primarily on a perceived value of simulator-based training. It has authorized sea-time remission to assist the maritime academies in meeting the STCW sea-service guidelines and to encourage training.

Simulated training is expensive even for maritime universities that have their own simulator facilities. As a result, between 1990 and 2000, the numbers of hours of simulated training for a student were very limited. That is the main reason for the lack of systematic research and comparative statistical studies based on the practical achievements of cadets that had only on board training and other groups that had only simulator training. On the other hand, a teaching institution could not undertake such a study, because all its students have the same number of simulated training and very much the same on board training periods.

With the new generation of FMBS, purchasing and training cost decreased considerably. On the other hand, the new technical capabilities increased the flexibility of scenario design allowing the creation of a better-tailored scenario for all kind of navigational tasks and teaching objectives.

Is the 6 to 1 ratio remission of sea time applied by the USCG justified? The study of Marine Safety International Rotterdam and TNO Human Factors Research Institute (DGSM, 1994) revealed that a ratio of 7.25 to 1 could also be considered as pertinent. In 1996, the US Maritime Academy Simulator Committee (MASC) conducted a survey to compare shipboard and full-mission ship-bridge procedures to validate this proposed equivalency of 12 to 1 (CSBST, 1996).

What is the main role of the cadet during watch hours? He is mostly an observer of what, when and how things happen on the bridge deck.

Has the cadet full access to the radar? In at least 70% of the cases, the answer is no. In most of the situations he could use the radar for:

- measuring bearings and distances in order to determine the ship fix;
- measuring bearings and distances to a target ship;
- plotting target ships on an ARPA.

The cadet is not allowed to:

- change without permission the radar motion or radar display stabilization configuration;
- set up his own Parallel Index or NAVLINES;
- make adjustments to the Gain, Rain and Sea clutter controls;
- use the TRIAL function in order to simulate collision avoidance maneuvers;
- approach the radar when Master and/or Pilot are on the bridge.

Has the Cadet the opportunity to make his own collision maneuvers? He has not.

Has the Cadet the opportunity to steer the ship in open waters? In most of the cases, yes.

Has the Cadet the opportunity to steer the ship in confined waters? No.

Has the Cadet the chance to start and setup *the electronic navigation equipment?* We do not think so.

How many ship's fixes will be determined by the cadet during the watch? Maybe 6 to 8 fixes, if the officer in charge is very focused on the Cadet training.

Has the Cadet access to the VHF radio-telephone? No.

If we are realistic, we could find another page of arguments to demonstrate that the Cadet's role on board a merchant ship is mainly as an observer.

And now the big question: *Can the Cadet perform, by himself, all the watchkeeping tasks and actions of a Third Deck Officer, during a FMBS scenario?* Of course he can and all his actions will be monitored, assessed and rectified by the teacher/instructor. In the above mentioned paragraphs we talked only about routine navigation. Regarding the training for navigation emergency situations there is no doubt that it can be performed using only a simulated environment (J S Habberley, et al., 2001).

Without any reliable statistical evidence we could only make the following logical assumptions concerning the on board training period:

- in 80% of the cases, a cadet did not spend more than 200 days on the bridge, performing watchkeeping duties;
- because cadets will be embarked on all types of merchant ships, we could consider that from the above mentioned 200 days, only 70% of this period (140 days) could be considered as near coastal voyages;
- a near coastal voyage implies also port arrival and port operations. As a result, a 15% ratio of time spent in ports (21 days) could be applied. Lets also assume that on these near coastal voyages, 40% of the transit time is represented by passing maritime areas with high traffic, confined waters, dangers for navigation, high risk areas;

In conclusion, in a 12-month compulsory sea time period, the cadet carries on watchkeeping duties for 200 days. The ship in this period will perform 140 days of near coastal voyages, including 21 days of port operations. From the remaining 116 days, 47 days will be considered as ship passages through areas dangerous for navigation, meaning that during the 1-year on board training, only 12.8% of that time will be spend by the cadet in a really challenging environment.

In contrast with the real opportunities offered by ship's voyages, all the FMBS scenarios are designed for near coastal navigation and most of the simulated areas are maritime areas difficult for navigation.

The necessity of simulators and simulations as complement of the on board training is also recognized by the big shipping companies. Many of them had different CBT (Computer Based Training) programs implemented on their onboard PCs. For example, in 2001, A.P. Møller installed 16 SimFlex On-board Training Systems on their vessels that are used for training cadets and deck officers in rules-of-the-road and general ship handling.

5. Conclusions

We think that for original licenses issued to Third deck officers, the 6 to 1 sea service equivalency ratio applied by the USCG is fair enough, but with a well structured and balanced training program that uses all the capabilities offered by the new generation of FMBS, this ratio could be increased to an 8 to 1 ratio. This ratio means that 1 watchkeeping hour performed on a Class A FMBS is the equivalent of 8 watchkeeping hours carried out by a cadet during the compulsory 12 months on board training period. Transforming this possible 8 to 1 remission of sea time ratio into days, it means that one hour of FMBS training could be the equivalent of 1 day spent on board the ship.

Considering that IMO STCW 95 requirements for the practical training of cadets are well justified, we propose the following alternative to the 12-month on board training rule:

"Every candidate for certification as deck watch officer has to prove that he completed:

- 6 months of seagoing service (at least 4 months of this period the cadet must perform bridge watchkeeping duties);
- 180 hours of simulated training on a Full Mission Bridge Simulator (FMBS) Class A."

In accordance with the Constantza Maritime University curricula, the Navigation Department had prepared for its students a training program that guarantees for each student 168 hours of training using FMBS environment. These 168 hours are accumulated during the last 2.5 years of study, using the lab hours of various courses related to navigation, shiphandling, communication and watchkeeping procedures.

If the on board service time for cadets can be reduced to 6 months, we will have the practical opportunity to increase the FMBS training period with another 28 -32 hours, in the first semester of the fifth year of study.

We also propose that in 2005, the IAMU Steering Board (with the participation of all IAMU members) undertakes a full study regarding:

- the practical skills that could be achieved by students and cadets using the capabilities of the new generation of full mission bridge simulators;
- the realities of the on board training periods for cadets;
- the main problems of ensuring and monitoring the efficiency of the on board training programs.

The results of this study and an official request regarding the implementation of the sea service equivalency ratio concept should be forwarded to the IMO MSC Sub-Committee on Standards of Training and Watchkeeping.

We think that at the beginning of the 21st century, IMO MSC will have to admit the importance and benefits of simulators, and the achievements of training in simulated maritime environment.

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BIOGRAPHY

Sea Service Equivalency for Full Mission Simulators training

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Engine Room Simulator Training Plan And Evaluation Method At Istanbul Technical University Maritime Faculty

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ABSTRACT
Evaluation is an important aspect of Engine Room Simulator (ERS) training. It provides the means to determine the student's abilities. The evaluation method is used to monitor and evaluate the results of a training session. Evaluation method must be as easy as possible and objective evaluation should be performed.

We have created a new evaluation method that has different sheets, curves and etc. The evaluation sheet represents the degree of achievement of operation and the time to the degree of achievement. It is important to divide all operation procedures into suitable steps and to decide necessary time pertinently for the operation. These steps are made into the scale of the degree of achievement.

This paper describes the training method and the evaluation method, which are applied for different types of ERS training. Also, the authors discuss the feasibility of the use of the ERS to establish higher level skills of trainee, such as plant operation management, risk management, team management, and "internal" and "external" communication.

1. Introduction

Maritime training institutions all over the world started to recognize the value of simulation systems as a training tool. The International Maritime Organization (IMO), the highest international maritime body, has now officially promoted the utilization of simulators.

Engine Room Simulator is designed to simulate various types of machinery and equipment as used in the engine room of an actual ship. The main objective of ERS training is that the training be carried out efficiently, reliably and with cost-effective configuration by simulating a realistic environment. The biggest advantage of using ERS as a training tool is the possibility of creating malfunctions repeatedly, and in that way, increasing the troubleshooting skills of trainees.

Our ERS consists of two types of ERS. One is CBT type ERS; the other one is full mission type ERS. We have six units of CBT type ERS and one full mission type ERS. CBT type ERS is called WS. The trainee is able to practice the operation of the engine plant in individual or a small number of trainees on the Work Station (WS). The trainee can view mimic pictures representing the various simulated systems on the monitor. These graphic mimic process diagrams are interactive so that the process can be both monitored and controlled. And then, by full mission type ERS, the trainee is able to practice more realistic operation than WS in suitable size of group. The full missions type ERS consists of the large-sized mimic panel which imitates an engine room, a control console which imitates a control room, an

Subject	Objective	Method	Evaluation
Simulator I	Fundamental plant operation	WS checklists	Training report I
	Machinery operation	ERS scenario I	Evaluation sheet I
	Watchkeeping	Log book & Oil record book	Log book, Oil record book, Training report II
	Emergency operation	ERS scenario II	Evaluation sheet II
Simulator II	Plant operation management	ERS checklists	Training report III
	Team management	ERS scenario III	Evaluation sheet III
	Risk management	ERS scenario IV	Evaluation sheet IV
	Maritime communication Internal & external communication	Communication phrases	Evaluation sheet V

Table 1. The ERS training plan

instructor console which imitates a bridge of an actual ship and a main switchboard which has same function as monitoring system and remote control system.

Each composition apparatus has the function of the almost same grade as the apparatus in a ship. Almost all the main machineries, equipment and associated system are represented on the mimic panel and it makes a realistic operation available.

2. Engine Room Simulator Training Plan

An efficient training plan is necessary to realize effective ERS training. Sophisticated equipment and an efficient training plan result in outstanding training performance. The following basic concepts should be taken into consideration when an ERS training plan is created:

- It should be verified what training can be carried out by utilizing ERS.
- It should be clarified what is wanted to teach through ERS training.
- It should be considered that ERS training is completed in a true meaning by combining the training objective, the training method and the evaluation method.
- It should be confirmed what competence is required for ERS training in STCW convention.

We have created the ERS training plan, which is shown in table 1 depending on abovementioned concepts. The training plan indicates training subject, objectives, training method and evaluation type. The training plan contains simulator I and simulator II as training subject. Simulator I is realized as capability of the operational level depend on the competence of STCW convention. Simulator II is realized as capability of the management level depends on the competence of STCW convention. The aim of Simulator I training is that the trainee learns basic plant operation procedures such as normal start and stop each plant composition machinery, correct order of starting up the engine plant, the duty of the watchkeeping and recovery emergency situation. For this purpose we have prepared four objectives shown in Table 1. The aim of Simulator II training is that the trainee learns higher skills concerning plant operation such as plant management and team management. We have prepared four objectives for Simulator II training.

3. Training Objective

An objective expresses the skill that should be acquired by the training. It is taken the following concepts into consideration when training objective is set up.

- The knowledge and the skill of training objective mastered may be limited to the range of the function of ERS.

- Set up training objective individually for each subject as much as possible.

- In order to utilize the simulator training as effectively as possible, it is necessary to grasp its function enough.

- It is required for the trainee to be conscious of what he is performing now for what purpose during training implementation.

3.1 Fundamental Plant Operation

The aim of this training objective is that trainee learns fundamental plant operation by performing WS with making use of WS checklists. In an actual ship, it is required to have several operation methods of the plant composition machineries. But here, trainee is required to obtain only basic knowledge and skill through this training. Therefore, fundamental plant operation methods in correct order are described in WS checklists. Fundamental operation means usual or normal operation. Unusual operations are not included.

3.2 Machinery Operation

The aim of the machinery operation is familiarization of the operation for selected machineries by utilizing full mission ERS. We have selected main engine, diesel generator system, turbo generator, oil fired boiler and oil purifiers etc. as training target depending on the function of ERS. The trainee can learn unusual operation methods such as manual operation and emergency operation etc. about the selected machineries through this training.

3.3 Watchkeeping

The aim of the watchkeeping is that trainee learns how to take over the duty of the watch by using full mission ERS and how to fill Log Book, Oil Record Book up. Under the state of navigation in ERS, a trainee performs the publication to the required documents of Log Book etc. based on the state. Then, the training which duty of watch keeping is taken over to the other trainees is performed.

3.4 Emergency Operation

The aim of the emergency operation is that trainee learns how to recover emergency situations such as black out, ME shut down, ME auto slow down, Oil fired boiler burner trip, etc. Mainly, under the state of navigation, making an emergency malfunction intentionally, a trainee performs operation for recovering it to a normal state.

3.5 Plant Operation Management

The objective of the plant operation management is that trainee learns how to obtain the engine characteristic such as thermal efficiency, heat balance and fuel oil consumption rate by collecting running data and calculating these data at the suitable engine condition.

3.6 Team Management

In a crisis, a leaderless group will achieve nothing. A simulator is a valuable tool for demonstrating how good leadership is vital for establishing and motivating team effort. The highest priority of a team is to accomplish team goals. If those qualifications are lacking or missing effective machinery space management will break down and the ship will be thrown into risk. Achieving those qualifications is very important, that's why this objective is set up.
For this purpose, a trainee learns team play under proceeding plant operation such as start up of the engine plant, stand–by station for entering/leaving port and emergency operation.

3.7 Risk Management

To reduce human error, training for troubleshooting repeatedly with good communication and teamwork is needed and therefore utilization of ERS for this purpose is proposed. This part of the course is about increasing the ability of trainees to manage risk.

The objective of this risk management training is to teach the trainee how to take counter measures by predicting an emergency state from the running date that is out of the normal range. Mainly, under the state of navigation, for example, it is performed by taking necessary counter measures after detecting high temperature of scavenging air caused by fouled surface of the airside of air cooler.

3.8 Maritime Communication

Although Standard Communication Phrases (SMCP) is in force, there is not yet any clear identification for marine engineering terminology. 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 marine accidents based on communication failures

The maritime communication is to learn how to communicate with other staff members in the engine room and how to communicate with the bridge, further more to learn technical terms. It goes without saying that communication, both in an upward and downward direction, is vital for good management in day-to-day routines and in crisis. ERS can be utilized to demonstrate that, without good communication, tasks are made much harder due to lack of direction and misunderstanding.

4. Training Method

The other important matter is training method. When it is determined suitable training method, some important points should be taken into consideration. These points are the following:

- Training method should correspond to the training objective.
- The objective can be recognized by a trainee
- Training method should be more effective and steady progress.
- Training environment in training method should be more realistic so that effective training can be realized.

Each training objective has different training method in the training plan in our simulator-training plan. There is relationship between the training objective and the training method. The training method includes some documents such as checklists, scenarios and records. These documents are follows:

- WS checklists
- ERS scenario I
- Log book & Oil record book
- ERS scenario II
- ERS checklists
- ERS scenario III
- ERS scenario IV
- Communication phrases

4.1 WS Checklists

WS checklists have been developed to standardize training and operations procedure and ensure the avoidance of faults due to wrong operating procedures. The procedures for the operation from the state of cold ship to the state of ship's navigation are described in the WS checklists. The checklists contain mainly the following items:

- Start up procedures from cold ship to running diesel generators for ME preparations
- Fire up oil fired boiler
- Starting purifiers
- Main engine preparations
- Starting main engine
- Maneuvering operations
- Normal procedures and keeping the systems under normal operating conditions

WS checklists have been implemented in such a way that the whole engine room operation has been divided into many smaller, typical tasks. The checklists give clear instruction what to do and how to do.

INSTRUCTOR	STUDENT	
	STEP	PROCEDURES
Make the initial condition in generator single run. Announce the subject <Commence the operation of changing DG from DG1 to DG2>	1. Preparation	Check LO level of LO sump Tank and supply with LO if necessary →Check FW level of Exp. Tank and supply with FW if necessary →Set LO pump to AUTO → Open LO valves concerned → Open SW valves concerned → Open FO valves concerned
	2. Starting DG2	Open starting air valves concerned and confirm air pressure Reset control system if necessary and set control position to LOCAL→ Start DG2 and set it's speed to 720 rpm → Set FW Temp controller to 70 degree → Set control position to REMO
	3.MSB Operation	Adjust and confirm volt and frequency of DG2 → Turn synchronize indicator to on → Turn ACB of DG2 to on
	4.Stopping DG1	Adjust electrical load of DG1 and DG2 to even → Adjust electrical load of DG1 to 0 → Turn ACB of DG1 to off Set control position to LOCAL → Stop DG1 → Set LO pump to MAN and close LO valves concerned →Close FO valves concerned → Close SW valves concerned

Table2. Extract of ERS Scenario I for Diesel Generator Operation

INSTRUCTOR	STUDENT	
	STEP	PROCEDURERS
Choose the state of full ahead engine as an initial condition. Make trainees watch and confirm the present condition in the engine room. ME: Running under navigation full (102rpm) TG: Running DG: State of standby Auxiliaries: The number of auxiliaries etc. Announce the subject. <Start the excise of emergency operation. Black out will happen. After that, recover the plant condition into the same as before. Set Emergency shut off valve of TG to 10%. Black out occurred	ME restart	Confirm TG trip and Emergency G and DG start up Confirm ACB of DG "IN" Set control position of ME to ECR Set ME control mode to "maneuvering mode" Set maneuvering lever to "0" Reset ME shut down indication Set ME Maneuvering Lever to 100% <later> Confirm ME revolution 77rpm and set ME control mode to "at sea"

Table 3. Extract of ERS scenario II for black out

4.2 Log book & Oil record book

The Logbook and Oil record book are used for the objective of watch keeping implementation. We have prepared ordinary logbook and oil record book depend on the function of ERS.

4.3 ERS Scenario I

The ERS scenario I indicates steps to be followed and what to do to attain the step for trainee. The ERS scenario I contains the following items:

- Main engine operation
- Diesel generator operation
- Purifier operation
- Oil fired boiler operation
- Fresh water generator operation

4.4 ERS Scenario II

ERS scenario II (Table 3) shows steps and indicates what to do to recover emergency situations such as black out and ME shut down in the same format as ERS scenario I.

4.5 ERS Check List

ERS checklists means data measurement sheet and it is used for collecting data which is necessary to calculate the thermal efficiency and to draw engine characteristic curve and heat balance diagram. The trainee can collect the necessary running data by filling this measurement sheet up.

4.6 ERS scenario III

ERS scenario III (Table 4) has been prepared for team management. For example, five trainees as one team may process the procedures for plant operation by using scenario III under the leadership of the trainee who was appointed as chief engineer.

4.7 ERS scenario IV

ERS scenario IV is used for Risk management. ERS scenario IV shows steps and indicates what to do to avoid serious situation of engine plant in the same format as ERS scenario I.

4.8 Communication Phrases

The communication phrase, which contains typical conversation pattern and technical terms for this training, has been prepared.

INSTRUCTOR	STUDENT	
	ORDER	RESPONSE
1. 25 miles to the harbor limit. (interphone)	1. <all right>	
	2. 25 miles to the port limit, begin the operation for entering port.	2. <all right>
	3. Start DG 1 with HFO use. <all right>	3. Started DG 1 with HFO USE. Running condition is good.
	4. Alternate electric source from TG to DG 1. <all right>	4. Connected DG 1 to Main Bus Bar and set it on AUTO. Disconnect TG from Main Bus Bar.
	5. Stop TG. <all right>	5. Stopped TG and begin to cool down. Closed valves concerned.
	6. Stop Condensate pump 1 and Vacuum pump 1. <all right>	6. Stopped Condensate pump 1 and Vacuum pump 1. Closed valves concerned.
	7. Stop FW Generator. <all right>	7. Stopped heating and closed valves concerned. Stopped Ejector pump and closed valves concerned Stopped Distilled Water pump and closed valves concerned.
	8. Select MANEU MODE on ME. <all right>	8. Selected MANEU MODE on ME.

Table 4. Extract of ERS scenario III for Entering Port

These patterns include standard engine order, preparation main diesel machinery, arrival in port, watch keeping in the engine space of a diesel ship, fire fighting and drill.

5. Evaluation Method

The evaluation is the most important element of simulator training. If the reasonable training evaluation is not carried out, simulator training will lose its true meaning. Therefore, the suitable evaluation method should be established in simulator training. The evaluation method is used to monitor and evaluate the results of a training session. The concept of our evaluation methods is:

- A trainee can estimate easily accomplishment after training implementation by oneself with the result of the evaluation method.
- The evaluation method is utilized for the follow-up after training implementation.
- The evaluation method is utilized as a reference when an instructor estimates trainee's individual results.
- The evaluation method should be as easy as possible, and consider it so that a difference may not arise by evaluators and objective evaluation can be performed.

As for evaluation, the instructor as much as possible should not cause a difference. Since it carries out through actual training, we have to make it a thing as simple as possible and effective. According to the characteristic of training equipment, as for the evaluation method, a suitable one should be prepared for each training session. Evaluation method should be grasped easily what the trainee fully understands or what the trainee scarcely understands by the evaluation result.

For the evaluation concerning operation, the specific evaluation method is preinstalled in ERS. This preinstalled evaluation method is to measure the trainee's skill level with the degree of deviation from normal value of running parameter and its importance. To define the normal value of running parameter as the standard of evaluation is caused to limited evaluation method and also it should not be practical evaluation method of realistic training.

We have created two types of evaluation method. One is report system and the other one is evaluation sheet. We have prepared fixed evaluation sheet for machinery operation, emergency operation, team management, risk management and maritime communication.

5.1 Report System

The training report should evaluate the com-prehension concerning ship's propulsion plant effectively.

ITEM 1:Sea Water System (MD 01)	
QUIZ	YOUR COMMNTS
What is role of SW pump.?	
What is role of Filter in High Suction and Low Suction lines?	
When do you use High Suction?	
For what is SW recirculation line shut off valve installed?	
For what is Emergency Bilge suction installed?	
For what is Direct Emergency Suction installed?	
What is role of Emergency Fire Pump? Why is its Sea Suction separated from suction for Fire Pumps?	

Table 5. Extract of training report I

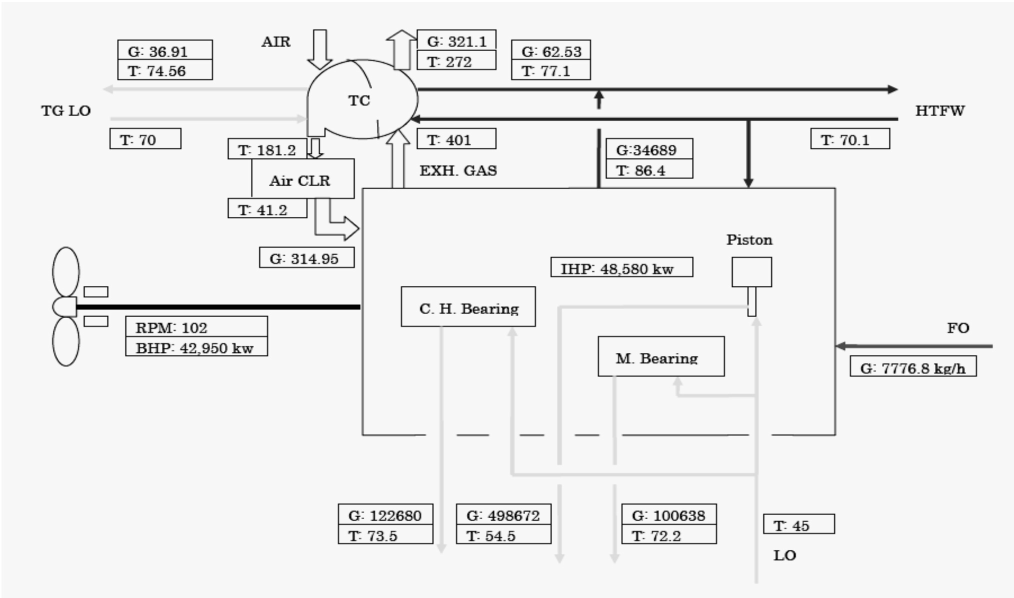

Fig.1 Heat balance diagram

There are training reports I, II, III, a log book, and an oil record book. Training reports I and II are that trainee fills the blank up with answers to a quiz in the training report I and II. It means that the trainee must proceeds their performance on WS with answering to questions at a certain period and he/she must submit the training report forms(I,II, to the instructor when he/she finishes their training performance. Table 5 shows extract of training report I. The instructor checks the submitted report forms if the answer is sufficient and judges the level of comprehension of the trainee and what knowledge is insufficient. And the instructor will follow up insufficient knowledge.

Training report III is the calculation item sheet and trainee calculates the thermal efficiency with making use of data in the ERS checklists. Trainee also draws and the heat balance diagram which is shown in figure 1 and 2, the engine characteristic curve which is shown in figure 3 by using calculation results to learn the plant operation management totally. The instructor judges the level of comprehension of the trainee on this subject according to the results of calculation and the other result.

5.2 Evaluation sheet

The evaluation sheet evaluates comprehension level by measuring trainee's degree of achievement about the knowledge concerning plant composition, plant composition machineries etc.

The degree of achievement can change with the comprehension level that the trainee has, and it can be represented as a function of time. That is, in the case of performing operation towards the set up objective, required time is represented with the sum of the physical time when it is required for operation including change of running parameters, and the time which trainee's judgment takes. As far as simulator training, the time needed to change running parameters is fixed. And then the physical time when it is required for operation may be thought that it is almost fixed, when the trainee with the almost same fundamental ability receives training by the same program and receives a prior briefing.

The time which trainee needs for judgment of operations will change with the trainee's comprehension level of knowledge concerning plant operation such as the plant composition,

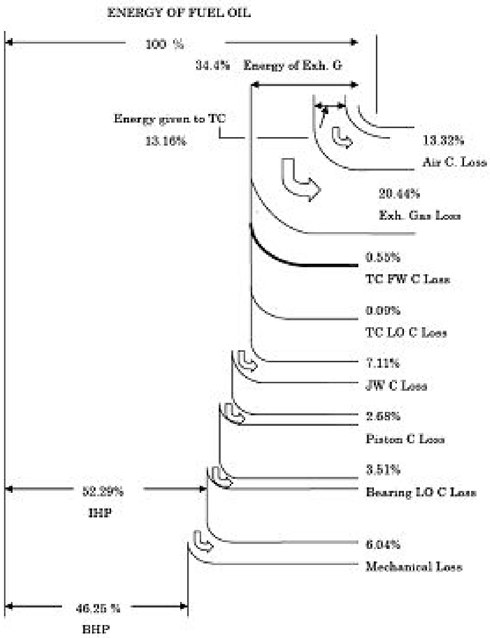

Fig. 2 Heat balance diagram II

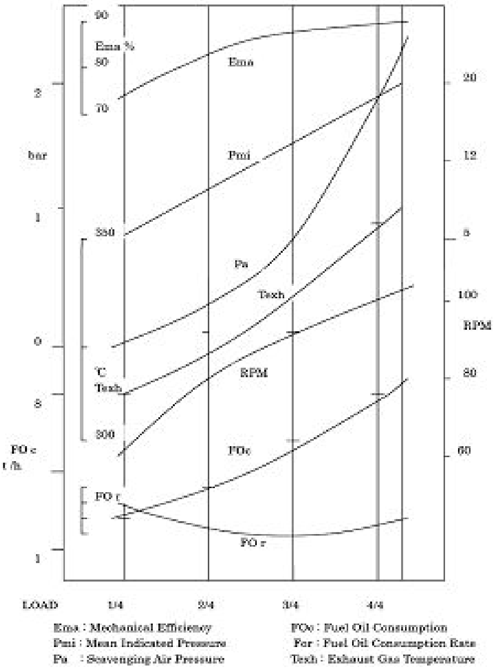

Fig.3 Engine characteristic curve

plant composition machineries, an operation of machineries and its operation, and this comprehension level will be represented by the evaluation sheet as a function of time.

It is thought that this evaluation sheet might serve as the most suitable evaluation method of all operation training only when the all operation procedures are divided into suitable steps and these steps were made into the scales of the degree of achievement. In the evaluation sheet, the vertical axis represents the degree of achievement of operation and the horizontal axis represents the time to the degree of achievement. Each evaluations sheet has two lines. These lines are standard line, which is shown in figure 4 and 5 as black line and success line, which is shown in figure 4 and 5 as green line.

As for the standard line, the adequacy is important. The standard line is created with average of the operation results that the faculty's instructors made. The result of operation refers to actual time that they needed to complete the operation. Since it is accepted that the general capability of these instructors concerning ship's propulsion plant is in the management level of STCW convention from the qualification and career, generally it is appropriate to consider that the results of these instructors are regarded as the standard of the evaluation.

We created the success line by multiply some coefficient to the time of standard line. Because the standard line which made of faculty's instructors, in a way, represents the best achievements and it must be hard for the trainee to attain the same level as the instructors and also it is not necessary to attain the same level through the training. Therefore, we may consider that the success line is regarded as operational level and management level of STCW convention in comparison with the standard line.

That is, if the completing point of operation is in the left-hand side of the success line, it can be recognized that the trainee completed the operation in successful and he/she has sufficient knowledge on the operation that he/she has done. Under proceeding the operations when he/she deviates from the success line, it is thought that the knowledge on the portion from which it deviated is insufficient, and it should become the material of follow-up. Thus, the instructors evaluate the trainee’s achievements by comparing their result line with the success line.

The instructor plots the time required for each step of operation on the graph by measuring actual time taken during the training implementation. And the trainee’s result line (actual operation curve) is created by connecting each dot on the graph.

the operation of these three steps. Trainee B needs approximately double time of the success line about the operation to Step 1. The operation of Step 1 means the operation whereby the trainee confirms recovery of power supply after black out and then restarts the main engine after resetting the abnormal condition of main engine. Trainee B proceeds to restart auxiliaries smoothly after restart main engine and ends the operation to Step 2 at the same time as success line. And after Step 2, the trainee completes all the operation to Step 3 favorably. In this case, it can be considered as "success", however, follow-up is necessary about the operation to Step 1.

Trainee
Date

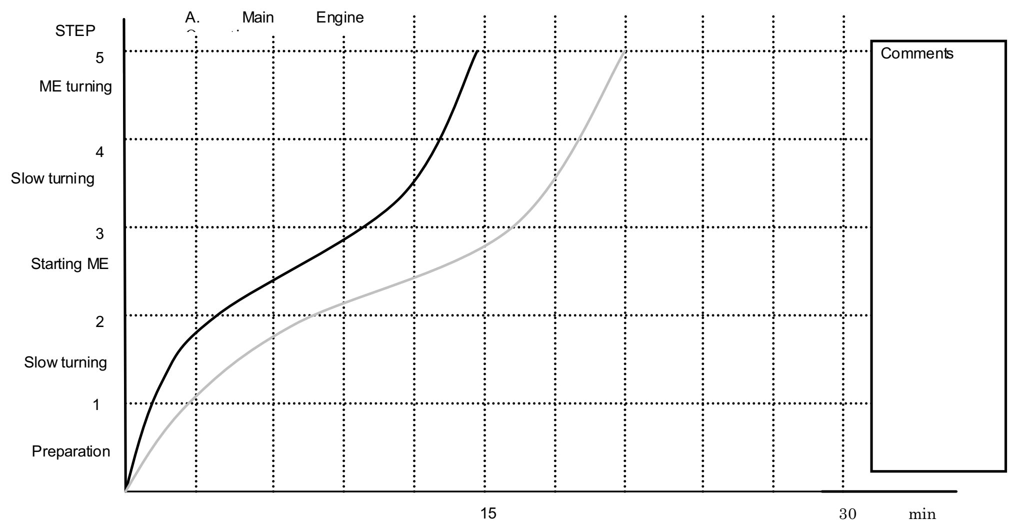

Fig. 4 Evaluation sheet for ME operation

Figure 5 shows a sample by putting three trainees' results. In this figure, step 1 means the operation form the black out to ME restart. Step 2 means the operation from ME restart to completion of restart all auxiliaries to be necessary. Step 3 means the operation from completion of restart all auxiliaries to completion of alternating power source to TG that was in service before black out. Trainee A‘s result is mostly located in the middle between the standard line and the success line. Therefore, it can be judged that trainee; he/she has knowledge required about

The following two points can be pointed out as a reason that he/she needed longer time than success time to reach to Step 1:

a. It was late to have acknowledged the recovery of power supply, beside the time was required in order to judge necessary operation for main engine.
b. The required knowledge about the operation for restart main engine after shut down is insufficient.

It is necessary to deepen understanding to

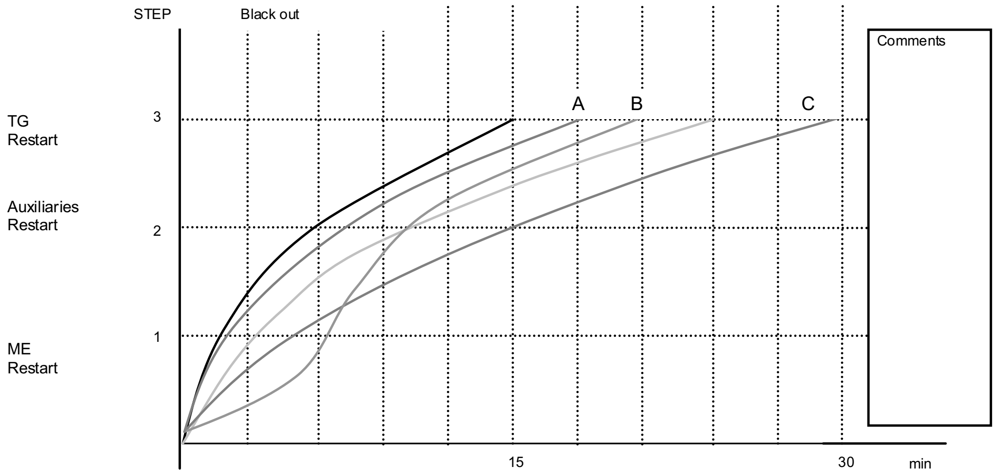

Fig. 5 Evaluation sheet for black out

the power supply system about "a", and to deepen understanding about restart conditions of main engine and the operation method after the main engine shut down about "b".

It can be judged that the trainee C is insufficient in the knowledge and understanding about this training because the result is below the success line about the all operations.

6. Conclusions

It is recognized that suitable training utilizing engine room simulator is effective in some specific field and limited field. In order to perform suitable simulator training, setting up the suitable objective, the suitable training and the evaluation method for the objective are indispensable. We created them in the ability of the maximum practical use of the simulator to be carried out, and it is considered that these are appropriate. However, about the training concerning the main apparatus such as main engine, diesel generator and boiler etc. since these simulation functions are lower than the function that they have individually in these individual simulators, it is considered that improvement of the simulator should be made for further substantial training.

As for the evaluation, it is necessary to verify the results of evaluation sheet to be appropriate from general view from now on. It may be also necessary to research on the ability of the trainee who achieved "good result" in an actual ship. After that, we can declare that our evaluation method can contribute widely in the field of simulator training. The evaluation should cover all the training objectives and it should also indicate whether the training plan and the instructor are adequate.

On the other hand, an engine simulator instructor needs to find out what training is possible by the simulator, and needs to establish the training method and evaluation method as a means for the completion of training purpose. Therefore, it is required for having sufficient knowledge about general ship's propulsion plant composition, the composition apparatus, physical and mechanical characteristic, the meaning of each operation, the order of operation, etc. depending on actual on board experience and also it is required for having the knowledge about characteristic of simulated engine plant and operation of the simulator. For example, in being related with operation, it becomes the most important thing that series of operation can be divided into suitable steps in our training method and evaluation method. These become possible when it has sufficient knowledge about plant operation.

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Why A Qualitative Research Strategy? A discussion on research strategies, focusing on qualitative research; a challenge for the maritime cluster

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ABSTRACT
This paper discusses the qualitative versus quantitative strategies in research, emphasizing the qualitative strategies. With the increased importance in studying maritime human behaviour, in a research area historically dominated by quantitative strategies, a qualitative strategy will give additional and deeper knowledge relevant to every IAMU researcher. Qualitative strategies have been used since the mid 60s. What do they signify? Are they unbiased? It certainly cannot be just an ignorant interviewing of a population and its world that the researcher wishes to investigate. There is more to it. We must realize that human perception is highly selective. What people "see" is dependent on their interests, biases and backgrounds. Those who do observational research are expected to go beyond ordinary looking and do systematic "seeing". *Nota bene*, if the researcher lacks method-knowledge there is the risk of subjectivity. This paper introduces, to the MET world, a few research strategies to reasonably do away with subjectivity.

Both qualitative and quantitative data can be collected in the same study. We have to realize that different perspectives give different types of insight. Qualitative strategies are preferably used in social science.

In walking together and communicating with the research object the researcher attains knowledge that s/he otherwise would not be able to discover. Truth is created by dialogue and by observing people's reactions to specific occurrences. Through language humans handle situations, surroundings, themselves, relationships, etc. Classroom teaching articulates ways of using language in social relations. Research strategies sometimes classified as "loose" can certainly be justified.

1. Introduction

Social science research is vitally important for the welfare, safety and security of the one million people who work at sea. In an article in the Numast Journal May 2004 the Nippon Foundation of Japan is launching a fellowship grants program on human related aspects in shipping in partnership with the SIRC in Cardiff. This contribution indicates the need for research on the human factor in shipping. The call for applying appropriate strategies naturally follows.

The type of research carried out in shipping activities usually builds its validity on quantitative strategies. With increased interest in research on phenomena where human beings have a focal role these strategies perhaps do not justify means, nor meet expected objectives. Numbers, by means of human figured formulas dealt with in computers, cannot be the only tool to justify a certain statement according to an assured hypothesis. Already, numbers and formulas have their origin not only in natural science but also from social science, realizing that person/s with specific knowledge have worked with it.

Discussions in this paper are mainly drawn and inspired by the following four books:

1) Steinar Kvale (1997): *Den kvalitative forskningsintervjun*
2) Marianne Winther Jörgensen & Louise Phillips (2000): *Diskursanalys som teori och metod*
3) Michael Quinn Patton (1990): *Qualitative evaluation and research strategies* and
4) Norman Fairclough (2003): *Analysing Discourse, textual analysis for social research*

There are two strategies within the theory of research methodology: Quantitative investigations and qualitative investigations. Quantitative investigations are built on a positivistic research theory and the qualitative on hermeneutics. Both these theories follow established science theories (almost similar to knowledge theories) where:

1) Theories and not conceptions of belief are discussed
2) The truth (perhaps a theory is truthful when it correctly describes and corresponds to the world) is discussed
3) Scientific theories must be supported
4) A scientific theory must be used
5) A general consideration of scientific rationality and development of science.

A quantitative research strategy is often a) associated with a deductive approach i.e. it begins with a theory and tests to show evidence to a provided pre-set hypothesis, b) usually linked to the notion of science as objective truth or fact and c) the strategy usually begins with pre-specialized objectives focused on testing preconceived outcomes. The opposite approach, the qualitative research strategy, is often a) associated with a inductive approach i.e. observations are made usually in order to develop a new hypothesis, b) often identified with the view that science is lived experience hence subjectively determined and c) begins with open-ended observations and analysis looking for explanations to *how* and *why* questions.

Natural sciences try to find explanations to reasons for certain phenomena whilst social sciences try to understand the meaning of certain phenomena from its context. And the quality (the success) of a strategy is determined by its ability to explain new data. *Strategy*, as recommended by Hartman, is a word that in this paper will be used to cover and describe the array of possibilities and methods that exist to conduct a qualitative research.

In maritime research, to the author's knowledge, so far no researcher has stated *what qualitative strategy* that has been used. This paper will show that there are valid and reliable research strategies without a hypothesis to be tested.

2. Quantitative research strategies

Quantitative research is defined as the numerical representation and manipulation of observations for the purpose of describing and explaining a phenomenon that those observations reflect. Quantitative research is often based on statements like: anything that exists does exist in a certain quantity and can be measured. To quote Lord Kelvin "When you cannot measure, your knowledge is meagre and unsatisfactory".

A quantitative approach makes it possible to measure reactions of many people but to a limited number of questions. Still, this facilitates comparison and statistical regression of data. It is, however, important that the instrument used measure what it is supposed to measure. This can be done by adhering to prescribed procedures and by following a set standard for the instruments used (test items, survey questions etc.). Data is usually easily aggregated for analysis and should be systematic and standardised. Findings are usually not difficult to present.
The concept is to separate facts from values

and science from politics. The aim is often to foresee_and control people's behaviour by producing scientific, objective, quantifiable and unbiased facts that can be reproduced. The latter is very important in order for other researchers to build on a previous research and for decision makers to use the findings for their decisions.

Questions usually necessitate a quantifiable yes or no and the questions have to be standardized. Quantitative research, long held to be the only form of research that was statistically valid and reliable, starts by the researcher formulating a hypothesis that must be tested. Hartman (2004) says that it is irrelevant how the hypothesis has been found because it is more important that it can be given necessary scientific support. This is one of the reasons why quantitative strategies are used now in conjunction with qualitative research strategies, the latter in studies that cannot be adequately described, measured or fully interpreted.

Observations and enquiries can be part of the study. Observations become independent of the interviewee's memory and willingness, but it is an expensive and time-consuming strategy. The analysis of all types of data has to be statistically calculated. If the hypothesis can be supported it also has to pass a significant level that normally is set to 5%.

For any type of observation it is necessary to have a scale of measurement. But how does one measure the level of people's depression, physical health, psychological condition, intelligence or e.g. the force of being convinced? Without being able to measure no investigations can be made unless we find another strategy. A qualitative approach might be the solution.

3. Qualitative research strategies

If one wishes to know how people see their world and their lives the best way is to ask them. The reason for this being that the world and self has a *meaning* to each of us.

By using a qualitative research strategy the researcher tries to understand the world from the interviewee's point of view. In this way knowledge is built through an exchange of views between two persons. It is defined as a non-numerical examination and interpretation of observations, for the purpose of discovering underlying meanings and patterns of relationships. The whole person has to be investigated because our values of life cannot be fragmented.

A qualitative strategy produces detailed information usually of a smaller group of people. This increases the understanding of that particular group but, of course, reduces the possibility to generalise. The researcher in himself/herself is the instrument. Therefore, the result depends a lot on the researcher's skill and diligence. Usually, collected data are longer in presentation, more detailed and the content is variable. Diligence is required because data is neither standardised nor systematic. "*Open-ended* responses on questionnaires represent the most elementary form of qualitative data" (Patton 1990, p.24, author's italics) but it requires skill to interpret.

To explain system behaviour it is necessary to apply synthetic thinking. This is different from doing an analysis. A SWOT analysis (quantitative) answers many questions but, as well, it should be important to find the interdependency (qualitative) between its parts. Qualitative strategies are appropriate when phenomena under study are complex, social in nature, and do not lend themselves to quantification. Qualitative strategies can contribute to practical problem solving, decision-making, action research, policy analysis and organisational development.

The idea of introducing qualitative research was also to make research and science less dramatised. The point is to put forward the genuine knowledge interest of the researcher and the skill of interpreting (reading between the lines) in science. Any hypotheses, to be proven or rejected, are not necessary. Instead, the starting point becomes loosely formulated questions. The door is open for surprises. This is a strategy with an opposite approach to working with e.g. questionnaires. On the road to the truth the researcher formulates findings *after* his work in the field. It is important that the researcher has few pre-stated answers to his area of research and instead keeps open questions like: "What does it mean to…?" or "What is happening …"? etc.

Grounded Theory emphasises the importance of creating something new. Therefore, theoretical creativity is needed. The spoken and written language should be mastered at the same time knowing that it sets borders to our possibilities of comprehending the world. If one does not have words to describe a certain phenomenon one does not see it. The world is organised and interpreted by the use of language. It is not possible to discard either our mother tongue or our cultural inheritance. The researcher has to be prepared to pose questions on what is seen and on what conditions this seeing is based upon. In this way the research becomes exempted from fact contaminations.

What we do becomes less important than *how* we do it. The process is the main point. "Arguments are thus primary in social science and not proof" (Kvale 1989, p.121).

Börjesson (2003) states that the research expectation is to find some correlation between words and things; coordination between what has been spoken and what is. A methodological problem appears when interviewed people say something but do it in a different way; there is a gap between words and deeds.

It is the combination of personal experience and intensity that yields an understanding of a phenomenon. In a researcher's report it is important for the reader to know the researcher's experiences and knowledge in the research subject. A question could be raised: How can a researcher know and be able to motivate that his/her research is "better" than other researchers? The answer is that s/he cannot; this is why the researcher's pre comprehension is important in order for the reader to judge validity in the researcher's arguments. In qualitative research the researcher becomes a tool to produce results. To study others is the same as studying ourselves. One cannot talk about the world without having an impact on the world. Therefore, it is essential that the researcher is vigilant to avoid bias. The question is not what material best represents reality because reality is objects made by humans. It would be smarter to study how our world is being formed and use empirical material to suit our own purposes.

The object for studies is something that has to be anchored at its cultural context, the phenomenon needs to be contextualized rather than be given a general explanation. Therefore, a starting-point becomes to realize that discourses are speaking discipline and a logic that govern the limits of what is culturally and socially accepted as: truth, trustworthy, common sense, good and bad etc. These limits of discourse show what is not possible to say in a certain context (Börjesson 2003).

The choice of research strategy influences the way in which the researcher collects data. Specific research strategies also imply different skills, assumptions and research practices. The researcher must believe in the theories of the strategy chosen - a very important statement.

The researcher has a number of strategies to choose between. Sometimes only a fine-tuning separates them. The strategies discussed in this paper are:

1) Phenomenology
3) Discourse analysis
2) Phenomenography
4) Action research and Case study

The discourse analysis strategy will be

emphasised because it appears to be a method widely and more and more practised.

How does one practically get on with a qualitative research? Nowadays a lot has been written but to quote Jonathan Potter: “study how others have done it by reading their research” (Potter pers. comm. 2004).

The following provides a brief insight to some of the above strategies. Each strategy has a key person or “originator” and this has been indicated by the expression “here represented by…”.

3.1 Phenomenology
(here represented by Husserl)
Mr Edmund Husserl (1859-1938) was a German philosopher.

Phenomenology is perhaps the most significant philosophical movement in the 20th century. The word has become synonymous with qualitative research and sometimes viewed as a paradigm, perspective and sometimes as a strategy.

A phenomenological perspective follows a concentration on the value of life, a unique openness to the experiences of the interviewee, a priority to exact information given and an attempt to find static meanings in the information. Patton (1990, p.69) says that the strategy (author’s definition) focuses on the question: “What is the structure and essence of experience of this phenomenon for these people; or how is it that they experience what they experience”?

Phenomenologists tend to conduct research in a style that could be described in the below abbreviated approach-list:

1) Oppose the acceptance of unobservable matters
2) Oppose naturalism
3) Justify cognition
4) Believe that not only objects but also a conscious life itself can be made evident and thus known
5) Inquiries ought to focus upon objects as they are encountered
6) Recognize the role of description by means of causes, purposes or grounds

3.2 Phenomenography
(here represented by Marton)
Mr Ference Marton is a professor of Pedagogy at Gothenburg University.

This empirical strategy describes how people experience, conceptualise, understand, perceive and apprehend various phenomena. The different ways in which people see a phenomenon is shown in the words they use to describe it. This we can state because it is impossible to deal with an object without in some way experiencing or conceptualising it. The strategy works extremely well in confirming practical problem solving and decision-making (Patton 1990).

It has now been more and more realized that the conceptualization of distinctively different ways in which people understand various phenomena is of great interest in itself. The principle of this strategy is to identify logically interrelated ways in which a situation is experienced or understood. The different ways that all this depends on is our way of describing them and is independent of the differences between experience, perception, apprehension, understanding, conceptualization etc. What happens during a conversation is important to understand. Besides the wording it is important to observe and interpret how humans act. Psychologists, doctors, sociologists and other scientists do the same in their work. What a person answers, and how s/he answers has a meaning for the total attitude of life, feelings and acts.

The object is human experience. The aim is to find the variation that defines a phenomenon. As expressed by Marton (1986, p.32): “What are the critical aspects of ways of experiencing the world that make people able to handle it in more or less efficient ways”? The strategy was developed from empirical studies of learning in higher education. This might be the most powerful way of finding out how the development of knowledge and skills within these domains can be facilitated. It is tantamount to characterize the collective mind encompassing the different ways in which people make sense of the world. He states that if we are interested in how people think about e.g. school success the answer cannot be derived either from what we know about general properties of the human mind or from knowledge about the school system itself. Neither combination of these two parameters will give us the required insight. Researchers have to find another way. The natural choice is phenomenography.

3.3 Discourse analysis

The following scholars provide the base for the most well-known social construction strategies. There are many philosophers/researchers/scholars etc. that have similar implications. The strategies below are known to be the leaders in the field:

1) Potter & Wetherell: "Discoursive Psychology" (DP)
2) Fairclough: "Critical Discourse Analysis" (CDA)
3) Laclau & Mouffe «Discourse Theory» (DT)
4) Derrida: "Deconstruction" (D)

The reason for mentioning these different strategies is to get an understanding that the view of the world has many faces and the researcher has to make up his mind on the preconditions for his/her belief in relation to his/her research objective and then choose a strategy that suites both criteria. Different discourse strategies use different discourse conceptions. Any of the above discourse strategies has an interest in analyzing how the structure in the form of discourses is constituted (made up) and altered depending on the context.

In the above strategies it is realized that our understanding of world-reality always comes through language. Language is a "machine" that constitutes the social world. When we have a change in discourse it manifests a change in our social world.

In constructive research the belief is that all that which is being studied is constructed. With a discursive analysing strategy the question being posed is *how* something is constructed, in what *context*, within what *framework* and with what *consequences* for the human being. According to Winther Jörgensen (2000) researchers repeatedly have to ask themselves the following questions:

1) How extensive is the discourse – who has a relation and who presides over this discourse?
2) From where does this discourse take place – what type of people carry the discourse forward (interest)?
3) In what manner does the discourse exist and for whom – methodology (collective or individualistic)?
4) When does it take place – risks for anachronism?
5) Does it have any competitors – why is this discourse dominating, or is it?
6) Why do discourses change – with time, controversies, competitive ways of thinking?

A researcher's report should be comprehensive in order to give the reader a possibility to judge the researchers interpretations. The report must be transparent. The report should contain examples from the empirical material and clearly show how the researcher has moved from discoursive data to conclusions.

The following should illustrate the major strategies (theoretical perspectives) in a little more detail.

3.3.1 Discoursive psychology – DP

(here represented by Potter & Wetherell).
Mr Jonathan Potter is a professor of Discourse Analysis at the Department of Social Sciences at Loughborough University and Ms Margaret Wetherell is a professor of Psychology at the Open University.

This strategy states that the interest is in investigating how people strategically use a discourse to present themselves and the world in an (often) egoistical social interaction. To study the social consequences that such behaviour might have is fundamental in this strategy. This strategy wishes to investigate relationships between individuals and between groups to find out the meaning, the consequences and the actions taken in such relations. The actual language used in such constellations therefore becomes very important. “The study of language is particularly vital to social psychology because it simply is the most basic and pervasive form of interaction between people” (Potter 1998, p.9).

DP rejects the cognitive effort to explain attitudes. Instead it is social activities that make us act as we do. An individual’s attitude is not seen as stable mental dispositions, but seen as products of social interaction. When using questionnaires it is taken for granted that people’s attitudes are stable mental dispositions. Small differences in the formulations of the questions give a big difference in answers. Attitudes are not stable. Potter defends the strategy saying that in DP the variations and contradictions are considered in answers (Winther Jörgensen 2000, author’s translation).

To speak is the same as constructing an identity. Humans have several flexible identities according to researchers using DP. Identities are connected, incomplete and unstable. The identity becomes visible in particular events.

Certain expressions can be suppressed in certain social contexts. Discourse analysis can investigate the importance of language in processes of suppression. The awareness that certain contexts are put under taboo will make the person refuse certain discourses and this has ideological consequences because certain ideas of the world will be excluded. It is also possible to analyse why people are silent in certain discourses. The researcher analyses peoples’ conversations as an expression of a world that the participants create themselves. Speech is action oriented and therefore varies with the social context.

This strategy differs from other strategies by being interested in how meanings are constituted in discourses that people use as a resource to talk about the world with a specific opinion. The researcher should focus on *how* people in discourses create their constructions of the world and form groups and identities.

Like all qualitative strategies DP rejects the positivistic epistemological strategy for collecting material (a structured strategy where the social interaction between the interviewer and the informer is minimised). Epistemological strategies cannot accept, for reliability reasons, diffuse formulations, leading questions or questions that are set together. Even wrong answers can be rejected with the motivation that the question was not measuring what it should measure. On the other hand, in DP the interview is considered to be a way to survey how people attribute importance to various phenomena in a social context.

One has to choose a transcribing system that makes it possible to analyze the interview. First thing, in the process, is to read the transcribed text and identify themes being put in categories. This is done repeatedly until the researcher has fully understood what categories best describe the text. It is interesting to search for the pronoun that has been used e.g. a change from “I” to “we” indicates a change of discourse. The coding is usually standardised and done by two researchers in order to sustain reliability.

3.3.2 Critical Discourse Analysis – CDA

(here represented by Fairclough).
Norman Fairclough is a professor of Language in Social Life at Lancaster University.

This theory states that it is discourse that creates the social world. Fairclough’s theories focus on investigations of changes. It means that all discourses are built on historically established definitions. It is the variety in the language we use that changes the discourse and with this also the cultural and social world.

Foucault is very much associated with discourse. He focuses on the relation between power and knowledge. His strategy of discourse analysis will help to find out what is the truth. This sets limits for what is conceivable. Who is allowed to speak and upon what grounds does such legitimacy rest?

There are five common criteria for CDA. Fairclough (Winther Jörgensen 2000, author's translation) explains them:

1) Discoursive practises are an important way of constituting the social world, including social relations and identities.
2) In a CDA strategy both language and discourse are seen as types of actions because discursive practises have an impact from forces in society.
3) CDA helps to create and reproduce relations of power-groupings between social groups. This is the reason for establishing groups of any kind.
4) CDA is not to be considered as politically neutral. Contrary, it makes an effort to be a factor in social change. In order to do that people have to be more aware of how language is dealt with, in particular to achieve political or social power.

The discourse forms an important role in social practices; it reproduces and transforms knowledge, identities, and social relations including power relations and at the same time is itself formed by other social practices and structures. Discourses contribute in constructing: social identities, social relations and systems of knowledge and meaning.

In cultural studies as well as in communication studies it is realised that *meaning* is partly created in the process of interpreting texts. A specific text has several potentials of meanings and these connotations might well be contradicting each other. Therefore, all texts are open to analysis. People's social relations and identities are not based on fixed social positions but rather created using negotiations in daily interactions. CDA is not just another form of academic analysis. Part of the task is to spread the awareness of language as a factor of domination.

3.3.3 Discourse Theory – DT

(here represented by Laclau & Mouffe)

Mr Ernesto Laclau is a professor in Political Theory at the University of Essex and Ms Chantal Mouffe is a senior

Research Fellow at the Centre for the Study of Democracy at the University of Westminster.

This theory states that the social world never can be fixed because any language fundamentally is unstable by nature. A certain discourse is constantly subject to reconstruction in contact with other discourses because a discourse can never be seen in isolation.

Power is what brings the social world to existence and that makes the world develop. It is power that carries our knowledge, our identities and relations to others as individuals or as group members forward. It is in discovering what social possibilities that have been excluded that one can discover social consequences for the individual. The subject identifies itself as an individual by comparing itself to something outside itself. These outside identities form the foundation of an identity but can also create a feeling of alienation. The complete identity is something one imagines; it is a needed horizon, in the creation of the ego and one's social world. The discourse forms a special protocol for actions of human beings; a protocol that is very binding telling what one pretends to be i.e. your identity.

All people do not have access to the same subject position. For example, there are limits on what a patient can say in front of the doctor to be trustworthy and believed. Therefore, one of the tasks in DT is to map how people are categorized in groups and how this classification has an impact on their way to act i.e. to say and do something. According to Jonathan Potter (Potter pers. comm. 2004) "this strategy is on the opposite side of the hill compared to DP".

3.3.4 Deconstruction

(here represented by Derrida)

Mr Jacques Derrida is a French philosopher and professor of Strategy. Today he directs the École des Hautes Études en Science Sociales in Paris.

Deconstruction is a philosophical strategy directed towards the (re)reading of philosophical writings. Derrida suggests that there is nothing beyond text i.e. the strategy is partly based on the fact that the development of the world is seen as a complex historical and cultural process rooted in the relations of texts. Human knowledge is not as controllable or as cogent as Western thinking would believe. Language operates in an understated way and often is contradictory. Therefore, it has a tendency always to elude us.

Derrida contends that the traditional or metaphysical way of reading makes a number of false assumptions about the nature of texts. A traditional reader believes that language is capable of expressing ideas without changing them. The author of a text is the source of its meaning. Derrida's deconstructive style of reading subverts these assumptions and challenges the idea that a text has an unchanging, unified meaning. Western culture has tended to assume that speech is a clear and direct way to communicate. Drawing on psychoanalysis and linguistics, Derrida questions this assumption. As a result, the author's intentions cannot be unconditionally accepted. This multiplies the number of legitimate interpretations of a text.

By deconstructing the works of previous scholars, Derrida attempts to show that language is constantly shifting.

3.4 Action research and Case study

Action research is a process through which practitioners study their own practice to solve their personal practical problems. Teacher action research, for instance, means daily practical problems experienced by teachers. It does not refer to theoretical problems defined by pure researchers within a discipline of knowledge. It is characterized by repeated problem identification, systematic data collection, reflection, analysis and, finally problem redefinition. The approach is built on collaborative observation and very similar to case study strategy.

In a case study the belief is that the goal of a study establishes the parameters. The objective must be met and if so there is no doubt as to validity and reliability. A case study can well satisfy the methodological rigor of: describing, understanding and explaining. The player's views are incorporated in the study.

This strategy is criticised because a single case renders it weak in providing a generalizing conclusion. Case studies are not representative of entire populations, nor do they claim to be. The case study researcher should take care not to generalize beyond cases similar to the one(s) studied. In statistical analysis one is also generalizing to a population based on a sample, which is representative of that population only. With a large sample generalizations can be made.

4. Discussion

In any research, the researcher should consider the following general questions:

1) Who will use the findings?
2) What kind of information is needed?
3) What is the purpose of the evaluation?
4) When is the information needed?
5) What resources are available to conduct the research and to evaluate the findings?

Having obtained an answer to the above questions, the researcher should ask:

6) What strategies are appropriate?

Item 6) has become the reason for writing this paper to awaken maritime researchers to shun subjectivity. In the maritime field and particularly in researches conducted on the human factor there is an evident lack of item 6): information on the strategy that has been used. When qualitative research methods are used this becomes very important for the reader in order to judge a papers reliability etc. Equally important is telling the reader the researcher's pre comprehension; what reason gives him or her right to speak.

The latest major study on e.g. crew societies is the SIRC study "*Transnational Seafarers Communities"* where the method is described as "Tape-recorded, depth interviews used extensively and transcribed verbatim. They were translated as necessary and organised into thematic files for collation and analysis" (Kavechi, 2001, p.2). Fine, but the author assumes that a professional reader expect more details on actually *how* these transcriptions were analysed.

Quantitative and qualitative constitute alternative strategies but are not mutually exclusive provided there is logic in the reasoning. Different strategies are appropriate for different situations. Patton (1990, p.39) states, "A paradigm of choices rejects methodological orthodoxy in favour of methodological appropriateness … for judging methodological quality". A qualitative strategy, in isolation, is indeed relevant as long as the objectives are met.

According to the author, discourse is an encircled and analysed *system of conversation* in line with some type of perspective. It is all about what we look for in life; on what questions we put forward and the strategy we use to answer the great questions in life. The efforts to find interpreting possibilities are an important ambition in itself. The researcher can dramatise his study and analyse the result. The researcher's "story" of the world will give a new picture of the world, or an old story that has been dramatised in a new way.

To understand the world does not necessarily mean that you tell how the world really is. The issue is to understand what conditions apply to understand something that can be understood in different ways. To *reflex* is the key and the goal to understand the discourses that are studied. "Knowing who you are in our society is in part knowing that you are part of a tradition in which knowing who you are is important and which is committed to this quest", (Gouldner, quotation from Börjesson 2003, p.187).

An individual can have many identities. Critics then argue: How can it be possible to have an opinion on a group with a mixture of identities? Critics also mean that there is room for too many subjective interpretations; there is no system to separate between good

Type of concept	**Strategy**	
	Quantitative (positivistic)	**Qualitative (hermeneutic)**
Reasoning	Deduction	Induction
	Objectivity	Subjectivity
	Causation	Meaning
Question	Pre specified	Open-ended
	Outcome ended	Process oriented
Analysis	Numerical estimation	Narrative description
	Statistical inference	Constant comparison

Table modified from A.Casebeer and M.Verhoef (1997) *Combining Qualitative and Quantitative Research Methods*

Table 1. Opposing strategies

and bad interpretations and valid and invalid conclusions. Quantitative researchers always give the critique that a qualitative strategy is a lot less stringent and therefore less valid in its conclusions. As an answer to such skeptics Winther Jörgensen (2000, p.116, author's translation) states, as one argument, that ten interviews can give equally good information as one hundred answers on a questionnaire.

Statistical data provide a succinct and parsimonious summary of major patterns and are easily aggregated for analysis, while qualitative research such as case studies provide depth, detail and individual meaning.

Table 1 illustrates the differences between the two opposing strategies. The concepts are fundamental in any research.

The analyser's power for explanation, including the capability to forward new explanations, shows validity. The problem is not to add facts but to arrange facts making them understandable in their context and then better understood.

5. Conclusion

The *rules* of research strategies are seen as a guarantee that personal or cultural preferences do not govern the research result. Quantitative variables can be quantified with validity, reliability, and credibility. On the other hand, in qualitative research the validity of a statement depends a lot on who is presenting a specific statement (a privileged speaker). For example, as in Figure 1, the classroom is a platform (formation) for many discourses. The two identities, culture and communication, are examples of discourses in a mixed ethnic classroom.

The researcher's task is to make clear how the two discourses form an opinion on the world in the classroom and what social and learning consequences it might have. The activities in the discourses create boundaries on what is false and what is truth. Some become more relevant than others (perhaps even unthinkable). In this way the discourses constitute a social process. The world in the classroom also depends on what has not been said and on discourses outside the room. Together all will form some consequences that could be of interest to analyse. Perhaps, a classroom analysis will show that it is human *power* that creates the social environment because power is often linked to knowledge. Really, who has the power in the classroom? Perhaps it is someone outside the room.

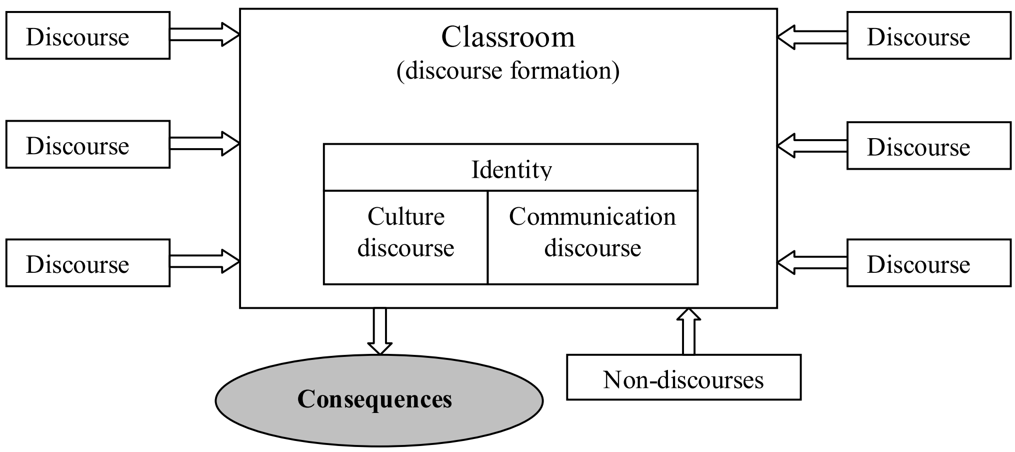

Figure 1. Classroom discourses

To give an example on how a qualitative research, according to one of the above strategies, could be another challenge.

> Being unable to recognise the difference between the spring blossom and the summer fruit, the scholar never realized that he had not experienced what he was looking for
>
> From Halcolm's Evaluation Parables

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BIOGRAPHY

Jan Horck
Captain Jan Horck has a Master Mariner examination from the Malmö Maritime Academy, 1970. He also has an “Extra Master” (Navigationslärar examen) from the University of Stockholm, 1979. From the University of Lund and the University of Malmö he has obtained academic points in mathematics, astronomy and pedagogy. In 2003 he obtained an MSc in Education at the Malmö University.

Between 1965 and 1982 he served onboard ships, of the Broström Shipping Company, in different positions. In 1980 he enrolled at the Maritime Academy in Malmö (University of Lund) as Associate Professor. In 1982 he took part in the pre-planning of World Maritime University (WMU), and in 1983 he was contracted with WMU. Presently he is a Lecturer at WMU.

His international experience includes conducting and lecturing at IMO/SIDA international courses on survey MARPOL Annex II and I and presenting papers at inter alia BIMCO, IAMU and IMLA seminars. He is also a visiting lecturer at IMO’s International Maritime Academy (IMO/IMA) in Trieste, Italy and the TUW Academy Middle East in Abu Dhabi, UAE.

Besides lecturing at WMU he has been, and is, engaged in research projects like the EU project on Harmonization of European MET systems (METHAR), EU Study Project on the Maritime Education and Training Systems of China, India, Indonesia and the Philippines (CIIPMET), Maritime Training in Malaysia and currently in the EU project on Information exchange and impact assessment for enhanced environmental-conscious operations in European ports and terminals (ECOPORTS).

Systems Approach For Effective Control Of GHG Discharge From Sea Transportation

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ABSTRACT
The concentration of green house gas (GHG) in the global atmosphere is continuously increasing year by year, and the control of anthropogenic GHG discharge is becoming a very significant problem for the human world. The Kyoto Protocol adopted by UNFCCC/COP3 requires IMO to make a GHG emission control plan of international sea transportation by 2005. This paper studies on some key issues such as emission index, control target, technological measures for CO_2 emission control, etc. from the viewpoint of systems approach. The study indicates that emission factor EF, which is defined as the CO_2 emission amount per unit transportation quantity, is appropriate for indexing the emission from ship. Regarding the emission control plan, the paper investigates some important issues from both technological and institutional aspects. The paper derives some useful formulas for EF, which represent clearly the effects of each component composing the ship system on EF. Those equations could be used for carrying out research and development systematically and effectively in order to improve the EF.

1. Introduction

The concentration of green house gas (GHG) in the global atmosphere is continuously increasing year by year, and the control of GHG anthropogenic discharge is becoming a very significant problem for the human world. As well known, the Kyoto Protocol, which has been adopted by COP3 in 1995, and is the first international plan of GHG discharge control Though the Kyoto Protocol is not yet put in force at the present of July 2004, it is the most important international plan for GHG discharge control intending to reduce the GHG discharge quantity by 6% compared to the quantity of 1990 by the commitment period from 2008 to 2012. As for the GHG discharge from the international sea transportation, the Kyoto Protocol requires IMO to make an international control plan by 2005. The IMO/MEPC, therefore, is now carrying out the investigation in the working group specially organized for this task.

[Note] COP: The conference of the parties. The parties are the nations who have signed the United Nations Framework Convention of Climate Change (UNFCCC), which has been adopted at the Rio-Summit in 1992. The COP has being held every year since 1993. The COP3 is the 3rd session of COP held in Kyoto, Japan.

In advance of GHG control, the NOx and SO_2 emission regulation is going to enter in force (19 May 2005) by the IMO MARPOL73/78 ANNEX VI. The GHG control, especially CO_2 control, however, would be more serious compared to the SO_2 and/or NOx control.

GHG	CO_2	CH_4	N_2O	Others
Discharge percentage as CO_2 equivalent	96-97 %	1.0 %	0.8 %	1.2-2.2 %

Table 1. Contribution of each GHG discharged from international sea transportation (equivalent CO_2 % counted by green house effect (S&O 2001))

Because, in the case of CO_2 emission control, there would be no measure but to reduce fuel consumption so far as ships are dependent on fossil fuels. In order to respond the CO_2 problem, therefore, it is needed to construct an international plan based on the integrated technological measures from the viewpoint of total system.

The Kyoto Protocol has designated six materials of CO_2, CH_4, N_2O, hydro fluorocarbons (HFCs), per fluorocarbons (PFCs), sulphur hexafluoride (SF_6) as the GHGs. In the case of GHGs discharged from ships, CO_2 has the overwhelming contribution compared to the rest as seen in Table 1. This study focuses, therefore, its attention on the CO_2 discharge, and firstly investigates various factors which influence the CO_2 discharge of sea transportation system. Based on this investigation, secondly, some key issues of technology and institution for $CO_{2\,are}$ considered from the viewpoint of total system.

2. Present situation of CO_2 discharge from maritime transportation

The transport sector shares the dominant part 57% of world final oil consumption in 2001 (IEA), and continuously increasing year by year. This enormous amount of oil consumption is mostly due to road transportation, and, as for maritime transportation, its consumption part is not so large. So the CO_2 discharge from maritime transportation is relatively not large viewing from the ratio to the world total, but it could not be said that absolute discharge amount is small according to the estimation by S&O (2001) as seen in Table 2.

In the Kyoto Protocol, the domestic water transportation is discriminated from the international one, and the emissions from domestic segment are counted among individual national emissions, and, as for emissions from navy ships and non-commercial state-owned ships, those are also counted among national emissions. The emissions from fishing vessels are counted into the category of "Agriculture/Forestry/ Fisheries". The ships concerned for IMO are, therefore, those ships engaged in international sea transportation.

Since all ships for international transportation use the bunkers delivered internationally, the total quantity of CO_2 emitted from international

	Discharge Quantity 10^6 tones	Percent to total world discharge
Total quantity from all ships including those for domestic transport, fishing vessels, recreational boats etc.	554.2(1995)	2.4 %(1995)
Ships for international transportation	394.7(1995), 373(1997)	1.7 %(1995) ---

Table 2. CO_2 discharge from ships and its share to total world discharge in 1995 and/or 1997

Kind of ships	Fuel consumption (10^6 tones/y)	CO_2discharge (10^6 tones/y)	Ratio (%)
Tankers	35	105	28
Bulkers	37	111	30
Containers	45	135	36
Others	7	22	6
Total	124	373	100

Table 3. Fuel consumption and CO_2 discharge of various ships (1997)

sea transportation could be calculated by the use of the data of bunkers delivered. The total emission quantity of 394.7 million tones in Table 2 was estimated by the just mentioned manner using the data of IEA Energy Statistics. The total emission quantity might be used for setting a general target of the emission reduction, but it could not give useful information required for investigating the emission control measures. In order to make a plan for emission control, it is needed to investigate the emission process of CO_2 from sea transportation systems. The Ship & Ocean Foundation has carried out a comprehensive investigation on the CO_2 emission by the procedure of summing up the fuel consumption of individual ships. The obtained results, which have been reported in S&O (2001), give the useful information. There are many kinds of ships. How does each of them contribute to the CO_2 emission? Table 3 shows the estimation of S&O (2001) mentioned above. It can be read out from Table 3 that 3 kinds of tankers, bulkers, and containers, have dominant contribution to the CO_2 discharge of international sea transportation.

3. Technological issues for planning the CO_2 control

3.1 Importance of emission factor EF as emission index

The CO_2 emission quantity Q can be expressed as follows,

In order to reduce Q, any of 3 factors in the right side of eq.(1) and/or all of them have to be reduced. If the industrial society is recognized as a hierarchical system as shown by Fig.1, Wc and L, that is, the transportation demand is dominantly determined by the economic and industrial systems, which are the higher tiers than the tier of sea transportation system in Fig.1. Wc and L are, therefore, not controllable and should be considered to be the given conditions from the standpoint of the tier of sea transportation. When the planner is investigating a reduction plan at the tier of sea transportation, therefore, there can be only one controllable factor, which is the EF in eq.(1). That is the reason why EF is very important and should be defined clearly from both aspects of quality and quantity.

$$Q = EF \cdot (Wc \cdot L) \tag{1}$$

where, EF ; emission factor which is defined as the CO_2 discharge quantity when a ship transports 1 unit cargo by 1 unit distance, that is, kg/(ton·km),

Wc; transportation quantity of cargo,

L; transportation distance.

EF can be expressed as follows by the introduction of fuel consumption FC,

$$EF = f_{CO2} \cdot \frac{FC}{Wc \cdot L} \tag{2}$$

where, f_{CO2} ; ratio of CO_2 emission quantity to fuel consumption,
FC ; fuel consumption for transporting the cargo of $Wc \cdot L$.

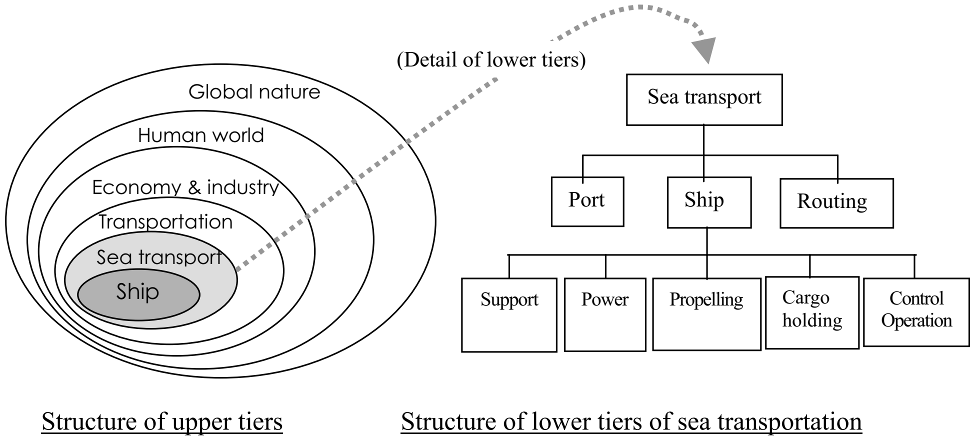

Fig.1 Hierarchical structure of human industrial society

As for marine oil fuel, f_{CO2} shows a little variation among various kinds of fuels. That is, f_{CO2} can be approximated as constant with acceptable errors for various marine fuel oils. EF, therefore, can be considered to be approximately proportional to FC. Accordingly the EF control is actually nothing but the FC control. FC has the direct effect to fuel cost, and Fuel cost is the most significant cost for shipping. Therefore the importance of EF would be understandable for the persons concerned in the sea transportation.

Thus above, viewing from both points of quality and quantity, the EF defined by eq. (2) is considered to be a reasonable and appropriate quantity as an emission index.

3.2 Technological expression of EF

What technological factors are affecting the value of EF? In order to understand the relation between EF and ship systems, here, the transportation energy performance TEP, which is defined as the fuel consumption per unit transportation quantity, that is, (kg of fuel)/(ton·km). TEP can be expressed by the next equation (Nishikawa2002).

$$TEP = \frac{FC}{Wco \cdot L} = \frac{P}{Wco \cdot V} \cdot SFC \tag{3}$$

where, Wco ; cargo loading capacity of ship,
P ; power of engine system, $FC = P \cdot (L/V) \cdot SFC$,
V ; ship velocity,
SFC ; specific fuel consumption of engine system.

Then EF can be expressed as follows,

$$EF = f_{CO2} \cdot TEP \cdot \frac{Wco}{Wc} = f_{CO2} \cdot \frac{P}{Wco \cdot V} \cdot SFC \cdot \frac{1}{\gamma} \tag{4}$$

where, γ; load factor, that is, the ratio of actually loaded cargo quantity to full loading capacity.

As can be seen, EF is strongly related with TEP. TEP is the most important technological factor affecting the ship operation cost, so that the all persons concerned in sea transportation are always making efforts for improving TEP. The data of P, V, Wco, SFC, f_{CO2} for each ship could be obtained easily, and therefore EF could be estimated easily for each ship when the load factor γis informed. As for Wco, DWT (dead weight tones) could be applied instead of Wco for tankers and bulkers, and, for container ships, it would be better to adopt the containers' number Nc instead of Wco.

3.3 Measurability of EF

As mentioned above, the EF defined by eq.(2) is recommended here as the CO_2 emission index. One important characteristic required for the emission index is to be able to be measured reliably with satisfactory accuracy for individual ships in actual service. The EF could also meet to this requirement. As can be seen in eq.(2), the definition is very simple. If the data of fuel consumption and transportation quantity over a certain period, say a year, could be informed, EF can be calculated easily. As for the FC, ANNEX VI of MARPOL73/78 for NOx and SOx regulation, which will be entering in force at 19 May 2005, could be very useful. SABSTA (2004) have described as follows regarding the data of fuel consumption,

"According to regulation 18 of Annex VI… …after the entry into force of Annex VI, data will be available from 'all ports' for 'all bunker loading'. From these data a national collation could be made. The data will give: ship ID (hence type/GT/ etc.), date and place of bunkering, and quantity of type of fuel oils loaded. Each delivery will only generate one bunker receipt; so double counting will be avoided. However, the following fuel supplies will not be covered:

(a) Fuel delivered only for intra-national non-commercial usage
(b) Fuel for recreational, national only usage
(c) Fuel for military and non-commercial state-owned ships, because governments in most countries buy, store and deliver fuel for such usage. However, such data may be available from other national sources (i.e. Ministry of Defense or other national authorities).

Though the description indicates some problems as (a)-(c), those are considered to be not so serious that the data of FC of each ship could be available owing to ANNEX VI of MARPOL73/78. As for the transportation quantity, every ship should make the documents of cargo drop-offs and pick-ups at each calling port. Therefore, if any appropriate soft ware tool and data management system for the collection of those documents have been developed, the data of [Wc·L] could be also available by the use of those collected transportation documents. The ratio f_{CO2} of fuel oil, as mentioned by SABSTA (2004), does not vary so much that average value of f_{CO2} could be applied for all marine fuels. For example, S&O (2001) has adopted the value of 2.999kg-CO_2/(kg of fuel) for bunker oils.

Thus above, the emission factor EF would be available for individual ship by the use of her bunker receipts and cargo transportation documents.

4. Institutional issues for CO_2 emission control

4.1 Decision of emission control target

As for the emission control target of whole international sea transportation, its decision seems to be not so difficult, because it could be decided corresponding to that of Kyoto Protocol both for quantitative target and time schedule. Following the decision of whole target, the next step is to assign the individual target to each ship according to the whole target. This assignment to each ship would not be so simple as the whole target decision. Here two points are discussed. One is the method for setting the individual target of each ship, and two is who should be responsible for managing the emission of each ship according to the target.

4.1.1 Use of EF for target of each ship

As for the whole target, it would be possible to decide the target by the emission amount, but as for individual ship target, it is considered to be appropriate to adopt not an emission quantity but a value of EF. Because working condition and transportation quantity of each ship are varying now and then. Target setting of EF should be made taking into account of the relation with the whole target. Introducing the following quantities,

KEF* is the ratio of EF at target year to that at base year. It would be better to adopt not the value of EF but the ratio KEF* as the target. If the future transportation amount (Wc·L)t is predicted to increase compared to the base year, the target ratio KEF* should be decided to be more strict corresponding to the increase of transportation quantity as expressed by the above equation.

k

Qt·b, Qt·t ; the total CO_2 emission amount at base year and target year, respectively,

EFave·b, EFave·t ; average value of EF for all ships at base year and at target year, respectively,

(Wc·L)b ; total transportation amount at base year,

(Wc·L)t ; estimated total transportation amount at target year,

then, the next relation can be derived from eq.(1). The ratio Qt·t/Qt·b , which should be of course less than 1, corresponds to the whole target of emission control.

$$KEFave^* = \frac{EFave \cdot t}{EFave \cdot b} = \frac{Qt \cdot t}{Qt \cdot b} \cdot \frac{(Wc \cdot L)b}{(Wc \cdot L)t} \qquad (5)$$

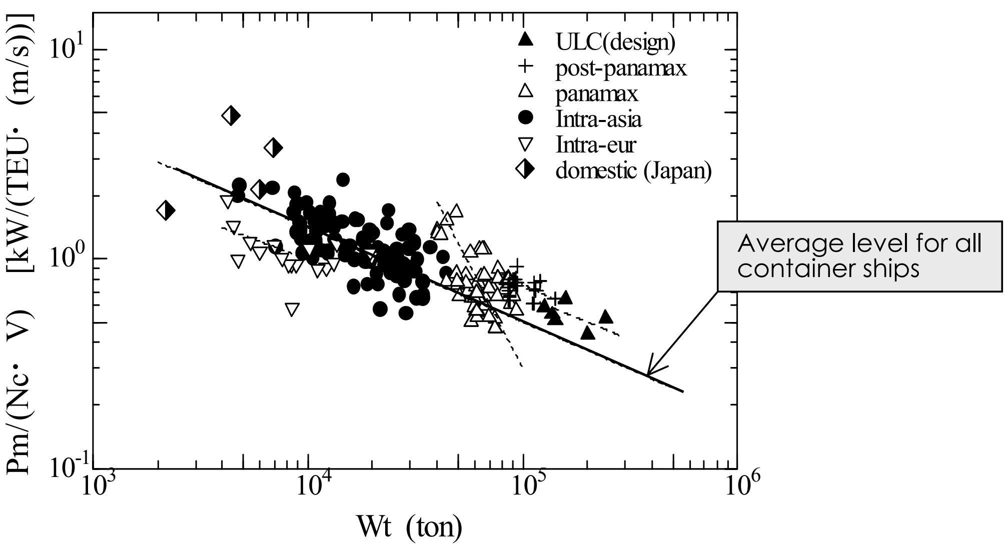

Fig. 2 Relation between Pm/(Nc·V) and Displacement Wt for container ships

How should the individual target be assigned to each ship? It seems to be reasonable and feasible to adopt the KEFave* as the average target for all ships. But EFs of individual ships would be scattering. Some ships have better EF and the others have worse EF compared to the average. Therefore, it would be reasonable that individual target of each ship is assigned taking into account her EF at base year. In order to do so, it would be convenient to introduce a weighting coefficient α for assigning the individual target KEFind*, that is,

$$KEFind^* = \alpha \cdot KEFave^* \qquad (6)$$

α could be given by the value proportional to the deviation of each ship's EFind from EFave·b, for example, by the use of the below relation,

$$\alpha = k \cdot (EFav \cdot b - EFind \cdot b) \qquad (7)$$

The constant k would be arranged from political aspect rather than technological aspect.

The EFave·b can be obtained according to the statistical analysis of many ships' data. As an example, let us investigate the data of container ships. EF is expressed by eq.(4). In eq.(4), f_{CO2} is almost constant and SFC is the engine performance, so that the most important term affecting EF is P/(Wco·V). Fig.2 shows the trend of this term of container ships. In the figure, loading capacity Wco is expressed by container number Nc (TEU), and P is represented by main engine power Pm. The data plotted in the figure were collected from those references of Containerisation International Yearbook, Lloyd's Register of Ships, Data Book of Japan flagged ships. As seen, ship-size is very effective on Pm/(Nc·V) so that EFave·b has to be treated as a function of ship-size. As for the value of EFind, it could be made clear by the method mentioned previously in Section 3.3. Finally, as for load factor γ in eq. (4), annual average value of all containerships over base year could be applied.

Once the individual KEFind* has been assigned, then its value should be labeled as the individual value of each ship regardless of her owner, her flag state, her operator, etc.

4.1.2 Who is responsible for controlling the EF of individual ship?

Recently the structure of international sea transportation systems has been changing drastically. Formerly one shipping corporation had its own ships and crews, and operated and managed them by itself, that is, the shipping corporation took a comprehensive role integrating necessary functions such as ownership, ship operation, ship management, manning, etc. Nowadays, however, those component functions for international sea transportation have been individually separating from each other, and becoming to be left individually to separate corporations. The international sea transportation system is becoming a complicated transnational, trans-subjective system. This situation brings about a problem that it is becoming difficult to identify who and/or which corporation is responsible for the CO_2 emission control. The general management of CO_2 emission control plan would be carried out by IMO as the same procedure with MARPOL73/78 ANNEX VI. Actual tasks for emission control, however, have to be carried out not by IMO but by those who engaged directly in the international sea transportation. It is important, therefore, that the regulation system should be constructed by taking into consideration of the situation mentioned above.

4.2 Methodology for forwarding the emission control plan

MARPOL73/78 ANNEX VI will be entering in force at 19 May 2004 for NOx, SO_2 control. The same methods for NOx, SO_2 control could be applied also for the management of CO_2 control. In order to facilitate individual ships for achieving their emission target, it might be desirable to introduce a procedure similar to that provided by the Kyoto Protocol, called as "emissions trading". That is, when a ship could achieve her emission reduction in excess of her target, she can transfer a part of the emission reduction quantity to another ship and/or, to the contrary, a ship can acquire some emission quantity from another ship and can add the quantity to her emission reduction quantity. Of course, this emissions trade should be allowed as far as the trade can contribute to promote the emission control of international sea transportation.

5. Technological measures for EF control

It could not be avoided that all ships will be required to reduce CO_2 emission in near future, so that it is important to investigate technical factors affecting the EF improvement. Let us investigate a bit more precisely the technological meanings of previous equation (4). Ship resistance R, and engine power P can be expressed by next equations, respectively,

The technological meaning of each term in the right side of eqs. (10,11) are as follows,

R/Wt; Resistance performance. It is influenced by the hull design and, further, when a ship is in service in actual sea area, it is influenced by various conditions such as wave motion corresponding to sea state, hull surface fouling, etc. So, those measures such as weather-routing, hull maintenance, propeller maintenance etc. are effective for EF improvement.

η; Total propulsion efficiency. It is influenced by propeller efficiency, transmission efficiency, hull efficiency, and propeller roughness.

$$P=(R \cdot V)/\eta \tag{8}$$

$$R = Ct \cdot (\rho/2) \cdot Sw \cdot V^2 \tag{9}$$

Introducing these relations to eq.(4), then,

$$EF = f_{CO2} \cdot \frac{R}{Wt} \cdot \frac{1}{\eta} \cdot \frac{Wt}{Wco} \cdot SFC \cdot \frac{1}{\gamma} \tag{10}$$

$$= f_{CO2} \cdot \frac{\rho}{2} \cdot Ct \cdot \frac{Sw}{Wt} \cdot \frac{1}{\eta} \cdot \frac{Wt}{Wco} \cdot SFC \cdot \frac{1}{\gamma} \cdot V^2 \tag{11}$$

Further, the following relation can be derived,

$$\frac{Pm}{Wt \cdot V^3} = \frac{\rho}{2} \cdot \frac{Sw}{Wt} \cdot \frac{Ct}{\eta} \propto \frac{Ct}{\eta \cdot \Delta^{1/3}} \tag{12}$$

where, Ct ; total ship resistance coefficient,
Pm ; power of main engine
R ; total resistance of ship,
SFC ; specific fuel consumption of engine system
Sw ; hull wetted area
Wt ; total weight, that is, displacement tones of ship
η ; efficiency of propulsion system
ρ ; density of sea water,
Δ ; displacement volume

Wco/Wt; Cargo loading performance. In case of those ships transporting low density cargoes such as container ship, car carrier, ferry, design considerations of hull structure are very important for the improvement of this performance.

SFC; Powering performance. It is nothing but the efficiency of engine system. The engine system should be considered to be included, here, all machines installed on board not only main engine but also auxiliary engines and boilers.

V; Ship velocity affects strongly EF. Speed-down is one of most effective and easy measure for EF improvement. On the other hand, since speed-down induces the increase of time cost for transportation, speed-down measure would require the cooperation of operator and shipper.

γ; When fully loaded, γ=1. In case of tanker and bulker, γ≒1 in in-voyage, but γ=0 in out-voyage, so average value of γ equals nearly to 0.5, so that, for tankers and bulkers, the possibility of γ improvement would be little for EF control. For container ships, however, making efforts for γ improvement is very important and effective for EF improvement.

The term $Pm/(Wt \cdot V^3)$ of eq.(12) expresses the combined performance of resistance and propulsion of ship. In case of tankers and bulkers, there is almost no room for improvement of cargo loading performance Wt/Wco, so that the performance $Pm/(Wt \cdot V^3)$ is very important for them. Fig.3 shows the data of tankers, bulkers, and container ships. The performance of tankers and bulkers is almost same with each other. On the other hand, the performance of container ships is better compared to tankers and bulkers. Size-up is very effective, as well known, for improving this performance for all ships.

Almost all components composing the ship system are expressed clearly and can be understood how they affect the EF by eqs.(10-12). These equations, therefore, would be useful for the effective and systematic considerations in order to improve the EF.

6. Conclusion

Kyoto Protocol of UNFCCC has required IMO to make the GHG control plan of international sea transportation by 2005. From the viewpoint of systems approach, a study was carried out here about some key issues such as CO_2 emission index, control target, technological measures for CO_2 control. The results are summarized as follows.

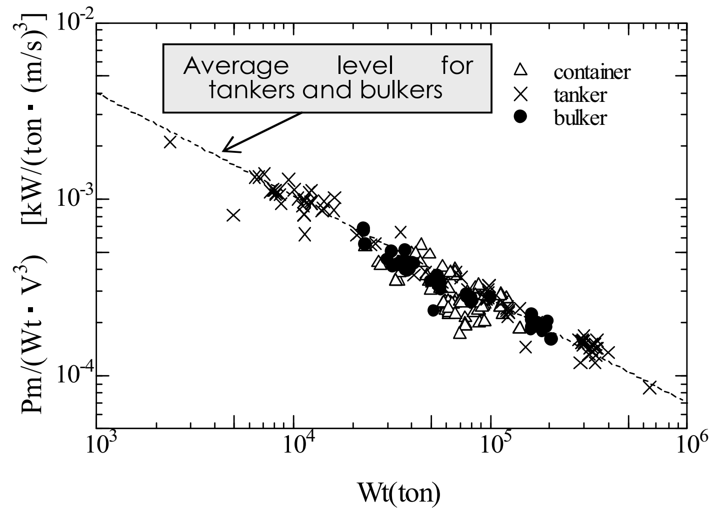

Fig.3 Resistance and propulsion performance of tanker, bulker and container ship

* The emission factor EF defined by emission amount per unit transportation quantity is considered to be an understandable and reasonable emission index.
* As for emission control target, KEF*, which is the ratio of EF at target year to EF at base year, seems to be an appropriate scale, and the target value KEF* should be decided taking into account the trend of future transportation quantity.
* Equations(10-12) have been derived. These equations express clearly how any component of ship affects the EF. Those equations could be useful for carrying out research and development for EF improvement.

Taking into consideration the recent situation of climate change due to GHGs pollution, the GHG control will be becoming an inevitable task for sea transportation in very near future. The study carried out here could propose only some fundamental ideas for the CO_2 emission control of international sea transportation. In order to make a control plan and to put the plan into practice, further concrete and practical investigations are required. It is hoped that above results obtained here could be useful for those further investigations.

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BIOGRAPHY

Systems Approach for Effective Control of GHG Discharge from Sea Transportation

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Dr Eiichi Nishikawa was a professor of the Kobe University of Mercantile Marine for many years and has retired from it at March 2004 under the age limit. He had been engaged in the Propulsion Systems Laboratory in the Marine Engineering Department of KUMM during the entire time. He had been engaged also in research works and education on energy-and-environment problems in the graduate courses of KUMM. He is now a Professor Emeritus of KUMM. He was a visiting professor of the World Maritime University and gave a lecture on Transportation Vehicle technologies for the years from 1996 to 2003.

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Automatic Identification System And Its Integration On The Great Lakes And St. Lawrence Seaway

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Student Presentation

Executive Summary

The Automatic Identification System (AIS) has been characterized as the greatest advance in navigation safety since the invention of radar. Currently every commercial vessel greater than 300 gross registered tones (GRT) transiting through the St. Lawrence Seaway must be equipped with AIS. A final report on the AIS, focusing on the positive and negative aspects of the system on the Great Lakes and St. Lawrence Seaway's shipping industry, has been thoroughly researched and compiled.

The AIS is a shipboard broadcasting transponder system, operating on the very high frequency (VHF) Maritime radio band. It is capable of sending and receiving vessel information, including: course over ground, speed over ground, latitude, longitude and distance to nearby vessels.

To fully understand the potential of the AIS, a background regarding the point of view of vessels, shipping companies, and shore based seaway operations is needed. Industry has been polled to get first hand views and opinions of how AIS has affected them in short and long-term objectives and day-to-day operations. The report also outlines and discusses the technical aspects of the Automatic Identification System, concerning its complete operation within the ship-to-ship and ship-to-shore based infrastructures.

This report proves that the AIS greatly benefits the shipping industry, for both shipboard and shore based trade, with positive aspects far outweighing any negative aspects arising from the implementation of the system. With the great success of AIS in the shipping industry on the Great Lakes and St. Lawrence Seaway so far, the recommendation is that the AIS be implemented on all commercial vessels transiting the Great Lakes and St. Lawrence Seaway. The primary role of this implementation is to utilize AIS as an aid to navigation safety, and secondary as a way to improve the efficiency of the shipping and related industries on the Great Lakes and St. Lawrence Seaway.

Table of Contents

List of Abbreviations:

AIS	Automatic Identification System
VHF	Very High Frequency
GRT	Gross Registered Tonnes
USCG	United States Coast Guard
VTCC	Vessel Traffic Control Center
ETA	Estimated Time of Arrival
SLSMC	St. Lawrence Seaway Management Corporation
SLSDC	St. Lawrence Seaway Development Corporation
ECDIS	Electronic Chart Display Information System
MMSI	Maritime Mobil Service Identity
TDMA	Time Division Multiple Access
DSC	Digital Selective Calling
GPS	Global Positioning System
DGPS	Differential Global Positioning System
VTS	Vessel Traffic Services
IMO	International Maritime Organization
UTC	Universal Time Coordinate
CPA	Closest Point of Approach
ECS	Electronic Chart System

1.0 Introduction

1.1 Purpose

The Automatic Identification System (AIS) is a shipboard broadcasting transponder system operating on VHF Maritime radio band. It is capable of sending and receiving vessel information, including; course over ground, speed over ground, latitude, longitude, distance to nearby vessels fitted with the automatic identification system, etcetera.

The purpose of this report is to illustrate the effects that the Automatic Identification System has on the shipping industry within the Great Lakes and St. Lawrence Seaway.

1.2 Background

Sollosi (United States Coast Guard, February 11, 2003) states "The Automatic Identification System has been characterized as the greatest advance in navigation safety since the invention of radar." Currently every commercial vessel over 300 GRT must be equipped with an AIS system in order to transit through the St. Lawrence Seaway.

1.3 Scope

To understand the AIS, the aspects and improvements dealing with respect to safety and improved efficiency to the shipping industry must be compiled and analyzed. The point of view of vessels, shipping companies, and shore based seaway operations will help us to better understand the benefits this system has throughout the Seaway. Technical aspects of the AIS concerning its operation with the ship and shore based infrastructure are discussed in detail.

1.4 Methodology

In order to find the necessary information to explain this system, a number of informational resources have been utilized. Internet websites and documents from various companies and management corporations related directly to the St. Lawrence Seaway have been collected. For example, the St. Lawrence Seaway Management Group, United States Coast Guard (USCG), Canadian Coast Guard, Seaway Management Transport, etcetera. A number of emails and surveys have been established with the companies, raw material and opinions have been gathered and processed.

1.5 Resource Requirements

For completion of the technical report, a number of resources have been used to develop such an in-depth paper. These resources include: classroom space for various group meetings, computer and Internet access for research and word-processing of the report. Also, human resources have been used such as interviews and e-mails conducted with experts involved in the St. Lawrence Seaway shipping industry.

2.0 Implementation Overview

Since March 25, 2003 the shipping industry on the St. Lawrence Seaway has been greatly altered with the mandatory implementation of an Automatic Identification System (AIS) on every commercial vessel over 300 GRT (USCG, 2002). Through integration with Vessel Traffic Control Centers (VTCC) throughout the St. Lawrence Seaway, it has greatly enhanced safety within the seaway to avoid collisions, groundings, changes in navigational aids and up to date weather conditions at strategic locations. It has not only enhanced safety, but also the efficiency of the seaway by allowing users to foresee navigational risks such as meeting points with other ships, turning points and lock orders. This is not to say that the AIS system is without faults and imperfections. Throughout the report we will weigh the positive and negative aspects of the system, and give our educated opinion on whether the implementation should be mandatory for the rest of the Great Lakes.

2.1 Background of AIS

Over the past decade, there has been a growing demand for an effective and reliable vessel identification system for the St. Lawrence Seaway, as well as world vessel management. Governments, for the most part, have led in shaping the technology and its applications.

In the past, the Seaway has relied solely on visual, cameras at the locks for instance, and predictive vessel movement information. Vessel arrival times were received at various locks and call-in points and entered into the VTCC. This would then drive the graphic displays, vessel models over the river, using a dead reckoning method. Vessels would move on a predetermined track based on their estimated time arrival (ETA) for the next location. This has been the process used for over 20 years throughout the Seaway (A. Godard, personal communication, May 5, 2004).

On February 5th, 2000, the Saint Lawrence Seaway Management Corporation (SLSMC) and its counterpart, the Saint Lawrence Seaway Development Corporation (SLSDC), informed the world as to its intention to implement the AIS technology into its operations. These corporations completed various performance tests throughout the shipping season to ensure its proper operation throughout its system of vessels, locks, and manually operated lift-bridges. Each of the major companies that transit the St. Lawrence Seaway frequently (Upper Lakes Shipping, Algoma Marine Central, Canada Steamship Lines), received an AIS integrated system onboard-selected vessels to enhance the testing of the new system (J. P. Asquariello, 2002). The selected vessels received evaluation forms to be completed and then analyzed by the SLSMC and SLSDC to see how well the system would affect the whole seaway (Refer to Appendix A).

The next step was to develop the specific AIS message that would be broadcasted in the Seaway system, and was finalized on September 5th, 2002; this will be highlighted later in the paper. Also during this time the regulations of AIS on the Seaway were completed (See Appendix B). The AIS broadcasting and receiving antennas were installed, and conducted the AIS signal coverage testing during December of 2001. All of the network control software for the system was completed on May and the installation of the AIS shore stations equipment and network testing was concluded in July of 2002 (J. P. Asquariello, 2002). A total of nine base stations were added along the seaway, covering approximately 425 miles of canal and lakes and all integrated through a wide area network (Refer to Appendix C). Each base stations covers a 20 to 30 nautical miles radius in river waters, and 50 to 70 nautical miles on the lakes (A. Godard, personal communication, May 5, 2004).

The AIS systems onboard the carrier vessels finished and evaluated the AIS/Electronic Chart Display Information System (ECDIS) during August to November 2002. Various meetings between these major companies were held to receive their input on the system and any problems that they were noticing in the test system (J. P. Asquariello, 2002).

As with all new technologies, there are always some problems associated with it, some minor, others major. A. Godard (personal communication, May 5, 2004) discusses some problems:

> The Masters onboard the various AIS trial run vessels received evaluation forms for the system to help indicate some of the problems. Problems that arisen in the system included wrong Maritime Mobile Service Identity (MMSI) numbers for some of the vessels, heading and speeds incorrect, misplaced positions of the vessels, and incorrect information from the VTCC concerning water levels and Seaway alerts. After, specialized AIS technicians and programmers tried to work the problems out of the system, and then it was then ready for implementation on the St. Lawrence Seaway.

During the first operational season, the SLSDC reported the system conversion and operation went smoothly, and the benefits have been almost immediate. The implementation of the AIS came into effect on the start of the shipping season on March 31st, 2003. These new laws and regulations for the carriage of the AIS onboard transiting vessels have been consistent, since the majority of the ocean going vessels have already been equipped with foreign-installed units. A new law of speed enforcement on the Seaway began November 1st, 2003, as AIS provided the exact velocities of the vessels where these speed regulations are in place. For any vessels that do not have an AIS installed, there is the option of renting or purchasing a system in Montreal or Quebec before they can enter the St. Lawrence Seaway ("Sault AIS installation nears competition," 2003).

2.2 Operation of AIS

To first be able to give an educated opinion on the positive and negative aspects of the AIS, the basics of; what AIS is, how it works, the ship based and shore based infrastructure required to use AIS to its full potential, and how it has effected the St. Lawrence seaway since its implementation must be understood.

The AIS is a complex operational system, as explained by the USCG:

> To send and receive information each AIS uses one VHF transmitter, two VHF Time Division Multiple Access (TDMA) receivers, and one VHF Digital Selective Calling (DSC) receiver. A standard marine electronic communication link (IEC 61162/ NMEA 0183) to its shipboard display and sensor systems is also installed in the AIS. (USCG, 2002)

The input for position and timing into the AIS is normally done through the Global Positioning System (GPS) receiver, which may be integrally built into to system or and external GPS connected to the AIS. The Differential Global Positioning System (DGPS) is used for precise positions in costal or inland waters, such as on the Great Lakes and St. Lawrence Seaway.

The AIS is a transponder, as well as a receiver. The transponder normally works in an autonomous and continuous mode, always updating its last transmission. The transmission will be broadcasted continuously, regardless of whether it is operating in the open seas or costal or inland areas. "All of the transmissions are broadcasted over 25 or 12.5 KHz channels using 9.6 Kb GMSK FM modulation and HDLC packet protocols" (USCG, 2002). The AIS only requires one channel to operate, but is more precise with multiple channels. To avoid any interference problems over the channels, the AIS uses a station for transmissions and a station for receiving information. As the vessels will be on route to their required destinations, they will come into and out of the different stations. The AIS automatically corrects itself so the channels can be shifted without any communication loss between the station, itself, and other vessels. The system will continuously give precise information even in highly overloaded situations (The complete guide to AIS, 2001).

The AIS range of coverage is similar to that of VHF radio. It depends mainly on the height of the systems antenna. Longer wavelengths cause the system to have better propagation than radar. The normal range is approximately 20 nautical miles, however, atmospheric and weather conditions can greatly affect this value to a much lesser or greater extent (USCG, 2002).

2.3 AIS Display Information

There are several categories of information displayed by an AIS, depending if it is integrated with an ECDIS, or if the ship is in a Vessel Traffic Services (VTS) zone, which also incorporates an AIS setup such as the one on the St. Lawrence Seaway. The information may include all or part of the following:

- Static data
  - The ships International Maritime Organization (IMO) Number
  - MMSI number
  - Call sign and name of the vessel
  - Length and beam
  - Type of ship
  - Location of position fixing antenna on the ship

- Dynamic data
  - Ship's position with accuracy indication to 1/1000 of a minute and integrity status
  - Time in Universal Time Coordinated (UTC)
  - Course over ground to 1/10 of a degree
  - Speed over ground to 1/10 of a knot
  - Heading from gyro input
  - Navigational status (underway, anchor, etc)
  - Rate of turn

- Voyage related data
  - Ship's draft
  - Hazardous cargo and type of cargo
  - Destination and Estimated Time of Arrival (ETA)

- Safety messages
  - Sent as required

Static data is programmed into the unit when the system is commissioned onboard the ship. The information is transmitted every six minutes or when requested from a VTS operator. The dynamic data is derived from other navigational equipment onboard, such as GPS, gyrocompass, rate of turn indicator, speed log, and can also be entered manually. The update rates vary from every two seconds to every three minutes depending navigational status and speed. This voyage related data is entered manually by the master or officer of the watch through a password protected procedure and the information is transmitted every six minutes or when requested. The safety messages are entered manually and sent out as required. The AIS is also capable of sending brief text messages from ship-to-ship, ship-to-shore and shore-to-ship. These messages can include notice to mariners, navigational warning, weather forecasts, tides and currents, search and rescue communications, and instructions from VTS. Some examples of how this text messages are utilized on the St. Lawrence seaway are; obtaining lock orders, water levels in the river, current traffic, seaway alerts, ice conditions in the seaway, wind speed and heading on lock walls and any other relevant information for transiting the seaway (The complete guide to AIS, 2001).

2.4 Associated Costs of AIS

The implementation of this new navigational technology has been costly on all aspects. Over the first three years, the overall project cost was approximately $2,400,000 Canadian. This cost has been shared equally between commercial carrier users and the two seaway management corporations. During the transits on four legs of the seaway, upbound / downbound the Welland Canal and upbound / downbound Montreal-Lake Ontario, each shipowner is required to pay a fee of $0.06 Canadian for every GRT of the vessel. This annually totals $5000 per vessel and this levy was mandatory since May 1, 2001 ("Shipboard automatic identification system displays: meeting the needs of mariners," 2003).

The cost of AIS transponders varies with the manufacturers and the options available. The basic price ranges from $15,000 to $25,000 Canadian. The estimated AIS unit cost for 2007 in expected to drop significantly, between $12,000 to $15,000 Canadian per unit. Since the approval of the universal standards, more and more manufactures worldwide are making the product available in the market place ("Shipboard automatic identification system displays: meeting the needs of mariners," 2003).

2.5 AIS: Pros and Cons

As with any new development in technology, the Automatic Identification System has been examined from many different aspects. Some people focus on the advantages that would result from the implementation of the system, while others are concerned with the disadvantages that could occur. To fully understand the application of this new technology as a whole, both the pros and cons of the system must be taken into consideration. To do this, the point of view of the navigator, as well as shore based seaway operations, will help us to better understand the effects that this system has throughout the Seaway.

When the AIS is implemented onboard a vessel, it has a number of potential benefits for the navigator. The officer on watch becomes more aware of the situation they are faced with, because the AIS can be used as an additional navigational aid. It displays the actual movements of other vessels, unlike radar, which will allow the officer to more effectively predict the movements of the other vessel. The system provides instant identification of ships that are fitted with AIS in the area, therefore radar targets can be easily identified. This is very important in avoiding “target swapping” on the radar when two vessels pass close together, because the ships can be identified from the AIS (“The complete guide to automatic identification system”, 2001). Instant identification is also valuable when contact is being made with other vessels in the vicinity, especially for collision avoidance. It allows the officer to call the appropriate vessel by VHF to make collision avoidance plans, eliminating the problem of making plans with the wrong vessel (“Shipboard automatic identification system displays: meeting the needs of mariners”, 2003). Another benefit of having the system onboard is the capability of knowing whether or not a ship is around a bend, behind an obstacle or suppressed in the radar shadow of another vessel or heavy rain/sea clutter, where the radar would not be able to detect the other vessel. This can be very useful in collision avoidance, especially in areas of high traffic density. The opinion of Captain Peter Schultz of the M/V Peter R. Cresswell during the initial trails of the AIS confirms these benefits. Captain Schultz (personal communication, August 4, 2002) writes:

> We had ‘first contact’ with the Canadian Prospector this morning. We picked them up at 18+ miles and had them still at 35+ miles. This was during a particularly heavy and violent thunderstorm so in better conditions the ranges may be substantially higher. We were able to maintain plot on them despite the rain/lightening, we lost track on all other ARPA targets and all the differential stations. The rain clutter was such that we couldn’t see much of anything. We both felt that this was a benefit but that the real bonus would be in the Seaway when we could ‘see’ round corners and past locks to the true position of opposing traffic.

The AIS can also be used for collision avoidance when other vessels are in the vicinity by determining the predicted time and place of Closest Point of Approach (CPA) with the other vessels. If a vessel changes course, the AIS can almost immediately determine the heading change, unlike ARPA, which requires time for calculations. AIS gives ship movement information in real time, for example, if the vessel is accelerating, decelerating and the rate of turn (“The complete guide to automatic identification system,” 2001). The system allows the exchange of information between ships, including vessel’s destination, ETA, loading condition, etc, and between ship and shore. Eventually, with the automatic exchange of information, voice traffic on VHF radio will be reduced (“Shipboard automatic identification system displays: meeting the needs of mariners,” 2003).

The implementation of the Automatic Identification System also has a number of benefits for the VTS center controller. It provides instant identification of radar targets, providing information about the ship and cargo, and helps to prevent the danger of “target swapping”. When interfaced with an ECDIS, it will display the exact position of the ship on the map. This will help in the quick response to safety and marine pollution incidents (“Shipboard automatic identification system displays: meeting the needs of mariners,” 2003). It will also allow controllers to schedule vessels through the system more efficiently, because they have a better idea of where ships are in relation to others, allowing vessels to reduce their transit times, and also save on fuel costs. The total vessel savings from this is estimated to be $400,000 Canadian per year ("St. Lawrence Seaway fields first AIS technology on inland waterway in the world," 2002). In the event of bad weather or interference when the radar picture is impaired, the AIS will provide constant coverage, identifying the location of a ship even when the radar does not. The system is also useful in identifying the location of a ship when it is behind an island or obstacle. One benefit that is of great importance to the VTS controller is the capability of the system to automatically log all data ("The complete guide to automatic identification system," 2001). This is extremely important in situations where collisions or incidents of any type have taken place, because it provides evidence of what occurred during the situation. The incident can be recalled for any time, date, area and vessel. This capability has also been extremely useful for the Transportation Safety Board. The AIS is also beneficial because of its ability to send information automatically to all ships in the vicinity, including port data, weather forecasts and safety messages. Certain information, including water elevations, wind speed and direction, visibility and lockage schedules can also be sent to vessels with the proper add on to ECDIS or Electronic Chart Systems (ECS) ("Shipboard automatic identification system displays: meeting the needs of mariners," 2003). The ability to send and receive information between shore-to-ship may reduce the amount of radio communications by almost half (Sollosi, 2003). Using AIS to send messages can also help reduce misunderstood messages between ship-to-shore. The VTS controller can monitor the speed of the vessel at any time using AIS technology, and this can be of importance in regions where speed limits exist. The traffic controller will be automatically informed when the vessel is over the allowable speed, therefore they can quickly ask the vessel to reduce speed. Speed monitoring can also help in determining meeting areas, because the system will detect when the vessel speeds up or slows down. The AIS system also provides security benefits, because a vessels exact position in the seaway or on the lake can be determined at all times ("Shipboard automatic identification system displays: meeting the needs of mariners," 2003).

There is bound to be a number of problems arising from the implementation of any new development in technology. This is also true for the AIS. There are a number of problems associated with shipboard use of the system. One of the main concerns is the over-reliance in this new technology. Officers may put too much trust in the system, and not cross check information with other navigational aids. This could eventually lead to a poor navigational watch, where officers rely on the information presented to them on a screen, rather than looking out the window for visual observations. Not all vessels carry an AIS unit, especially small pleasure craft. These vessels will not be represented on the AIS display, therefore a proper watch must be maintained. Training is another important issue on board. Officers may think that the AIS is basic, but they may not be aware of all the capabilities, limitations and operations provided by the system. Many officers do not receive proper training informing them of these aspects, which could present problems in AIS use. The need for input of information by the ship's crew may pose a problem, especially on busy vessels where there is only one person in the wheelhouse. The AIS unit should not interfere with the safe operation of the vessel, by occupying the officer for information input ("Shipboard automatic identification system displays: meeting the needs of mariners," 2003).

There are also a number of problems experienced by the VTCC. One of the more common problems experienced at the VTS stations is receiving outdated voyage related ship data, such as draught, destination and ETA. Certain features can be misused, for example, the 'safety related messages' feature. It was found that some difficulties were encountered on ships receiving safety related broadcast messages and binary broadcast messages. In some instances dynamic data, such as the ship's heading, had a large error. Static data may also be faulty, caused by incorrect input of information including ship's name and MMSI number. Input of information from the ships sensors may be incorrect as well (Norris, 2004).

Along with the information problems experienced, there are also a number of technical problems. There may be interference caused by the AIS and VHF antennas placed in the wrong positions. When the system is interfaced with other navigation equipment, it may be operated incorrectly (Norris, 2004). The information provided by AIS and other navigational aids, such as radar, may not be identical (for example, another vessel's position). Also, with implementation, the equipment may not always be compatible with new AIS models, causing problems with the broadcasted information. This is a problem, because seaway centers require a DGPS and Gyro signal ("Shipboard automatic identification system displays: meeting the needs of mariners," 2003). Shore based networks that receive and decode information have determined that many AIS units are improperly programmed. If the AIS unit is installed incorrectly, the system will not perform as well as other units (Norris, 2004). Certain problems, such as incorrect data input, may cause the unit to function improperly, or it can be disabled from the vessel intentionally, therefore the ship will not be visible to other ships in the area ("Shipboard automatic identification system displays: meeting the needs of mariners," 2003).

Security is also a large concern with the implementation of the system. Everyone who owns an AIS unit has access to the information it provides, and sometimes this information is used inappropriately. Terrorism is now a huge concern, and the AIS unit could be used to determine which vessels are best to attack. Also, the data entered in the unit can be easily altered, or the unit can be turned off, making it impossible for authorities to track a certain ship using the AIS (Ramsvik, 2004).

3.0 Conclusions/Recommendations

There are many results and factors that provide evidence that the AIS should be maintained on the Great Lakes – St. Lawrence Seaway water system and expanded to all commercial vessels, regardless of the tonnage. This is because of:

- Increased navigational safety
- Well-organized canal and river transits
- Improved national security of ports and states along the seaway
- Increased awareness of weather information
- Reduced congestion of unnecessary radio communications
- Enhanced awareness of VTCC during dense traffic periods
- Saved money through increased efficiency

All of the advantages greatly outweigh the disadvantages. This is why the system should be maintained and used to maximize these advantages. Also, research should be continued to provide a better operational system to fix any of the minor problems currently affecting AIS.

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Appendix A: AIS Evaluation Form

Evaluation Form – Participating Vessel

Instructions: *This form is to be completed by each AIS-equipped vessel when transiting the Seaway during AIS-ECDIS trials. [Note: only one form is required per transit (i.e., upbound or downbound)]*

Vessel (circle which one)

Algoma Central	Canada Steamship Lines	Upper Lakes
M/V Algoville	M/V Nanticoke	M/V Canadian Olympics
M/V Algo Cape	M/V Niagara	M/V Canadian Progress
M/V Peter R. Cresswell	M/V Paul J. Martin	M/V John D. Leitch
		Montrealais
SLSDC	Portable Piloting Systems	Quebecois
M/V Robinson Bay	SLSDC #1 Vessel ____________	Pilot ______________
	SLSDC #2 Vessel ____________	Pilot ______________

Date	Traffic Control Sector		Entered (time)	Departed (time)
________	1	Lake St. Francis (Pt. Mouillee) to St. Lambert Locks	______	______
________	2	Bradford Island to Lake St. Francis (Pt. Mouillee)	______	______
________	3	Crossover Island to Bradford Island	______	______
________	4	Mid-Lake Ontario to Crossover Island	______	______
________	5	Port Weller – Mid-Lake Ontario	______	______
________	6	Welland Canal	______	______

AIS Communications

With Other AIS-equipped Vessel
Name of Vessel(s) ________________________
Location/distance from vessel _________/_______
Time first acquired___________

Status of Comms
__ Continuous
__ Intermittent
Time when lost _______
Time regained _______
__ Not Operational

With Seaway TMC
Time first acquired ______
Ownship location in Seaway ______

__ Continuous
__ Intermittent
Time when lost _______
Time regained _______
__ Not Operational

AIS Information Received from Other Vessels (check all that apply)

Vessel Name _________________
__ Speed
__ Course
__ Length
__ Draft
__ Beam
__ Status
__ ETA
__ Other _________

Vessel Name _________________
__ Speed
__ Course
__ Length
__ Draft
__ Beam
__ Status
__ ETA
__ Other _________

AIS Information Received from TMC (check all that apply)
__ Wind
__ Weather
__ Water level
__ Water flow
__ Lockage order
__ Lock times
__ Other ____________________________
__ Other ____________________________

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Most Useful AIS Features (check all that apply; number the top three)

Comments:

__ __ Comparison to radar/ARPA target
__ __ Location in waterway
__ __ Vessel speed and course
__ __ Traffic scheduling
__ __ Reduced voice communications
__ __ Ability to make navigation decisions earlier
__ __ Other ____________________________
__ __ Other ____________________________

Contribution of AIS during: (for each, circle one)

Reduced visibility	Hindrance	No Effect	Helpful
Weather fronts (wind gusts)	Hindrance	No Effect	Helpful
Thunder storms/lightening	Hindrance	No Effect	Helpful
Heavy traffic	Hindrance	No Effect	Helpful
Other ______________________	Hindrance	No Effect	Helpful
Other ______________________	Hindrance	No Effect	Helpful

AIS Criticisms (check all that apply, number the 3 most critical)

Comments:

__ __ Difficult to understand/interpret AIS symbols
__ __ Lack of participation by all vessels
__ __ Screen clutter on electronic chart display
__ __ AIS system failures (specify type/nature: ____________________________________
__ __ Confusing when used with radar/ARPA
__ __ Too much useless information
__ __ Too little beneficial information
__ __ Other ____________________________
__ __ Other ____________________________

Operational Ratings of Electronic Chart – AIS Integration (circle number)

	Hindrance ←					→	Helpful				
Vessel navigation safety	-5	-4	-3	-2	-1	0	1	2	3	4	5
Bridge Resource Management (BRM)	-5	-4	-3	-2	-1	0	1	2	3	4	5
Reduced visibility navigation	-5	-4	-3	-2	-1	0	1	2	3	4	5
Improved economy (e.g., reduces transit time)	-5	-4	-3	-2	-1	0	1	2	3	4	5
Seaway traffic management	-5	-4	-3	-2	-1	0	1	2	3	4	5
Environmental information (weather, water levels)	-5	-4	-3	-2	-1	0	1	2	3	4	5
Scheduling, cargo operations	-5	-4	-3	-2	-1	0	1	2	3	4	5

Additional Comments:

Appendix B: Regulations of AIS on the St. Lawrence Seaway

Automatic Identification System

(1) Each of the following vessels must use an Automatic Identification System (AIS) transponder to transit the Seaway:

(a) each commercial vessel that requires pre-clearance in accordance with section 22 and has a 300 gross tonnage or greater, has a Length Over All (LOA) over 20 meters, or carries more than 50 passengers for hire; and

(b) each dredge, floating plant or towing vessel over 8 meters in length, except only each lead unit of combined and multiple units (tugs and tows).

(2) Each vessel listed in paragraph (1) of this section must meet the following requirements to transit the Seaway:

(a) International Maritime Organization (IMO) Resolution MSC.74 (69), Annex 3, Recommendation on Performance Standards for a Universal Shipborne AIS, as amended;

(b) International Telecommunication Union, ITU-R Recommendation M.1371-1: 2000, Technical Characteristics For A Universal Shipborne AIS Using Time Division Multiple Access In The VHF Maritime Mobile Band, as amended;

(c) International Electrotechnical Commission, IEC 61993-2 Ed.1, Maritime Navigation and Radio Communication Equipment and Systems –AIS – Part 2: Class A Shipborne Equipment of the Universal AIS – Operational and Performance Requirements, Methods of Test and Required Test Results, as amended;

(d) International Maritime Organization (IMO) Guidelines for installation of shipborne Automatic Identification System (AIS), NAV 48/18, 6 January 2003, as amended, and, for ocean vessels only, with a pilot plug, as specified in Section 3.2 of those Guidelines, installed close to the primary conning position in the navigation bridge and a standard 120 Volt, AC, 3-prong power receptacle accessible for the pilot's laptop computer; and

(e) Computation of AIS position reports using differential GPS corrections from the U.S. and Canadian Coast Guards' maritime Differential Global Positioning System radio beacon services; or

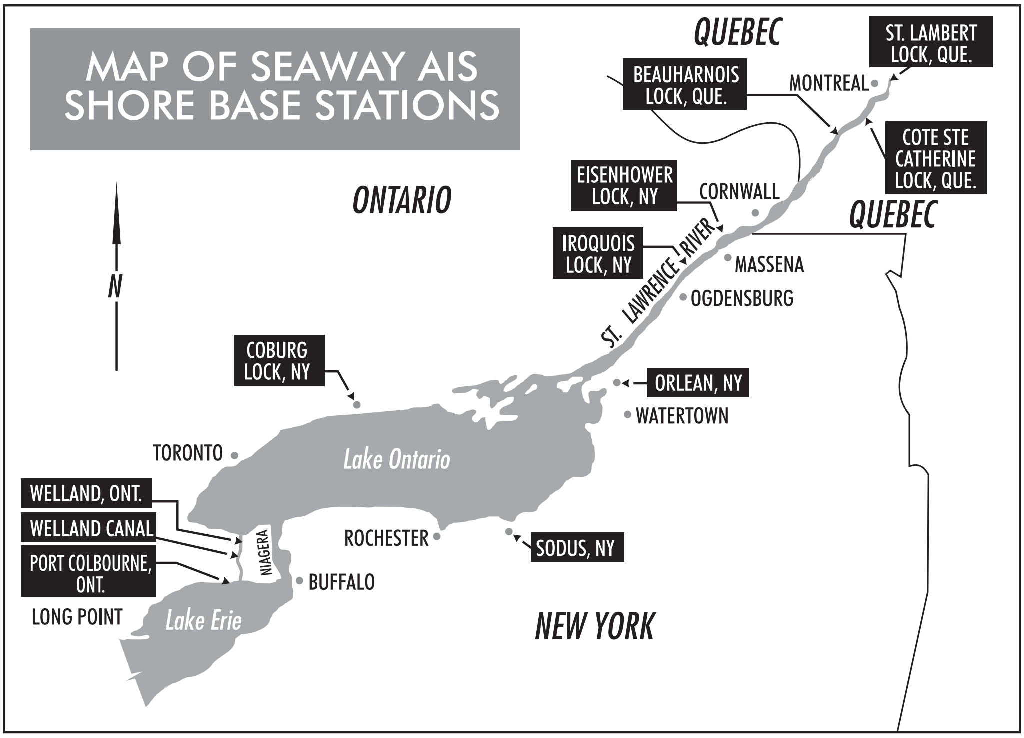
(f) The use of a temporary unit meeting the requirements of subparagraphs (2)(a) through (e) of this section is permissible; or

(g) For each vessel with LOA less than 30 meters, the use of portable AIS compatible with the requirements of subparagraphs (2)(a) through (c) and subparagraph (e) of this section is permissible.

Requirements for U.S. Waters of the St. Lawrence Seaway

In addition to the requirements set forth elsewhere in these Practices and Procedures, ships transiting the U.S. waters of the St. Lawrence Seaway are subject to the requirements set out in Schedule 1.

Appendix C: Map of the Seaway AIS shore based stations



A Study Of The Technical Treatment Within Environmental Appetency For The Ballast Water

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ABSTRACT
In accordance with adoption of new Convention for the control of ship's ballast water at the diplomatic conference held in February 2004, every country has to regulate the ballast water and deposit matters.

When this Resolution comes into effect in 2009, all vessels engaged in international voyage must have a ballast water control program, ballast water records and equipment that is suitable to the standard of exchange and performance for the ballast water.

This study estimates objectively their performances, merits and demerits of the ballast water treatment technique and exchanging techniques for safe operation of ships.

It is desirable to design an equipment to control the ballast water using the brush-type vacuum suction nonstop reverse cleaning system to overcome the clogging phenomenon and the direct disc filtering to maximize filtering area for the optimum process considering biological availabilities.

It will be expected to protect against marine pollution and to maintain clean sea if it is secured to develop new ballast water treatment techniques.

And it will also cope with the Resolution and each regulation of the developed countries from the ballast water.

1. Introduction

It brings about main issue of the marine environmental sides to destruct marine ecosystem due to coming microorganism included in the ballast water.

Therefore some developed countries like U.S., Australia and etc. are going to reinforce the regulation of ballast water discharge from the ship coming into their ports for the protection of marine ecosystem and marine environment.

The Resolution was made for the control of ballast water discharging from the ship to protect the marine environment and marine ecosystem and to minimize occurring from all kinds of danger which are generated from harmful organic substances and deposit matters.

The Resolution consists of the standard of the exchange of ship's ballast water including deposit, discharging regions, standard of discharging and treatment, survey to the control of the ballast water and required conditions for the certificate.

In accordance with adoption of new Convention for the control of ship's ballast water which was approved at the 49th Meeting of IMO MEPC held in Feb, 2004, every country has to regulate the ballast water and deposit matters.

When this Resolution comes into effect in 2009, all vessels engaged in international voyage must have ballast water control program, ballast water records and equipment that is suitable to the standard of exchange and performance for ballast water.

When the Resolution comes into effect, securing the technique of the ballast water treatment has a great influence on the receiving orders of shipbuilding. And their relevant markets in Korea, Japan, and China will become red-hot due to explosive demands of ballast water treatment equipments. That time is expected to be between 2005 and 2010. And it will be on the arena of competition of marketing those goods including technical competition for the advanced countries.

Some of companies around the world send hundreds of their samples to domestic shipbuilding yards for the prior occupation of the market in spite of incompleteness of practical use and performance.

And their kinds will be increased as their technical developing project become to produce on a commercial scale. The present technique for the ballast treatment will be versioned-up and settle down with a stabilized technique going through trial and error, but ship owners and shipyards put off selecting the equipment owing to their initial trial and error watching another company's record of performance and experiences.

Thus this study estimates objectively their performance and merits and demerits of the equipments produced inside and outside of the country about treatment technique and exchanging technique for the ballast water.

It will be expected to protect against marine pollution and to maintain clean sea if it is secured to develop new ballast water treatment technique.

And it will also cope with the Resolution and each regulation of the developed countries from the ballast water.

2. IMO's Recommendations and a Developing Tendency on the Ballast Water Treatment Technology

2.1 IMO's Recommendation

Reballasting at sea, as recommended by the IMO guidelines, currently provides the best-available measure to reduce the risk of transfer of harmful aquatic organisms, but is subject to serious ship-safety limits. Even when it can be fully implemented, this technique is less than 100 % effective in removing organisms from ballast water. Some parties suggest that reballasting at sea may itself contribute to the wide dispersal of harmful species, and that island states located 'down-stream' of mid ocean reballasting areas may be at particular risk from this practice.

It is therefore extremely important that alternative, effective ballast water management and/or treatment methods are developed as soon as possible, for the replacement of reballasting at sea. Significant research and development efforts are underway by a number of scientific and engineering research establishments around the world, aimed at developing a more complete solution to this problem. Options considered by IMO include as follows.

- Mechanical treatment methods such as filtration and separation.
- Physical treatment methods such as sterilization by ozone, ultra-violet light, electric currents and heat treatment
- Chemical treatment methods such as adding biocides to ballast water to kill organisms.
- Various combinations of the above.

All of these possibilities currently require significant further research efforts. Major barriers still exist in scaling these various technologies up to deal effectively with the huge quantities of ballast water carried by large ships. Treatment options must not interfere unduly with the safe and economical operation of the ship and must consider ship design limitations. Any control measure developed must meet a number of criteria, including as follows:

- It must be safe.
- It must be environmentally acceptable.
- It must be cost-effective.
- It must work.

One of problems currently faced by the global R&D community is that besides the general criteria above, there are currently no internationally agreed and approved performance standards or evaluation system for the formal acceptance of any new techniques developed. In addition, many groups are working in isolation from each other, and there are no formal mechanisms in place to ensure effective lines of communication among the community, governments and ship designers, builders and owners. These are vital if the R&D effort is succeed (IMO Global Ballast Water Management Program, 2003).

2.2 An Overseas Developing Tendency of the Ballast Water Treatment Technology

Recently those equipments such as ballast water treatment filtration, ultraviolet sterilization and etc. have been developed in U.S. and Europe, and it is increasingly in demand of those ones centering with passenger ships.

Global Ballast Water management Program for the developing countries is underway by UNDP and IMO. Most of those technologies are underway of testing for the stage to put them to practical use.

They are under development according to the way of mechanical, physical, chemical and etc. There are the ways of filtering and centrifugal separation in mechanical treatment. And also there are the ways of treatment by ozone, ultraviolet, electric, and heat for disinfection in physical treatment.

There are the ways of aiding chemical materials such as biocide, harmful gases and etc for chemical treatment.

The numbers of companies come to about 120 which have sent samples made by the mixed processing type such as connected filtering and sterilizing for the commercial purpose to domestic shipyards (Sang Gil Kang et al, 2003).

The matter of adoption has been left open owing to lack of reliability of those goods for the practical use and economical side and then even the classes watch the development of the situation and states of those equipments without suggesting any clear examination standard for fear of trial and error.

3. Existing Ballast Water Treatment Technologies and Assessments for Their Application

3.1 Ballast Water Treatment System

3.1.1 Ballast using treated water

As the method of the ballast water treatment using treated water, ballasting with city water and loading from the water treatment facility in port before ship's departure was suggested (Carlton et al, 1995). These two methods need piping system’s net of water and its supporting facilities to supply enough fresh water for all berths.

Because all ships need ballasting for safe operation before departure, it will be delayed to load cargos, and additionally increased charter fee and potential demurrage with additional water fee (Oemeke, D., 1999).

3.1.2 Onboard treatment under ballasting

This is the method to remove or sterilize the objective biota using filtration and sterilizing technology during loading ballast water onboard.

It should be considered first, not to hamper to ship's operation when ballasting or deballasting with balance between incoming ballast water quantity and ballast water treatment quantity. Secondly it should also not cover much space, and it needs not excessive maintenance expense (Oemeke, D., 1999).

3.1.3 Onboard treatment at seagoing

This is the method to treat ballast water during the navigation and this is also the way to put biocide into the ballast tank, or heat treatment.

The method of heat treatment is to heat ballast water using remained heat on the cooling process of engine or to heat ballast water using the heat from the exhaust gas equipments.

For the case of using biocide, the method is effective for the treatment, but there might be worry about second contamination by biocide when ship discharge ballast water.

3.2 Exist Ballast Water Treatment Technologies

The method is roughly divided up two within physical treatments and chemical treatments using sterilizing for the ballast water treatment by now.

There are filtration, hydro-cyclone, UV irradiation, ultrasonic, heat, electrolysis, electro-magnetic and etc for the physical treatment, and there are chlorine, ozone, hydrogen peroxide, copper silver ion, lack of oxygen, pH control, salt control and etc. for the chemical treatments.

Disinfection means to destruct selectively microorganisms causing sickness. In this process, it is not to kill all kinds of organisms. This is a point of difference between disinfection and sterilization, which means the destruction of all kinds of organisms.

Because microorganisms, zooplankton and phytoplankton are organisms in the end, they are go to dead underway of oxidation finally.

If we see microorganism and plankton as an organism, they consist of oxygen, carbon, hydrogen, nitrogen and etc, and then change into CO_2 and H_2O in the end when they are disintegrated with help of oxygen.

Therefore, a good oxidant gives no effectiveness to ship's safety (operation) within effective removal of aquatic lives and no harmfulness to the human body.

The broadly used methods of sterilization by now are heating (boiling) and usage of chemical chloride, ozone, hydrogen peroxide, chlorine dioxide and etc. They are representative chemicals. Among these chemicals most cheap one is chlorine, but recently it produces THM as a problem of by-product, so it is going to replace it with ozone or hydrogen dioxide, and use in parallel with chlorine and ozone.

4. Merits and Demerits of Treatment Technologies, and Analysis of Their Performance

The most difficult problem of most of ships in connection with ballast water treatment onboard is that the quantity of treatment has to be a huge capacity and volume, weight and expenses in supplement with their treatment systems.

The capacity of ballast pump of the large ship is 500 - 3000 m^3/hr, but the case of oil tanker and bulk carrier is available more than 60,000 m^3/hr.

The flow-rate decreases and ballasting time is increased because the available delivery water head of the ballast pump in the existing ship is increased by the added treatment system.

As external problems of ballast water treatment equipments, besides the problems of treatment technologies and economic expenses, the limitation of huge capacity pump onboard about the problem of applying area and space owing to such a large capacity and increased water head comes to the fore.

The ballast water treatment technologies suggested by now consist of composite connections with the greater part of primary treatment and 2nd treatment.

The primary treatment means to remove large organisms or buoyant solid bodies from the ballast water to enhance the effectiveness of the 2nd treatment.

And the 2nd treatment is defined as the process to make inactively remained organisms and to sterilize ballast water in order to satisfy for delivery.

Sometimes there is the case in which the treatment procedure between the primary treatment and the 2nd treatment is changed.

4.1 Primary Treatment

4.1.1 Filtration

Filtration is a famous technology that is effective to the sediments and various organisms as well as filtration of sand, pre-coat, membrane and screen.

The big problem when we use filtration process for the ballast water treatment is the coping capacity with the clogging.

There is a difficulty for the ship of which should treat huge capacity of ballast water in a short time. Meantime it is more difficult as international convention comes to reinforce.

Especially, if the limitation on the convention is decided less than 10μm, for the case of the ship needed to treat more than 1000 ton per hour, it needs huge size of filtration due to the loss of increased water head of the pump.

So those conditions cannot be satisfied by the generalized filtration technologies.

By the prior studies, for the effective 2nd treatment it is a prior condition that should be separated enough 50 - 100 μm solids from primary treatment.

Filtration process should have automatic reverse cleaning ability and the loss of reverse cleaning water, as a major parameter, has to be less than 1% of the total filtering water.

And the loss of the reverse cleaning water will be more increased if the size of the particle limitation of filtration is limited 10μm as the nowadays standard.

It is found that the loss of reverse cleaning water as the size of particle goes to bigger increase linearly proportion.

In order to solve these problems, disc type filtration equipment, which has maximum filtration area, was developed and is in use, but it has demerits like the problem of durability and decrease of the effectiveness of reverse cleaning.

Therefore, the standard of performance limitation about the size of biologic bodies of the international convention should be decided after considering the level of present technique and economical side and effectiveness.

And it is desirable to reinforce the standard step by step along with the extent of the development of technique.

4.1.2 Cyclonic separation

Specially designed hydro-cyclone demands less pump's delivery pressure than filtration and can separate about the 50μm of sediments and solids.

The merits of this process are that first of all its equipment is very simple and minimized the loss of pump's water head and it is not necessary for reverse cleaning.

Additionally it is effective to sterilize a part of zooplankton on inactive.

It should be studied and developed with concentration from now on, due to having various merits like compactness of volume, good for durability and simplicity of separation between solids and liquids.

But existing hydro-cyclone can't separate the solid of which specific gravity is higher than water's, and it needs additional process due to existing various benthic (bacteria, pathogen, zooplankton, phytoplankton) which is not separated from the water by cyclonic separation.

There is a demerit that now adopted treatment system is used to sterilize and then for the next process to remove solids for application other than for the primary use.

4.2 Secondary Treatment

There are many cases to use more than 2 processes including electro-chemical treatment and UV irradiation for the secondary treatment by now, considering heat, de-oxygen, high intensity ultra-sonic and low frequency, physical corrosion and shearing stress, cavitation, electro-chemical treatment, chlorine, ozone, hydrogen peroxide, and inclusion of other's biocide (Euk Jo Kim, Doctor thesis, 2003).

4.2.1 UV irradiation

Ultraviolet rays' sterilization is inexpensive and very effective in sterilization and if used in parallel with ozone, hydrogen peroxide, chloride and etc., it goes higher sterilizing effectively.

It is best using process because its equipment is simple, no problem in durability, possible to treat large capacity in series.

For the demerits, there is a possibility that a variation of biota comes out from the survivals after treatment.

If there are particle materials like sediments the effectiveness decreases and it needs to a certain degree contact time due to the effectiveness of sterilization increase exponentially.

If there are muddy materials and contaminated ones, the sterilized effectiveness decreases rapidly.

4.2.2 Heat treatment

There is a result of a study result that it is possible to perish all kinds of organism s if the heat system using exhaust heat of cooling water for internal combustion engine with large capacity heat exchanger and its piping system stays at an extent of 40°C for two days. Those studies are actively in progress.

It is a merit that does not need primary treatment like filtration, low energy consumption and a certainty of sterilization. But actually there is much limitation for practical use.

First of all it is impossible to increase more than 1000 tons of seawater from 20°C to 40°C in the side of energy balance.

And it is far from practical use to re-circulate salt water in tank to heat exchanger due to the problem of expense to set up piping system and navigation condition.

4.2.3 Ozone, chloride and other's biocide treatment

Direct chemical sterilization with ozone and chloride is the most effective and it's no need treatment equipment.

There are merits to decompose organisms as well as it can perish lives within minimum additional equipments.

The function of ozone has sterilizing power to interrupt cell's respiration and to destroy cells by intensive oxidizing power of an hydroxyl.

Chlorine is the cheapest biocide and it has a function of powerful sterilization, but there is a residue and chlorine induces THM (Trihalo-methane) causing cancer.

Even though the price is high, ozone is highlighted as a sterilizer.

The treatment equipments for ozone consists of ozone generator, pump, piping system, large reaction tank for ozone's treatment of which material is stainless steel or steel applied epoxy inside.

For the demerits, it is very corrosive and needs comparatively much operation fee and for the case of chloride it should be set a liquid chloride tank onboard.

And there is a possibility to make another kind of organisms from the unresolved ones resulted by ozone.

4.2.4 Electrolyte treatment

It's possible to sterilize effectively without necessity of additional chloride tank because of electrolyte treatment of salt water with DSA electrodes of interrelated titanium, which has no elution of electro-board generate chloride from the salt water.

The sodium chlorite generated by electrolyte is an effective biocide of which prevents revival of sterilized lives at sea due to having remaining and can sterilize continuously remaining lives.

In spite of big consumption of electric energy, the problem of energy does not matter so much because ship can use her own power economically, so it uses small size and compacted electrolyte equipment.

For the demerits, there is an anxiety of hull corrosion and it can give effect of no good to the life system by remained chlorine while ballasting overboard, and the price of the equipment is high and difficult to treat large capacity.

4.2.5 Deoxidizing treatment

The study has proceeded about the way of perishing lives caused dry up oxygen solved in salt water using ballast water by many researchers centering U.S. which does not need any kind of pre-filtration treatment and is so simple.

As sprayed salt water comes into the vacuum chamber, it delivers dissolved oxygen with difference of pressure and then it becomes the state of no oxygen where lives can't exist.

Within this process, in general the aerobe were perished completely, but compounded treat method is used with mixed engineering method because there is a problem on the phytoplankton's destroy. But there is a difficulty when applying it to the ship of which should set up a large vacuum tank onboard because ballast tank cannot be used as a vacuum maintaining room.

4.2.6 Ultra sonic or low frequency treatment

The technique of perishing lives by ultrasonic treatment or low frequency treatment induced recently is not verified completely, but test results from the laboratory looks very effective.

For the merits, this technique is operated by simple equipment with low energy, so it is economical and does not need pre-treatment and it is possible to have fixed use after setting up that one interior of the ballast tank.

While on the other there is a demerit of hull weakness of endurance due to erosion by ultrasonic equipment.

This treatment technique is a part of the up-to-date technology, which should be studied henceforth and by now in progress between industry and school from KMU.

4.2.7 Physical collision, shearing force and cavitation treatment

The Special pipe developed in Japan generates collision, cavitation and shearing force from the baffle plate posted in the high speed running salt water in order to perish lives.

Above all, pre-treatment is not necessary, more effective as running high speed, fit for large capacity, compact, easy set up progress, but it's not inspected for the practical use undergoing developing equipment.

It's a problem of endurance of equipment by collision and cavitation and has demerits that should add ozone and the other's sterilizing process to perish phytoplankton and microorganisms.

5. Conclusion

In accordance with the adoption of the international convention about ballast water management at the last diplomatic conference, all ships engaged in ocean going have to establish equipments which are suitable to the standard of performance or to satisfy the standard of ballast water exchange as provided by new convention.

It needs much time and big labors for ballast water exchange, and it's impossible to work when ships navigate shortly. There is a possibility to bring deep danger to ship's safety.

Emphasis is laid on the development of ballast water treatment technologies fundamentally.

Therefore it is required to develop techniques to satisfy the standard of treatment for the ballast water that is more reinforced.

According to the new convention of the ballast water treatment performance standard, the preliminary process needs to satisfy those standard of more than 10μm live organisms and 3cfu.

The economical and effective ballast water treatment technology development should be carried out for the satisfaction of the standard of filtration process and the subject which can filter to 10μm alive organisms by centering the sterilizing process.

It should be considered the limitation of ship's design to adopt the optimum process for the ballast water treatment. And first of all those treatment technologies should not obstruct ship's safe and economical operation.

Therefore the principle standard should be satisfied to the safety of the ship and crew, environmental acceptability, economic, and practical use.

The big problem with most ships is that they need large capacity for treatment, and its volume and weight and expense to the when ballast water treatment was carried out.

According to the capacity of ship, their due date is different, both of the exist ship and new ship should satisfy to the Regulation D-2, Ballast Water Performance Standard, of the new convention.

For the case of exist ship, available pump delivery water head increases due to added treatment system, so it generates some problems that decrease flow quantity and increased ballasting times.

Besides the problem of treatment technology and economic expense, there comes to the fore the limitation of huge capacity pump according to large capacity and increasing water head.

Onboard applying area and spatial problem come to the fore.

In this study, it is recommended to suggest optimum process for the ballast water treatment considering biologic effectiveness, application onboard onto treatment technology, through collecting data about ballast water treatment technology and conducting their performance estimation.

For the first treatment, filtration process which has automatic reverse cleaning system to remove more than 10μm alive organisms, and for the second treatment, it's a combined process united UV irradiation and electrolytic to extinct or to render inactivate remaining alive organisms in the ballast water.

Because size limitation was reinforced as 10μm at new convention to live organisms, it could not satisfy that condition by generalized filtering technology.

Therefore it is desirable to design equipment which uses disc type filtration to maximize filtering area and used brush-type vacuum suction nonstop reverse cleaning system to overcome clogging phenomenon in order to solve such as effective problems.

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Fuzzy Inference As An Approach To Safety Management System (SMS) Analysis

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ABSTRACT
Safety analysis is one of the major areas of Ship Management company activity that frequently comes face to face with a nontraditional problem of "measurements of safety". The question arises of how to estimate or measure the safety level? There is no doubt that, post-accident, *a priori* statistical analyses or Formal Safety Assessment are not effective instruments to apply in a real-time interval, especially in emergencies. The majority of problems are directly linked with the human factor, which is very difficult to formalize.

The safety analyses generally serve as decision aids. Wise decisions are essential in any safety program. Human decisions depend on numerous factors that transcend requirements and physical response, and many of these can be captured mathematically using fuzzy logic. Fuzzy logic is conceptually easy to understand in SMS applications. It is flexible. With any given SMS it's easy to massage or layer more functionality on top of it without starting again from scratch, for example: to incorporate ISPS Code procedures into the already working SMS. Fuzzy logic is tolerant of imprecise data and there is a lot of such data in shipping. Fuzzy logic can model nonlinear functions of arbitrary complexity. Fuzzy logic can be built on top of the experience of maritime safety experts and it can be blended with conventional control techniques. The most impressive feature is that fuzzy logic is based on natural language.

The paper highlights some problems mentioned above and contains the research findings on evaluation of technical and human factor impact on safety at sea using *fuzzy logic* approach and applying such factors (linguistic variables) as safety, fatigue, OOW distractions, deficiencies, near misses, skill, level of education and training, technical failures, company policy/culture, etc.

1. Introduction
Why Use Fuzzy Logic in SMS analysis?

a. *Fuzzy logic is conceptually easy to understand.* SMS must be understandable for all personnel and the mathematical concepts behind fuzzy reasoning in SMS are very simple. What makes fuzzy logic nice is the "naturalness" of its approach and not its far-reaching complexity.

b. *Fuzzy logic is flexible.* With any given SMS it's easy to massage it, or layer more functionality on top of it, without starting again from scratch, for instance to incorporate ISPS Code into SMS.

c. *Fuzzy logic is tolerant of imprecise data.* Everything is imprecise if you look closely enough, but more than that, most things are imprecise even on careful inspection. Fuzzy reasoning builds this understanding into the process rather than tacking it onto the end. So we can improve SMS and its analysis without any restrictions.

d. *Fuzzy logic can model nonlinear functions of arbitrary complexity.* You can create a fuzzy system to match any set of input-output data (Human/Technical - safety data). This process is made particularly easy by adaptive techniques like ANFIS (Adaptive Neuro-Fuzzy Inference Systems), which are available in the Fuzzy Logic Toolbox of MATLAB software.

e. Fuzzy logic can be built on top of the experience of maritime safety experts. In direct contrast to neural networks, which take training data and generate opaque, impenetrable models, fuzzy logic lets you rely on the experience of people who already understand your SMS.

f. Fuzzy logic can be blended with conventional control techniques. Fuzzy systems don't necessarily replace conventional control methods. In many cases fuzzy systems augment them and simplify their implementation.

g. Fuzzy logic is based on natural language. The basis for fuzzy logic is the basis for human communication. This observation underpins many of the other statements about fuzzy logic.

Shipping is perhaps one of the most ancient industries in the World. The statement (*g)* is perhaps the most important one and deserves more discussion. Natural language, that which is used by seafarers and other people on a daily basis, has been shaped by thousands of years of human history to be convenient and efficient. Sentences written in ordinary language represent a triumph of efficient communication. We are generally unaware of this because ordinary language is, of course, something we use every day. Since fuzzy logic is built atop the structures of qualitative description used in everyday language, fuzzy logic is easy to use.

2. Foundations of Fuzzy Logic

Is there any relation between number of near misses ***N*** on board ship and probability of an accident? The answer is affirmative. Yes, there is such a relation and we can say that if a lot of *near misses* have occurred then the level of accident probability is high.

So, let us compose a rule of the following type:

N near misses are (always … never) followed by a serious accident

Try to identify ***N*** and fill up the space between "*always*" and "*never*" by the most detailed mode. Let us link in Table 1 the findings from Mcnail & Freiberger (1993) and statistical information about *near misses* from Hojnacki (2003). In general the sentence may be formed as follows:

(N) near misses are (ADVERB) followed by a serious accident

Here is the *linguistic variable* "*near miss*" which may have 20 *values* from *always* -to- *never* interval and may be described by ***N***. The main idea is that these adverbs have no crisp borders with respect to ***N***.

The theory of Fuzzy sets, on which basic ideas have been offered by American mathematician Lotfi Zadeh, allows us to describe qualitative, fuzzy concepts and knowledge of world around and to operate with this knowledge, with the purpose of reception of the new information. The methods of construction of information models based on this theory essentially expand traditional areas of computer applications and form an independent direction for scientifically applied researches which has received the special name - Fuzzy modeling.

Modeling of SMS is a system modeling, and SMS itself is a complex system consisting of a set of components connected among themselves. In this paper we do not put forth a problem of detailed SMS analysis. We want to show only opportunities of *Fuzzy Inference System* (FIS) for solving of such tasks with respect to some aspects connected to the human factor.

Table 1. The *values* (adverbs) of *linguistic variable "near miss"*

N	ADVERBS
1	3
300	always
261	very often
237	usually
222	often
222	rather often
216	frequently
216	generally
150	about as often as not
102	now and then
87	sometimes
84	occasionally
66	once in a while
48	not often
48	usually not
27	Seldom
24	hardly ever
21	very seldom
15	Rarely
6	almost never
0	Never

Fuzzy logic starts with the concept of a fuzzy set. A fuzzy set is a set without a crisp, clearly defined boundary. It can contain elements with only a partial degree of membership.

Now consider the set of safe depths for an oil tanker with a maximum draught of 10 meters. For instance, we are considering the risk of grounding of a vessel:

Q: Is the depth 10 meters safe for navigation?
A: 0 (no, or false)
Q: Is the depth 30 meters safe for navigation?
A: 1 (yes, or true)
Q: Is depth 11 meters safe for navigation?
A: 0.5 (may be yes, but not quite as much as a depth 12 meters).
Q: Is the depth 12 meters safe for navigation?
A: 0.8 (for the most part yes, but not completely, it depends on the vessel's speed, weather conditions, and so on).

What about the depth 11 meters? It "feels" like a part of the set of safe depths, but somehow it seems as though it should be technically excluded if the keel clearance is not enough for safety. So, the above *safe depth* tries its best "to sit on the fence". Classical or "normal" sets would not tolerate this kind of thing. Either you're in or you're out. Human experience suggests something different though: "fence sitting" is a part of life, and so it is a part of safety systems.

Of course we're on tricky ground here, because we're starting to take individual perceptions and safety culture background into account when we define what constitutes the safe depth. But this is exactly the point. We're entering the realm where sharp-edged *yes-no* logic stops being helpful. Fuzzy reasoning becomes valuable exactly when we're talking about how people really perceive the concept "safe depth, safety" as opposed to a simple-minded classification useful for accounting purposes only. More than anything else, the following statement lays the foundations for fuzzy logic. In fuzzy logic the truth of any statement becomes a matter of degree.

Any statement can be fuzzy. The tool that fuzzy reasoning gives is the ability to reply to a *yes-no* question with a *not-quite-yes-or-no* answer. This is the kind of thing that humans do all the time (think how rarely you get a straight answer to a seemingly simple question) but it's a rather new trick for computers. How does it work? Reasoning in fuzzy logic is just a matter of generalizing the familiar *yes-no* (Boolean) logic. If we give "true" the numerical value of 1 and "false" the numerical value of 0, we're saying that fuzzy logic also permits in-between values like 0.2 and 0.7.

A Membership Function is presented by a curve that defines how each point in the input space is mapped to a membership value (or degree of membership) between 0 and 1.

The point of Fuzzy Inference System (FIS) is to map an input space (say, routine activities of crew members and shore staff) to an output space (say, safety) and the primary mechanism for doing this is a list of *if-then* statements called *rules*. All *rules* are evaluated in parallel and the order of the rules is unimportant. The rules themselves are useful because they

Table 2. Fuzzy features of Hazards (**Culture**)

HAZARD /Linguistic variable X(*)	T (set of values of X)	Universum of X
1	2	3
1. OOW distractions (during the watch)/ Distraction (1)	Small number Considerable number Dangerous number	[0, 20]
2. Insufficient manning/Manning (2)	Sufficient Insufficient Dangerous	[0,10]
3. Cost cutting pressure/Investments into safety (2)	Insufficient Sufficient Super sufficient	[0,100]
4. Time pressure , keep schedule/Time (2)	To be late In time To arrive earlier	[-5,5] [hours]
5. Tired, pressure, not sufficient rest /Fatigue (1.7)	Insufficient Sufficient Super sufficient	[0,16] (hours)
6. Policy, responsibility of officers, etc./ Responsibility (1)	Irresponsible About as often as not responsible	[0,100]
7. .We have 1st priority. attitude /Safety culture (2.8)	Infringe always Infringe about as often as not Never	[0,100]
8. Insufficient simulator training/Training (1.8)	No training Poor Medium High	[0, 100]
9. High operational speed/Speed (2.2)	Full Half Slow	[2,18] knots
10. Company policy/culture /Company policy (2)	Poor High	[0,300] near misses
11. Not optimized training/Training programs (1.7)	Insufficient Sufficient Super sufficient	[0,100]

* Identified hazard's IMPORTANCE to the shipping industry: *1 = Is regarded as a large problem for the industry, 2 = Is regarded as a moderate problem for the industry, 3 = Is regarded as a minor problem for the industry,* (NAV 49/INF.2 ,2003).

refer to variables (linguistic variable) and the adjectives or adverbs (set of values) that describe those variables.

A single fuzzy *if-then rule* assumes the form:

if X is A then Y is B

where ***A*** and ***B*** are *linguistic values* defined by *fuzzy sets* on the ranges (*universes of discourse*) of ***X*** and ***Y*** respectively. The

Table 3. Other hazards

Navigator: 12. Unfamiliar with vessel/bridge 13. Dependence on technology 14. Incapacitation 15. Incorrect use of equipment 16. Misjudgment when approaching quay, in narrow waters 17. Underestimate weather conditions (distance to hurricanes, poor training for these situations, etc.) 18. Misjudgment of traffic situations **Procedures:** 19. Communication between navigators, misunderstandings (may be measured in communication breakdowns) 20. Communication with pilot (linguistic problems, etc.) 21. Heavy traffic, many simultaneous situations (per watch) 22. Interaction, minor/leisure traffic 23. Navigational rules not known 24. .GPS assisted /Radar assisted. collision 25. Too many company procedures to follow / paperwork 26. Checklists are not used as a tool, but as a goal in itself 27. Insufficient/wrong procedures	**Technical systems:** 28. Insufficient radar functionality 29. Quality of equipment (ECDIS (update), etc.) 30. Technical failure (power supply) 31. Communication equipment failure 32. Large vessels, difficult to maneuver 33. (Integrated Nav. System/Integrated Bridge System) failure (incl. software) 34. GPS malfunction 35. GPS jumps 36. Gyro failure 37. Autopilot malfunction 38. Hard rudder as a result of loss of rudder feedback system **User interface:** 39. Poor bridge design, physical work conditions 40. Too much information (AIS, etc.) 41. Barriers regarding poor user interface 42. Alarm confusion 43. Local conditions (poor quay, marking, anchoring conditions, .) 44. Complex operating procedures compensating for poor technical systems **Other:** 45. Sabotage (spoofing of GPS signals, lead/force vessel on ground.) 46. Complexity of navigation area

The following human-related factors applied for accident investigation (BERTRANC, 2000), may be structured in the same way using appropriate *linguistic variables*.

Table 4 (a) Human-related factors applied in accident investigation

People factors : Ability, skills, knowledge of the people involved Personality (mental condition, emotional state) Physical condition (medical fitness, fatigue, use of alcohol or drugs) Activities prior to the accident/occurrence Assigned duties at the time of accident/occurrence Actual behavior at time of accident/occurrence Attitude	**Working and living conditions:** Level of automation Ergonomics of equipment and the working environment Adequacy of living conditions Adequacy of food Opportunities for recreations Vibrations, heat, noise ship motion **Ship factors:** Design State of maintenance Equipment (availability, reliability) Cargo characteristics, including securing, handling and care Certificates

if-part of the rule "***X is A***" is called the *antecedent* or *premise*, while the *then*-part of the rule "***Y is B***" is called the *consequent* or *conclusion*, where ***X*** and ***Y*** are *linguistic variables*. An example of such a rule might be:

If there are a lot of near misses then the safety level is low

In general, the input to an *if-then rule* is the current value for the *input variable* (in this case, number of *near misses*) and the *output* is an entire *fuzzy set* (in this case a low level of safety). This set shall later be *defuzzified,* assigning one value to the output.

If we want to talk about the complexity of the area of navigation, we need to define the range by which the area's complicity can be expected to vary, as well as what we mean by the word *complex*. We may use a 3-point scale as is recommended in IMO Resolution A.953 (23) and use complexity levels as 1, 2 and 3.

Fuzzy inference is the process of formulating the mapping from a given input to an output using fuzzy logic. The mapping then provides a basis from which decisions can be made, or patterns discerned. There are two types of fuzzy inference systems that can be implemented in the Fuzzy Logic MATLAB Toolbox: *Mamdani-type* and *Sugeno-type*.

Mamdani's type was based on Lotfi Zadeh's 1973 paper on fuzzy algorithms for complex systems and decision processes.

3. Construction of FIS with respect to maritime safety (example)

Here we apply *input linguistic variables* ***X*** which it is possible to use to describe some hazards (NAV 49/INF.2, 2003) related to safety of navigation.

These hazards are divided into different classes: CULTURE, NAVIGATOR, PROCEDURES, TECHNICAL SYSTEMS, USER INTERFACE, OTHER. In Table 2, column 1 gives the name of a hazard and the name of a *linguistic variable* ***X***, column 2 indicates the set of values of ***X*** and column 3 proposes the Universum for ***X.***

So, how to evaluate the safety? There is no doubt that safety level is a function of all variables mentioned above and this set, frankly speaking, is not complete.

For example, we want to evaluate safety as a function of 3 *input linguistic variables* in some not extended time interval: *navigation area, number of OOW distractions and number of near misses.*

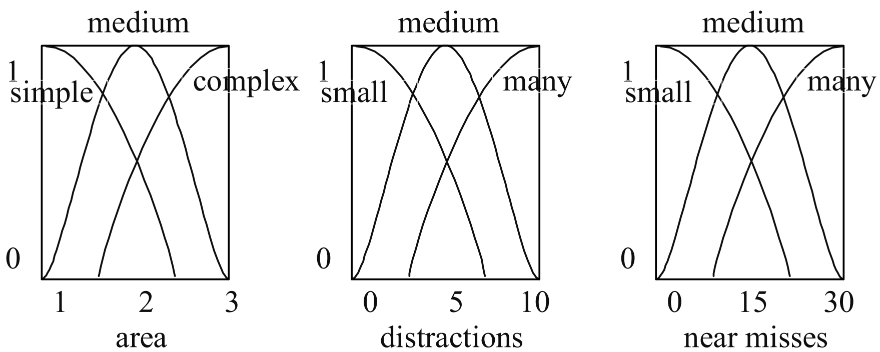

Fig.1 Membership Functions of input variables

Safety as a probability of accidents is designated to be *the output linguistic variable*.

Let us suppose that its Membership Functions will be as follows in Fig.2.

We selected the output *Membership Functions* in accordance with data from the frequency (Table 1). Number of near misses is reduced the ***N*** 10 times, guarding the appropriate proportions with linguistic values taken from the above said frequency table, supposing that time interval for evaluation is not very extended.

We composed the set of 27 fuzzy *if-then rule*s of the following type:

1. If (navigational area is simple) and (number of distractions is small) and (number of near-misses is small) then (safety has a high level)

…

27. If (navigational area is complex) and (there are many distractions) and (there are many near-misses) then (safety has a low level).

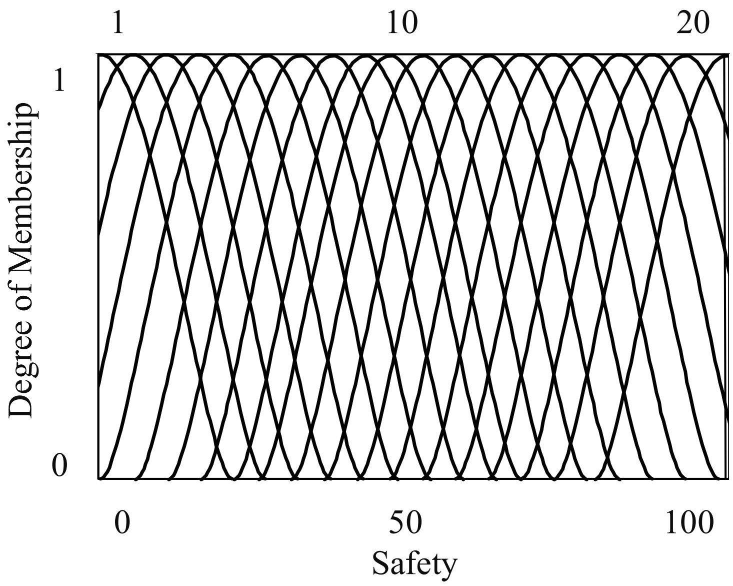

Fig. 2 Membership Functions of output variable *safety*

So, the FIS has of the following structure:

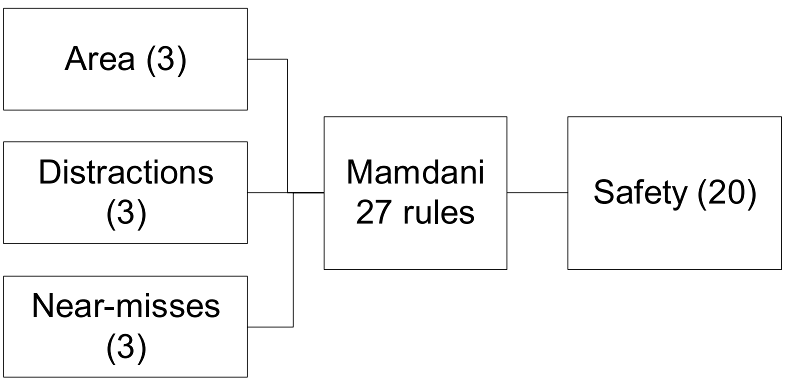

Fig. 3 FIS safety system analysis structure (3 inputs, 1 output, 27 rules)

The graphic results are presented on Fig. 4 and Fig. 5:

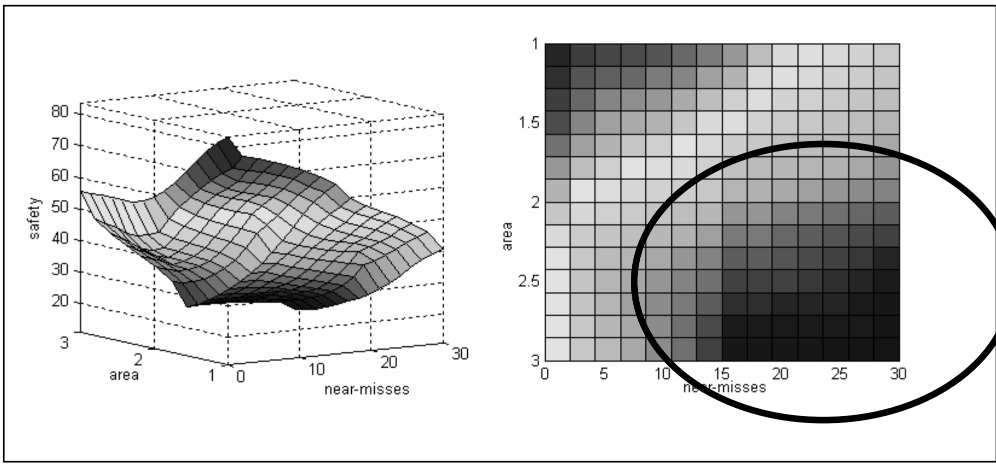

fig. 4 Safety surface as a function of *area complexity* and number of *near misses*

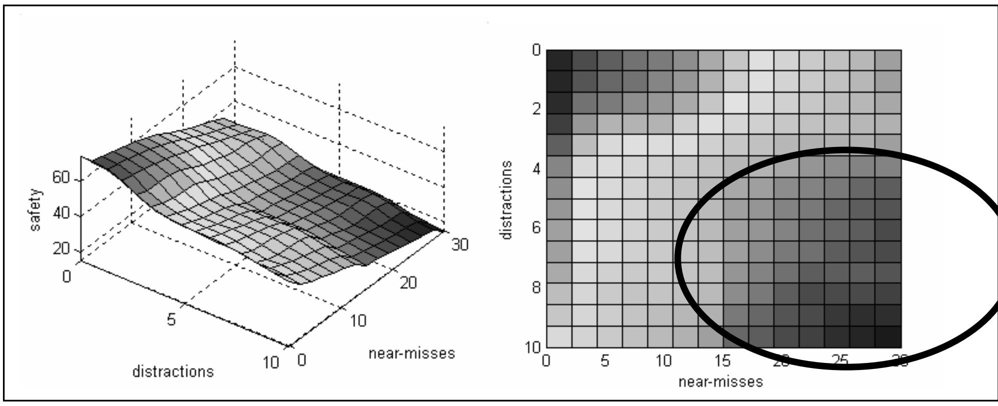

fig. 5 Safety surface as a function of *OOW* distractions and number of *near misses*

4. Results and Discussion

Figures 4 and 5 show the safety level as a function of 3 components. Ellipses outline the most dangerous areas of 20% level of safety. In principle the foundings obtained from this analysis are trivial, but they encourage us to go ahead in more comprehensive application of Fuzzy Sets for SMS analyzing and it's "tuning".

The safety analyses generally serve as decision aids. Wise decisions are essential in any safety program. Human decisions depend on numerous factors that transcend requirements and physical response, and many of these can be captured mathematically using fuzzy logic. Fuzzy logic is conceptually easy to understand in SMS applications. It is flexible. With any given SMS it's easy to massage or layer more functionality on top of it without starting again from scratch, for instance to incorporate ISPS Code procedures into the already working SMS. Fuzzy logic is tolerant of imprecise data and there is a lot of such data in shipping. Fuzzy logic can model nonlinear functions of arbitrary complexity. Fuzzy logic can be built on top of the experience of maritime safety experts and it can be blended with conventional control techniques. The most impressive feature is that fuzzy logic is based on natural language.

5. Conclusion

We have produced a little investigation of safety on the basis of FIS showing, by our opinion, all the positive features of fuzzy logic mentioned above. The Matlab Manual was used to prepare the paper and we are happy, that to have become acquainted with such an easy, understandable manual and software (MATLAB Software, 2002).

We hope this is only the beginning of Fuzzy Sets implementation in Safety Management Systems research that will provide the opportunity for their optimal and effective "tuning".

Intensive development of various types of very important and useful regulations and standards in the shipping industry over the last few years is, in a lot of cases, not well enough coordinated with the quantity and quality of resources required to meet these regulations and standards and ensure their proper implementation. These resources, for example, are as follows: intellectual, educational, skill resources, technical, technological, informational, financial, human and time resources, etc.

Application of such “catalysts of efficiency and safety” as ISO and ISM Code standards without granting the appropriate resources to meet their provisions has led to the emergence of some negative tendencies, in which new terms and concepts have been generated, such as “paper safety”, “paper audit”, “paper quality”, etc. But in carrying out many such bureaucratic “paper procedures” to keep the “paper image” of a MET institution, a shipping company or a vessel resources are wasted and, in many cases, the level of quality and safety is reduced.

Safety and Quality systems in shipping need some type of “tuning”. Such systems may be managed with the help of information obtained from Fuzzy Inference.

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BIOGRAPHY

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Comparisons Between Various Search And Rescue (SAR) Systems And Their Implications To The Development Of Chinese Maritime SAR System

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ABSTRACT
Maritime Search and Rescue (SAR) is important for the control of maritime accidents and mediation of damages and losses at sea. Lots of attention has been paid and many efforts have been made by maritime nations to establish and develop their SAR systems.

China has established a SAR system. However, maritime accidents in recent years necessitate research on the further development of such a system. The essay introduces and compares important SAR systems in the world in respect of SAR management regimes, system effectiveness and efficiency, infrastructures and legislation, etc, for the purpose of providing consultancies on further development of Chinese SAR system, benefiting those nations whose SAR system needs to be further developed as well, and finally contributing to safety and pollution prevention at sea.

Introduction

China has a maritime Search and Rescue (SAR) system in place, which is presently administered by the Ministry of Communications. However, with the fast development of the shipping industry and higher standards of maritime safety legislation, and the maritime disasters sustained in recent years, more efforts should be made to upgrade the system. This essay discusses the progress of achieving such upgrading and how to learn from other SAR systems. All the comparisons done in this paper are on the basis of the analysis of major topics of the US, UK, and Australia SAR systems because they represent a type of SAR system, and are well known for the quality of their SAR capabilities.

1. SAR management regimes

1.1 Comparison

Maritime SAR is a complicated, highly technical, and professional system, involving different parties such as professional SAR organizations, fishery departments, meteorological departments, army, medical service departments, etc. To reduce the damages and losses caused by maritime accidents, first of all, it is important to have a sound, highly effective and efficient SAR management regime. This will affect whether a system can respond to emergencies fast, follow standard SAR procedures and therefore assure the success of SAR actions.

In such a regime, the most important thing is to designate an adequately authorized co-ordination and command center to manage the huge SAR system. Most maritime nations have such a center in their SAR system, but the authority and capabilities vary from nation to nation. (See table-1). Next, such a system should have many resources that are available from different aspects for SAR purposes, other than those professional SAR parties or special governmental agencies.

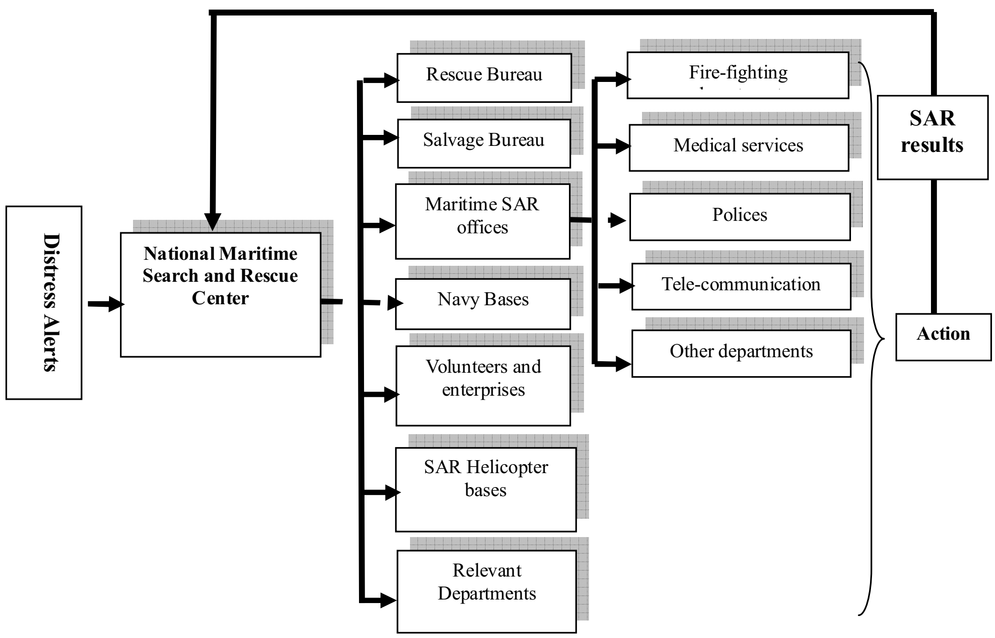
Table 1 SAR management regimes in some countries

States	Co-ordination & command center	Superior	Other SAR resources or members which could be co-coordinated
The U.S	The US Coast Guard	Ministry of Transport	● The Department of Defense ● The Federal communication committee ● The Department of Commerce ● The National Aeronautics and Space Administration ● Land managing components of the Department of the Interior ● Other parties in the SAR system via National SAR plan
The U.K	HM Coast Guard	Department for Transport	● Other branches of the Ministry of Transport ● The coast guard (MCA) ● Civil airlines ● The Ministry of Defense, etc.
Australia	AusSAR	AMSA	● The Department of Defense ● Bureau of Meteorology ● Australian Customs Service, and other Australian National Agencies via National Search and Rescue council ● Resources of coastal states (by making arrangement of Responsibility between the Commonwealth and coastal states) ● Volunteer Commercial and Private Organizations based on contractual relationship (commercial airlines, general aviation operators, oil companies, fishing companies, aero clubs, and large landholders)

1.2 Introduction to the Chinese maritime SAR system

The present maritime SAR system in China is basically under the management of the Ministry of Communications (MOC). The National SAR center is attached to the Maritime Safety Administration, which is under the umbrella of the MOC. Its main functions are to respond and assign various maritime distress alerts, and to take command of, and co-ordinate SAR operations. The Rescue and Salvage Bureau, which is also under the MOC, is responsible for the execution of maritime SAR and salvage operations. In the year 2003, a reform took

Table 2 The present maritime SAR system in China



place --- three Rescue Bureaus and three Salvage Bureaus were re-organized. The former takes care of basically life-saving matters and other tasks as assigned by the state. In return, the state government will invest continuously in them. The latter deals mainly with property salvage and other tasks as assigned by the government. However the government only promises financial support for several years following this reform. Those bureaus are under the management of the Rescue and Salvage Bureau.

Table 2 shows the present maritime SAR system in China. The above reform was developed after several maritime disasters that have occurred in recent years such as the sinking of MV DASUN and HEJIANG. In addition to the reform, the Chinese government makes every effort to promote the capabilities of its SAR system. This can be evidenced by a series of activities - joint SAR exercises in the mouth of YangZi River and HongKong, speeding up the establishment of new RCCs and Local SAR offices, etc.

1.3 Analysis on the Chinese SAR management regime

So by the analysis above, it is important first of all to have an integrated SAR system, together with a center that has strong capability for co-coordinating and commanding. These are the prerequisites to respond promptly to maritime emergencies, to take proper actions, and to achieve successes of SAR operations.

Most maritime nations have established SAR systems of their own and have designated a coordination and command center. However, the main problem is the capability and authority of such a center. It is easy to understand that the success of SAR operations relies on the performance of, and co-operation between various parties such as the army, fishery administration, and meteorological administration. But the following possibilities may exist and should be dealt with. For instance, those parties, particularly those belonging to different Ministries, are established with their own purposes and benefits and are operated in their own ways. Their responsibilities in the SAR system may not be clearly defined. The communication between them may be poor. Additionally, during SAR operations, those parties may have to report to their superiors according to their reporting procedures, which may cause delay and negatively affect the results of SAR operations. …In China, the problems listed above do exist to some extent and the reasons behind them are quite complicated. Poor capabilities and authority of National SAR co-coordinating and command center; lack of maritime SAR legislation; lack of a clear understanding of the significance of SAR by society as a whole, and/or excess bureaucracy are some of the reasons.

Another problem that exists in the Chinese SAR management regime is that the Chinese government must make more of an effort to provide social or private SAR resources. Currently the resources so provided for the SAR system are very few. The reasons could be lack of understanding of the society on the whole and of SAR legislation. Actually, the involvement of those resources is significant particularly when the central government cannot promise large investment in the SAR system.

1.4 The prospective ways

Theoretically, the capabilities and authority of a co-coordinating and command center could be secured in the following ways: 1). elevate the level of such a center in the national administrative system, from directorate level to ministerial level; 2). organize a national SAR committee or council, with wide participation from different governments, such as Australia and the USA, 3). delegate responsibilities and authority to the center by means of Maritime SAR legislation and a National SAR plan, such as found in Australia and the USA. Referring to the comparisons done in section 1.1, most of those centers are placed in Maritime Safety Administrations since SAR in itself is very much professional. This indicates that for China, 2) and 3) could be more realistic. In fact, the mechanism for

SAR co-coordinating and commanding in the past in China was something like the way of 2). Taking account of the fact that Chinese maritime SAR needs more legislation, the way that could overcome the present problems substantially is form 3).

As to the utilization of social and private SAR resources, China can do more. The successful experience of Australia can be borrowed in this regard. The future Chinese SAR system shall include individual volunteers, private companies, social associations, etc. instead of particular central governmental resources and professional SAR organizations. The SAR bases can be established and maintained by local governments, private companies, and social associations. This would help to mediate the financial pressure faced by the central government for a huge investment for SAR resources, and would facilitate the establishment of a net of various SAR resources. Based on this, the next step that the central government should do is to optimize the system by making it more rational, more efficient and more cost-effective.

2. Maritime SAR legislation

Special legislation for a maritime SAR is particularly important owing to the significance of SAR, the great risks and complex practical operations of SAR, and the benefits of different parities. In the USA and Australia, in addition to maritime conventions and guidance such as the 1979 international convention on Maritime Search and Rescue and IAMSAR, there are many other national rules and regulations regarding SAR that have been legislated, such as the Australia National Search and Rescue Manual, and National Search and Rescue Plan. Such legislation has the following features:

- Wide coverage on SAR matters, covering not only macro SAR system and micro operational procedures;
- Different levels of legislation, including national legislation and professional SAR organization's legislation;
- Clear definitions on the responsibilities of each party.

This legislation ensures a strong SAR system in these countries.

Table 3 Maritime SAR legislation of USA (other than those international conventions contracted)

●	National Search and Rescue Plan
●	International Aeronautical and Maritime Search and Rescue (IAMSAR) Manual （incorporated）
●	The United States National Search and Rescue Supplement (NSS) to the IAMSAR Manual
●	The Coast Guard Addendum (CGADD) to the NSS
●	Local state legislation

Table 4 Maritime SAR legislation of China (other than those international conventions contracted)

●	Maritime Safety law of the P.R.China （1983）
●	Detailed rules of ship emergency communication （1987）
●	Rules on the command and co-ordination of maritime salvage（1992）
●	Rules on the management of divers（1999）
●	Rules on the management of qualifications for the salvage of wrecks and objections（1999）
●	Regulations on the Search and Rescue of Aircraft of the P.R.China（1992）
●	Notices on the enhancement of maritime accident reporting system（2000）
●	Rules on maritime administrative penalty（2003）
●	Regulations on ship report system（2001）
●	Law of safety production（2002）
●	Rules on the investigation of severe accidents（1989）
●	Basis rules of flight of the P.R.China（2001）
●	Rules on the civil air traffic management （1990）
●	Civil Aviation law of the P.R.China（1995）
●	Maritime SAR legislation by coastal provinces

Table 5 Major SAR facilities in some states

State	Main facilities
US	● Various resources under the command of MRCCs ● AMVER ● National Distress and Response System --- the Rescue 21 System ● All available resources of certain states and local governments, civil and volunteer organizations, and private enterprises
UK	● 3 shoreline Search Regions, 6 MRCC and 13 MRSC, and many Coastguard Auxiliary Rescue Teams ● 4 SAR helicopter stations managed by Her Majesty coast guard, capable of providing aero-nautical SAR services 24 hours a day ● 4 Emergency Tug Vessels deployed in high risky sea areas ● The Royal Air Force and Royal Navy SAR Helicopters, Maritime patrol aircraft，and others possible aircrafts and vessels ● 229 lifeboat stations provided by the Royal Navy Lifeboat Institute ● Police, Ambulance, fire and Rescue services, British Telecom, and any other municipal resources ● Any other vessel or person who may be able to assist with an incident ● …
Australia	● The communication system established conforming to ICAO and IMO requirements. For maritime SAR, mainly relies on the GMDSS ● Australian Ship Reporting System (AUSREP) ● Torres Strait and Great Barrier Reef (Inner Route) Ship Reporting System (REEFREP) ● Other Supplementary Search and Rescue Unit (SSRU) ● Local assets ● Chartered Private and commercial aircrafts
China	● 18 RSC allocated along the coast ● DSC and Radar Monitoring system for ships ● VTS schemes adopted and operated in 16 major ports and the areas nearby ● SAR helicopters ● A uniform emergency call "12395" along the coast and Yangzhi River ● 17 distress alert services at 18 coastal stations ● 44 tugs for SAR purpose and 22 vessels for salvage purpose assigned and operated by the Rescue and Salvage Bureau.

While looking at the maritime SAR legislation in China, the problems can be identified as follows:

- It is not integrated and systematic on the whole. Many clauses regarding SAR are isolated and incorporated in different rules or laws;
- Short of SAR legislation in terms of the quantity;
- It is not an issue of high priority in the legislation system, which affects the application thereof;
- Much of the SAR legislation is outdated. (See Table-4).

The Chinese SAR system is thus adversely affected.

Referring to the legislation in USA and Australia, the future Chinese Maritime SAR legislation should cover all SAR activities. The new framework should be topped with a National SAR law or a National SAR Plan, and should be featured with clear definitions of the responsibilities of those parties involved in SAR, high effectiveness and efficiency, etc. It should focus on:

- The structure of SAR organizations and the management regime;
- The status and roles of professional SAR organizations, army, social associations and private companies;
- Basic requirements on the establishment of new SAR organizations;
- The rights and responsibilities of SAR organizations;
- The investment of the SAR system;
- The compensation, reward, punishment after the completion of SAR operations.

3. Maritime SAR infrastructures

3.1 Comparison

The extent of the success of SAR relies greatly on the resources put into SAR operations. So it is important to keep SAR facilities in place in respect of their quantity, types, quality, and functions. The following table indicates roughly SAR facilities in major SAR systems.

3.2 Problems and Solutions

Although the Chinese SAR system has already been equipped with basic SAR infrastructure and the government promises to upgrade them continuously, problems still exist when compared with other SAR systems. Even in the circumstance of the said reform, it takes long time to develop a modern fleet, such as:

- Aging and poor technical conditions of professional SAR fleet. The average age of the vessels in the fleet is about 15 years, and some of them can only sail slowly and with low reliability. Meanwhile, the technical conditions of some vessels cannot be secured due to inadequate funding for maintenance and up-keeping;
- Insufficient number of SAR RCCs and bases. For instance, there are only 14 RCCs and 18 bases along 18,000 km coastlines (usually they are located in the same county). The distance between them is on average1000 kilometers. So it takes by rough calculation about 15-20 hours to reach the distress position. Such a figure may be enlarged in case of rough weather certainly. Therefore currently the Chinese SAR system can mainly provide SAR services to coastal areas, instead of the deep seas;
- Low capability of joint aeronautical SAR operations. Usually such a joint operation requires very good SAR facilities, well-designed procedures and well-trained SAR personnel, and Chinese SAR system needs to develop them all;
- Low mobility and modernization of SAR infrastructures. There is limited number of helicopters exclusively for SAR purpose, and there are few SAR facilities like the DZgRS that Germany is using to put lifeboats/rescue boats into vehicles and transport them to designated places through fast land transportation.

The persistence of the existing problems will no doubt affect unfavorably the Chinese SAR system' compliance to the 1979 SAR convention and IAMSAR. All of these problems must be settled quickly. Hopefully the Chinese government is now anxious to do something. Again, the recommendation in this respect is to learn about the experiences and practices of successful SAR systems, taking into consideration the realities of each country. By the analysis above, the conclusion is that professional SAR infrastructures must be kept satisfactory in respect to the quantity, quality, and application of high technologies by means of continuous government investment, and other SAR resources from social or private aspects must be kept always available for SAR operations by means of maritime SAR legislation and/or contracts.

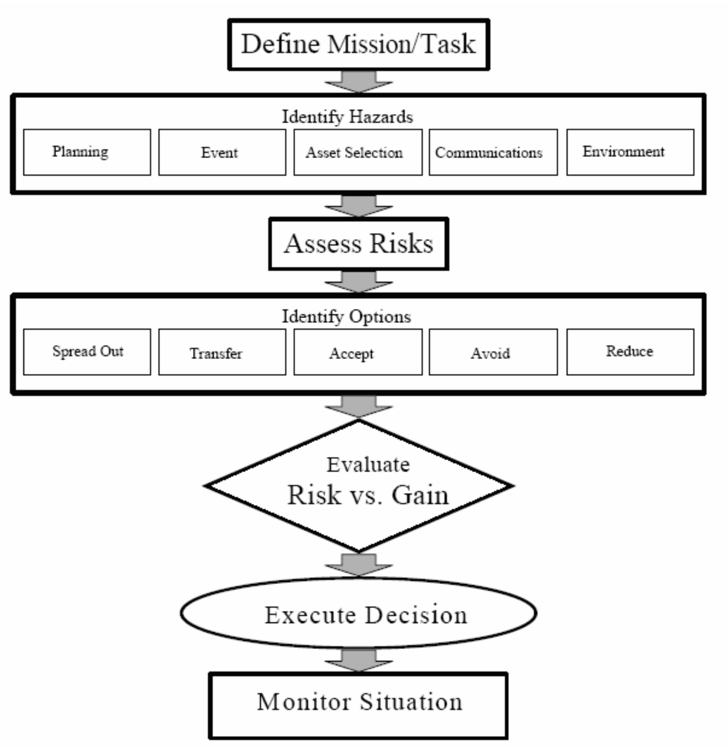
4. Maritime SAR plan, emergency response procedures and SAR techniques

The potential seriousness of maritime accidents requires that a response be made as soon as possible. How quickly a response is made depends on the procedures formulated previously.

Attention must be paid by the current Chinese SAR system to develop a systematic, scientific and reasonable Maritime SAR plan framework. Failing to do this has caused problems in the Chinese SAR system such as low SAR efficiency and effectiveness and even failure of SAR operations. The typical example is the sinking of M/V DASUN in 1999. After this, the Chinese SAR system should re-arrange and optimize, within such a framework, various emergency plans, highlighting different levels of plans, i.e., National SAR plan, provincial SAR plans and individual SAR organizations' plans. Meanwhile, detailed emergency responding procedures should be developed, particularly in respect to pollution at sea, aeronautical accidents, and maritime security. They should be incorporated into those plans or formulated independently as the US and Australia SAR system does. Finally, regular exercises should be done according to those plans and procedures to maintain practical capability of handling maritime emergencies.

Lastly, the IAMSAR handbook as an international guidance has established many SAR techniques. But still the whole effectiveness of using such a handbook depends on the "software and hardware" of a SAR system. It should be stressed particularly that other than those techniques laid down in IAMSAR, the application of risk management techniques shall be encouraged (see the following table-6, one of the processes for risk management and decision-making required by the USCG's SAR handbook). It will be helpful for the reduction of SAR risks and will ultimately improve the rate of success of SAR operations.

Table 6 Operational Risk Management Process for Tactical Decision Making (Source: The Coast Guard Addendum (CGADD) to the NSS, p.35)



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BIOGRAPHY

Comparisons between various Search and Rescue (SAR) systems and their implications to the development of Chinese Maritime SAR system

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A Study of the Development of Taiwan Maritime Casualty Database System

BY

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ABSTRACT
With the aim of creating a complete maritime casualty database which will facilitate an efficient maritime safety management system for Taiwanese government, this study designs and establishes a Taiwan Maritime Casualty Database System (TMCDS). Following the guidelines from the Code for the Investigation of Marine Casualties and Incidents of the IMO and also through a comparative study resulting from the different maritime investigation authorities, this study structures a comprehensive component of such a database. Further, based on the Structured Query Language (SQL) Command and adopting the technology of Active Server Pages (ASP), and Active Data Object (ADO), a three-tier maritime casualty database structure is created through Web server for the convenient of database management for either client side or server side interactively.

1. Introduction

A proper investigation and analysis of maritime casualties and incidents can lead to a greater awareness of casualty causation and providing useful remedial measures. Taking into account the rights and obligations of coastal and flag States, under the provisions of articles 2 and 94 of the United Nations Convention on the Law of the Sea (UNCLOS), a flag State shall cause an inquiry into certain casualties or incidents of navigation which might pose a risk to life or to the environment, involve the coastal State search and rescue (SAR) authorities, or otherwise affect the coastal State. Also, under relevant IMO conventions, such as SOLAS regulation I/21 and MARPOL 73/78 articles 8 and 12, each Administration undertakes to conduct an investigation into any casualty occurring to ships under its flag subject to those conventions and to supply the IMO with pertinent information concerning the findings of such investigations. The Load Lines Convention article 23 also requires the investigation of casualties.

In compliance with these international regulations, many countries establish a specific national authority to carry out maritime casualty investigations. For example, Australian Transport Safety Bureau (ATSB), British Marine Accident Investigation Branch (MAIB), Japanese Marine Accidents Inquiry Agency (MAIA), New Zealand Transport Accident Investigation Commission (TAIC), Swedish Board of Accident Investigation, Transportation Safety Board of Canada (TSB), and US Coastguard Office of Investigation and Analysis and US National Transportation Safety Board (NTSB). In addition, international organisations such as IMO Maritime Safety Committee, European Maritime Safety Agency, Marine Accident Investigators

International Forum (MAIIF), and International Transportation Safety Association have devoted themselves towards safer shipping and cleaner oceans.

Despite the best endeavours of the international organisations and flag states, casualties and incidents resulting in loss of life, loss of ships and pollution of the marine environment continue to occur. In fact, to learn from the casualty itself is one of the most effective measures to reduce the risk of occurrence of next casualty. Therefore, the analysis of causalities through different methodologies and techniques, such as incident modelling, causal analysis, event-based approaches, check-list approaches, mathematical models of causation, and comparisons, to identify and eliminate the regulatory, managerial, hardware, software, human or organisational failures or factors leading to a casualty is important. However, these techniques can only be successfully employed on the basis of an accurate, detailed, and accessible maritime casualty database management system.

This study, therefore, aims to structure a comprehensive three-tier maritime casualty database system through Web server. The system design follows guidelines from the Code for the Investigation of Marine Casualties and Incidents of the IMO and also through a comparative study results from the different maritime investigation authorities. Moreover, this study is to create a prototype of TMCDS, which will be a useful tool to facilitate an efficient maritime safety management for Taiwanese maritime safety authorities.

2. Existing Maritime Casualties Investigation in Taiwan

Taiwan straddles the Tropic of Cancer, about 200 kilometres off the eastern shore of the Chinese mainland. It is strategically located in the East China Sea, between Japan and Korea to the North, and Hong Kong and the Philippines to the South. With a land area of 36,000 square kilometres, it is comparable in size to the Netherlands.

Maritime transport is vital to Taiwan's trade-oriented economy. Almost 99.59% of imports and exports in Taiwan were transported by sea (Chen, 2004a). According to the International Trade Statistics 2003 by WTO, Taiwan was the world's 14th largest exporter and 16th largest importer. In addition to the Taiwanese domestic fleet, there are well over two hundred ships with foreign flags transiting Taiwanese waters daily from the Pacific Ocean to the South China Sea. Besides, Taiwan has in excess of twenty-seven thousand registered fishing vessels ranging from very small non-powered crafts to very large ships. Eighty-one percent of the vessels are less than fifty tonnes in displacement. These large amounts of not-well equipped fishing vessels and small general cargo carriers crossing the Formosa Strait between Taiwan and China are not only increasing the risk to the mariners navigating in this high-density sea traffic area but also to the marine environment and properties (Chen, 2004b).

Taiwan's maritime casualty database is governed by different administrative authorities. Harbour authorities are responsible for all the reported maritime casualties that occur in their administrative region, and report to the Ministry of Transport and Communication. Reports of casualties from fishing vessels are kept by the Fisheries Agency of the Council of Agriculture under Executive Yuan. The Taiwan Coast Guard Administration keeps data of all Search and Rescue cases. The Environment Protection Agency keeps records of marine pollutions.

The recording of maritime casualties' data by different government agencies indicates that the fatality and missing rates are fairly high. According to the information collected from harbour bureaus, an average 290 cases of maritime casualties occur annually in the SAR responsibility area of Taiwan. As far as fishing vessels are concerned, there are about 509 cases each year, but it has been suggested that there are missing figures regarding the fatalities arising from fishing vessels casualties

Table 2.1 Statistics of Maritime casualties
(1.1.1992~31.12.2002)

Data collected from Harbour Bureaus Ministry of Transport and Communication					
Year	Number of Casualties	Vessel Damage	Vessel Sunk	Injured	Death/ Missing
1992	372	148	63	23	50
1993	299	137	41	7	54
1994	280	153	43	13	32
1995	214	95	39	4	30
1996	301	142	35	8	75
1997	306	143	19	6	15
1998	295	120	40	7	42
1999	315	133	68	13	44
2000	287	142	64	10	112
2001	276	105	44	50	36
2002	254	81	41	13	29
Total	3199	1399	497	154	519
Average	290.82	127.18	45.18	14	47.18
Definition of Casualties by MOTC includes: Collision, Grounding/ Stranding, Fire, Explosion, Oil Spill, Capsized, Machinery Failure, Extraordinary and Others					

Data collected from Fisheries Agency (FA) Council of Agriculture, Executive Yuan						
Year	Number of Casualties	Vessel Sunk or Missing	Death	Serious Injured	Injured	Missing
1992	451	124	89	13	49	73
1993	275	53	70	12	19	38
1994	433	49	69	11	8	43
1995	378	39	65	12	9	40
1996	1032	155	73	10	19	65
1997	441	42	46	12	30	21
1998	552	49	59	12	39	25
1999	527	96	62	6	77	18
2000	519	96	68	16	38	14
2001	556	109	58	11	92	20
2002	442	70	59	8	51	18
Total	5606	882	718	123	431	375
Average	509.6	80.2	65.3	11.2	39.2	34.1
Definition of Casualties by FA includes: Weather Damage, Engine Breakdown, Collision, Flooding/Leaking, Grounding/Stranding, Fire, Propeller Twisted and Others						

because of the inaccuracy in reporting the actual number of crew on board (Chen, 2003). Consequently, it is estimated that the actual number of lives lost might be somewhat higher than that provided in the official statistics (Table 2.1).

Comparing with countries which have a national authority to carry out maritime casualty investigation, the Taiwan's maritime safety matters are governed by different government authorities, but the fact is that none of these agencies could represent a true picture of maritime casualties in Taiwan (Chen, 2004). As a consequence, this leads to an inefficient and ineffective management system of the investigation of maritime casualties, which will impede the achievement in preventing or reducing the risk of occurrence of another casualty by learning from pervious casualties. Additionally, it is anticipated that in the future, once the waters is open to leisure boats and various maritime activities, or the removal of ban on direct shipping between mainland China and Taiwan, the number of maritime casualties may further increase. Hence, with the shortcomings of existing maritime safety management system and the consideration of the possible increase in the volume of traffic, and in order to achieve the goal of increasing effectiveness and working towards a seamless integration with international procedures on the maritime accident investigation, it is necessary for the government to have a comprehensive and efficient maritime safety management system to be in place to address such crucial situations.

Revealed by this study, the current data of maritime casualties kept in different agencies are mainly hardcopy only, with some in Microsoft WORD format. Furthermore, information collected from these agencies are generally basic, limited and sometimes very rough. Only very limited cases are investigated or discussed. This does not comply with IMO MSC/Circ 953 and other requirements. Hence, with the aim of establishing an efficient maritime safety management system, it is necessary for the government to compile data of maritime casualties from different agencies and create into a complete maritime casualty database.

Table 3.1 TMCDS Developing Environment

FRONT-END	Visual Studio6.0, Mse6.0, Frontpage 2000
DATABASE	Access 2000
WEB-SERVER	Internet Information Server (IIS) 5.0
PLATFORM	MS-Windows 2000, MS-Windows NT Server 2000
TOOLS	Microsoft Development Environment (Mse6.0), Frontpage Server Extension, Microsoft Office2000, WS_FTP, Microsoft Internet Explorer6.0, Adobe Photoshop5.0

3. Structure of Maritime Casualty Database

3.1 Development Environment

With its three-tier architecture, this Taiwan Maritime Casualty Database System (TMCDS) aims to create a user-friendly environment through wide, interactive, and accessible internet at http://www.safetysea.org. The client-side (user interface) system is used as browser to connect the interactive function provided by web server and Maritime Casualty Database on server-side.

TMCDS employs ActiveX Data Objects (ADO) and Active Server Pages (ASP) techniques to retrieve data from a SQL Server database. Active Server Pages (ASP) is a standard programming system for Internet applications hosted on the server-side execution environment in Microsoft Internet Information Server (IIS). APS enables users to open a compile-free application environment, in which HTML pages, scripts, and ActiveX server components can be combined to create powerful Web-based business solutions to be dynamic and interactive by embedding scripts, i.e. either VBScript or JScript, Microsoft's alternative of JavaScript. The environment of developing TMCDS are summarised as follows:

3.2 Data Structure

The basic database structure of TMCDS is designed on the basis of Taiwan's existing maritime casualty report forms collected from different administrative agencies, and relevant resources such as:

1. IMO Sub-Committee on Flag State Implementation - 5th session, casualty database construction submitted by Norway, and reports submitted by Netherlands and Australia.
2. IMO Resolution A.849 (20), Code for the Investigation of Marine Casualties and Incidents
3. IMO Resolution A.884 (21), Amendments to the Code for the Investigation of Marine Casualties and Incidents (Resolution A.849)
4. IMO MSC/Circ.953, MEPC/Circ.372, Reports on Marine Casualties and Incidents, Revised harmonized reporting procedures - Reports required under SOLAS regulation I/21 and MARPOL 73/78 articles 8 and 12
5. Norwegian Maritime Directorate, KS-0197 E Marine Casualty Report
6. Guidelines and Investigators Manual, Marine Accident Investigator's International Forum
7. Guidelines and report forms from Australian National Search and Rescue Manual (Australia), National Search and Rescue Manual and SAR Seamanship Reference Manual (Canada), National Search and Rescue Committee (USA), Search and Rescue Manual (IMO/ICAO)

According to the characteristics of each casualty, data structure are categorised into static data and dynamic data through the following five data types to explain casualties, namely, characters (attribute, phrase), logic, number, date, and summary.

Static data are data that will not be affected by accident and incident, such as particulars of ships (Table 3.2) and information on seafarers (Table 3.3).

Table 3.2 Static Data Structure- Particulars of Ships

Name of field	Content	Type of data		Name of field	Content	Type of data
imo_num	IMO number	character		pre_class	previous class society	character
nat_num	National reg number	character		keel_laid	keel laid (yyyy/mm/dd)	date
ship_name	name of ship	character		deli_date	delivery date (yyyy/mm/dd)	date
flag_state	flag state	character		Dwt	DWT(tons)	number
ship_type	type of ship	character		Hull_mater	hull material	character
Grt	GRT(tons)	number		Hull_constru	hull construction	character
Length	length overall	number		Build_yard	building yard	character
Width	width of ship	number		Hull_num	hull number	character
ship_class	classification ship	character		Crew_num	number of crew	number
shipowner	registered ship owner	character		passen_num	number of passengers	number
Manager	ship manager	character		data_source	source of data	character
pre_name	previous names	character		writer	import	character
pre_flag	previous flag	character		write_date	date to import	character

Table 3.3 Static Data Structure- Information on Seafarers

Name of field	Content	Type of data		Name of field	Content	Type of data
Rank	rank	character		Tele	telephone	character
Crew_name	crew name	character		Serv_com	service company	character
addre_in	address	character		Hold_lice	License hold	character
nation_in	nation	character				

The structure of dynamic data is created on the basis of the SHEL model to describe data with respect to the occurrence and consequences of a casualty (IMO, 2000a). These dynamic data include On-scene data (Table 3.4), Previous 96 hours activities (Table 3.5), Ship's factors (Table 3.6), Environmental factors (Table 3.7), Human factors (Table 3.8), and Consequences of the incident (Table 3.9).

Table3.4 On-scene Data

Name of field	Content	Type of data		Name of field	Content	Type of data
ship_caur	course	number		Visib	visibility scale	character
Speed	speed (knots)	number		Wind_scale	Beaufort scale	character
Wind_caur	wind course	character		sea_state	state of sea	character
Etd	ETD: (yyyy/mm/dd): (hh:mm)	Date, time		Swell_state	Douglas swell	character
Eta	ETA: (yyyy/mm/dd): (hh:mm)	Date, time		Water_depth	depth of water	number
Weat_conti	weather notation	character				

Table3.5 Previous 96 hour's activities (D-X day of casualty)

day\time	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
D-4																								
D-3																								
D-2																								
D-1																								
D-X																								

Table 3.6 Ship's Factors

Name of field	Content	Type of data		Name of field	Content	Type of data
Struct_fail	structural failure	logic		equi_fail	failure equipment	character
design_fail	failure to ship's design	logic		Cargo_cause	cause to cargo	character
main_fail	failure machine	character		oth_ship_cause	other cause of ship	summary

Table 3.7 Environmental Factors

Name of field	Content	Type of data		Name of field	Content	Type of data
othship_unact	other ship unsafe action	logic		aids_fail	failure of aids navigation	character
busy_water	busy water	logic		exter_cause	external	character
sea_fact	factors of sea	character		oth_enviro_fact	other environment factor	summary
weat_fact	factors of weather	character				

Table 3.7 Environmental Factors

Name of field	Content	Type of data		Name of field	Content	Type of data
othship_unact	other ship unsafe action	logic		aids_fail	failure of aids navigation	character
busy_water	busy water	logic		exter_cause	external	character
sea_fact	factors of sea	character		oth_enviro_fact	other environment factor	summary
weat_fact	factors of weather	character				

Table 3.8 Human Factors

Name of field	Content	Type of data		Name of field	Content	Type of data
phys_fact	mistake of physical factors	character		crew_viol	crew violation	character
phyc_fact	mistake of psychological factors	character		crew_unsf_act	crew unsafe action	character
soc_med_fact	mistake of social and medical factors	character		Contri_acci	latent conditions to contribute accident	character
work_env_fact	mistake of workplace and environment	character		oth_hum_fact	other human factors	summary

Table 3.9 Consequences of the incident

Name of field	Content	Type of data		Name of field	Content	Type of data
loca_date	local date(yyyy/mm/dd)	date		dea_mis_pass	dead or missing passengers	number
loca_time	local time(hh:mm)	date		dea_mis_oth	dead or missing other person	number
Posit	position(latitude ,longitude)	character		Serinj_crew	seriously injured crew	number
Locate	location	character		Serinj_pass	seriously injured passengers	number
ev_cont	continuous event	number		Serinj_oth	seriously injured other persons	number
ev_ord	event order	number		tankoil_pol_type	oil in tankers- pollution	character
ev_type	type of event	character		cargoil_pol_type	oil cargo-pollution	character
oth_ship_name	other name of ship	character		Chem_pol_type	chemical in bulk-pollution	character
Pilot_onbo	pilot on board	logic		Dango_pol_type	dangerous goods-pollution	character
ship_end	consequence of the ship	character		pol_quan	quantity of pollution	number
dea_mis_crew	dead or missing crew	number		Sum	summary of events	summary

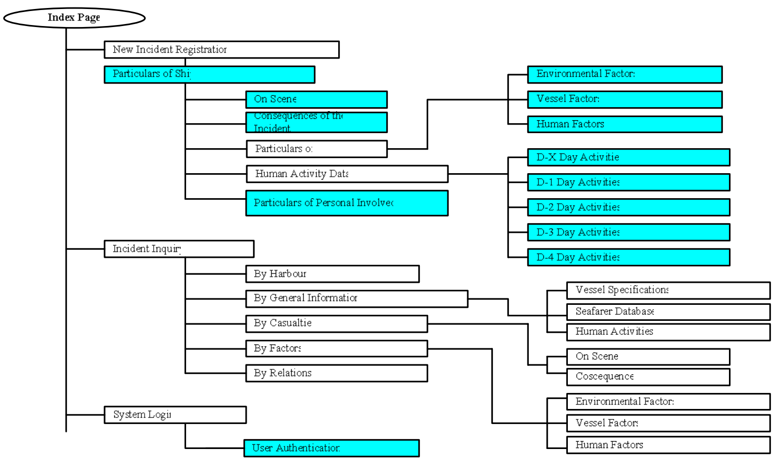

Figure 4.1 HIERARCHICAL STRUCTURES OF THE

4. System and Module Design

4.1 System Structure

The TMCDS provides persons the data required for maritime research and investigation. The HTML script is used in TMCDS to construct the basic web page for user interfaces, followed by inserting into ASP script code and SQL script to control database. The web-hierarchical structures of the system could be simplified as Fig 4.1.In TMCDS, three modules, namely, management module, operation module and storage module are designed. Each module is connected to the others by different levels of functions and authentications.

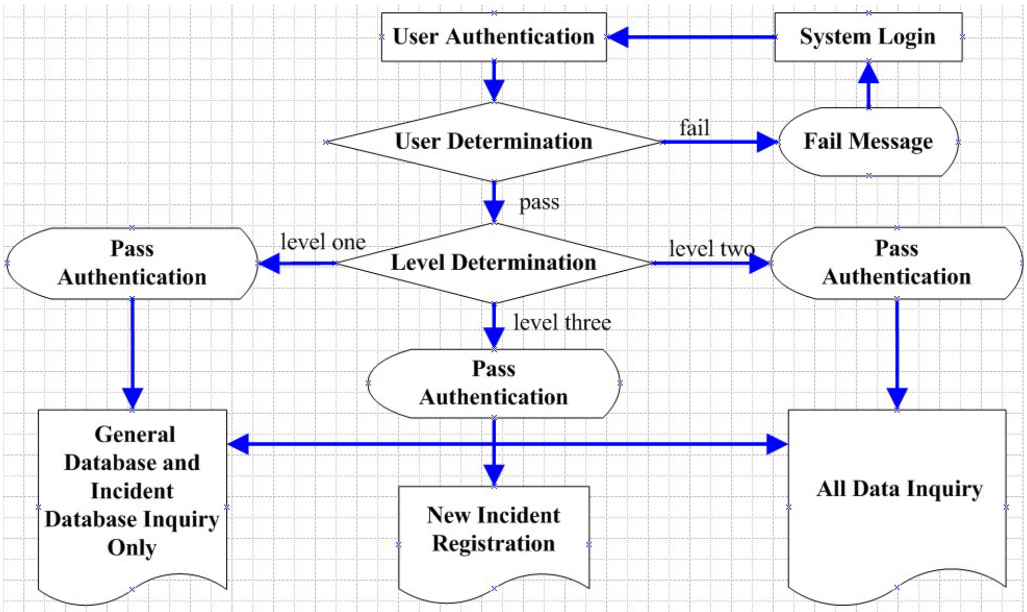

Figure 4.2 AUTHENTICATION PROCESS

4.2 Management Module

The management module is designed to guard this system. For security purposes, this system is only accessible by authentic users. Through an application procedure, eligible users will be authorised to have a level of access right (Figure 4.2). Level one user could interrogate the general casualty database. Level two users are entitled to access into all casualty databases. Only level three users are qualified to register a new casualty or perform data modifications.

The process of new incident registration or data modification is shown in Figure 4.3. The process could be divided into four parts, including general information, causes, consequences, and functions of inquiry.

4.3 Operation Module

The operation module consists of user interfaces and enquiry functions provided by the TMCDS. Users are categorised into general users, relation inquiry users and incident information providers (Figure 4.4).

4.4 Storage Module

The storage module comprises three different databases under main tables, attribute tables, and management tables. Information stored under the main tables including both categorised and classified static and dynamic data. Database stored under the attribute tables consists of all defined elements of different data such as type of ship, ship's hull, wind, weather conditions, type of event etc. Management tables consist of names, passwords and all personal information of the system users. Enquiry into the system needs to follow the different interfaces to access different tables. (Figure 4.5)

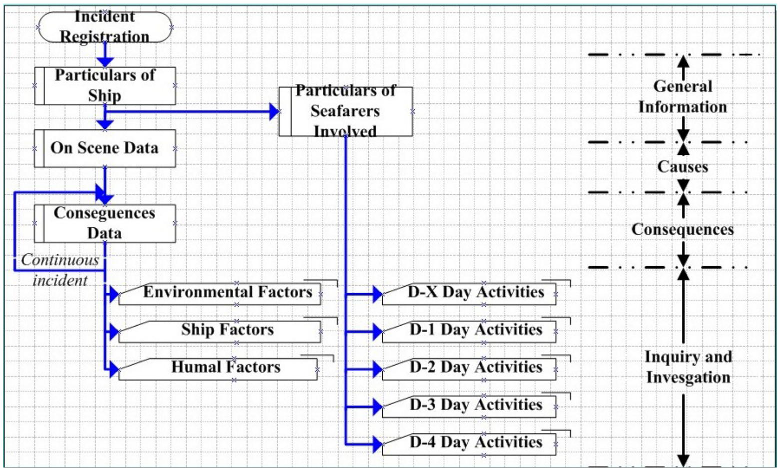

Figure 4.3 INCIDENT REGISTRATION PROCESS

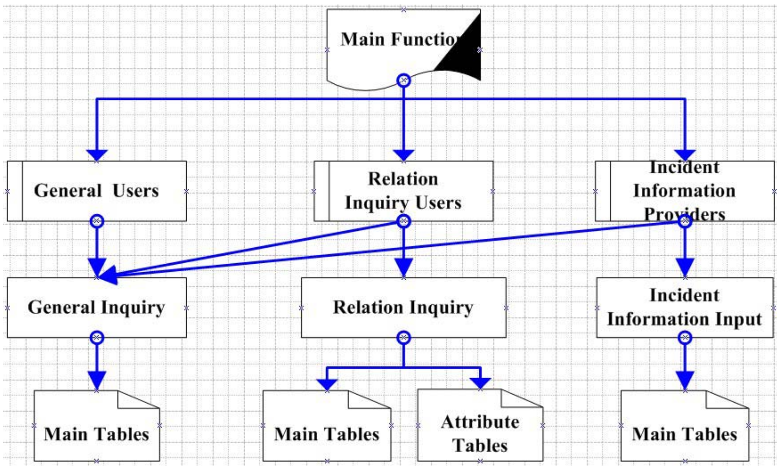

Figure 4.4 OPERATION PROCESS

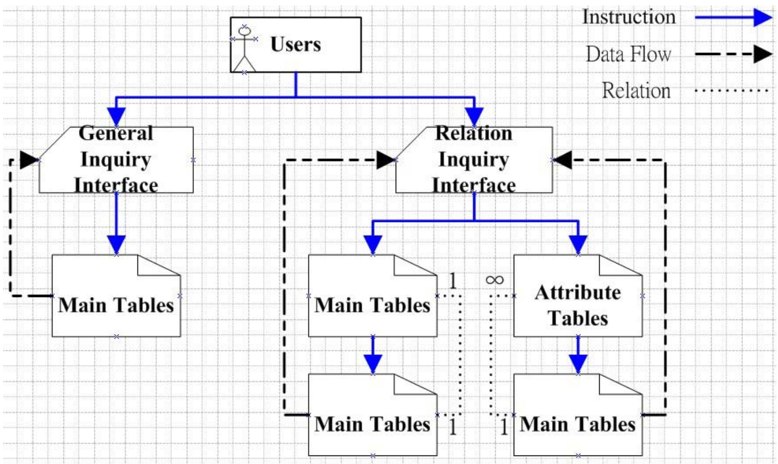

Figure 4.5 SYSTEM ENQUIRY STRUCTURE

5. Operational and Functional Tests

5.1 Database Creation

To register a new casualty case, a total of 460 fields of data are expected. These static and dynamic data include ship's particulars (69), information on seafarers (7), on-scene data (84), previous 96 hours activities (120), ship's factors (34), environmental factors (24), human factors (77), and consequences of the incident (45) etc. After a successful registration, a confirmation message will be replied to the user by the system with a code delegated to this casualty and the user is allowed to proceed with all the following data registration.

Figure 5.1 Registration of ship's particulars

Figure 5.2 Confirmation of registration of ship's particulars

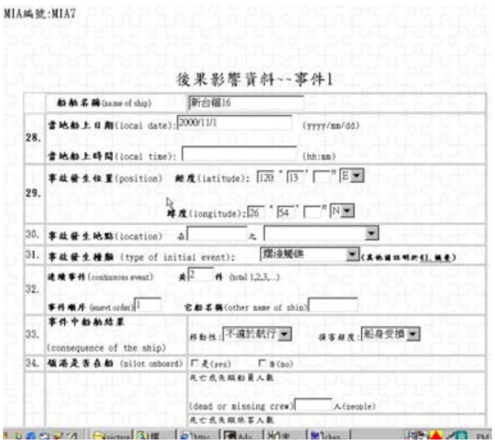

Figure 5.3 Registration of consequences of the incident

Figure 5.4 Data from server side

5.2 Administrative Enquiry

Administrative enquiry is established according to the regions of administrative responsibility of harbour bureaus and source of data provided by different harbour authorities and government agencies. Criteria of enquiry include ship's particulars, characters, and consequences of casualty

5.3 Relation Enquiry

Relation enquiry is created to carry out an advanced search for users enquiring into the system by setting relational criteria that are more specific. Six types of relation enquiry are provided as follows:

1. ship, rank, and personnel activities
2. types of ship, and consequences factors
3. types of ship, characters of casualty, and ship particulars
4. characters of casualty and on-scene data
5. location of casualty and on-scene dada
6. pollution and on-scene data

Fig 5.7 Relation enquiry by types of ship, characters of casualty, and ship

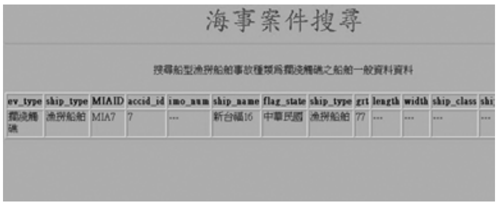

Figure 5.8 Results of relation enquiry

6. Conclusion

Shipping, fishery, and all the maritime activities are extremely important to Taiwan, which has been enjoying remarkable achievements in these fields fostering Taiwan's economic growth in the last four decades. However, through an examination of Taiwan's maritime casualties' records, there is clear evidence showing that Taiwan's maritime achievements are building upon the sacrifice of life, loss of ships, pollution of the marine environment, and uncountable loss of properties.

Information technology in Taiwan has been enjoying a high reputation worldwide, and Taiwan has been the world's fourth-largest computer hardware supplier since 1995. The information technology industry is relatively strong, popular, acceptable and accessible to the public. However, the utilisation of IT as an administrative tool to supervise Taiwan's maritime safety affairs seems sluggish or even stagnant. There is no doubt that maritime safety issues in Taiwan are alarming, and there is a strong need to diagnose Taiwan's maritime safety system. Data collected from maritime casualties is one of the most important links in the chain leading to effective measures to reduce the number of maritime casualties. Hence, the development of Taiwan's maritime casualty database system is essential and vital.

Although this prototype TMCDS system is developed with very limited research funding support, its operational functions, management functions, and storage functions have successfully embedded in the system. Moreover, a total of 2927 casualty cases have also been registered in the system by the authors. Now, the TMCDS has been becoming an important tool and been attracting researchers and interested parties' enquiries.

Following the requirements set by international organizations and referring to different maritime casualty databases from many developed maritime countries, this prototype TMCDS is planning to improve its functions to a more convenient environment for search, retrieval, and management access to data in its database. The structure of the database will be expanded to include data, text, pictures, voice, and possibly video images. The integration with ECDIS or GIS is currently under study. In addition, TMCDS is also planning to add a data exchange program to receive casualty data from other countries for further maritime safety analysis.

Last but not least, with an advantageous position of IT and economic strength, Taiwan has its wonderful environment for system development. However, the desirable and ideal TMCDS is still in the future. To receive Taiwan government's support and approval is one issue; to convert government's maritime casualty administrative people from original paper works to a new computerized system and key-in details of all existed cases is another, even a challenge!

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BIOGRAPHY

A Study of the Development of Taiwan Maritime Casualty Database System

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Dr Solomon Chen is currently an Associate Professor of the Department of Merchant Marine and the Head for the Centre of Maritime Safety and Security at the National Taiwan Ocean University. Between 1993 and 2003, he has acted as a Secretary of the College of Maritime Science, Head of the Research and Development Office, Head of Department and Head of Shiphandling Simulator Centre at the National Taiwan Ocean University. He has previously held a position as Visiting Scholar at the Australian Maritime College from February to September 2004.

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Research On Advancing Informational Support During Shiphandling In Congested Waters

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ABSTRACT

The given research will help the navigator to be trained fully in accordance with:

- STCW – 78-95, Code STCW –95
- SOLAS 1974 as amended
- IMO Resolutions A. 224(7), A. 282(8), A.342 (9), A.424 (11), A.477 (12), A.526 (13), A.529(13), A.574(14), A. 575(14), A.665(16), A.694(17), A.817(19), 823(19).

Despite the fact that real-time simulating equipment (e.g. Full Mission Ship Simulator - FMSS) is in use all over the world for training navigators and navigational cadets, manned physical models of large capacity allow us to carry out various tasks of Shiphandling in congested waters, in environments, much more closer to real-life conditions than any computer-based simulator ever built. Such manned model ideally imitates ship's maneuvering in congested waters, where due to transience of all processes, most navigational control tools cannot be used. The navigator should then evaluate the situation "by eye", and "by feeling". Control and decision-making is based on dynamics of changes in the environment/surrounding conditions. Assessment of a ship's hydrodynamics and applied forces is essential - when analyzing such an environment.

In order to carry out the research we have performed following activities:

- Imitated navigational area's environment
- Developed ships' maneuvering scheme algorithm
- Designed model of ship's maneuvering control
- Emphasized ergonomic and psychological aspects of navigator's activities

Main results of the research are:

- Increase navigational safety due to higher level of Shiphandling training.
- Received results serve for designing ships' maneuvering system and for choosing its structure.
- Offered combined training program for navigational officers using manned models and FMSS.

Introduction

One of the most important aspects of solving the problem of safe navigation in congested waters is the profound knowledge of ship's properties as an object of control. The possession of this knowledge by a navigator, in addition to good practical skills, allows him to control the ship more efficiently under different conditions of navigation, which results in decreasing accident rate in the shipping industry.

That is why a very important problem consists in obtaining the information concerning the elements of ship's maneuverability with the further usage of the above information in the process of simulator training of ship control. The acquisition of the required information may be effected by both physical and model trials. The latter ones are especially important for the sake of accumulation of statistic data concerning the ship's behavior when performing a certain maneuver.

Despite the fact that real-time simulating equipment (e.g. Full Mission Ship Simulator-FMSS) is in use all over the world for training navigators and navigational cadets, manned physical models of large capacity allow us to carry out various tasks of ship handling in congested waters, in an environment much closer to real-life conditions than any computer-based simulator ever built. Such a manned model ideally imitates ship's maneuvering in congested waters, where due to transience of all processes, most part of navigational control tools cannot be used. Navigator should then evaluate the situation "by eye", - and "by feeling". Control and decision-making are based on dynamics of changes in the environment/surrounding conditions. Assessment of ship's hydrodynamics and applied forces is essential when analyzing such an environment.

Standard training and implementation of model trials requires the maximum possible similarity of the models to the prototype ships. Since the efficiency of the navigator's simulator training depends, to a considerable extent, on the profundity of the theoretical knowledge of ship's dynamics, an acute necessity arises to prepare the full amount of the data reflecting the principal peculiarities of ship's behavior under different conditions of maneuvering.

The accumulation of a sufficient amount of statistical data for acquiring ship maneuvering process quantitative assessment requires considerable expenses and time. As already mentioned above one of the possible solutions of the problem is the application of physical modeling methods.

1. The ship process maneuvering modeling method.

In Odessa National Maritime Academy (ONMA) large scale manned models of LNG carrier "Mossoviet" and bulk carrier "Khariton Greku" are used for this purpose. A series of trials of the model of m/v "Khariton Greku" was effected aiming at the investigation of the ship's behavior in the maneuvering process in particular, the determination of the transitional curve shape when the ship enters the circulation. In the trial process the model path, the course angle in relation to a conspicuous object when the ship was moving with the predetermined rudder-deflection angle were fixed. Altogether 47 experiments have been made (18 for rudder deflection angle of 30° to port and 15° for rudder defection angle of 30° to starboard included) in different weather conditions (wind, rough sea) 0-3 when brought to the scale of a real ship. Model path measurement precision using the method of theodolite marks is estimated with the root mean square course error of 6-12 cm., the course angle measurement accuracy is 0.5°. The processing of the natural observations data allowed to obtain the information concerning the (PP) model movement path, alterations of the course, speed, angular speed, drift angle and the path curvature (K) for every experiment instance and also the fluctuation of mean values and root mean square errors of the above parameters for every group of experiments (rudder deflection angles). The information about the fluctuations of the path mean average curvature values and their root mean square errors and the course for the ship's movement in circulation with the rudder deflection angle of 30° to port and starboard are given in Figs 1. and 2.

The obtained in the experiment dependences of turning path curvature of the course angle and the distance covered prove the theoretically obtained expression for the current radius of turning ν_i:

$$\nu_i = R_0 \frac{\sqrt{\varphi_0}}{\varphi_i}$$

where R_0 – radius of constant turning.

φ_0 - course angle causing providing for circular path formation.

The notion of ship turning is to be regarded as a probabilistic process. The practice of ship's control proves the fact that the fulfillment of turning the ship in similar conditions and by means of identical control actions results as a rule not in a single path but in a whole band covering a number of paths. The width of this band in the vicinity of course change by 90° in relation to the previous one (in the point of rudder turning) is comparable with the ship's hull length. The hypothesis of the probabilistic character of ship's movement during the turn was proved experimentally during the physical trials of m/v "Captain Polkovskiy" and "Yargara".

A similar work was fulfilled on board bulk carrier "Khariton Greku" although the amount of operations was rather limited as compared to the previous one. The arrangement of trials and the weather conditions practically completely excluded the influence of the external interferences on the process of ship's movement along the curved path. There were effected altogether 6 turns with the change of the course by 90-100° in relation to the initial direction of movement with the rudder deflection angle 15° to port. As the experiments proved (you may see the paths of turning on Fig. 3) again, a whole band of paths was obtained in spite of the limited number of maneuvers. For the evaluation of the dispersion of paths in small samples (the number of samples range from 2 to 12) it is recommended to use the scope that facilitates although not very efficient but quite acceptable evaluation of the product of the standard divergence by the known multiplier of general totality (aggregate). The scope of paths (or the formed (by the paths) band width) in the vicinity of rudder turning equaled 0.45 kbt (83.44m) or 0.41 of the ship's hull length.

Thus, the above model trials and physical experiments with the real prototype ship vividly visualize the probabilistic character of principal cinematic parameters change during ship's maneuvering. Consequently, when planning ship maneuvers, one should not speak about an assumed path of ship movement but with a certain probability degree about a whole band of possible ship movement.

The comparison of inertia-braking characteristics of a model and a prototype ship shows that relative difference of braking paths for the maneuver of FSSA-FSA may amount to 12%, but one should take into account, - that the movement at full speed when maneuvering in congested waters is practically not applicable, that is the above maneuver for the manned model is not practicable. In all the rest of the maneuvers where active braking is effected the difference is less than 10% and that gives evidence of a good accordance of the inertia-braking characteristics of a model with those of the prototype ship. A clear view of that accordance is given by means of the graphs of speed and the braking path of the ship and the model presented in pairs on Figs 3-9.

2. Research and training.

In the process of the above investigations the planned researches with the use of manned ship models aimed at the processing of certain elements of ship movement modeling and setting of simulation problems were combined with training of refresher-courses navigating officers groups.

The essentials of the methods of this sort of training were developed during investigation.

The quantitative forms of assessment and monitoring of the listeners progress were also proposed in that process. But the full - scale practical application of this method of assessment in practical training is hindered by the absence of certain instrumentation the necessity of a great number of measurements and, most importantly, their processing. That is why it doesn't suit nowadays for operational practice of simulation training process but is used for the preparation of the problem in the process of its setting up identification. On today's stage maneuver zone parameters are determined for every category of assessment. Further on in the process of simulation lessons the maneuver zone dimensions obtained in the task fulfillment are to be compared with those of the standard pattern zone. As we can conclude from the above, any judgment of the maneuver zone drawn from one experiment would be false, as the parameters are characterized by the statistic divergence. The reliable and objective means of the exercise fulfillment monitoring would be video record of the process. A joint viewing of the record together with the instructor right after the training cycle would enable the listener to give a proper assessment to his actions (taking into consideration the normal statistic divergence) observing ship model movement against a background of navigational buoys and marks imitators, hydrotechnical facilities and other objects depicting the aquatorium, to express the geometric parameters of the ship's hull dimensions (length, width of the hull, etc.). The maneuver kinematics e.g. changes of the angular speed when turning, the stern throw, the change of the ship's position in relation to the wind etc.

3. Training method

The training procedure is as follows: preliminary theoretical instruction in the classroom with the whole group to be present. Full Mission Ship Simulator (FMSS) is to be used at these lessons. Then the group is subdivided into "crews" containing 2 persons each, who in turn occupy the positions of navigator and engineer-helmsman. In the process of exercise fulfillment at every model the orders are given from the "bridge" and the "engineer-helmsman" carries them out without any interference in the control process.

During the classroom lessons the students get acquainted with the required theoretical sections of the ship-handling course, the notion of controllability of the ship with the particular inertia-braking characteristics, when a man-operator acts in different navigation-hydrographical and hydro-meteorological conditions. The students are also introduced to the main principles of ship navigation simulation and rules of their operation, aquatorium facilities, the conditions of simulation exercises and the order of their fulfillment, the accumulated experience of simulation and the peculiarities of the usage of manned models for training the tasks of safe navigation.

The practical training is affected with separate "crews" which in succession fulfill the tasks for the day prepared to solving the forthcoming problems by means of a situational analysis. They are also instructed in the technique of model control. Every exercise is performed not less than three times. After every exercise the instructor can give, if required, his remarks and recommendations. Analysis with the crewmembers is done after every cycle of exercise repetitions and a joint group analysis after every cycle of problems.

After the performance of a block of exercises every students is to solve a complex attestation problem, including elements of various problems. A very advantageous element of training proved to be the observation and analysis of the actions of a colleague, performing an exercise by a group of training navigators.

Practice shows that the instructor should by no means impose his own scheme of exercise fulfillment on the students. His role should limited to setting the problem, instruction in control, recommendations of the tactics of maneuvering, and observation and joint analysis of the results. His direct assistance may be necessary during the time of students adaptation to the model (1-2 first period) or in case of series of fails when the navigator starts feeling constrained and uncertain.

ONMA's method of physical modeling (simulation) of different sailing conditions using manned ship models and methods of training and investigation gives an opportunity not only for the investigation of any particular conditions of navigation (and on the basis of the analysis of the above investigation to prepare practical recommendations) but also to help the navigators (masters, chief officers and pilots) to develop the habits (skills, abilities) to handle the ships in congested waters. Multiple repetitions of maneuvers in different situations facilitate the strengthening of these skills and the experience of safe maneuvering.

Analysis of the acquired experience shows that the correct arrangement of the lessons, combining the survey theoretical instruction (FMSS included), practical exercises on water with observation from the shore and recording of all the actions by the video-tape-recorder provide positive results in two directions:

First, in compliance with the requirements of STCW-78/95 Convention, Regulation II-2 and IMO Resolution 17 the navigators acquire practical skills of handling ships when sailing in congested waters. An important component of this training is modeling (simulation) not only of safe navigation, but also emergency situations, for the reproduction of which the simulator is the only possible means.

Second, comparing the requirements of safe navigation criteria and an actually observed situation on the aquatoria, when the tasks are worked out at the imitator-simulator, a navigator acquires the skills of situational analysis (i.e., preliminary study and planning of the maneuvers, determination of critical values of the ship's movement, the limitations of the navigation conditions caused by the forces of the environment). The choice of the navigation tactics is made on the basis of the preliminary situation analysis in the aquatorium.

Conclusions

The principal peculiarity of the simulation problems in question is their relative complexity and that of the methods used the systematic repetition of the training problems, i.e. the method of "attempts and fails". The solution of simulation problems was often affected under hard conditions of the influence of extreme hydrometeorologic conditions.

In parallel with model investigations, the steering of ONMA training vessels through the Bosphorus in very heavy conditions of navigation was done. The obtained results give us grounds to conclude that efficiency of the navigator's work when sailing along complicated straits is low. These conditions prove the acute necessity of developing means and methods of steering that would eliminate the trespassing of dividing and boundary lines, and simulator training of such methods of steering.

Analysis of the results of a simulation problem concerning steering through a rectilinear shallow channel shows that the navigators comparatively quickly acquire the necessary skill that they retain for a year. The statistical data obtained facilitated the development of an analytical model of ship's steering through a channel in different hydro-meteorological conditions, which has its proper specialization – theoretical essentials of conception instruction.

Complicated simulation problems (e.g., "making fast", or "turn in narrow waters") were the most time-consuming in the process of training. The obtained results provide the opportunity for tracing the dynamics of trainability; - however, the experimental data still remain contradictory. When the problems are being worked out the absence of the methods of navigators' psycho-physiological state check-up (fatigue, high emotional stress, information overflow etc.) as well as the used training method of “attempts and fails” (which is rather time-consuming) are the factors that contribute to the contradictory character of the data. But at the same time this method enabled the instructors to determine the initial level of practical knowledge and skills of the navigators, participating in the experiment and facilitated the identification of the way to more effective training, which in our opinion should combine practical knowledge and skills.

Thus, further improvement of the training methods will proceed in the described direction and the training exercises will include complicated critical situations and working skills that cannot be formed in real conditions.

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BIOGRAPHY

Research On Advancing Informational Support During Shiphandling In Congested Waters

Dmytro Zhukov

Dmytro Zhukov is currently the Designated Person Ashore of Odessa National Maritime Academy (ONMA). This entails responsibility for ONMA safety management system and the sailing training ship *Druzhba*.

Capt. Dmytro Zhukov commenced at the ONMA in 1998 as the Ass. Professor of the Marine Safety Department, where he is primarily working on the development and implementation of quality management systems within ONMA's training centers. He studied in ONMA from 1984 till 1990. Between 1990 and 1998 he was employed by the Black Sea Shipping Company and Foreign (Flag) Companies as 4th, 3rd, 2nd, Chief Officer and Master. Since 1998 he lecturers the post graduates Conventional Courses. Since 2002 he was appointed as ONMA Shiphandling Department Senior Lecturer. Since 2003 he is a Head of Navigational simulator of the Maritime training Centre "Lesozavodsk".

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Mykhaylo Miyusov

Prof. Dr. Mykhaylo Miyusov started his career in 1983 at the Odessa Higher Engineering Marine School (1944-1991 Odessa Higher Engineering Marine School, 1991-2002 Odessa State Maritime Academy, 2002- till now Odessa National Maritime Academy) as an engineer. In 1997 he came to the position of Pro-rector on Distance Education of academy. During all that period he has worked as an engineer, a seafarer, scientific worker and senior lecturer. Prof. Miyusov has more than 51 publications in different books, magazines and scientific journals. In the year of 2000 he has obtained the position of rector.

He is a Fellow of the Institute of Marine Engineering, Science and Technology, Academician of Transport Academy of Ukraine, Academician of Academy of Sciences and Shipbuilding, Head of Specialized council on Defense of Doctor Dissertations in Odessa National Maritime Academy on specialty "Navigation and Ships' Power Plants", a member of the Rector Council of Universities of Ukraine, a member of Executive Committee of the International Association of Maritime Universities, a Head of the II Working Group.

The Evaluation of Fuel Cells for Ship Application

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Student Presentation

Summary
This project's purpose is to evaluate the use of fuel cells as a power source for use in a dc electric ship propulsion system.

The majority of ships running in the world's oceans and waterways today are powered by diesel engines. Oil is a limited resource, the use of which is not environmentally friendly. Fuel prices fluctuate daily with a general upward trend in the past few years. The accidental leakage and dumping of oils overboard has caused terrible effects on marine environments worldwide. On top of this, increasing amounts of fossil fuel combustion have been linked to devastating global environmental effects through emissions of green house gases.

A fuel cell utilizes basic electrolytic properties of oxygen and hydrogen molecules to produce electricity. The transfer of electrons between the molecules can be used to supply dc power. The supplied electrical power will be continuous as long as both oxygen and hydrogen flows are maintained and constant. The only waste byproduct produced by this ideal system is pure water. Unlike batteries that also use this fundamental principle, this cell will not degenerate over time. This hypothetically provides a permanent electrical power supply needing minimal support, and requiring only the provision of a fuel and oxygen supply.

The project includes the construction of a scale working model of a solid oxide fuel cell. The design also involves selecting, as well as implementing the necessary safety requirements, including sensors and relief valves.

A series of tests will be conducted to evaluate the power output and the corresponding fuel input. The level of power output would then be extrapolated to that required for the full scale propulsion system under the study. These results will be used to determine the fuel cell system that may be required to run a ship's propulsion system. This will include the fuel cell size and arrangement, as well as the required fuel tank sizes.

From the analysis of the measured and extrapolated values, it will be determined whether the use of fuel cells will be feasible in the near future for ship propulsion. This utilization of fuel cells would allow for a large savings in fuel costs, a better overall efficiency of ship operations, and a more environmentally sound ship propulsion method.

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Virtual Dredging of a River

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Student Presentation

SUMMARY

It is a well known trend in shipping that the ships become bigger and bigger.
For the adaptation of waterways expensive dredging and construction measures are necessary. Especially simulation studies are suitable methods to estimate the potential effects and costs of such activities in advance. For the purposes of scientific case studies several models for coastal and inland navigation traffic scenarios were developed and implemented at the Shiphandling simulator of the Maritime Simulation Centre Warnemuende.

The project here deals with pre-research work to a further enlargement of a waterway.
As a basis for the simulator set up the Electronic Navigation Chart (ENC) has to be prepared according to the real and future layout of the waterway. Specifically for these investigations the new water depth and tidal data have to be integrated into an existing ENC.
These ENC data are not only representing the underwater topography and the current for the simulation, they also form the basis for the ECDIS system to be used on the simulator bridges and they will also used for the generation of the RADAR images and the sea areas for the visual system.

Within this simulation environment a big container vessel and a large bulker will be tested in various conditions to get some information on the quality of the waterway design and the procedures how to handle the ships in an optimal way.

Studies on Tow Forces of Tugboat in Regular Head Waves

Ship Model Experiment

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Student Presentation

SUMMARY

The tow force of tugboat is brought through the bollard pull test that is executed under the condition of still water and no forward speed. This is only information relating to towing works, which is offered to tugboat operator and pilot. However, since tugboat always works in waves and with forward speed, it is needed to know practical the tow force in waves. But the characteristics of tow force in waves have not been studied in series.

In our studies, the characteristics of the tow force in regular head waves are examined by water tank experiment using ship models. To make clear the above characteristics, we divide the directly measured tow force into two components, namely the mean tow force Tm and the fluctuating tow force amplitude Ta. And influences such as the elevation of towline, wavelength, wave height, forward speed on the above analyzed Tm and Ta are revealed. The information on the characteristics of Tm and Ta in waves will become useful data for planning navigation and checking for strength of towline.

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Introduction of the Double Trolley Quayside Container Crane

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Student Presentation

SUMMARY

With the recent advent of super post-panamax container vessels, which can carry more than 8000TEU, the increasing requirement of the improvement of container port productivity and efficiency has led to the adoption of the advanced type of cargo gears in container ports worldwide, including the port of Busan. A container crane functions as the most important and influencing factor on the process of cargo operation. The new technical trend of a container crane shows its improved promptitude and automation. We will hereunder introduce the double trolley quayside container crane, which has been newly selected by prospective hub ports.

The Double Trolley Quayside Container Crane has advanced characteristics in some aspects compared to other ordinary container cranes. The two trolleys, which consist of, a main trolley and a portal trolley are located and travel on the rails at different heights to the main trolley girder and portal beam without any interference. On the seaside sill beam, the crane has a switchboard to transfer a container between the main trolley and the portal trolley. While unloading, the main trolley transfers the container to the switchboard. The portal trolley then takes the container to the chassis (container vehicle), and the loading process is vice versa. The productivity of the double trolley container crane depends on the main trolley. The main trolley can return immediately after transferring the container from the vessel to the switchboard, which has a fixed position, so reducing take-off time during the twist lock operating cycle. This again raises the productivity of the main trolley and consequently elevates a whole container crane's processing rate. Also, there is a cab hung under the main trolley girder, and from the cab the driver aligns containers while hoisting up and down. Other main trolley operations such as traversing are all executed automatically, and the portal trolley uses a full automatic operating mode with no driver required.

In conclusion, by utilizing this kind of container crane which offers theoretical productivity of 60 containers per hour, it is expected that such prompt loading and unloading ability will be achieved and finally it will contribute to the winning of hub port status.

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Statistics And Analysis Of Maritime Accident In Chinese Navigable Waters

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ABSTRACT
For the purpose of evaluating the maritime safety situation in Chinese navigable waters, statistics and analysis work on maritime accidents occurred in Chinese navigable waters in last ten years has been done in this paper. It presents that number of maritime accidents steadily decreased while direct economic loss and number of life loss seems fluctuating during the period 1993-2002. In accordance with the analysis results, except the human factors, which have been involved in most of major maritime accidents, some other factors such as management of shipping companies, ship conditions, conditions of navigable waters, marine traffic volume and maritime traffic safety assuring and supporting system were also play an important role in all those maritime accidents. Based on the results of analysis, some recommendations on measures and policies against the maritime accidents are presented.

1. Introduction

China is one of the main maritime countries in the world. Chinese waterborne transportation plays a very important part in the development of domestic economy and international trade, but maritime accidents, which occurs frequently and causes losses of property and life and damages environment, impedes the development of waterborne transportation. Thereby, Chinese government and maritime society has paid more attention to maritime safety and taken every necessary measure to avoid occurrence of maritime accidents and to decrease the number of accidents.

The key steps in accidents avoidance is to identify the factors and causes that leads to the occurrence of maritime accidents. Statistics and analysis of maritime accidents can be helpful to find the rules of occurrence of accidents, causes and contributory factors of accidents, as well as learn lessons from accidents, so as to take correct and necessary measures to improve maritime safety situation. In this paper, statistics and analysis work on maritime accident occurred in Chinese navigable waters in last ten years are introduced, for the convenience of analysis work, the status of waterborne transportation in China has also been introduced.

2. Status of waterborne transportation in China

Chinese domestic economics and international trade develop very fast in last ten years with annual increase rate 10% and 15%. In this progress, waterborne transportation plays a very important part. As shown in table 1 and fig.1, although the increase rate of cargo carried by sea is lower than that of GDP and international trade during the period, the trend of this increase is continuous and steady.

Corresponding to the rapid development of domestic economics and international trade, the capacity of Chinese waterborne transportation also made a great progress during the same period from 1993-2002, as shown in table 2 and fig.2.

Table 1 the relationship between Chinese domestic economics and waterborne transportation

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Population (Billion)	11.85	11.19	12.11	12.24	12.36	12.48	12.59	12.95	12.76	12.85
GDP (1000×Billion RBM Yuan)	3.14	4.38	5.83	6.78	7.48	7.96	8.19	8.94	9.59	10.24
International trade (100×Billion USD Dollars)	1.96	2.37	2.81	2.90	3.25	3.24	3.61	4.74	5.10	6.21
Waterborne transportation (Billion Ton)	0.98	1.07	1.13	1.27	1.13	1.1	1.15	1.23	1.33	1.41

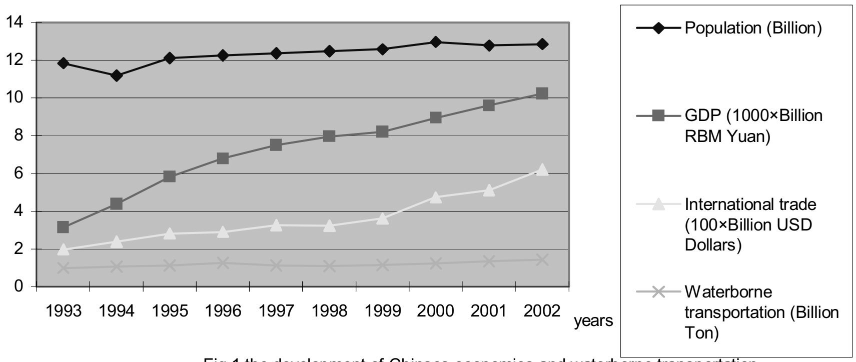

Fig.1 the development of Chinses economics and waterborne transportation

Table 2 Capacity of Chinese waterborne transportation

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Number of ships (10,000)	38.29	36.17	36.50	33.09	27.19	26.36	24.20	22.98	21.08	20.30
Fleet in dwt (mt)	44.00	48.55	50.43	49.12	48.00	47.94	47.89	51.00	54.50	57.06
Cargo throughput (100mt)	15.7	16.9	18.0	18.4	18.4	18.1	19.6	22.1	24.0	28.0

Source: Statistical communiqué on the national economic and social development (1993-2002), National Bureau of Statistics of China.

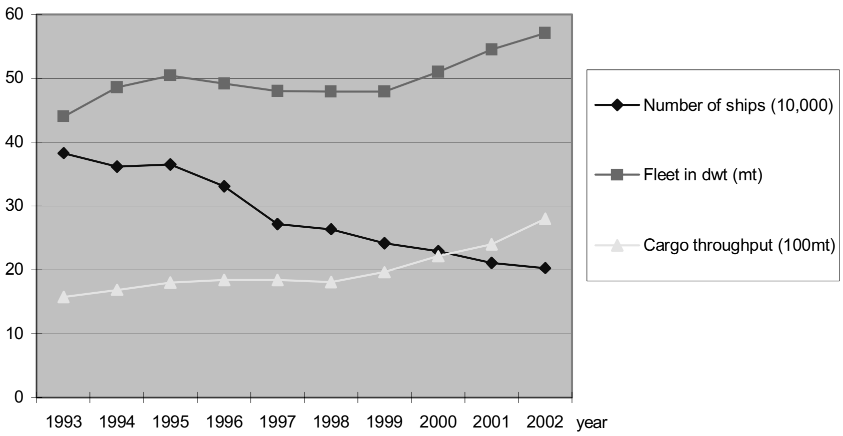

Fig.2 Capacity of Chinese Waterborne transportation

Form table 2 and Fig. 2, it can be seen that the size of fleet in dwt and the cargo throughput of ports was increasing steadily while the number of ships was decreasing year by year, that means the size of ships was getting larger continuously.

1. Statistics of maritime accidents in China

With the fast development of waterborne transportation in China, the situation of maritime safety is drawing more and more attentions from the maritime community of China since the situation of maritime safety has a deeper influence on the development of the domestic economics. For evaluating the maritime situation in China, number of accident, number of foundering, number of dead and missing and direct economic loss are taken as indicators of safety status by maritime safety authority of China, which is also called four indices of maritime accidents.

In Table 3, the annual figures of four indices of maritime accidents during the period 1993 to 2002 are presented. For convenience of analysis, the table 3 has been transferred into Fig.3-6.

In accordance with Fig3, Fig4, Fig5 and Fig.6, it can be told that in the past ten years, the number of accidents fell steadily from about 200 in 1993 to around 700 in 2002, while the number of foundering, the life lost and missed at sea, the direct economics loss seems fluctuating during the period in question.

Table 3 Statistics of maritime accidents during the period 1993 to 2002

Year	Number of accidents		Number of foundering	Deaths and missing	Direct economic losses (million RMB Yuan)
	Total	Serious			
1993	2002	444	364	527	115.89
1994	1781	803	332	543	206.68
1995	1486	718	277	731	206.90
1996	1232	608	257	665	316.92
1997	981	532	267	582	295.80
1998	984	563	295	606	221.15
1999	832	529	253	769	251.00
2000	633	481	234	576	135.96
2001	645	445	290	490	164.72
2002	735		384	463	161.35

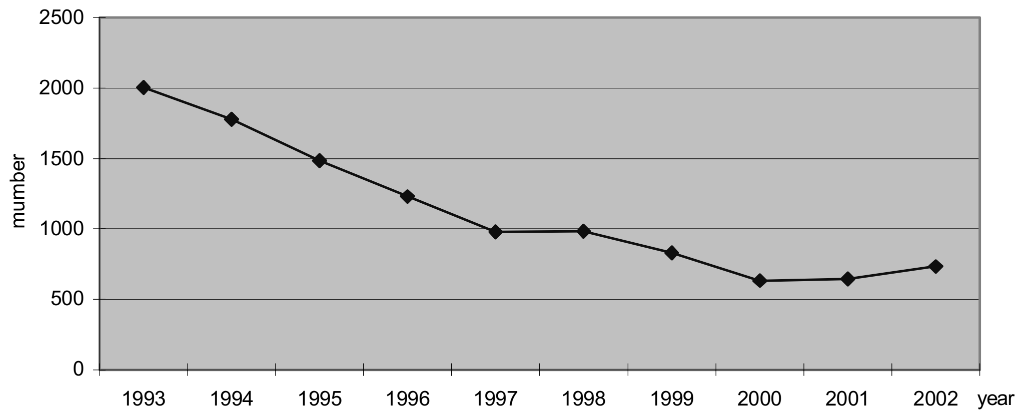

Fig 3 Number of maritime accidents

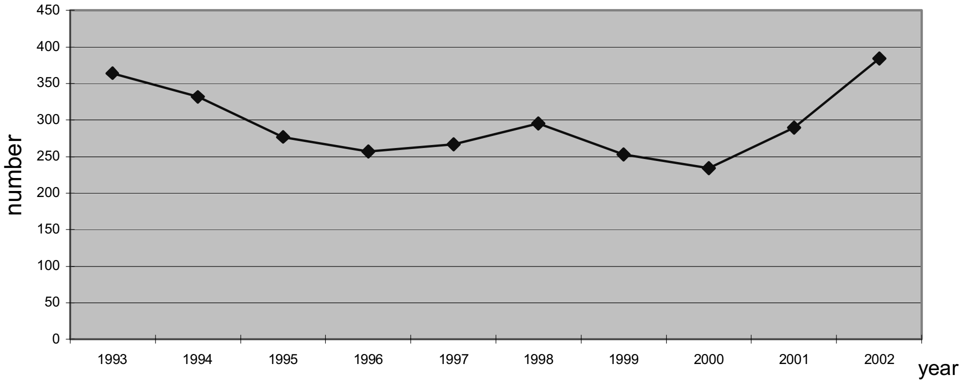

Fig.4 Number of foundering

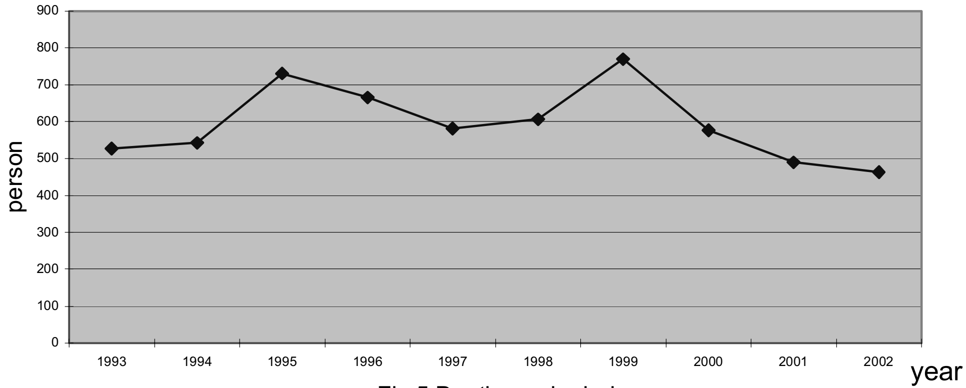

Fig.5 Deaths and missing

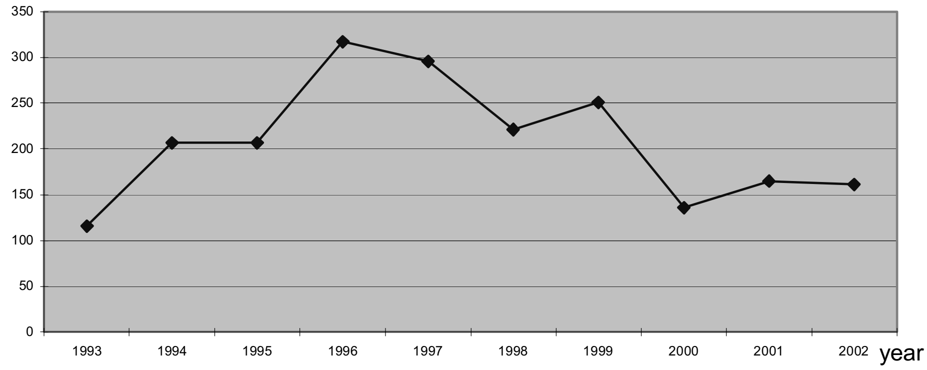

Fig.6 Direct economic losses (million RMB Yuan)

Table 4 Maritime accidents occurred on small ships in 2000

	Number of accidents	Number of foundering	Deaths and missing	Direct economic losses (million RMB Yuan
Total	633	234	576	135.96
Small ship	297	145	345	38.7
Ratio (%)	44.1	59.8	59.6	28.5

Among all these maritime accidents, it is necessary to mention that small ships owned by the individuals who live in small towns and villages are involved in maritime accidents with a very high ratio. For example, in 2000, the four index of maritime accidents of small ships are 297, 145, 345, and 38.7 respectively, that share 44.1%, 59.8%, 59.6% and 28.5% of total in the country (as shown in table 4).

4. Analysis of Maritime accidents in China

Investigation of accidents indicates that the causes of maritime accident can be derived into following areas:

4.1 Human factors

Fig.8 shows that more than 90% accidents involve human factors. In this analysis human factors is not only related to seafarers, but also related to these personals in shipping company, ship classification society and maritime safety administrations. "Da Shun", a ferry sailing between Dalian and Yantai, sunk in heavy weather in 1999, caused 282 lives lost, is a very serous maritime disaster happed in China waters in last 10years. Investigation indicate, Captain's improper operation is the main cause of the accident, but ship company gave the pressures on the ship for leaving out the harbors, local maritime safety administrations did not carry out formal inspection before Da Shun leaving out of harbor are other main reasons which caused the accident (CMSA 2001).

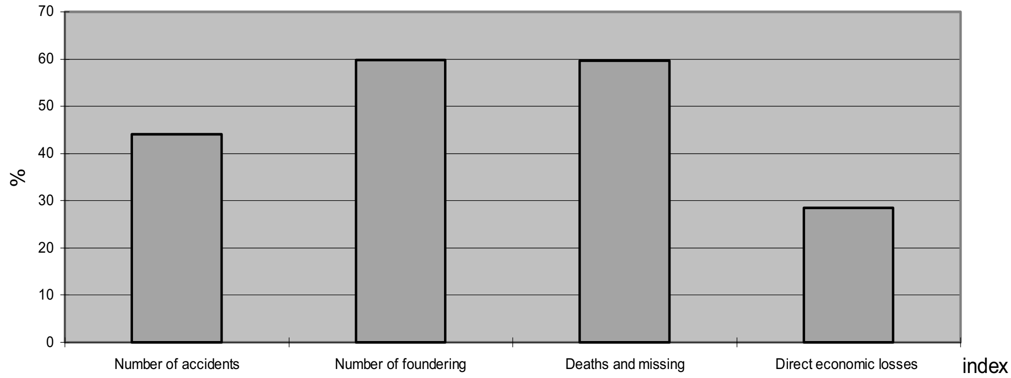

Fig.7 Ratio of small ships involved in accidents presented in index

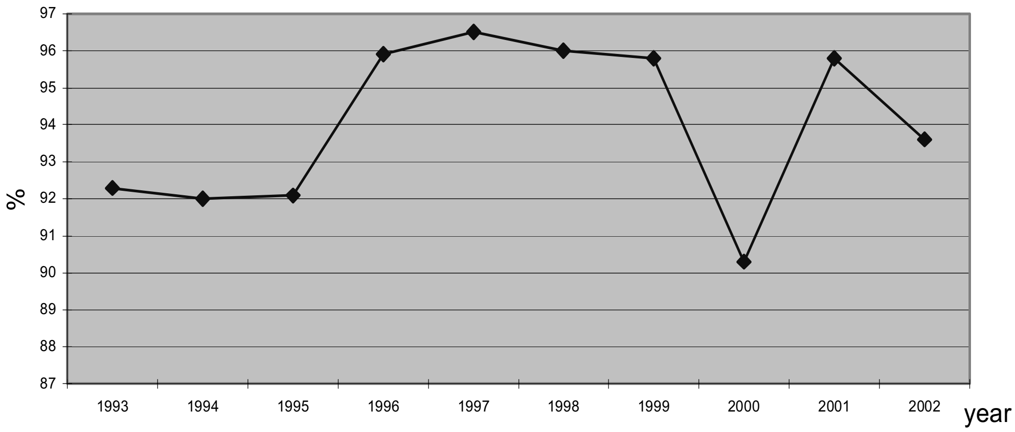

Fig.8 The ratio of human error involved accidents

Table 5 Comparison between Chinese fleet and world fleet

	Liquid carrier		Bulk carrier		General Cargo		Container	
	China	World	China	World	China	World	China	World
Structure of fleet (%)	14.9	42.3	53.4	34.2	19.1	12.7	9.2	8.4
Deadweight tonnage (, 000)	20.6	46.4	39.3	49.2	8.4	7.5	20.0	26.1
Average age (years)	18.3	15.7	15.9	14.7	21.6	18.1	10.8	10.1

Source: compiled from statistics in ISL 2000(ships of 1000gt and over)

4.2 ship conditions

China is a developing country, the ship owned by Chinese shipping companies and individuals have relative low technical conditions, such as the size is small, the age is high, a lot of second-hand vessel and wooden ship are still used in coast and inland waters. Table 5 gives the comparisons results between Chinese fleet with the world fleets.

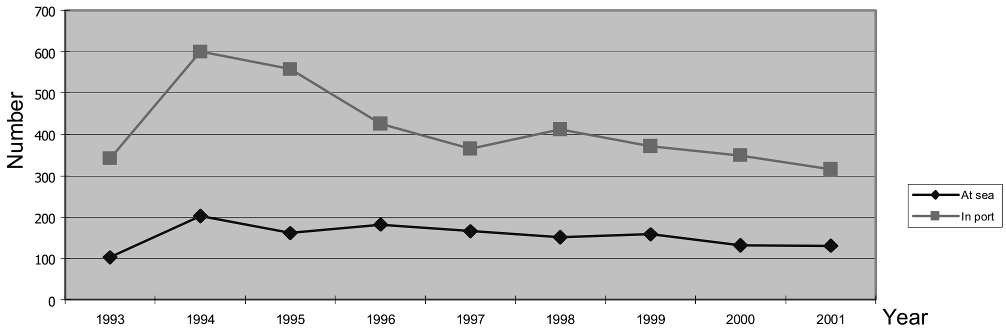

Fig.9 The Comparison between the accidents ocurred in port area and sea

4.3 Navigational water circumstances

With the development waterborne transportation and other productive activities at sea, the navigable water circumstances seems to be worsen and harder to marine traffic. The waters seems to be more narrow and risk of accidents increased for the density of marine traffic is increased and the also the size of ships. Statistics prove that more maritime accidents occurred in port and harbor area than that in open sea, as show in Fig.9.

The most dangerous waters that maritime accidents frequently occurred in Chinese navigable waters is shown as Table 6 and Fig10 (Zhu 2003). It shows that except port and harbor waters, straits and estuaries are also the areas where maritime accidents frequently happened.

4.4 Maritime Traffic assurance and support system

For the purpose of maritime safety and marine environment protection, a mechanism called maritime traffic safety assurance and support system has been primarily established and strengthened in China since her liberation. As a whole, the system includes the subsystems as maritime safety laws and regulations, maritime safety superintendence, aids to navigation, ship survey, maritime communications, search and rescue, and emergency reactions. The system has already play an active part in the preventing the happening of maritime accident and reducing the impacts of maritime accidents since its beginning. But, Frankly to say, there must be a close relationship between the high occurring rate of maritime accident

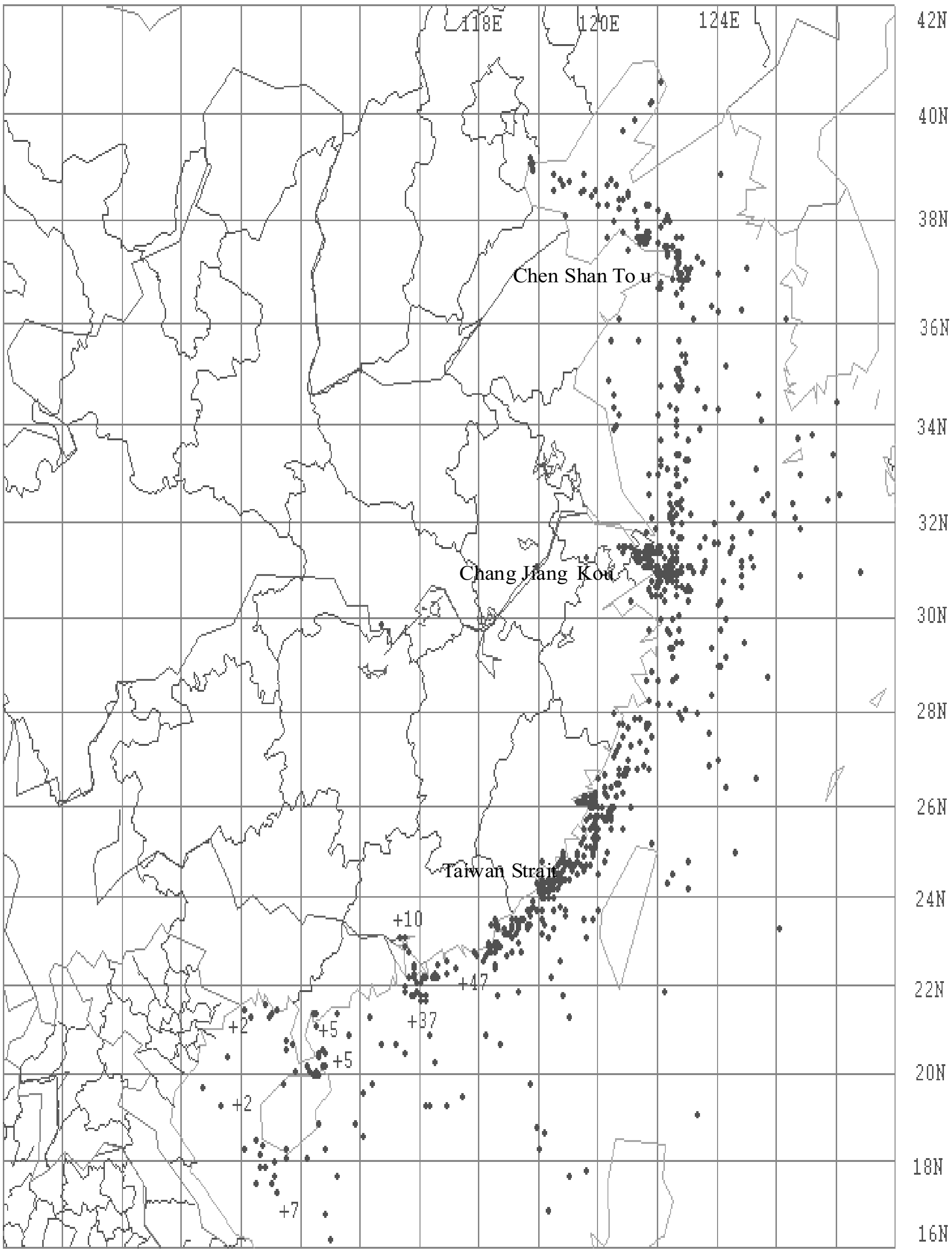

Fig.10 the distribution of maritime accidents in Chinese waters

Table 6 Accident frequently happened area in Chinese waters

Coastal waters	Lao Tie Shan Strait, Chen Shan Tou Channel, the estuary of Zhu Jiang river, Taiwan Strait waters, Qiong Zhou strait and the estuary of Yangzi river
Inland waters	Yangzi river and its branch, Xi Jiang river, Jing-Hang canal, Hei Long Jiang river

Table 7. The adaptability of maritime safety assuring system to waterborne transportation in China

General index	Adaptability	Index	Adaptability	Sub-index	Adaptability
Waterborne transportation assurance	0.652	Safety situation	0.645	Number of fatal maritime accidents per 10,000 ships	0.547
				Dead per 100 millions km (person)	0.690
				Direct economic per million ton-km in RBM Yuan	0.871
				Spilled oil per million ton transported oil (ton)	0.500
		Capacity of assurance	0.665	Arriving time in emergency （min.）	0.429
				Ratio of successful life saving（%）	0.704
				Ratio of successful ship saving（%）	0.822

and the system's incompleteness. An important research project was carried out and completed by the author of this paper. In this project the present maritime traffic safety assurance and support system was evaluated (Wu, at al 2004). The evaluating results are as shown in table 7.

Based on Table 7, it can be told that the adaptability of Chinese maritime safety assuring system to the requirements of the development of Chinese economics and transportation is still low. The general adaptability of the system is as low as 0.652. Compared with the other indices, the arriving time in emergency case or responding action is two slow. It means that the hardware for emergency reaction in China is lack behind the requirements of the waterborne transportation. Immediate improving action on Chinese maritime safety assuring and support system is strongly needed.

4. Conclusions

Based on our research, the following conclusions could be get:

- As the rapid development of Chinese domestic economics, the requirements on waterborne transportation are also enhanced. There is a trend that the traffic in Chinese waters will continuously increased.
- The safety situation in Chinese navigable waters is still not optimistically. Although the number of maritime accidents reduced drastically during the period of last 10 years, the loss of life and direct economic still keep at a high level.
- The causes of maritime accidents are multi dimensions. The major factors that lead to the accidents in Chinese waters are human errors, traffic environment and ship conditions. The incompleteness of the waterborne transportation safety ensuring and supporting system has also somewhat negative influences on maritime safety situation.
- For the purpose of Chinese waterborne transportation, it is necessary for Chinese government to pay more attention the completeness of Chinese waterborne transportation safety ensuring and supporting system.

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BIOGRAPHY

Statistics and Analysis of Maritime Accidents in Chinese Navigable Waters

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Analysis Method Of Compounding Maritime Incidents Using Fault Tree Analysis

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ABSTRACT
After the oil spill incident of M/V Nakhodka, Russian oil tanker, in Japan Sea in 1996, a research group on maritime risk management has started in our university. The group has developed a roll play simulation system of many kinds of marine incidents and trained the students on the email network. At the beginning, the group set the fixed scenario for a roll simulation, then the group understood that the incidents usually accompany life saving, oil spilling, fire, flooding or sinking.

Generally, we have no incident on the transportations with well-trained operators, well-maintained machinery and well-facilitated traffic systems. As a marine traffic example, marine hazards of a collision, grounding, sinking, fires or flooding are common at sea.

These incidents are usually investigated the causes and concluded human error from the psychological and medical viewpoints. After those incidents, it is very important to research for developing and improving safety devices or systems and understanding the reappearance of incident. An analysis method of compounding maritime incidents especially after collision using Event Tree Analysis and Fault Tree Analysis is introduced.

Introduction

At once marine incidents happened we always have fear of loss or damage of lives, sinking or capsizing after ships collided. And we may have serious environmental damage by spilled oil or dangerous cargos from those ships. So far there are research reports on the process and factors of ship collision[1-4], however researches on environmental damage, number of casualties, frequency of oil spilling after the marine accidents are very rare. The Incidents are varied by size, type, and voyage condition of ships.

In this paper, 470 incidents picked up from the judicial precedents of the Japan Marine Accidents Inquiry Agency[6] are surveyed, with the collision being a starting event of the process in the Event Trees and Fault Tree. And casualties or oil spill are as a result event.

Statistics of incidents

The 470 collision cases were picked up from the judicial precedents of the Japan Marine Accidents Inquiry Agency between 2001 and June 2004.

These precedents were surveyed about casualties and oil spill. We set an oil spill as a top event in the case of oil tanker and the existence of casualties as a top event in the case of the other type vessels for composing the Event Tree or Fault Tree.

The probabilities to reach the top event were calculated from these precedents.

Table1. The statistics of the damage by collision

Light or no damage on the hull 199 (42%)	Controllable condition 189 (40%)	Casualties	11 (2%)
		Non casualties	178(38%)
	Loss of propulsion 10 (2%)	Casualties	5(1%)
		Non casualties	5(1%)
Serious damage on the hull 271 (58%)	Sunk or capsized 26 (6%)	Casualties	12(3%)
		Non casualties	14(3%)
	Not sunk 245 (42%)	Casualties	64(13%)
		Non casualties	181(39%)

Result of the survey
The aftereffects of ships' collision are assumed into three categorizes 'light damage' and 'Serious damage' and 'loss of propulsions'. The cases of damage on the hull without cracks or opening, graze or bend are assumed 'Light damage'. The damages on the hull cause flooding are assumed 'Serious damage'.

The third case, the hull has minor damage but trouble of engine plants or propeller caused the loss of propulsion.

3.1 The case study of collision of oil tanker

From the result of investigation, the Event Tree of oil spill after collision of oil tanker is shown in Fig 1. In the accidents of oil tanker for 4 years, 'light damage' was 63% (12 tankers) and 'serious damage' was 37% (7 tankers). 5% (1 tanker) in the total of 'serious damage' had spilled oil.

The flow of the event reached 'oil spill' from the collision is:

The event flow goes to 'serious breakage on the hull' (37%) ➠ 'Not sunk' (37%) 'Breakage on oil tank' ➠ 'Oil spill' (5%).

Fig 1. shows the effect after tankers collided, but the probability in progress has not been indicated because of that we could not find the detail of accidents for example loading condition of oil, total breakage of oil tank itself and the size of opening from the precedents.

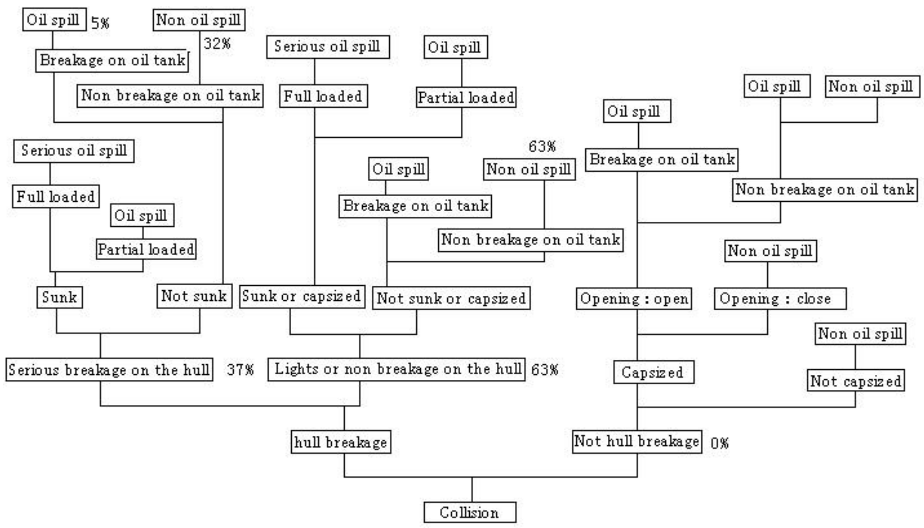

Fig.1 Event tree of the tanker

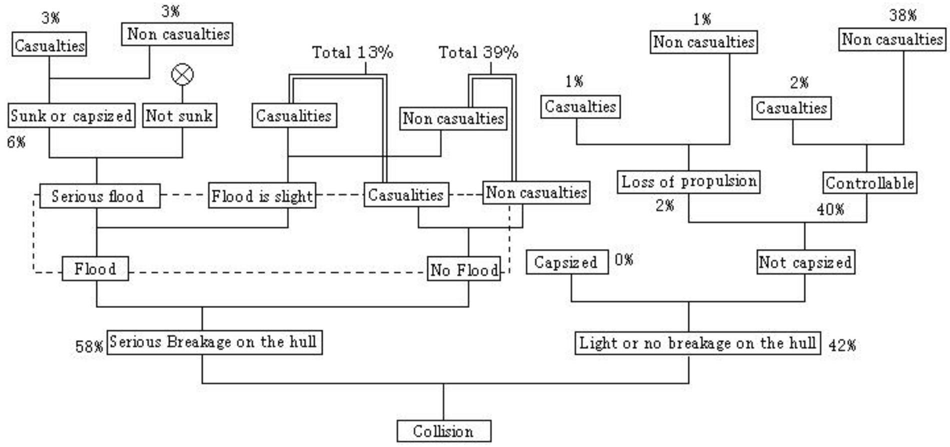

Fig.2. Event Tree of existence of casualties

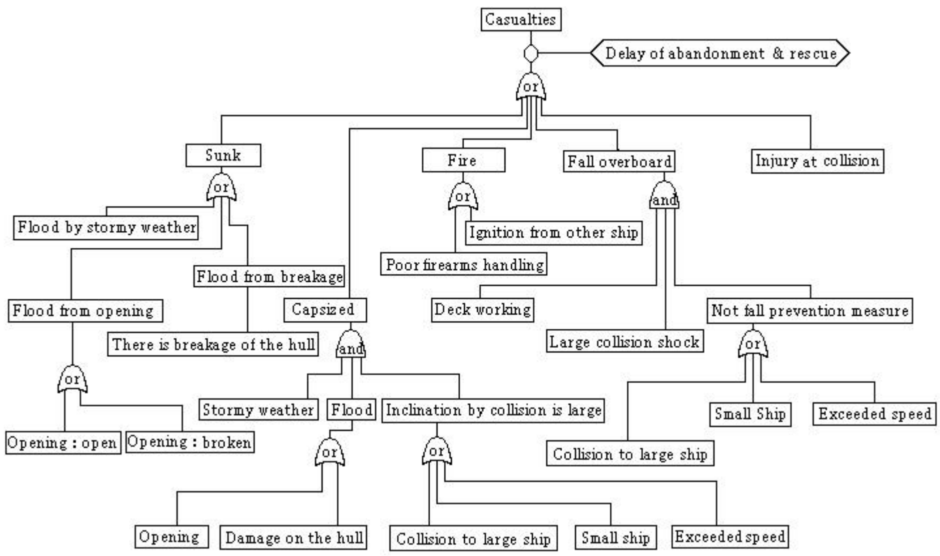

Fig.3. Fault Tree of existence of casualties

Actually the probability of tanker collisions was very small and the cases of oil spill were few. The vessels collected from Japan Marine Accident Inquiry Agency's Statistic record in 2003 are fishing boats, cargo vessels and small pleasure boats; there are few oil tankers. However we had several catastrophic environmental damage by spilled oil from collided tankers e.g. Exxon Valdez, Nakhodka, Amco Cadis. Therefore it is very important to estimate and study on the aftereffects of tanker's collision.

Moreover, we are researching on the oil spill process and reasons from oil tankers not only the case of collisions but also the case of all other accidents.

3.2 Casualties and hull damage after collision

Regarding the existence of casualties related to the damage of the hull after the collision, the Event Tree of existence of casualties is shown in Fig.2. The cases of 'serious damage' were more than 50% of total collisions and the case of 'light damage' had casualties and had very rare of 'loss of propulsion'. In the case of 'serious damage', capsize and sunk were 6% of the total accidents. The area enclosed by the dotted line is related to flooding with/without casualties. The ships are belonging to 'serious damage' without capsize/sunk had 13% casualties of and non-casualties 39% in the total accidents. Fig.3 shows the Fault Tree from same collision to the existence of casualties. In this figure, we assume that 'Fire' is one factor but there was no fire and casualties in the precedents. Consequently occurrence of 'Fire' is very low possibility at collision. The other three cases of sunk, capsize and fall overboard had a half of casualties of the total numbers. And they died by drawing. The majority of injured persons were bruised and broken a bone by the shock of collision. Some of them lead to fatal cases.

Conclusion

The 40-50% of collisions had 'light damage' and continued to sail without oil spill and casualties. The cases of 'light damage' had 14% oil spill and 28% casualties in these accidents.

The direct and important factors related to the damage of hull were speeds, collision angles, size and type of both ships. We surveyed all precedents from Japan Marine Accident Inquiry Agency for 4 years and studied the process and causes of damage of the hull or casualties after collision using the Event Tree analysis methods.

These analyses are very effective to understand and estimate the effects after collisions.

If we can use the speeds, types, details of collisions as an initial date in the calculation program. We will be able to evaluate the damage and aftereffects using these analysis methods.

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BIOGRAPHY

Analysis method of compounding maritime incidents using Fault Tree Analysis

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Risk Management Training: The Development Of Simulator-Based Scenarios From The Analysis Of Recent Maritime Accidents

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ABSTRACT
This paper opens with a brief introduction to the development of crew resource and risk management training in the international shipping industry. A review of three case studies is used to highlight some of the current risk management issues raised by recent maritime casualties. The paper provides an overview of how these issues have led to research-led developments in simulator-based maritime risk management training and assessment. The first development has been the design of more effective training courses through a better understanding of the nature of the skill requirements. The current training is outlined and other areas of research, which are now being undertaken, are described. The paper concludes with a summary of further research and development needs.

1. The Development of Maritime CRM Training

The use of simulation in providing solutions to the problems of risk and crisis management and the optimal use of crew resources has a long established pedigree in maritime training. The first simulators were introduced for radar training over thirty years ago. Training in the proper interpretation of radar information started as a result of a number of radar-assisted collisions in the 1950's, notably the collision between the passenger ship "Andrea Doria" and the "Stockholm". Those early simulators consisted of real radars, located in a set of cubicles, and fed with simulated signals. Individuals or teams could learn the skills of radar plotting under the guidance of an instructor working at a separate master console. Other navigational aids in the simulator were fairly basic and certainly did not include a visual scene.

Bridge simulators with a nocturnal visual scene made their appearance in the 1970's and allowed teams to conduct simulated passages in a realistic environment but with only a few lights available to indicate other vessels and shore lights. It was apparent from the casualty of the Very Large Crude Carrier (VLCC) "Metulla" in 1974, in which the vessel grounded in the Magellan Straits with two pilots and watch keepers present on the bridge, that bridge teams were not working effectively in supporting each other or the pilot. Simulator-based training courses were introduced primarily to train the skills of passage planning and the importance of the Master/Pilot relationship (Gyles and Salmon 1978). This training initiative developed into the Bridge Team Management (BTM) courses that are conducted today on many simulators world-wide and contain many of the elements to be found in Crew Resource Management (CRM) courses developed in other industries, such as aviation. These courses were developed to focus on the non-technical skills of flight operations and include group dynamics, leadership, interpersonal communications and decision making. (Helmreich and Merritt 1998). Bridge Resource Management (BRM) courses are a more recent initiative, adapted directly from the aviation model for training the non-technical skills of resource management, and are not always based on the use of simulators.

The 1980s saw the introduction of Engine Room simulators and towards the end of that decade, cargo operations simulators also became available. These types of simulator have primarily been used to train officers in the handling of operations, including fault finding and problem diagnosis, and increasingly to train teams in the skills of systems, resource and risk management. Many types of simulator: bridge, engine and cargo control room, have tended to emphasise a physically realistic environment in which these exercises occur, although the use of PC-based simulators for training some tasks is increasingly widespread. In some parts of the world, simulators have been developed which have very high levels of physical fidelity, for example, multi-storey engine room mock-ups and bridge simulators including features such as 360 degrees day/night views, pitch and roll, and full vibration and noise effects.

The only mandatory requirements in the maritime domain for the development of the non-technical skills of crisis management are those of the International Maritime Organization's (IMO) Seafarer's Training, Certification and Watchkeeping Code (International Maritime Organization, 1995). Table *A-V/2* of this code specifies the minimum standard of competence in crisis management and human behaviour skills for those senior officers who have responsibility for the safety of passengers in emergency situations. The competence assessment criteria detailed within the Code are not based on specific overt behaviours, but rather on generalised statements of performance outputs, and as such are highly subjective and open to interpretation. Although these standards of competence indicate that IMO recognises the need for non-technical management skills, both the standards and their assessment criteria are immature in comparison with the understanding of non-technical skills, and their assessment, within an industry such as civil aviation.

In summary, resource management training to mitigate risk has become established in the curricula of many maritime training establishments. Courses take a variety of forms and cover both deck and engine room disciplines. The courses are often simulator-based, but not always, and their syllabuses reflect CRM training in other industries. As can be seen from the history of this development, most major training initiatives have resulted from the lessons learnt from a succession of casualties. The next section reviews three recent casualties and the resource, risk and crisis management issues they raise.

2. Case Studies in the Failure of Resource, Risk and Crisis Management.

A recent review of accident databases from the USA, UK, Canada and Australia confirms that human error continues to be the dominant factor in maritime accidents and reveals that in 70% of recorded incidents attributed to human error, failures in situation assessment and awareness predominate (ABS, 2004). The following three case studies illustrate how such factors contribute to accident causation.

2.1 Case Study 1: The Grounding of the "Royal Majesty".

2.1.1 The circumstances

In June 1995 the passenger vessel "Royal Majesty", with 1509 passengers aboard, went aground near Nantucket Island on a voyage from Bermuda to Boston. The vessel was fitted with an integrated bridge system including an autopilot which, when engaged, was capable of steering the vessel along a pre-programmed route using the vessel's GPS system as a primary source of positional information. In the case of insufficient satellite data, the GPS was designed to default to a Dead Reckoning (DR) mode. The autopilot, however, was not capable of recognising any change in GPS status and thus, with the GPS in DR mode, was only able to continue navigation without correction for wind or current.

The autopilot was set on departure from Bermuda, but after about an hour the GPS defaulted to DR mode (probably as a result of a loose connection on the receiver cable), and for the next 34 hours, the vessel was navigating on DR through the autopilot. At no time during this period was this situation detected by the bridge team, so that when the vessel eventually grounded, she was 17 miles off course.

The official National Transportation Safety Board report gave as the probable cause of the grounding:

> *"the watch officers' over reliance on the automated features of the integrated bridge system, Majesty Cruise Line's failure to ensure that its officers were adequately trained in the automated features of the integrated bridge system and in the implications of this automation for bridge resource management, the deficiencies in the design and implementation of the integrated bridge system and in the procedures for its operation, and the second officer's failure to take corrective action after several cues indicated the vessel was off course." (NTSB, 1997).*

2.1.2 The analysis

- This case illustrates the problems of over reliance on the available technology by the bridge team. All the officers have been lulled into a false sense of security by a modern system that appears to be protecting the vessel but is vulnerable. Their understanding of the system and its weaknesses is incomplete.

- The reliance on technology has led the team to use only a limited number of sources of information to determine the vessel's position. Other sources are ignored and not used for cross-checking. This deviance from normal watch keeping practice has gradually become the accepted norm by all members of the team.

- There were several opportunities when both the chief officer and the second officer on their respective watches could have avoided the grounding through the observation of buoys visually and by use of the radar. However, because of their over confidence in the GPS, the team is in a "mind set" where conflicting evidence is not analysed critically and assumptions are not questioned. The result is that the individuals remain confirmed in their bias towards the information from one source and remain in blissful ignorance of the real situation.

2.2 Case Study 2: The Grounding of the "Green Lily".

2.2.1 The circumstances

On 18th November 1997, the 3,624 grt Bahamian registered vessel "Green Lily" sailed from Lerwick in the Shetland Islands with a cargo of frozen fish for the Ivory Coast. The weather on departure was bad with wind speeds increasing to severe gale force 9. The following morning, while hove to about 15 miles south-east of the island of Bressay in the Shetland Isles in storm force 10 winds, a sea water supply line fractured in the engine room. The engineers controlled the flooding and pumping out had begun when the main engine stopped. Unsuccessful attempts were made to restart the engine while the vessel drifted northwards towards Bressay. Shetland Coastguard was advised and three tugs, the Lerwick RNLI lifeboat and a coastguard helicopter prepared to proceed to the casualty.

Attempts were made by two of the tugs to secure a line and tow the "Green Lily" away from land but although initially successful, each line parted. The starboard anchor was released and the third tug attempted to snag the cable and pull her head to wind, but the cable parted. At this time, the lifeboat rescued five crewmen, including two injured, from the ship's deck. The ten remaining crewmembers were rescued by the Coastguard helicopter, but the winchman, who had remained on the deck of the ship, was swept into the sea and lost. The "Green Lily" went aground and started to break up. The investigation by the Marine Accident Investigation Branch (MAIB), published in June 1999, advised the cause of the grounding was:

> *"the lack of propulsion and failure to restart the main engine to arrest the drift of the vessel towards the shore in the prevailing environmental conditions. Contributory causes included flooding of the engine room, failure to reset the mechanical over-speed trip, inadequate knowledge of the cooling water system, failure of the towage attempts and inadequate teamwork"* (MAIB, 1999; pp. 9)

2.2.2 The Analysis

- An initial technical failure precipitated events and was compounded by a hostile environment and further technical problems and failures. The situation was escalating in severity. An emergency was becoming a crisis, but the actors in this tragedy did not have the benefit of hindsight to read the 'script'.
- The available emergency plans, which tended to be procedures based on single failures, were not applicable. The individuals involved were forced to fall back on their experience to cope with an increasingly complex and unpredictable set of circumstances.
- Initial diagnosis of the technical failure was incorrect and led to a faulty but persistent mental model of the situation. In this case, the chief and second engineers, together with the electrical engineer, failed to understand why the main engine stopped and were consequently unable to restart it. They believed that the main engine failure was due to the effect of the flooding, previously caused by the fracture of the sea suction pipe. The probable reason for the main engine stoppage was actually due to the mechanical over-speed trip either not being reset or reset incorrectly.
- Awareness of the overall situation by individuals was based on incomplete or inaccurate information. In this case, both the Master, based on his calculation of drift, and the engineers, were over optimistic in their belief that a tow would be available before the ship ran aground. Meanwhile, the skippers of the rescue craft had unexpressed reservations about various aspects of the operation including the appropriateness of some of the towing gear, the weather conditions and sea room, and the ability of the ship's crew to handle the towlines.
- Individuals and units were separated physically and several agencies were interacting through various forms of communication. In these circumstances, it was very difficult for the key players to communicate meaningfully and maintain a shared and agreed awareness of the rapidly changing situation.

2.3 Case Study 3: The "Diamant" and "Northern Merchant" Collision.

2.3.1 The circumstances

On the morning of 6th January 2002, two ferries were crossing the Dover Strait in reduced visibility of less than 200 metres. The "Diamant" had sailed from Oostende and was heading for Dover. The "Northern Merchant" was heading to Dunkerque from Dover. Both vessels were travelling at close to normal cruising speed: "Diamant" a high-speed craft was travelling at 29 knots, and the "Northern Merchant", a Ro-Ro ferry, was travelling at 21 knots. If both vessels had continued their course and speed, their paths would have taken them to within half a mile of one another. However, at just over a mile apart, the bridge teams started to question the assumptions they had made about each other's probable course of action and started to implement course changes, but not speed changes, that would, they believed, put a greater distance between themselves. At 0952 they collided.

The MAIB report lists 18 possible causes and contributing factors in this accident, including the unsafe speed of both vessels, bridge team failures in risk assessment, violation of collision regulations and adherence to an "unwritten rule" that high speed craft will keep clear of all other craft. (MAIB, 2003; pp. 43-44)

2.3.2 The Analysis

- This case is similar to previous incidents in reduced visibility in which the participants have violated regulations and operational practices. Both teams are making assumptions about the intentions and actions of others and, at the speeds involved, have little time to rectify the developing crisis situation when they realise what is actually happening.
- However, this case also raises questions about the ability of training to provide solutions to this type of problem. The actors in this case were all experienced and professional officers who know the rules perfectly well but, for one reason or another, violate them, probably as a matter of routine. The root causes of these violations may not be resolved simply by sending "offenders" on remedial training in the interpretation of radar interpretation or the collision regulations.
- Organisational culture plays an important part in reinforcing the appropriate behaviours required. If an organisation's shore-based management team pays "lip service" to its own operating policies and procedures by failing to implement them on the vessels and, at the same time, tacitly accepts or rewards deviant behaviour, then the individual officers on board will adopt a similar cultural attitude.

3. Advances in Research for Maritime Training and Assessment.

In the year 2000, the Maritime Coastguard Agency (MCA), following a recommendation of the Marine Accident Investigation Branch (MAIB) in response to the loss of the "Green Lily", awarded a project to a research team at Warsash Maritime Centre. The remit of the project was to investigate the potential use of simulators for training in the handling of escalating emergencies. This project enabled the researchers to review current concepts and models in the field of crisis management across a range of safety critical industries and to conduct a survey of expert opinion on the optimal training and assessment regimes for handling escalating emergencies (Barnett et al 2002). One of the findings of this study was the recognition of the essential differences between emergency and crisis situations and the need for different training syllabuses to address them.

An emergency can be defined as a situation outside normal operating parameters where corrective decisions and actions are based on documented procedures. In the maritime context, examples might be "Man overboard", steering gear failure or a report of a fire in a cabin. Emergency procedures can be trained effectively both on board and at onshore training establishments.
A crisis differs from an emergency in that successful decisions and actions may not necessarily be based on documented procedures. Appropriate pre-defined responses may not exist, and even if they do, in practice they may have conflicting requirements. Those responsible for handling crises will have to think through the situation, and respond in creative and flexible ways.

This distinction between emergencies and crises has a significant impact on the training requirements for their management. Training in handling emergencies may simply be training in following pre-prescribed procedures and drills. Training in crisis management is likely to require a much more demanding approach to practise the situational awareness and decision making skills required in these situations.

So what skills *are* required to handle crises? There is now considerable evidence from both military and civilian sources that the main requirements are for the high-level cognitive skills of problem solving and decision making. Crichton and Flin (2002) suggest that, at its most simplified, there are two fundamental and inter-related skill requirements:

- Situation assessment – "what's the problem"
- Decision making – "what shall I do".

The following sections describe three research-led initiatives in the field of maritime CRM, risk and crisis management currently being undertaken at Warsash:

1. To develop more effective CRM training courses through a better theoretical understanding of the nature of shared situational awareness and mental models in "real world" maritime operations.
2. To identify a set of behavioural markers for assessing the non-technical skills of crisis management.
3. To explore the role of organisational factors in safe operation, in recognition of the limitations of operator training to prevent the reoccurrence of accidents.

3.1 Situational Awareness, Mental Models and the Paradox of RPD

Modern concepts for understanding decision-making have progressed from classic rational choice models to ones that try to reflect the way decisions are actually made in the real world. The most influential of these models is the naturalistic decision-making (NDM) model and has been defined as follows:

> *"The study of NDM asks how experienced people, working as individuals or groups in dynamic, uncertain, and often fast-paced environments, identify and assess their situation, make decisions and take actions whose consequences are meaningful to them and the larger organization in which they operate."* (Pruitt et al, 1997)

This definition reveals a number of characteristics of the situations in which NDM takes place:

- The situations in which decisions are made are uncertain, unpredictable and dangerous.
- Knowledge of the situation is incomplete, and constantly changing.
- The consequences of decisions and actions based on poor situational awareness are potentially catastrophic.
- Experienced people, not novices, generally conduct decision making in such situations.

Another important feature of NDM is that, unlike classical models of decision making, where the objective is to provide optimal decisions, the objective for real world decision makers is to arrive at actions based on decisions that will satisfy the immediate concerns of the situation, without those decisions necessarily having to be the best ones. There are a number of different models within an NDM approach to describe the process by which decisions are made. The dominant model is the Recognition-Primed Decision (RPD) model. Orasanu (1997) provides a comprehensive description of the process:

> *"Its basic principle is that experts use their knowledge to recognise a problem situation as an instance of a type, and then retrieve from their store of patterns in memory an appropriate response associated with that particular problem type. The response is evaluated for adequacy in the present context, and if it passes, it is adopted. If it is found wanting, either another interpretation of the situation is sought or a second level response is retrieved and evaluated."*

The RPD model works well to describe decision-making situations in the maritime context. But the model does have serious implications for the training of "real world" decision-making skills.
In crisis situations, just when the expert needs to draw on a reliable repertoire, the situation is unpredictable and atypical, so no repertoire can be called upon. The crisis handler has to revert to a creative response i.e. they have to think their way through the novel situation. The primary justification for the direct training for crisis management is based in the belief that

by exposing individuals or teams to a variety of potential crisis scenarios, their ‘patterns’ or mental models of situations will be enriched, thus enhancing their situational awareness techniques and their repertoires of decision making. The key to this approach is in the ‘richness’ of the mental models developed by the individual or team, but paradoxically, the problem is that if the training scenarios are too prescriptive, then the learned repertoires may be inappropriate to the real emergency encountered.

This repertoire driven process can lead to dangerous consequences when facing an unpredictable situation. On the one hand, the decision-maker may derive increasingly bizarre hypotheses to explain the available information cues – the “kaleidoscopic” effect; or the decision-maker may become fixated on one pattern, refusing to change repertoires in the face of obviously conflicting information – the “mind-set” problem as exhibited by the “Green Lily” engineers and the watch keepers on the “Royal Majesty”.

Decision-making is a skill. Like all skills, it may be honed through practice. By reducing cognitive load through practice, experts will be less stressed than novices in threatening situations. In addition to specific contextual skills, there is a set of more general cognitive skills involved in situational awareness and decision making. The direct development of such generalised critical thinking skills, which encourage team members to question their assumptions about their assessment of situations, might counteract the RPD paradox and the consequences of stress.

In summary, the nature of crisis situations suggest that there are at least two specific training requirements for the development of situational awareness and decision making skills:

1. To provide exercise scenarios in which the individual’s mental models of systems, situations and the cues by which they recognise them, may be enriched;
2. To develop a general critical thinking skill which resolves conflicting information and tests the assumptions on which decisions are based.

Based on the principles described above, an innovative CRM training course is currently being developed at Warsash. The course uses a number of forms of simulation, including role playing exercises and full mission simulator exercises, which combine both bridge and engine room teams. In addition to the specific development of critical thinking skills and the enhancement of situational awareness, the objectives of the course also include the development of the other non-technical skills of CRM, for example, communication, team co-ordination and leadership development.
The course builds the learning experience from classroom lectures on theoretical aspects, followed by brief exercises to practice specific techniques, culminating in simulator-based scenarios in which the various elements can be brought together. The final exercises bring both bridge and engine room teams together, through linked simulators, where complex evolving situations have to be managed by both teams.

The development of the course is leading to further research. A major issue is to what extent will the CRM skills, learned in a simulated environment, *transfer* to the real world? It is hoped to use questionnaires to follow up course participants to assess what has been retained from their training after a defined period.

Two other research issues are of particular interest in the maritime context. The first is related to the sharing of situational awareness between members in a team and also between distributed teams. Both the “Diamant” and the “Green Lily” cases demonstrate difficulties in communicating mental models between teams on the same vessel and/or between separate agencies involved in a crisis situation. Video observations from our own simulator exercises suggest that team leaders can find it difficult to articulate their understanding of the situation to other team members. This difficulty is not limited to intra-team communication, but as the “Green Lily” case shows, can work at an inter-team level too. In addition, it is apparent that one team can easily become oblivious to the information needs of a separate team when under stress, for example, bridge and engine room teams habitually fail to update each other as a training scenario unfolds. Measuring the effectiveness of synchronous training and the characterisation of behavioural markers for distributed teams represent interesting challenges to the maritime training community.

The international shipping industry shares with the offshore industry a similar working environment in that multi-national, multi-cultural crews work and socialise together in an isolated environment for months on end. Cultural and linguistic effects on team working is a particularly challenging area of research. Our experience from simulator training suggests that different national cultures do work together in noticeably different ways, for example, a UK/US team does display a more individualistic way of sharing situational awareness than those from a more "collective" culture (Hofstede, 1991). Questions that have yet to be addressed include:
What effects are produced by cultural factors and how may they be characterised? What is the impact on the overall safety performance of a team, especially in stressful situations, by placing individuals from one culture into a different culturally based team?

3.2 Towards the Development of a Maritime Assessment Framework

A PhD research programme is also currently being undertaken at Warsash that is intended to provide an understanding of how a behavioural marker system could be used to assess the competence in crisis management of merchant marine engineering officers.

Behavioural markers that could be used to assess competence in crisis management within the context of a simulated merchant vessel's engine room control room are being determined. Experiments are being undertaken to investigate the efficacy of these behavioural markers to assess competence in crisis management, and it is intended that this research will then go on to show if these behavioural markers can be used as the basis for an objective competence assessment framework.

The aims of this research programme are:

1 To understand how behavioural markers can be used to objectively assess competence in crisis management of merchant marine engineering officers.
2 To develop and validate an assessment framework that utilises specific overt behavioural markers to facilitate the objective assessment of competence in crisis management of merchant marine engineering officers.

3.3 Organisational Factors

The argument has been made earlier in this paper that the training and assessment of operators can only ever be part of the solution to reducing accidents. Organisational factors also play a significant part in accident causation. So what are the research issues in maritime operations, at an organisational level, which need addressing?

The analysis of human factors in accident causation is still relatively immature in the maritime world. Although databases held by the MAIB and other parties interested in the causal factors of accidents – e.g. insurers and classification societies – do include human error taxonomies, little analysis is undertaken to identify trends or patterns. Even less analysis has been attempted in assessing the significance or frequency of organisational factors such as the incidence of commercial pressure or the effects of organisational culture on accident causation.

The differences in organisational culture between shipping companies is a well known phenomenon, but there has been little work on understanding the effects of organisational culture on safe and efficient performance. In much the same way as we are striving to identify a set of behavioural markers to assess the competence of individuals, so there is a need to establish a set of organisational metrics to determine the competence of shipping companies to perform safely.

Not enough is known about the parameters governing functioning and performance of management systems. There is little research evidence to indicate what makes a management system work or indeed what prevents it from working. Equally, not enough is known about the metrics that enable the status of a management system to be determined. Ideally, what is required is a set of "leading" indicators that will predict future performance so that interventions can be made before accidents occur.

The research conundrum is, first, to agree what constitutes organisational behaviour; second, in deciding which "behaviours" are leading indicators of proficiency; and third, in designing methods that can measure these indicators accurately.

4. Summary and Conclusions

As in similar safety-critical industries, the analysis of maritime accidents over the years has revealed shortcomings in the ability of operators to manage both resources and crises. CRM training has been seen increasingly as a fundamental part of the human error management philosophy. The International Maritime Organization recognises the need for non-technical or resource management skills, but both the standards of competence and their assessment criteria are immature in comparison with civil aviation.

Studies of recent casualties involving human failures in resource, risk and crisis management confirms that lack of situational awareness is the predominant factor in operator error. Analysis of recent casualties also suggest that CRM training alone, although important, may not be a panacea for operator error and that organisational factors must also be taken into account.

A theoretical understanding of naturalistic decision making suggests that there are at least two specific training requirements for the development of situational awareness and decision making skills. Firstly, there is a need to enrich the individual's mental models of systems, situations and the cues by which they recognise them, and secondly, to develop a general critical thinking skill which resolves conflicting information and tests the assumptions on which decisions are based.

An innovative CRM training course is currently being developed at Warsash. The course uses a number of forms of simulation, including role playing exercises and full mission simulator exercises, which combine both bridge and engine room teams to develop the skills of communication, team co-ordination and management and leadership development.

In setting an agenda for future maritime research in this area, the following issues are suggested for consideration:

- If the direct training of resource and crisis management skills is pursued, to what extent will such skills, learned in a simulated environment, transfer to the real world?
- What are the optimum training environments to ensure effective transfer?
- How can these non-technical skills be assessed most effectively, both at the level of the individual and at the level of the team?
- What behavioural markers, both at individual and team level, predict safe performance?
- In multi-national environments, how may cultural factors be characterised and what is the impact on overall safety performance of cultural differences?

- We know that organisational factors also play a significant part in accident causation but how can their significance, frequency and impact be established?
- How does organisational culture impact on accident causation?
- Finally, what are the metrics that enable the status of an organisation's safety management system to be determined?

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BIOGRAPHY

Risk Management training: the development of simulator-based scenarios from the analysis of recent maritime accidents

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Professor Mike Barnett is Head of the Technology Research Centre at Southampton Institute. After a seafaring career to chief officer rank, Mike joined the Warsash Maritime Centre in 1985 as a lecturer in tanker safety, in which post he was involved in the development of the Centre's liquid cargo operations simulator. He was awarded a PhD from the University of Wales, Cardiff in 1989 for his work on human error and the use of simulation in training for emergencies. He has been Head of Research at Warsash since 1991, during which time the Centre has developed its research capability into various aspects of maritime human factors. His current post encompasses responsibility for the management of research and welfare of postgraduate researchers at Warsash and on the Southampton campus. Mike is a Chartered Marine Scientist, Fellow of the Nautical Institute and a current Vice-President of the Institute of Marine Engineering, Science and Technology (IMarEST) and a Member of its Council.

Analysis of the Correlation Between Casualties and Human Perception, Cognition & Decision-Making at Sea

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ABSTRACT
Analysis of maritime casualties conducted over the last 30 years showed no improvement in any aspect, and proved that the human factor is still dominant in most casualties.

To improve this situation, technology has been introduced to marine navigation an integrated navigation systems, however, this situation remains the same.

The collisions and groundings of ocean-going vessels continue to concern those within the maritime community, whose environment and livelihood are put at risk by such casualties. This concern does not stem from any proportional increase of such casualties with increasing trade, but from the disproportionate consequences of such casualties, in recent years and even after the application of the International Safety Management (ISM) Code.

The present research objectives are:

- Recognizing the human errors linked to the maritime casualties, i.e., collisions and groundings, before and after the application of the ISM Code.
- Determining the causal factors closely linked to those casualties, mainly, the special human factors including human perception and cognition.
- Helping officers on watch adjust to changes in the industry with a high priority given to education with great concentration on scientific background; training/retraining programs, especially emergency situations, human perception, cognition and decision-making.

1. Introduction

Situational awareness is the accurate perception of the factors and conditions that affect a vessel and crew during a defined period of time. More simply stated, it is ‘knowing what is going on around the individual’.

At the level of the individual, situational awareness can be thought of as a mental model that an individual has of a given situation and time. Mental models develop from cues in the immediate situation and environment, e.g., location, speed, presence of hazard, as well as information from education, training and experience. In the absence of a complete set of cues for a given situation, fragmentary information is sometimes combined with mental expectations and integrated into the mental model.

The rallying cry that most of casualties were caused by ‘human factors’ led to the natural corollary which human, about 75 – 96% of maritime casualties are caused, at least in part, by some form of human error (Rothblum, 1999). The resulting quest for a human to blame has become a raison d'etre of many investigation systems. Such systems have found this a convenient stop rule, i.e., once the expected outcome dictated by the human factors injunction has been satisfied, the investigation need proceed no further. Sadly this line of investigation has not prevented some of the most notorious casualties of modern times such as the "*Herald of Free Enterprise*", the "*Estonia*", the "*Exxon Valdez*" and more casualties after the application of the ISM Code and STCW 95, such as "*Erika*", "*Norwegian Dream",* "*New Carissa*", "*Prestige*" and recently "*Rocknes*".

A major perspective in approaches to risk assessment has been centred on quantification in terms of probability. But this approach does little to explain the social/behavioural influences on risk. There have been major contributions to this area of risk assessment in the work of Turner, (1978) and Douglas, (1986), but the area is still clearly underdeveloped. Both Turner and Douglas offer useful frameworks in terms of a social-anthropological approach.

Jackson and Carter, (1992) are concerned at the epistemological level and they attempt to assess the potential contribution of post-structuralist epistemological theory to understanding the social construction of risk assessment. In particular, on the basis of the maxim that the greatest levels of information are contained within those events which are least probable, they consider how this body of theory offers ways of expanding consideration of risk which legitimates inclusion of elements which enhance potential for information, as well as those which enhance meaning (cf. on the relationship between information, meaning and probability, (Robbe-Grillet, 1977; Cooper, 1981).

As investigated by Jackson and Carter, (1992) their interest is in the failure to perceive causal relationships that lead to system failure. The concept of system used here can be seen in an ordinary language or its more rigorous scientific sense, but it is used, generically, to refer to a set of interrelated activities which function for a specific purpose.

2. Classification of Maritime Casualties and their Causes with Emphasis on Human Error

2.1 Analytical Study and Cause Relationships of Collisions and Groundings of Vessels

In this analytical study the researcher intends to look into the causes of maritime casualties centering around collisions and groundings as well as the relationships between the causes of casualties and such factors as deficiencies in education, training and ship operating skills of OOWs, based on the actual shipping casualty records of the world before and after the implementation of the ISM Code (Hanafi, 2003).

In comparison with the previous analytical studies, a series of maritime casualties that occurred to bulkers, tankers, ferries and passenger ships worldwide over the period throughout 1995 to 2002 has brought the nature of these terrible disasters to the forefront of international concern as issues having a serious impact on the world's natural environment.

The researcher found, after more than 20 years, and even after the application of the ISM Code and the STCW 95 convention, through a classification of maritime casualties and their causes with emphasis on 'human error', that the same common causal factors remain nearly the same.

2.2 Statistical Survey of Collisions and Groundings for Ocean-Going Ships for the Period (1995-2002)

Figure (1) presents a summary of the number of collisions and groundings as one group for each year within the specified period. In addition, separate Figures are given for the two individual types of casualty.

The graph is only approximately accurate seen in proper relation to the number of vessels that have been actually exposed to the risk of

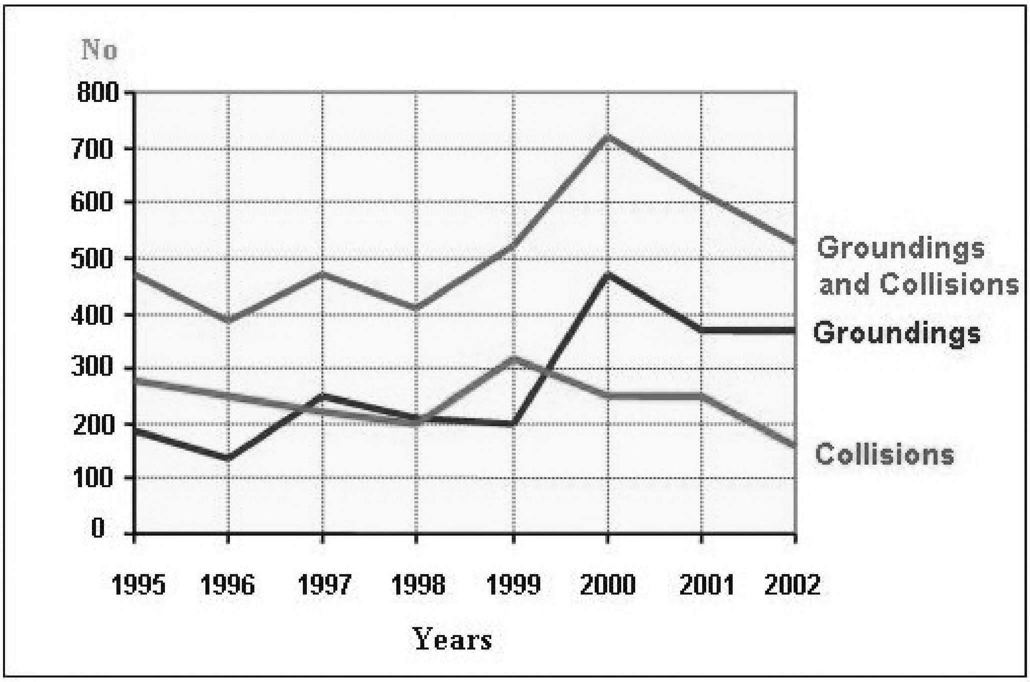

Figure (1) Yearly Distribution of Collisions & Groundings of Passenger Ships, Tankers and Bulkers.

collisions and groundings in each of the years.

2.3 Overview of the Causal Factors

The total sum of casualties and registered causal factors in Table (1) is 4258 and 8416.

According to the Table there is on average more than one cause registered per casualty and there are 21 groups of causes broken down into more detailed causal factors.

2.4 Analysis of Causal Factors and Situation-Dependent Factors For the Period (1995-2002)

Finally, from the analysis of this research, a discussion here of the most critical problems concerning the "human errors" resulting from causal group (V) 'Special Human Factors - Human Perception/Cognition Factors', which represent the highest percentage, and how to react to this essential factors at sea.

The four largest groups are among the most important for all casualty types are:

V.	**Special human factors – Human Perception/ Cognition factor.**	**19.3%**
R.	**Navigation and maneuvering factors applicable to personnel on own ship.**	**14.7%**
X.	**Knowledge, experience regard navigator.**	**11.7%**
N.	**Watchkeeping situation.**	**10.1%**

Table (1) Causal Groups / Casualty Type (1995-2002)

Causal Groups		Total	Collisions	Groundings & Strandings	Contact Damages
A	Faults in equipment in the bridge	132	49	58	25
B	Bridge design and arrangement	51	25	18	8
C	Serviceability of navigation aids	83	26	56	1
D	Remote control of steering and propulsion	131	53	42	36
E	Failure or deficiency in communication equipment	57	31	17	9
F	Errors or deficiencies in charts or nautical publications	128	18	82	28
G	External conditions which reduce the efficiency of navigational aids	159	31	113	15
H	Faults or deficiency in other ship	89	86	3	0
I	Fault deficiency or misleading information from lights and marks	117	7	96	14
M	Bridge manning and organization	585	202	325	58
N	Watchkeeping situation	850	320	503	27
O	Poor communication / internal	445	153	279	13
P	Reduced visibility	325	147	158	20
Q	Manoeuvering factor to own ship	675	100	465	110
R	Navigation and manoeuvering factors-applicable to personnel on own ship	1235	570	634	31
S	Operating of equipment -own ship	103	28	60	15
T	Information from fixed objects (lights, landmarks)	77	2	68	7
U	Wrong appreciation of traffic information	99	81	14	4
V	**Special human factors**	**1625**	**640**	**935**	**50**
X	Knowledge, experience with regard to navigator	985	427	528	30
Y	Casualty related to personnel on the other ship	465	425	15	25
Registered Causal Factors		**8416**	**3421**	**4469**	**526**
Number of Casualties		**4258**	**2104**	**2018**	**136**

3. Maritime Casualties Caused by Special Human Factors

From the analysis of previous casualties in four years period before and after the implementation of the ISM Code, it was found that in average 18.25% and 21.25% increase, respectively, of the casualties are attributed to 'human error' resulting from causal group (V) 'special human factors'.

This requires systematic scientific analysis in order to explore varied aspects of 'human perception' as a factor of casualties that are classified into:

- Non-perceived risk: unable to perceive how quickly the situation is changing and risk is developing, (Risk Assessment).
- Violation of spatial conditions.
- Non-epistemological factors, i.e., requirements of navigational accuracy depend on type of navigation: open sea, coastal and inland navigation.
- Inability to determine the proper ship's speed in dangerous conditions.
- Lack of scientific knowledge and facts necessary for apprehending the situations.
- Poor information analysis leading to wrong decision-making.

4. Perception and Reaction at Sea Problem

As indicated by Lussier, (1990) the term perception refers to a person's interpretation of reality. Through the perception process man selects, organizes, and interprets all environmental stimuli through his senses. No two people experience anything exactly the same through this perception process. Man's perception is influenced by heredity, environment, and, more specifically, by his personality, intelligence, needs, self-concept, attitudes and values. Some of the biases affecting perception include stereotypes, frame of reference, expectations, selective exposure, interest, and projection.

As an initial guide we take the following definition:

> "*Perception is the active psychological process in which stimuli are selected and organized into meaningful patterns*", (Huczynski and Buchanan, 1991).

5. The Perception of Risk

As studied by Jackson and Carter, (1992) the formulation of human cognition and the acquisition of knowledge highlights very clearly the enormous difficulty in assessing whether, and if so, to what extent, risk is present in any particular set of conditions. Obviously, it would be a considerable advantage to be able to specify the nature of the relationship between data and meaning, between signifier and signified.

Thus, suppose that the data set under consideration are a ship moving at speed into an ice field. In the case of the "*Titanic*", at the time, this was perceived as no-risk, but events showed that it was in fact a situation of very high risk. If a metaphorical approach is added to this negative feedback, it might reasonably be reformulated, at the level of principal as a problem of two objects moving relative to one another and trying to occupy the same space at the same time. Thus, the question to be asked might be, in what other data sets, which might not contain icebergs but which do contain two subjects, might the same effect be produced?

Conversely, in the case of "*Exxon Valdez*", the OOW couldn't deal with two problems happening at the same time with two different dimensions (collision with ice or grounding), i.e., a risk above the water and a risk below the water, in other words, he couldn't perceive the risks. He chose to avoid some patches of ice that were not dangerous instead of monitoring below the surface.

Risk is a human problem. System failure inevitably stems from human action, when the people involved in operation of a system fail to perceive some sets of conditions that might arise and cause the system to fail.

Preventing specific system failure requires the perception of system conditions that will cause failure. While learning from maritime casualties and their system failure undoubtedly contributes to enhancing system security, its utility is circumscribed by the epistemological conditions of cognition. Thus, because of our intrinsic limitations as information processors, we have to filter out a proportion of the available information that is perceived as irrelevant, using only that which is perceived as relevant for decision-making purposes.

As studied by Ashby, (1970) perception is influenced by non-epistemological factors and that this is an irreducible condition; it seems exceedingly poor. But there may be ways to ameliorate this depressing scenario. Whereas conventional monist understandings of systems where system failures have occurred have clearly failed to include potentially relevant formulations of explanation by virtue of their lack of authority, deconstructionist approaches deny the authority of a single interpretation and thereby permit any reasonable interpretation to be included. This expansive pluralist approach gives better chance that all relevant information will be discovered and, given that such claims of relevance can be judged and tested in terms of explanatory power, the possibility of identifying causes of system failure should be considerably enhanced.

The truth is the whole system, not any model of it. Thus the models of the system, whichever system may be in question, with which we work are fundamentally ideological, i.e., non-epistemological in that they derive from opinion rather than fact, (Ashby, 1970).

Some may take it to mean atmospheric and sea conditions, while others may take it to mean atmospheric conditions only. The use of the qualifier 'at master's discretion', which is often appended to the limitation further calls into question the effectiveness of such limitation, such as the grounding of "*New Carissa*".

The master's perception of risk is tempered usually by his previous exposure to similar conditions in over his previous years of operating his vessel in the same area. The master understood neither the serious shortcomings of the vessel's condition (with regard to watertight integrity) nor the effect that the strong wind would have on his vessel; he overestimated the ability of his vessel to withstand the head-on encounter with waves, and under estimated the result of shipping water, such as the sinking of the "*Erika*".

6. Decision-Making under Complexity and Uncertainty

In practice, ship safety is not merely a matter of track keeping, which can take care of fixed or known constraint. In the real world environment, other constraints are found such as traffic, currents, regulatory measures, and from time to time, uncharted obstacles which limit the degree of control and vary the ongoing objectives in real time. The capacity of the navigator, whether master, watchkeeper or pilot, to invoke these into the decision process will influence the likelihood of casualty.

Decision-making is the penultimate stage in processing a problem, lying as it does just before the taking of action in a typical event. Many decisions can be taken easily even by inexperienced novices in the maneuvering context as has been demonstrated by Schuffel, (1987).

At other times, decision-making in complex conditions can be represented by the two ends of a continuum where, at the one extreme, the situation is obviously complex and difficult to resolve in real time, and at the other extreme, the situation appears to be simplistic, but careful analysis reveals the existence of complex uncertainties. The two extremes are illustrated by the collision of the "*Norwegian Dream*" and "*Ever Decent*". In this case, the collision can be considered to be a confounding factor in the decision-making environment and the presence of land was a lack of perception and cognition.

7. Managing of Risk

The concept of managing risk is not new, even to the shipping industry. It has been practiced formally and informally on board ships from time immemorial by means of standing orders and established working practices. When a master or a chief engineer writes in the night order book 'call the master in case of fog' or 'call me 30 minutes before standby', they are managing risk. Unfortunately these working practices have been allowed to deteriorate to the extent that, in some cases, they have disappeared completely. The reason for their disappearance is purely because the people on board ships have by and large not been trained adequately.

By analysing the maritime casualties which occurred, specially the major casualties since the "*Titanic*" disaster to the recent "*New Carissa*", and after the application of the ISM Code it was found that 'special human factors', i.e., human perception and cognition were common factors in all those casualties.

8. Major Cases of Casualties Related to Relationship between Human Perception, Cognition and Decision -Making

8.1 The Collision / Sinking of the Cruise Ship "Titanic"

On 14 April 1912, the white star liner "*Titanic*", in the hours of darkness whilst in the vicinity of a known ice field, sailed at full speed into an iceberg. The ship, which was on her maiden voyage, sank in approximately 2 hours and 40 minutes and out of a total of 2201 passengers and crew only 712 were saved, (Eaton, 1987).

- ***Salient Features***

- From 0900 to 2140, "*Titanic*" received a total of six separate ice warnings described an area of ice 78 miles long. Unfortunately, there is doubt about whether the messages were ever delivered to the bridge or plotted on the chartroom map. Apparently not, since no one seems to have made the connection.

- At 2340, an Iceberg hidden beneath the surface, bumped and scraped the starboard side of the ship for a distance of 248 feet. [This iceberg is thought to have been the one responsible for sinking the "*Titanic*"].

- The "*Titanic*" was believed by many to be unsinkable, although the designers did not assume was that this was the case. However, as the builders' representative, who was also the designer, and the captain both perished in the disaster, one can assume that key actors in the design and operation of the *"Titanic*" were not expecting it to sink.

- Within 20 minutes of the collision, the designer came to the conclusion that it was inevitable that the "*Titanic*" would sink quite rapidly, (Wreck Commissioner's Report-1912, 1990; Eaton, Haas and Hutchings, 1987).

- ***Accident's Results***

- Clearly, from a rationalist point of view this is problematic. The rational solution is to identify such non-epistemological attenuation and replace it with attenuation based on scientific knowledge.

- This case is precisely analogous to the approach to prevention of system failure and risk assessment that uses negative feedback from a failure to prevent recurrence.

- Yet it is the utterly fundamental and ubiquitous process of attenuation itself that casts doubt on the potential of this case to make negative feedback effective in eliminating risk.

- This ability also depends on how the

problem which caused system failure is defined, which is also influenced by processes of attenuation and the associated non-epistemological factors.

- In this case, the first objective was satisfied in the replacing of the non-epistemological fact that the "*Titanic*" was unsinkable, with the scientific fact that all ships could sink.

- In the case of limitation of cause, the results have been rather different. For the sake of argument, we can suggest two vastly different conceptualizations of the cause of system failure: did the "*Titanic*" sink because it hit an iceberg at speed, or because it violated the physical 'law' that two objects cannot occupy the same space at the same time. If the former is perceived as prime cause then negative feedback can be said to have been remarkably effective in preventing similar occurrences.

- This case has not prevented other ships sinking, grounding or colliding, which also violated the spatial conditions.

- In terms of the latter specification of perceived cause, operating at the level of principle, and which enables extension by analogy to myriad other causes of ships sinking, it may have been less effective, perhaps demonstrating the limitations on the potential of negative feedback to operate efficiently.

- Certain things were done to avoid repetition of the "*Titanic*" disaster. Even this has not prevented ships from traveling at speed in dangerous conditions, (Turner, 1978 on the collision between the MV "*Redthorn*" and the MV "*Efpha*" in 1971).

- Even given a means of rationally defining causes that might overcome the tendencies of attenuation, it could still be argued that the idea of replacing non-epistemological influences with scientific knowledge is utopian, though this should by no means constitute a reason not to pursue it, Fig. (2).

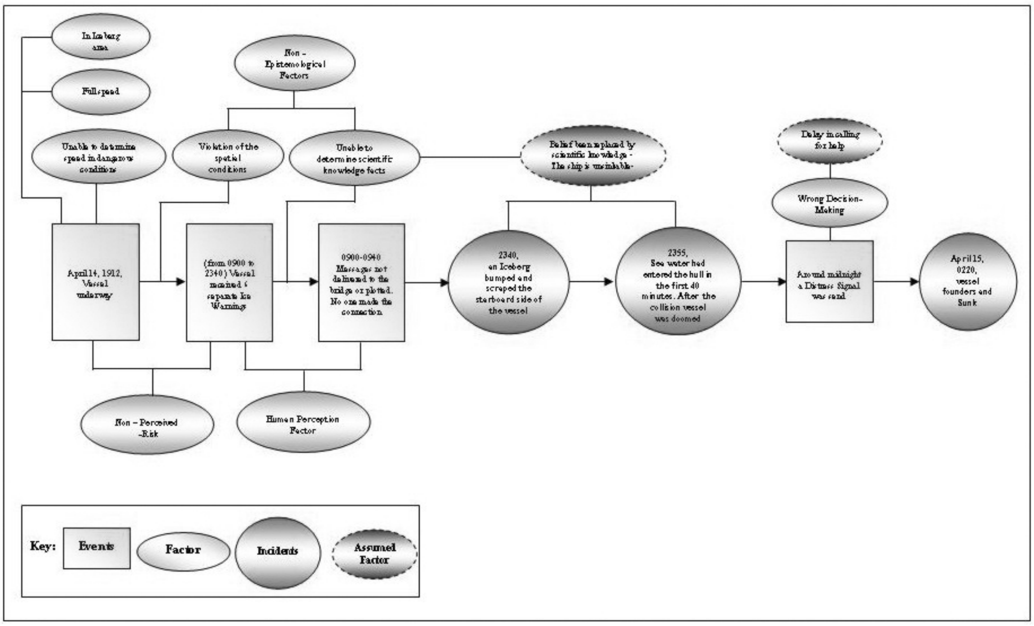

Figure (2) Roadmap to the Collision/Sinking of "Titanic" - Events and Special Human Casual Factors Chart

8.2 The Grounding of the Bulk Carrier "New Carissa"

On 4 February 1999, during an accurately forecasted winter storm, the 639-foot, Panamanian registered, bulk freighter M/V "*New Carissa*" ran aground on the shore north of the entrance to Coos Bay, Oregon, (NTSB, 1999).

- ***Salient Features***

- At 1900, the "New Carissa", using its port anchor and seven shots of chain (630 feet) eventually anchored in sand, approximately 1.7 n.m. off the beach.
- The wind at this time was from the south-southwest at 31 knots and the swell was approximately 12 feet from the west-southwest, capped by 5-foot wind generated waves.
- The latest national weather service forecast predicted the winds to moderate overnight with the seas to increase in height.
- 1930, the third officer plotted the ship's position using a single radar bearing and range off the end of the north jetty of the Coos Bay Entrance Channel.
- The master placed an anchor drag circle on the chart that was 200 yards larger than it should have been. A drag circle provides a means to readily determine if the ship's anchor is holding properly.
- The plotted positions of a vessel at anchor should remain within the drag circle, generally near its edge as the ship swings (weathervanes) in relationship to changing wind and swell direction, Fig. (3).

- ***Accident's Results***

- The grounding was a result of the master's ill-fated decision to anchor the "New Carissa" 1.7 n.m. from shore, in a gale with forecasted weather conditions calling for rising seas. These seas eventually caused the vessel to drag anchor on the morning of 4 February.
- A contributing factor to this event was the master's imprudent approach to anchoring. He chose to use only one anchor and did not layout more anchor chain as would he expected for the environmental situation.

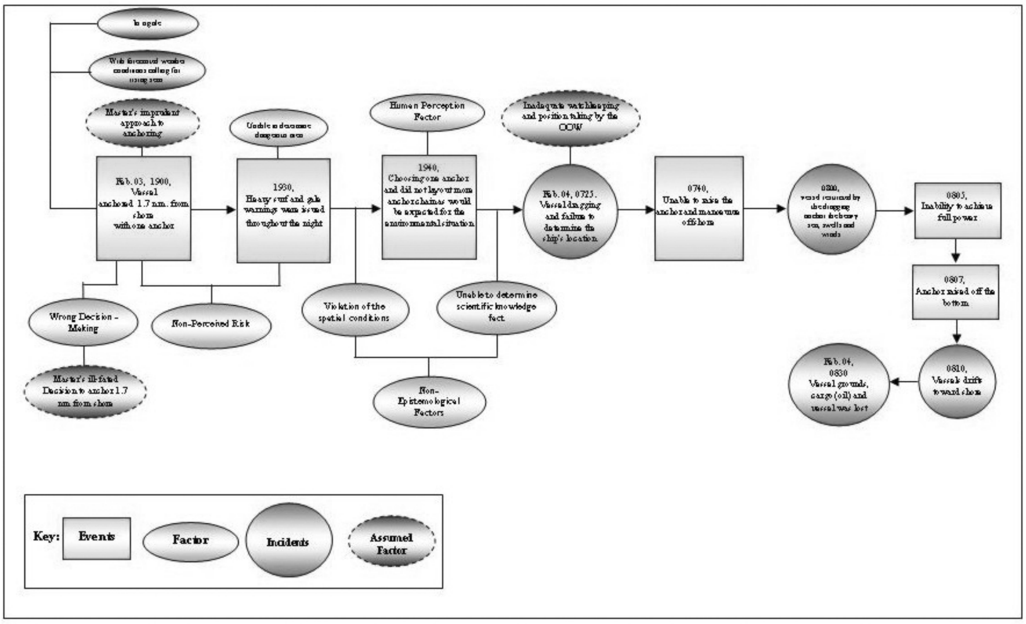

Figure (3) Roadmap to the Grounding of *"New Carissa"* - Events and Special Human Vasal Factors Chart

- Inadequate watchkeeping and position-taking by the ship's OOWs, in combination with an improperly sized anchor drag circle placed on the navigation chart by the master, delayed discovery of the ship's unintended movement.

- There is evidence of negligence on the part of the master of the "New Carissa" in deciding to anchor off Coos Bay, Oregon. The decision not to remain underway ultimately resulted in the vessel going aground.

- The master of the "New Carissa" made an error in judgment regarding how he chose to anchor the vessel. He had available additional chain, a second anchor and the ability to motor ahead slowly in an effort to reduce the strain on the chain while anchored.

- There is evidence of negligence on the part of the ship's OOWs in their watch standing. The chief officer and third officer used only one reference point to ascertain the vessel's position, even as the environmental conditions deteriorated, they failed to effectively monitor the vessel's position, to maintain accurate records of their watches, to heed the forecasted weather, and to immediately determine that the vessel was dragging.

- It is possible that the vessel had been dragging slowly for quite awhile and that the master, if given more warning, could have taken better preventive measures.

- Over the next several days, the "New Carissa" gradually worked her way closer to shore, where, on the night of 8 February, she broke into two sections.
- In this case, it was found that the same 'special human factors' were common factors, i.e., attenuation and the associated non- epistemological factors.

Finally, this case is a classic one and proves the relationship between the human perception/ cognition factors and the OOW's decision-making when casualties occur.

9. Conclusion

The statistics and analysis of previous and recent casualties from 1995 till 2002, before and after the application of the ISM Code, reveals any slight improvement in the aspects of collisions and groundings problems.

It is proved that the human factor is still dominant in most of these casualties. Also, it shows no change of the human factor percentage after the application of the ISM Code. In this respect, more deep analysis of the human factor has been done.

Problems resulting from maritime casualties at sea cannot be solved only with regulations or rules as suggested by the ISM Code.

The problems can be identified by following a concept of science and new analysis system.

Following that, the OOW have to go through steps starting from measuring precisely the data and process to get useful information. At the same time he must be able to find the multi solutions and to decide the optimum action (good decision-making).

This research has made an initial breakthrough into the integration of qualitative special human factors as a tool for investigation and analysis of casualties, i.e. collision and grounding.

The measures proposed need to be validated, initially, in the real life situation. A deep framework for understanding such special human factors needs to be developed and field-tested. A framework for the integration of human perception, cognitive thinking and decision-making research into the casualty investigation regime needs to be developed and a uniformity of practice worldwide needs to be established.

Amount of technological innovation can replace the common sense, experience and training of a professional crew, i.e., training in perception, cognition and decision-making. Great concentration on improving the cognitive thinking method to solve problems of multiple dimensions is vital.

To solve one of the most vexing challenges, preventing casualties and saving lives, the best safety device on any ship is a well trained crew by featuring emergency situations and casualties simulations, i.e., real situations which have caused ship casualties.

In conclusion, people who do not deal with emergencies on a routine basis are seldom aware that emergencies require immediate decisions and actions on the scene.

Finally, good training is not a luxury in international shipping. It is essential in order to ensure that ships are run efficiently and that means safely and without harm to the environment. Great concentration on training of OOWs in such cases of emergency and perception in order to gain new skills is vital.

A comprehensive research in the area of maritime casualties will provide great understanding on decision-making training using a scientific method integrated with Maritime Information System (MIS) and the relationship between information analysis and human perception, cognitive thinking to take decisions.

10. Contribution

This research was intended to specify the mechanisms that precipitate casualties resulting in collision or grounding of ocean-going vessels, and to investigate the role of initiatives that carry the potential to interrupt the train of events that culminate in such a collision or grounding.

This has been achieved through the study of casualties, specifically investigated against the findings of human error derived from human perception, cognitive thinking and decision-making, through case studies of casualties worldwide.

The primary contribution of this work was expected to be the initiation of a groundwork for lifting the twin fields of shipboard navigation and casualty investigation from a qualitative poorly validated foundation to a qualitative scientific foundation which could be molded to be intrinsically self validating and capable of error flagging.

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BIOGRAPHY

Analysis of The Correlation Between Casualties and Human Perception, Cognition and Decision-Making at Sea

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Dr. Ahmed Hanafi started teaching at the Arab Academy for Science and Technology and Maritime Transport in 1985 as a master mariner lecturer.

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Impact of New Maritime Security Measures

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Student Presentation

SUMMARY
The International Maritime Organization (IMO), when it amended the 1974 Safety of Life at Sea (SOLAS) Convention, increased port and ship security to a new level. The new protocol is called the International Ships and Port Facility Security (ISPS) Code and it mandates elaborate security-related regulations that affect international shipping. The ISPS Code has two parts, the first mandatory, and the secondary optional. However, the US has declared that it will be regarding parts A and B as both central to maritime security and therefore obligatory. Moreover, it is predicted that the European Union countries will follow suit. In light of these developments, the United States American Bureau of Shipping (ABS) is introducing its own stringent measures to interface with the regulations of the ISPS Code. The thrust of these new measures is to deter potential terrorist and pirate attacks, and the driving forces behind this legislation stem from international groups such as the United Nations Counter-Terrorism Committee, who study and deal with global terrorism. These committees believe that present security laws are archaic, and have to be updated with the rapidly evolving maritime industry. The IMO and ABS plan to initiate the transition from the previous policies to the updated version in July 2004.

Unfortunately, however, the new ISPS Code may nevertheless produce as many problems as it solves. First, compliance with the ISPS will be costly for private and public institutions alike. While advocates view the ISPS Code as an asset to public interest because it provides protection from pilferage, and a safe means of transporting cargo and passengers, companies see the ISPS Code in a different light, viewing it as a liability with high initial cost and expensive annual expenditures. Another disadvantage for US owned and operated companies is that the ISPS Code will most likely face more strict regulations than their international counterparts, and smaller US-based companies may find themselves on the edge of a financial precipice. Similarly, larger companies will be met with the cost of training crews and officers for the Code, and hiring additional labor for port and ship security. In turn, this will result in possible lost revenue due to cargo delays and increases in insurance and operating costs, all of which will be devastating to profits.

Cost savings have been a major concern for both US and international owned and operated maritime companies, especially since the costly Oil Pollution Act (OPA) of 1990. True, the OPA was in response to an environmental disaster rather than terrorist attacks, yet the costs of compliance with the OPA were, and still are, a daunting cost to shipping. The financial shock wave was crippling to companies delivering crude oil to the US, many companies spent millions revamping their fleets. Likewise, the ISPS Code will be costly since it deals with the complete spectrum of shipping, and is not limited to one specific trade.

The ISPS Code, however well intentioned, will most likely be blamed on an increase in operating cost, and a decrease in profits. Nevertheless, the looming deadline of July 2004 approaches. The USCG is working closely with the ABS to prepare for the new regulations, and is planning to impose financial penalties for those who are not up to par come this July. This is an expensive course to embark on and will be discussed in the research paper.

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ECONOMIC IMPACTS AND IMPLICATIONS OF
TRADE AND MARITIME SECURITY INITIATIVES ON MALAYSIA
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August 2003
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The Role Of Information Exchange On Navigation Safety And Security Enhancement

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ABSTRACT
Information exchange plays crucial role in navigation safety and security implementation, the fast improvement in communication technology, increased accessibility to information channels. Collected information could be used as negative or positive contributors to the safety and security of ships while sailing especially near coastal areas.

International shipping has been identified as vulnerable to global terrorism. Sound security management practices are considered essential if exposure to loss due to terrorism, piracy and other criminal activities is to be reduced. Statistics has shown dramatic increase in incidents involving ship's attacks especially in Far East regions and low social living levels areas around the world. Most of theses attacks have been planned and organized depending mainly on information pre-collected about targets.

Information about ships route, origin, speed, and destination could be used positively by the coast control stations to identify and secure ships and avoid collision or used to analyzing the traffic situation and carry out search and rescue operations. Breaches by unauthorized or illegal gangs to the ship's data could be used negatively to threaten and attack the ship.

Information breaches could threat the ship indirectly by Subversion, Espionage, and Sabotage. Information could be breached whether through person's formal or social relations or through routine information exchange between ships and control stations or through penetration to inboard satellite communication channels.

Shipping companies, port control stations and reporting systems should put clear policies concerning information security, and every one at shore or onboard a ship should be aware of the negative outcomes of information release and the possible ways of breaches and penetrations. Moreover, everyone concerned should know how information release could be used negatively to threaten the company interests or the company fleet itself.

1. Introduction

Easy Information Easy Targeting

Information and data collected or breached plays an important role in navigation safety and security, information collected by the coast control stations could be utilized positively by the authorities using, for instance, AIS (Automatic Identification System) and/or any other regional reporting systems like VTS (Vessel Traffic System) to collect, analyze, and process data in order to enhance navigation safety and security.

Simultaneously, most of accident investigation reports have declared that the majority of ships' attacks have been initiated and built up depending on pre-collected information released during ships` stay at ports, or through monitoring ship–to shore communications and using intercepted information to select targets. Violent piracy on the high seas has soared and more ships are being hijacked to kidnap the crew for ransom.

The risk of terrorist attacks can perhaps never be eliminated, but sensible steps can be taken to reduce the risk. We cannot continue to hope for the best and ignore the lesson. There was no concern on how ships were targeted? Why at this position? Why at that time? How pirates recognize ships' cargo and identify it? Answering to all of these questions is very easy, of course, because the evil gangs breached the ship's tracking information, and the ship was expected in time.

The International Maritime Bureau (IMB) declared that number of reported ship attacks jumped to 445 in 2003, 20% higher than the previous year and the second highest level since it began collecting statistics in 1991 until 2003.

The number of seafarers killed also climbed to 21, with another 71 crew or passengers listed as missing, while 88 were injured. This compared to 10 killed and 38 injured the previous year. The number of hostages taken also nearly doubled to 359 in 2003.

The figures show an increase in the number of the attacks and violence of the attacks. The IMB said the number of ships hijacked for the theft of the vessel and its cargo had dramatically reduced, but that more vulnerable boats such as tugs and barges were being targeted and crews were being abducted for ransom.

Indonesian waters continue to be the most dangerous with 121 reported attacks in 2003. The Malacca Straits, between Indonesia and Malaysia and one of the world's most strategically important shipping lanes, saw a rise to 28 attacks in 2003. Thirty percent of the world's trade and 80% of Japan's crude oil is transported through the narrow waterway.

Some Western intelligence agencies and maritime security experts have linked al-Qaida, or groups associated with it, to Indonesian piracy. Experts claim al-Qaida showed its seaborne attack capability by bombing the Limburg oil tanker off Yemen in 2002 and US warship USS Cole in 2000. "In 23% of the attacks, tankers were the targets," The following figure showing Monthly comparison of incidents from January to September 2003. (IMB, 2004)

Bangladesh was ranked as having the second highest number of attacks in 2003 with 58 and Nigeria came third with 39. Attacks off Nigeria almost tripled compared to the previous year and the IMB regards it as the most dangerous area in Africa for piracy and armed robbery.

However, some countries saw a reduction in piracy. Somalia had a 50% drop in reported attacks, although the IMB said the eastern

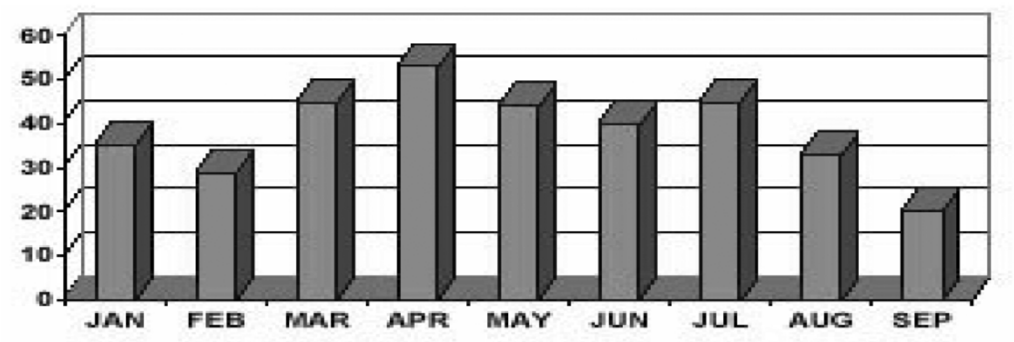

Figure 1 - Monthly comparison of incidents from January to September 2003.

and north-eastern coast of the African country remained a high-risk area for hijackings and kidnapping of crew for ransom. Other countries with fewer attacks in the past year included Cameroon, Ivory Coast, Ecuador, Guyana and Thailand. Malaysian waters saw a fall to only five attacks, with none reported in the last six months of 2003, which the IMB said was due to vigilant patrols by the Malaysian marine police.

Any vessel, not making a scheduled call in a Somali port, which slows down or stops close to the Somali coast, will be boarded by evil gangs. They had extorted substantial sums from owners for the return of the vessel and crew. This indicate the positive side of information exchange, as the ship could be secured if she only reports its arrival, but these reported information should be as well protected against breaches and intrusion during approach.

2. Sensitive information

Sensitive information might include timing (e.g.…departure, arrivals), location of the ship, routes (routes, charts and etc.), crew nationality, ship/port survey, assessments, designs and architecture, security plans and emergency procedures.

3. Sources of Information

3.1 Personnel sources

Information could be communicated by both authorized and un-authorized personnel, either through legal or illegal channels, using means of communications available such as VHF, Internet, and land networks. Personnel working in the coast radio stations, ships` agency and port traffic management stations could release information intentionally or accidentally to their friends and relatives. However, information could be communicated through social relations between those working onboard ships like ships crew or cargo gangs, stevedoring and subcontractors and their relatives and friends who have relations with piracy gangs.

3.2 Cryptographic and computer sources

3.2.1 AIS as information system

IMO carriage requirements for AIS become effective with the latest amendments to SOLAS chapter V on 1 July 2002, and its amendments in December 2002.

AIS System is a dynamic digital broadcast radio carried on vessels. AIS separately broadcasts relevant information about the vessel at regular intervals depending on the vessel speed, maneuvering or operational status, when these broadcasts are received and integrated with an appropriate display, AIS will present real time navigation and vessel traffic information to both mariner in the wheelhouse and at the vessel traffic service center. AIS information could be of security advantages to the authorities in monitoring and control of the traffic approaching or passing through its coastal waters.

AIS has the potential to become the key element for information exchange and will play an important role for the efficient and smooth flow of information among all parties concerned. AIS is also playing an important role to increase the safety of life at sea, protection of marine environment and efficiency of navigation through:

- Detect potential collisions and grounding.
- Allow ships to take proper action.
- Flow without significant additional activities.
- Enhance scope and quality of information exchange

In full accordance with international regulations AIS must provide automatically – shore stations, other ships and aircraft- information including:

- STATIC Data: IMO Number, call sign and name, length and beam, type of ship, location of position fixing antenna on the ship.
- DYNAMIC Data: ship position, time in UTC, course over ground and speed, heading, navigational status ROT (Rate of Turn).

- VOYAGE RELATED Data**:** Ship's draft, type cargo, destination and ETA, Route plane.
- Safety related data: As needed.
- International functional messages (when needed): Number of crew on board, ship's waypoints, and Route plan report.

3.2.2 Vessel Traffic Services

One of the most important services provided by VTS is Information Service. VTS is enabling essential or necessary information provided to the users, i.e. those on board subject to make navigational decision. Secondly, VTS is navigational assistance through the exchange of information between the ship and VTS stations. VTS also considered as a traffic organization service, used to prevent the development of dangerous maritime traffic situations of an early stage and in fact it regulates the traffic within the VTS area.

The role of VTS in ensuring security is growing in many areas around the world. Handling security related information within the VTS information network, resulted in adding the security organizations such as coastguard organizations to client's list of VTS.

Norcontrol IT, manufacturer and supplier of VTMIS, *"says that under and above water port surveillance and control system, can be integrated with VTMIS and AIS solutions to provide port security officers with vital prior warning at threats."*

Furthermore, the Polling or controlled mode as specified in AIS performance standards, will allow the VTS to interrogate specific data from ships at any time within the AIS coverage.
Adopting of the long range tracking using the AIS, will also improve the efficiency of monitoring the traffic for security purposes by extending the AIS range beyond VHF, using long range communication technology, e.g. INMARSAT, will facilitate the interrogation of ships in the Exclusive Economic Zone and beyond.

Exchanging security related information within VTS networks on regional and international bases will strengthen the control and combating of piracy, hijacking of ships and other crimes or terrorist acts against ships on international basis.

3.2.4 Functions of AIS when integrated with VTS

The type of AIS used in VTS systems is a shore-based device supporting VTS and surveillance services, as specified by ITU recommendation M.1371-1. The AIS base station could perform several functions includes:

- Act as the main link between the mobile AIS stations (onboard ships) and the VTS.
- Act as repeater to rebroadcast the AIS information.
- Managing the radio channels, including the use of alternate channels when AIS1 and AIS2 are busy.
- Interrogate AIS mobile stations, when authorized to do so.

Applying the AIS technology will improve many of the VTS functions, if not all of them, the following will indicate how the information technology may contribute in improving VTS operations, by clarifying the effect of such technology on each VTS function related to the safety, management and control of the maritime traffic.

3.2.4.1 Identification and communication

The use of AIS technology will eliminate the need of voice communication or at least reduce it, which will also facilitate the use of VHF effectively in emergency situations, for non AIS carrying ships and when verbal confirmation is required in certain situations. Moreover it will overcome the weaknesses of the current manual reporting process.

3.2.4.2 Safety of navigation

Information provided by the AIS to VTS operators, as well as the exchange of information between the VTS and traffic and the rapid and automatic update of the information are added value to the AIS application in VTS centres. Such information exchange will improve the situational awareness, and as a result will have a positive impact of many aspects, which contributes to the safety and quality of navigation.

3.2.4.3 Navigational information

In addition to broadcasting static, dynamic and voyage related information, the safety related messages, which are also broadcasted by the AIS, will provide enormous tools to VTS and ship operators to exchange additional information improving the situational awareness of all parties

3.2.4.4 Aids to navigation

VTS centres use aids to navigation for different purposes such as, marking traffic separations, port approaching, marking or organizing the traffic near a danger to navigation…etc.

A special type of AIS station, introduced by ITU Recommendations M.1371-1, the (AtoN AIS station) when fitted to an Aid to Navigation could provide information includes:

- Identification of the aid to navigation.
- State of health of the navigational aid.
- Tide and weather conditions,

Furthermore, AIS can monitor the performance of the navigational aid, as well as, the collection of AIS data of the transiting shipping traffic for navigational planning purposes. Moreover it could act as an AIS base station repeater.

Additional potential benefit of the AIS is the transmitting of the so called "Pseudo/virtual aids to navigation" for physically non existing objects, which can be used for many purposes such as, marking a prohibited area for navigation or naval exercise area…etc.

3.2.4.5 Broadcasting of DGNSS corrections

Various Global Navigation Satellite System (GNSS) were invented and used by navigators but none of them was as global or accurate as global positioning system (GPS).

The Differential GPS (DGPS) is regular GPS with an additional correction (differential) signal added. This correction signal improves the accuracy of the GPS up to 2 to 3 meters, and made it possible to broadcast it over any communication channel.

Broadcasting DGPS corrections using the AIS by VTS centre, provided with integrity monitoring system, will enable all ships equipped with GPS receivers in the VTS area to navigate with DGPS accuracy, which improves the position fixing accuracy; accordingly it will improve the safety of navigation.

3.2.4.6 Radar target broadcasting

The VTS can attach the information of a non AIS vessel to its radar target and broadcast it as Pseudo AIS target message to other vessels equipped with AIS in the VTS area. This function will allow non radar equipped vessels, which is only equipped with AIS, to view the VTS radar targets, which will increase their situational awareness of all the surrounding traffic, and will enhance the level of safety of navigation in the VTS area.

3.2.4.7 Metrological and hydrological information

The metrological and hydrological information are the most vital information required by the navigators, in order to proceed safely in their voyages. Receiving accurate information at the right time can save the ship, the crew and the environment.

One of the services provided by VTS centres is the information service which includes weather information among other information as specified by IMO Resolution A.857 (20), the AIS can play a crucial role in broadcasting the metrological and hydrological information, such broadcasting will depend on the type and capability of the measuring and processing equipments.

4. The threat

A ship, whether a merchant ship, a fishing vessel or a leisure boat, is exposed to various types of threats on the high seas, in coastal waters and in port areas. Different factors, among which, the isolation of the ship while sailing or berthed, the relative ease of access to her and the difficulty of setting up her own protection efficiently, combine to make the ship an easy target for attacks. Information collected or breached could be used destructively to threaten ship owner's interests, commercially or attack the ship itself by one or more of the following threats:

4.1 Piracy
Piracy consists of any of the following acts:

(a) Any illegal acts of violence or detention, or any act of depredation, committed for private ends by the crew or the passengers of a private ship or a private aircraft, and directed:
   (i) On the high seas, against another ship or aircraft, or against persons or property on board such ship or aircraft;
   (ii) Against a ship, aircraft, persons or property in a place outside the jurisdiction of any State;

(b) Any act of voluntary participation in the operation of a ship or of an aircraft with knowledge of facts making it a pirate ship or aircraft;
(c) Any act inciting or of intentionally facilitating an act described in sub-paragraph (a) or (b).

4.2 Armed robbery against ships
Armed robbery against ships means any unlawful act of violence or detention or any act of depredation, or threat thereof, other than an act of piracy, directed against a ship or against persons or property on board such ship, within a State's jurisdiction over such offences.

4.3 Subversion
Subversion means action designed to weaken the military, economic or political strength of a nation by undermining the morale, loyalty or reliability of its citizens.

4.4 Espionage
Espionage defined as the attempts to acquire information covertly or illegally in order to assist a foreign power and/or attempts to acquire information covertly or illegally in order to assist a political or commercial competitor.

4.5 Sabotage
Sabotage is an act or omission falling short of a military operation, intended to cause physical damage in order to assist a foreign power, further a subversive political aim, or reduce or destroy commercial competition.

4.6 Terrorism
The unlawful use of force, or the threat of force, against individuals or property in order to achieve political, religious or ideological objectives.

4.7 Other threats
- Investigative journalism
- Criminals
- Disaffected or dishonest staff
- Computer Hackers
- Computer Viruses

5. The shortcomings of using AIS in VTS systems
Alternatively, due to its simplicity in use and the wide variety of information provided by AIS systems, all ships in sea area are part of a network. AIS information could be used negatively through illegal sources and channels. At the time being, due to the enormous fast flow of information

"Every Body See Everybody"

However, there is a down side of the AIS to broadcast such critical and comprehensive data of a ship and its cargo to the public, as for the authorities to access information for security checks so can those with evil intent target vessels worth taking over.

Another warring aspect which should be focused on, is the failure of some AIS equipped vessels to update the voyage data, whether intended or not, whilst the navigation details are updated automatically and the vessels` basic data should remain a constant once it has been input, details of each voyage - primarily cargo and destination - must be loaded in at the commencement of each voyage. Although this is a mandatory requirement a number of cases being identified by VTS stations of vessels arriving in their areas with incorrect information being transmitted.

6. Security breaches in onboard communications

Owing to the increased accessibility to the marine communication and computing systems, the awareness has raised that network and IT security has become much more integral part of the design and specifications of ship's systems. Traditionally, onboard networks and systems have had two means that made them more secure:

Firstly, they are relatively isolated systems. A network device can only be protected from attack when unconnected.

Secondly, many onboard systems were often bespoke. Without insider knowledge of software code and design specifications, it would be nearly impossible to start an attack. The use of COTS (commercial off-the-shelf) hardware and software, and widely adopted standards like IP (Internet Protocol), can make it easier to access a ship's network without authorization, if it is not properly protected and maintained.

Alternatively, many operational functions, such as navigation, were completely independent systems. However, with the use of integrated bridge systems and LANs connect the whole ship's information to the AIS, the on board systems become integrated and connected within the vessel and back to shore.

There are several routes into a ship's system. It is possible- although difficult- for a third-party attack to be launched directly over a communications system such as the satellite link. An increasing number of satellite systems are based on the Internet, so designers need to factor this into onboard system design.

The use of e-mail and Internet on-board for many of the passengers and crew means that the threat of downloading viruses and causing unintentional damage has increased. Many viruses take advantage of the macro scripting languages of normal Microsoft Office software to infect applications, or worse still, the network servers themselves. E-mail viruses could cause a major problem if they were to cause the mail application to send unwanted e-mails over the ship's satellite link.

7. How information could be secured

7.1 Personnel security

Personnel security could be achieved by ensuring that those whose reliability, trustworthiness and circumstances are not in doubt have access to sensitive material. On the other hands, those who may be involved in terrorism, espionage**,** subversion or unauthorized disclosure are excluded. These could be accomplished by background checks, verifiable work history, personal references and security vetting.

Masters should bear in mind the possibility that attackers are monitoring ship-to shore communications and using intercepted information to select their targets. Cautions should, therefore be exercised when transmitting information on cargo or valuables on board by radio in areas where attacks occur. Members of the crew going ashore in ports in affected areas should be advised not to discuss the voyage cargo particulars with persons unconnected with the ship's business.

7.2 Physical security

Physical security could be achieved through access limitation for unauthorized persons, in addition to the following:

- Keep equipment locked when not in use.
- Screened from viewing.
- May require physical protection.

7.3 Cryptographic and computer security

Cryptographic and computer security could be achieved by encoding and decoding messages between the sender and receiver (e.g. secure e-mail), also, encode radio transmissions between vessels. For example, many Inmarsat service providers include sophisticated firewall features. Combined with a secure network infrastructure inboard, these make it very difficult for outsiders to gain entry.

Measures assigned to the ship's IP Gateway, which changes with each communications session, enhance security. Similarly, using tunneling technology and secured encrypted link between ship and shore. Access to the public Internet is governed by central security policies and having just one traffic profile for the tunnel makes the firewall configuration simple and very secure.

AIS information broadcasted should be well protected and kept away of unauthorized personnel or gangs, these could be achieved by limiting the wide variety of information broadcasted and /or coded the information into a certain number each indicate the ship and its cargo, then decoded at the coast radio station into the ship's full data.

However, vessels or a fleet should have an IT and communications security policy. This should stress that all crew need to be aware of the importance of keeping log-in and password details confidential, and that any intentional security breach will be dealt with severely.

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BIOGRAPHY

The role of information exchange on navigation safety and security enhancement.

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Captain Ahmed commenced his career as marine lecturer at the Arab Academy for Science and Technology and Maritime Transport in 1993. At the moment he is working as first lecturer in the Deanery of Maritime Safety Studies. He has 10 papers and researches published and presented in national and international conferences. He obtained his Master of Science on (Maritime Safety Administration) from the World Maritime University 1997. He has been nominated as regional expert and consultant in the enrollment of experts of Technical Co-operation Committee IMO. He was delegated to the United Arab Emirates coast guards as an expert in marine safety and search and rescue 1998-1999. He obtained a Bachelor of Technology in Maritime Transport Technology in 1994. He has held his Master of foreign going certificate since 1992 and worked as a marine officer for 12 years. He graduated from the AAST&MT in 1981 as second Mate.

Consideration on New Approaches to Maritime Security

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Student Presentation

SUMMARY

A new, inclusive security system for international shipping is set to enter into force in July 2004 following the adoption by a weeklong Diplomatic Conference of a series of measures to consolidate maritime security and prevent and oppress acts of terrorism against maritime transportation. The measures represent the culmination of just over a year's intense work by IMO's Maritime Safety Committee and its Intersessional Working Group since the terrorist outrage in the United States in September 2001.

A worry in threatening about ship's safety, passenger and a crew has been reflected by IMO since 1980. And recently, an importance of maritime security is getting emphasized. To have access to maritime security by other way, full knowledge of ISPS Code should be needed.

The International Ship and Port Facility Security Code (ISPS Code) was adopted by a Conference of Contracting Governments to the International Convention for the Safety of Life at Sea (SOLAS), 1974, convened in London from 9 to 13 December 2002. This ISPS Code aims, among other things, to establish an international framework for cooperation between Contracting Governments, Government agencies, local administrations and the shipping and port industries to detect security threats and take preventive measures against security incidents affecting ships or port facilities used in international trade and to establish relevant roles and responsibilities at the national and international level.

Maritime security includes the responsibility of Contracting Government, ship's security and Port Facility Security. The security plans that will be approved for each ship and port facility. Therefore the thorough preparation for future contingencies, terrorisms and accidents should be carried out. New approaches to maritime security will be starting from the right recognition of current maritime security system.

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Maritime Security: Joint Service Training and Development of Operational Tactics

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ABSTRACT
Response to Maritime Security threats and incidents requires swift, coordinated and flawlessly executed operations. Threats to ports, facilities and vessels include chemical-biological-radiological agents, weapons of mass destruction, improvised explosive devices, armed raids, or a combination of all.

Deterring these threats, or minimizing their impact, depends on timely and accurate intelligence followed by efficient and rapid transport and delivery of properly trained and equipped response teams. Meeting this goal requires detailed joint service training operations between the US Coast Guard, US Army Civil Assist Teams, Merchant Marine, State Response Teams and other US Military units.

New approaches to joint service and inter-agency training is the key to success and requires examination of key elements, such as terminology, physical fitness, small boat operations, vessel and helicopter transfer of personnel and equipment, communications, ocean survival, small arms, personal protective equipment, and vessel construction.

To assist in development of executable response plans Maine Maritime Academy is the Training Ship State Of Maine, R/V Friendship, and tug Pentagoet, and rubber inflatable boats (RIB) to conduct training with the US Coast Guard, US Coast Guard Auxiliary, US Army National Guard Civil Assist Teams, and civilian response teams. These evolutions are producing efficient and effective protocols and procedures for responding to the wide range of vessel and port facility threats.

1. Introduction

Protecting our ports, waterways, marine facilities and vessels from threats and attack is crucial for survival of our governments and societies. Accomplishing this goal requires aggressive and innovative planning and response procedures.

Sun Tzu in the art of war lists six principles: a) win all without fighting, b) avoid strength, attach weakness, c) use deception and foreknowledge, d) use speed and preparation, e) shape the enemy, f) use character-based leadership. Terrorists and criminals who threaten maritime assets use these principles, and so to prevent their success those responsible for protection of vessels, ports and facilities must respond in kind, adhering to the same principles.

A modern application of Sun Tzu is found in Mr. Jeff Cooper's book, "*Principles of Personal Defense"* which presents seven principles for protecting oneself; a) alertness, b) decisiveness, c) aggressiveness, d) speed, e) coolness, f) ruthlessness, g) surprise. Cooper succinctly says we should turn fear into anger, and anger into indignation.

Additionally, military tactical training emphasises flexibility to adapt to changing environments, accepting chaos and uncertainty as constants, seizing the initiative and maintaining that initiative, preparing to act instinctively and the ability to adapt to any situation encountered.

Success for those involved in maritime security and response depends upon blending Sun-Tzu, Jeff Cooper and military tactics into a pro-active response force culture that observes, detects, analyzes and acts to prevent or diminish terrorist and criminal threats.

2. At Home On and In the Water

Personnel involved with maritime protection must be at home in and on the water. Water must not be viewed as an obstacle but as their home environment. By being at home with the marine environment, responders will better be able to predict, anticipate, detect and thwart problems. For example, only a diver can understand underwater operations, just as only a small boat coxswain can understand the skills needed to operate a boat, and an expert shooter can understand the importance of being sure of your target.

All maritime response personnel need to be trained in water skills such as swimming, use of immersion suits and personnel flotation devices and operation of survival equipment such as flares and liferafts. Personnel with these skills and knowledge will have increased confidence and be able to operate and survive during stressful operations. Maine Maritime Academy has provided extensive ocean operations training to the Maine U.S Army National Guard Civil Support Team whose mission is response to threats and incidents involving chemical-biological-radiological agents and weapons of mass destruction. These highly trained teams exist in each State, but most have little or no maritime training, which is essential for effective response to regions with coastlines and inland waters. During four days of training for Maine's Civil Support Team we provided daily physical fitness training, use of immersion suits, personal flotation devices, liferafts, and small boats. We taught skills first in a daylight environment and then used a blackened pool to simulate night where we conducted underwater swims, and egress from an restricted enclosure (Figures 1, 2, 3)

Figure 1. US Army Civil Support Team learning ocean survival skills at Maine Maritime Academy, March 2004.

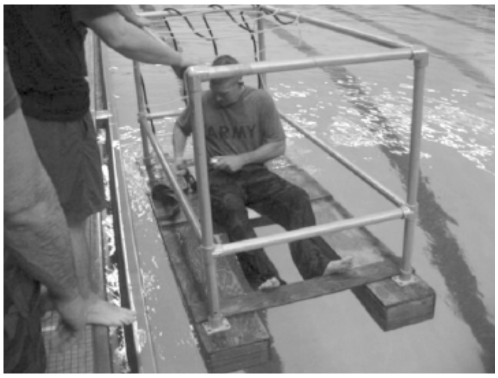

Figure 2. US Army Civil Support Team learning underwater egress skills at Maine Maritime Academy as part of their Ocean Operations Training, March 2004

Figure 3. U.S. Army Civil Support Team personnel perfecting underwater swimming and use of ocean survival equipment in a blacked out pool at Maine Maritime Academy during four days of ocean operations training in March 2004.

Once skills were learned in a pool environment, the same skills were executed in open water. Water temperatures in Maine range from highs of 50º F (10ºC) in the summer to 32ºF (0º C) in the winter. In March 2004, when the most recent training occurred, water temperature was near 40º F (4.4ºC). US Army personnel were required to jump into the water from a height of 15 ft wearing immersion suits. This skill was incorporated into a ship insertion exercise and was not announced, in order to create some anxiety and teach adaptability under stressful conditions (Figure 4.)

Figure 4. US Army Civil Support Soldiers entering 40º F (4.4 º C) ocean water during ship evacuation exercise as part of ocean operations training at Maine Maritime Academy during March 2004.

3. Physical Fitness

Strong bodies and strong minds are needed when operating under stressful environmental and psychological conditions. Many, if not most, mariners and land based response personnel are not in adequate physical condition to meet the demands of emergency operations. As a society our standards of personal fitness have declined dramatically. This is reflected in the rise of obesity and obesity related problems.

Physical fitness is a vital component of response capability. Too much emphasis is often placed on technology and organizational structure, to the detriment of physical conditioning for response personnel. High physical fitness increases overall endurance, the ability to perform critical thinking under stress, to out-perform adversaries, and to regroup faster and more effectively.

Evaluating and increasing maritime response personnel physical conditioning is accomplished using the US Navy SEAL (Sea, Air and Land) standards. Minimum performance for entrance into U.S. Navy SEAL training is satisfactory performance of the following skills, which is also suitable for evaluating maritime response individuals:

> Swim 500 yds. (1/4 mile) in 12.5 minutes. Rest for 10 minutes.
> Do 42 pushups in two minutes. Rest for two minutes.
> Do 50 sit-ups in two minutes. Rest for two minutes.
> Do 8 pull-ups. Rest for 10 minutes.
> Run 1.5 miles in boots and pants in 11.5 minutes.

This level of performance may seem high, but in reality is a level that most males between the ages of 18-50 should be able to accomplish. Much of our society has become lacking in physical conditioning due to the obvious problems of overeating, lack of daily physical activity built into our lives, and lack of understanding on the true need and benefits of physical conditioning. Personnel who do not meet the SEAL standard described above respond quickly to a rigorous daily PT program.

Figure 5. Maine Maritime Academy Midshipmen participating in US Navy SEAL PT regime during summer training cruise 2004. Increase in muscle strength and endurance increased dramatically within three weeks.

For example, students at Maine Maritime Academy who participated in a three times daily for 30 minutes PT program showed a remarkable increase in all areas of endurance and muscle strength after only 3 weeks of training (Figure 5.)

4. Small Arms Training

Use of small arms in maritime security requires training quite different from that often provided to land based law enforcement and security personnel. Transporting, carrying and effective use of small arms on vessels requires a solid understanding of munitions-what type of rounds will not ricochet off steel decks-how to carry a weapon up a pilots ladder, and how to tactically sweep enclosed ship spaces. Identifying and acquiring targets from and to a moving boat is an acquired skill. Whether response personnel carry or do not carry small arms they should be trained in their tactical use in order to understand the issues and concerns involved (Figure 6.)

Figure 6. Small arms training and confidence is an essential skill for all personnel trained for response to maritime security incidents. Small arms and the authorized us of deadly force are elements of a successful training program.

5. Communications

Vessels, ports and facilities use a wide range of communications systems, from cell phones to VHF to UHF radios. Shipboard noise, most often from machinery and deck equipment often preclude response personnel from engaging in verbal communications. As such, response personnel need to learn and use hand signals and standard response protocol to eliminate the perceived need for extensive and often distracting verbal communications. For example standard procedures for boarding a moving vessel from a rubber inflatable boat (RIB), without the use of verbal communications can be developed, as can procedures for securing bridges and engine main control spaces.

In addition, the extensive steel frames, longitudinal, hull plating and compart-mentalization of boats and ships often degrade or prevent the propagation of radio signals. Use of hand signals should be taught as standard procedure. Additionally, most response operations will involve use of small open boats, which are noisy and not suitable for receiving or sending verbal transmissions. Extensive verbal communications is often an indication of insufficient or poorly planned operations.

6. Maritime Terminology and Ship Plans

Often overlooked in response execution is an understanding of basic marine and shipboard terms. Most of us know how to describe and find our way around a hotel or office building, and likewise maritime responders need to have a solid understanding of cruise ships, tankers, military vessels and the like. Skill of how to locate and read ship fire and security plans need to be learned by all response personnel. How to locate a vessels bridge, engine room main control, and steering gear should be taught. During training exercises with the US Coast Guard and US Army National Guard, we have emphasized the skills of locating, reading and following ships plans. (Figure 7.)

Figure 7. Crew from the T/S State Of Maine, US Army National Guard and US Coast Guard confer over ships fire plans prior to making an entry into the ships aft house during a drill to detect hazard chemical substance. Understanding ship plans and location of compartments is critical to execution of a successful operation.

7. Conclusion

Preparation and adequate response to maritime security threats and incidents requires highly trained and pro-active personnel, who are both physically and mentally sharp, can operate effectively in stressful and adverse environments and who can adapt to a rapidly evolving physical and psychological environment. An in-depth understanding of ships nomenclature, construction, security systems, boarding procedures, use of small arms, ocean survival skills, bridge and engine room controls, and self defense techniques as well as superior physical conditioning are necessary. Through the coordinated training of US Coast Guard, shoreside security, and US military personnel, a seamless and highly effective vessel, port and facility security system will work.

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A New Breed Of Port Managers: Is There A Role For IAMU Institutions?

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ABSTRACT

Seaports are an unavoidable node in global supply chains. Besides their fundamental role of facilitating seaborne commerce, they have played a remarkable role in the history of humankind through such varied functions such as being centers of economic activity to being gateways for new opportunities. The port sector has received considerable attention in recent years for a number of reasons. New research raises several questions related to ports and their operations, organization, and management. Many ports are privatizing some or all of their traditional functions, and private terminal operators are becoming huge multinational entities. Ports are re-thinking their own operations and future planning, primarily driven by the carriers' operational strategies that are also in a constant state of flux. These are further complicated by the introduction of new mandates such as the recently adopted Maritime Transportation Security Act (in the U.S.) and the International Ship and Port Security (ISPS) Code amendment to the SOLAS Convention.

The changing dynamics in port operations and management mandates a new breed of port managers as well. Accordingly, contemporary port managers should build a skill set far superior to that of traditional port managers, and it should encompass non-traditional areas such as information technology, port security, and real estate and coastal zone management. The old approach based on learning fundamental business functions supplemented by maritime operations knowledge is no longer sufficient to meet these added functions and responsibilities. Furthermore, there is significant turnover in the port sector especially among top executives. There is an urgent need for restructuring the education of future port managers and for radical reengineering of existing curricula. A case can be made that high caliber maritime universities such as IAMU member institutions are ideally suited to provide leadership for educating better-prepared port managers. Accordingly, the paper will highlight new research in port operations and management. It will also advocate IAMU institutions broadening their mission and embarking on a reengineered curriculum for preparing contemporary port managers. Indeed this might be a growth opportunity for maritime universities because of seafarers' increasing proclivity toward life-long learning and pursuing alternative career options.

1. Introduction

The management of ports has received considerable attention in recent years. In many parts of the world, ports are dealing with a plethora of issues, including operational, organizational, environmental, political, and of late, security-related aspects. The role of port managers today is highly complex in light of the multitude of challenges posed to them. Management of purely maritime activities is a relatively minor part of their function today whether in developed nations, or in underdeveloped nations. The very scope of seaports and the activities they undertake have undergone a radical change in the last few decades. The current rapid turnover among high-level port executives in countries such as the U.S. is indicative of the very demanding environment in which they operate.

Another good indication of the increasing complexity in port operations and management is the increasing number of industry/trade journals that report these developments from various parts of the world and also the availability of dedicated scholarly journals such as the Journal of Maritime Economics and Logistics (formerly, the International Journal of Maritime Economics) and the Maritime Policy and Management journal. Approximately one-half of all articles published in these two scholarly journals are related to port operations and management.

There are many educational institutions that offer specialized port management programs at the baccalaureate, post-graduate and doctoral levels today. This includes top tier research universities in addition to traditional maritime colleges and institutions. The Association of American Port Authorities (AAPA), a trade association of port authorities in North and South America, offers its own post-graduate program culminating in professional port manager (PPM) certification. However, there has been very little published research that deals with the educational preparation of contemporary port managers, or an identified common core of knowledge deemed essential in contemporary port management education. It is the objective of this paper to make a contribution in this regard, and begin a dialog among interested stakeholders, in particular the IAMU institutions, about educating future port managers.

The paper begins with a literature survey and analysis of port operating environment in general. This is followed by a discussion of traditional educational preparation of port managers and is contrasted by what they ought to learn to function effectively in contemporary port operating environment. The author's primary survey of IAMU institutions in regard to port management education at their respective campuses is discussed next followed by structural and curricular recommendations for preparing a new breed of port managers.

2. Background and literature survey

The emergence of a global economy has had immense impact on the shipping industry, and simultaneously by its very nature, the shipping industry has played a valiant role in facilitating globalization (Kumar and Hoffman 2002). Their work provides useful extension to the contributions of other economists such as Thompson (2000) and Pedersen (2001) that give a heightened level of respect for transportation cost in economic analysis. Recent empirical analysis by Limao and Venables (1999) concludes that halving transportation cost increases the volume of trade by a factor of five. Micco and Perez (2001) and Sanchez et al (2002) analyze the impact of port reform on transport costs. One of the conclusions of Hummels (2000) is that "each day saved in shipping time is worth 0.5% ad-valorem, approximately 30 times greater than costs associated with pure inventory holding." This would only be possible if the port operations are smooth, and facilitate seamlessly the expeditious movement of cargoes to or from the interior points.

Kumar and Hoffman (2002) document the diffusion of the contemporary value chain across the oceans resulting in the evolution of global supply chains. According to them, the stimulants for this include decreasing barriers to trade as well as the apparent diminution of ideological conflicts between leading nations of the world (46). Thus, although shipping has been a global business ever since time immemorial, it has rarely had it so good until the last year. This is despite momentous exogenous shocks such as the September 11, 2001 tragedy in New York that temporarily halted the commercial activities of the world's largest trading nation. Yet, three years thereafter, shipping markets have reached new levels of euphoric growth and optimism, rivaling the golden 1970s albeit driven by the unprecedented growth of one single economic powerhouse, viz., the Chinese economy (Kumar 2004). Analogous to the dependence of the shipping industry on global economic conditions in general, changes affecting the global shipping industry have a direct impact on the port sector. The dynamics of the port industry today is such that in most cases, it is at the receiving end, constantly adapting to changes in the far wider exogenous environment that constitutes not only the ship operators and their agents, stevedores, and other port workers, but also an expanding subset of other stakeholders that now includes local, state, and national governments, a multitude of governmental agencies that include off-shore and on-shore law enforcement agencies as well as dedicated anti-terrorism agencies, local residents, public policy makers, and a long list of accessorial service providers. It is these developments that make the role of a contemporary port manager rather thorny and complex.

A paradigm shift in the role of ports, given the supply chain orientation of today's leading businesses, was dealt with in greater detail by Robinson (2002). His discussion (2002, 242-245) of the historical paradigm of ports is paraphrased below:

- Ports are places that handle ships and cargo
- Ports are operating systems that handle ships and cargo with operational efficiency
- Ports are economic units that handle ships and cargo within an economic efficiency framework
- Ports are administrative units that handle ships and cargo within efficient administrative and policy frameworks

The gradual transformation of ports from their historical paradigm to one of being an efficient channel member was recognized by many others (see Kumar 1993). This line of thought evolved from Christopher (1992) who forecasted the evolution of competing supply chains in future years rather than competing independent business entities. The role played by the port sector in such a dynamic environment is anything but stable and is discussed briefly.

2.1 Changing dynamics of the port environment

There are numerous changes affecting the port industry today that have a direct bearing on those who are responsible for managing those entities. The most radical of these changes evolve from the increasing specialization in international shipping operations. The traditional definition of a port as a place where cargo of various types is exchanged between the ship and the shore is of limited relevance today. Whereas a typical port in previous years handled all types of cargoes, liner as well as dry and liquid bulk, it is very common to find modern ports building a niche in a particular market segment, and in many cases, extending that specialization to sub-markets specializing in roll-on roll-off traffic or liquefied natural gas operations etc. Apart from this, all ports face the dilemma of increasing ship sizes, which leaves the ports constantly on the defensive. If they do not upgrade their facilities and infrastructure, or do not have the draft to accommodate the bigger ships, this would mean a loss in market-share, benefiting its competitors. This leaves all ports in a perpetual race with the others as seen in North America or in Western Europe. Indeed a similar outcome may happen among ports in the same country as documented in the U.S. case (Kumar 1999).

The stakes are even higher among the ports that specialize in liner cargo operations. This is primarily because of the regulatory liberalization of the liner industry in major trading nations and the relative diminution of power of the traditional conference system. New statistics indicate that close to 90 percent of the U.S. foreign commerce now move on contract basis (Kumar 2002). Thus, with contractual agreements between shippers and carriers driving the trade, the choice of port-of-call for the liner operator is often driven by the need to establish the most efficient channel rather than maintaining the historic geography-driven symbiotic relationship between a port and the trading community located in its immediate hinterland. The evolution of containerized shipping initially, and its gradual progression toward inter-modal bridge movements, has been a continuing challenge for the ports and their managers. Competition exists today among ports in the same region as well as between port-regions located as far away as on the opposite coast (Kumar and Rajan 2000). From a managerial perspective, this has left the ports in a perpetual struggle to retain their status as an efficient channel member, failure of which could result not only in the loss of high profile shipper clientele but also direct port calls by major liner operators.

Given the various pressures on ports today, and the increasing propensity on the part of governmental agencies to seek private capital as well as operational efficiency, many ports have privatized one or more of their basic functions, adding another dimension to the role of port managers. Baird (2000) uses three key port elements for classifying various port privatization options, these being port regulation, port ownership, and port operation. There are published studies that critique the privatization process (see Kumar 1997) as well as extensive surveys of privatization trends in ports worldwide (see Baird 2002, IAPH 2000). These studies show that although private operators may provide many port services including various value added options, the traditional functions still remain with the public body. So, port managers, whether working in the public sector or the private sector, have to be equally conversant in all aspects of port management today including the need to liaise with each other.

There is a plethora of other equally demanding issues that face a port manager today. These include maintaining technological sophistication in cargo handling and information system management, complying with various regulatory requirements related to the environment and pollution prevention, liaising with policy makers and elected officials to lobby for their port, negotiating contracts with their employees, and more recently, complying with the increasing number of regulations related to port and terminal security that went into effect world-wide from July 1, 2004 (Kumar and Vellenga 2004). Over and above all these is the perpetual problem of port finances, a highly sensitive issue (Luberoff and Walder 2000). Whereas most ports are typically struggling to keep their finances in the black, it is not unusual to find the city or state tapping into the port resources to fund their non-port activities. In summary, a port manager today needs to be proficient in far too many tactical and strategic aspects of management that would not be ordinarily considered in a management education curriculum.

3. Skill sets for contemporary port managers

The workplace in general has undergone significant changes in organizational structure and management during the last two decades in particular (Kumar 2003). Similar to other businesses, ports find themselves in a highly competitive world as discussed earlier. The availability of competent entry-level management employees with the right skills is essential for their sustainable competitive advantage in today's global economy. Maritime universities in particular are ideal campuses for imparting such skills to future port managers. Unlike the earlier years, these employees must be multi-skilled and able to contribute effectively as team players besides being current in their own field. Simultaneously, as in other businesses, they should be able to accomplish their tasks based on broad organizational guidelines and under very little supervision. They should be proficient in managing people and resources efficiently and have the big picture of port operations and management at all times while performing any task. Accordingly, adapting a US government report (1992) to the port environment, the new breed of port managers must build a portfolio of basic, technical, organizational, and port-specific skills to be successful.

Evers, Rush, and Berdrow (1998) argue that to be successful in the workplace, college graduates today must possess not only specific skills and knowledge in their areas of expertise but also certain core foundational skills and proficiency in general knowledge and cultural diversity. Thus, the learning outcomes of today's college curricula must facilitate the creation of generalists with specialized knowledge and skills who are also blessed concurrently with a repertoire of foundational skills that serve as the basis for lifelong learning and employability. The

Table 1: The Four Bases of Competence

Category	Description	Skill Sets
Managing self	Maximizing ones' ability to deal with uncertainties	Learning Personal organization and time management Personal strengths Problem-solving and analytic
Communicating	Facilitating the gathering, integrating, and conveying of information in many forms	Interpersonal Listening Oral communication Written communication
Managing people and tasks	Accomplishing tasks by planning, organizing, coordinating, and controlling resources and people	Coordinating Decision making Leadership and influence Managing conflict Planning and organizing
Mobilizing innovation and change	Conceptualizing, initiating, and managing change	Ability to conceptualize Creativity, innovation, change Risk taking Visioning

Source: Evers, Rush and Berdrow (1998)

foundational competencies they identify and their descriptions are shown in Table 1.

The authors argue that the bases of competence they identified would create a model of general skills essential to "thrive in the workplace and serve as the foundation for lifelong learning". Port managers are ideal candidates for life-long learning as their operating realm is in a constant state of flux, and the model has exceptional validity in their education. Primary research (through surveys) by Evers, Rush and Berdrow revealed that the first two competencies are usually well developed in the case of college graduates but not the latter two. There is usually no provision within a traditional university environment for graduates to build their abstract skills related to managing people and tasks, or mobilizing innovation and change. However, Kumar (2003) argues that maritime universities are strategically better placed in imparting these upper level competencies than their traditional counterpart universities. The following sub-section discusses IAMU institutions' involvement in port management education, and how it ought to be structured in a university environment.

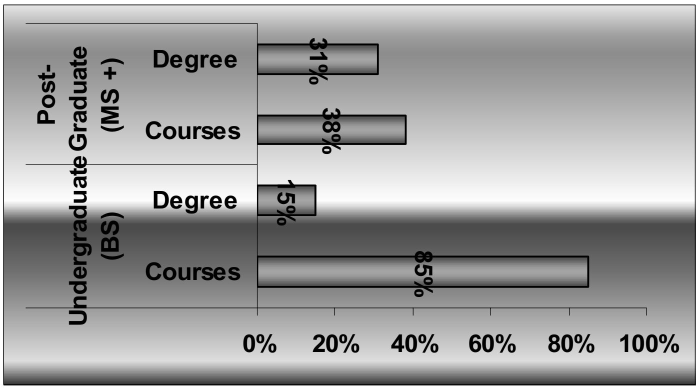
4. IAMU Institutions and Port Management Education

Although port management education can be imparted in any academic environment, maritime institutions are best suited for such programs. The reasons for this include not only the natural "fit" with the mission of a typical maritime college or university but also its proclivity toward experiential learning at a far superior level than that at traditional universities.

4.1 Port management education at IAMU institutions

The author conducted primary research to explore the current level of port management education at baccalaureate and post-graduate levels in IAMU institutions, and ascertain future plans of those institutions in this regard. A simplified one-page questionnaire (see Appendix A) was e-mailed to the contact person at each IAMU institution (36 member universities and 15 candidate universities) with a cover letter requesting feedback by e-mail or fax in two weeks. 14 universities responded to the

Figure 1. Port management education currently available at responding IAMU institutions



Source: Author's survey, 2004

request for participation (see Appendix B), giving a response rate of 27%. One of the responses was discarded as it did not answer the questions asked. Survey responses are presented in Figures 1 and 2.

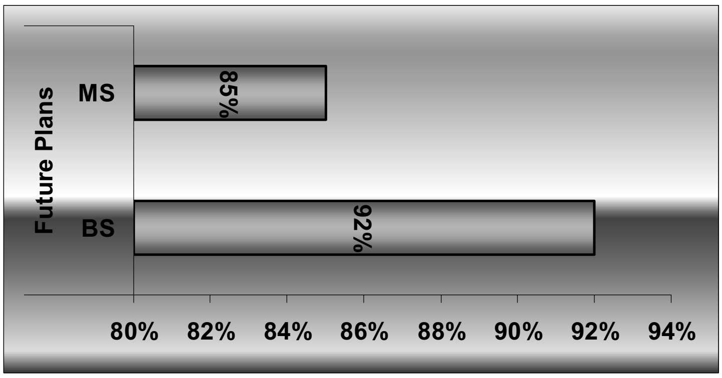
As shown in Figure 1, 15 percent of the responding institutions currently offer baccalaureate degree in port management, and 31 percent offer post-graduate degree at the MS/MSc level. A significantly higher number of the respondents offer academic courses related to port management as shown in the figure, viz., 85 percent offer undergraduate-level courses and 38 percent, post-graduate level courses.

Figure 2 presents the future plans of respondents with regard to port management education. As shown, there may be a six-fold increase in the number of maritime universities planning to offer undergraduate degree, and 124 percent increase in the number planning to offer post-graduate degree in one or more aspects of port management education. This confirms the author's position that most maritime institutions presently teach port management and operations in some fashion, or will do so even more in future years. The following sub-section discusses the author's philosophy of curricular structuring for a new breed of port managers.

4.2 Restructuring port management education

As discussed earlier, a contemporary port manager must be multi-skilled and proficient in many areas to rise up to the challenges of modern port management. Proficiency in general management along with good technical knowledge of maritime operations is no longer

Figure 2. Future port management education plans at responding IAMU institutions



Source: Author's survey, 2004

sufficient to meet the demands of contemporary port management. Yet, the fundamental reading, writing, and mathematical skills contributing toward critical thinking capability are essential for port managers today as in the past (Sherman pers. comm. 2004). Such skills would come through a strong liberal arts educational background. It is argued that such courses must constitute at least 50 percent of the undergraduate curriculum of a future port manager. These should be supplemented by courses in economics "the mother science of business", and the functional areas of business such as accounting and finance, marketing, organizational behavior, human resource management, operations management, and information systems, constituting approximately 25 percent of the curriculum. The remaining 25% should be structured to deal with port specific issues such as coastal zone and real estate management, pollution prevention and mitigation issues, legal environment of port operations, contract negotiations, lobbying and public speaking, maritime business, and port security management.

Experiential learning must be a significant component of the curriculum and would be one way to impart the upper level competencies identified by the Evers, Rush, and Berdrow (1998) model to be lacking in traditional university graduates. This could come through mandatory internships during the holidays each year. Ideally, they should spend each summer in a different port, and hold increasingly more responsible positions. It is the author's position that such a candidate will possess the knowledge as well as the experience base to contribute effectively as an entry-level port manager. Selection of candidates for such a program must be rigorous. While the demand for port managers is expected to increase in future years especially from the fast growing private port and terminal operators, supply of future port managers should be monitored so as not to flood the market.

Although the above model is primarily for the baccalaureate level of education, it can be easily altered to meet the rigors of post-graduate level of education and prepare middle managers for the port sector. Ideal recruits for such a program could be seafarers, especially given the high level of wastage that exists among seafarers (Kumar 2003). In this regard, maritime universities are once again at an advantageous position as the departing seafarers might have the natural inclination to return to a maritime college for post-graduate education. The post-graduate curriculum must include the critical thinking and communication components as well as core and elective courses related to port management discussed for the undergraduate education. The experiential learning component in this case could be a four month-long capstone project with a port, dealing with a specialized project pertinent to the student's choice of specialization. The entire experience can be packaged in a one-year (12 months) time frame.

An essential ingredient for the success of this curricular restructuring is the ports themselves. Unless the port industry and their trade associations are willing to collaborate with maritime universities such as the IAMU members heading in this direction, all these efforts would be fruitless. Ports, regardless of where they are located, should be willing to co-operate with the interested universities in shaping their curriculum, providing advice and services of field experts, and also in providing internship and capstone opportunities for students.

5. **Conclusion**

The paper examined the changing dynamics in port operations and management as a result of ongoing structural and strategic changes in the industry. A case is made that a new breed of port managers, capable of doing more with less while also concurrently satisfying multiple stakeholders with competing interests is required to manage modern ports and their operations. Essential competencies for functioning effectively in the 21st century based on published research were identified.

Author's primary research shows that a good number of maritime universities are either presently offering port management related courses and degrees, or are planning to do so in future years. Maritime universities are ideally suited for such education given their fundamental ethos of experiential learning, very essential for successful seafarer education. A curriculum that stresses basic critical thinking skills supplemented by functional and integrative knowledge in port business is also proposed at the undergraduate and post-graduate levels. However, the need to establish links with the port industry is paramount as stressed by the author. Maritime universities must build a partnership with their neighboring ports and collaborate with them in this venture through seeking expert advice, and internship and capstone opportunities for their students. In the absence of such industry support, even the most relevant curriculum offered at the most capable maritime university may be fruitless.

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APPENDIX A

Port Management Education at IAMU Institutions

The purpose of this survey is to identify IAMU institutions that offer port management education at the undergraduate and/or graduate levels, and gather relevant information that will be presented at the next Annual General Assembly in Tasmania. Survey recipients are requested to kindly answer the questions and e-mail or fax their responses by June 21, 2004.

1. Institution:

2. Do you offer Port Management education at your institution/university: YES/NO

- If "NO", please proceed to question #5

3. Please provide following details regarding undergraduate (BS/BSc degree) level port management education offered at your campus:

Criterion	Yes	No
Offer degree in Port Management?		
Offer courses in Port Management?		
How many courses are offered in Port Management?		
Please list the names of courses offered and hours of instruction		
Do you periodically evaluate your port management curriculum? If so, when was its last evaluation?		
If you have a web page with relevant information on your port management program, please provide the web address: http://		

4. Please provide following details regarding post-graduate (MS/MSc/Doctoral degree) level port management education offered at your campus:

Criterion	Yes	No
Offer degree in Port Management?		
Offer courses in Port Management?		
How many courses are offered in Port Management?		
Please list the names of courses offered and hours of instruction		
Do you periodically evaluate your port management curriculum? If so, when was its last evaluation?		
If you have a web page with relevant information on your port management program, please provide the web address: http://		

5. Do you plan to offer (or continue) port management education in future?
   i. Undergraduate level YES/NO
   ii. Post-graduate level YES/NO

Please attach additional pages for your comments if necessary; kindly send your responses by e-mail (skumar@mma.edu) or fax (011 1 207 326 2411) by June 21, 2004.

Thank you for your kind participation.

APPENDIX B

Responding Institutions

1. Arab Academy of Science and Technology
2. Baltic Fishing Fleet State Academy
3. Canadian Coast Guard College
4. Constantza Maritime Academy
5. Estonian Maritime Academy
6. Fachhochschule Oldenburg/Ostfriesland/Wilhelmshaven—University of Applied Sciences, Department of Marine Studies at Elsfleth
7. Hochschule Wismar—University of Technology, Business and Design—Maritime Studies
8. Istanbul Technical University
9. Kobe University
10. Maine Maritime Academy
11. Texas A&M Maritime Academy
12. Tianjin University of Technology
13. University of Plymouth

Innovative Techniques And Port Management: Implications For Port Organisations

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ABSTRACT
Integrated networks of interdependent businesses are created as part of the modern competitive paradigm. Port organisations are key elements of many diverse trading networks. Understanding key features of networks and the skills required to effectively manage these intangible assets may be vital for strategic development of ports. The ability of some innovative management performance models to assist in the management of these intangible assets for port organisations is discussed. By effectively linking business strategy and intangible assets, port organisations can better strategically manage the development of their unique competitive advantage.

1. Introduction

Today's global information economy is a dynamic system of increasing complexity. Increasingly, extended entities in a boundaryless world are becoming the norm, driven by the economics of networks (McGee & Sammut Bonnici 2002; Shapiro & Varian 1999). Integrated networks of interdependent businesses are created as part of this new competitive paradigm (Christopher 1998). These affect market dynamics and the competitive strategies required for businesses to succeed (McGee & Sammut Bonnici 2002). Adding to these complexities, sophisticated products and services, many of which continually change, dominate world trade (Bryant & Wells 1998). Trading networks are thus continually changing to accommodate this dynamic environment; networks of strategic alliances and relationships are formed to achieve competitive advantage (Kumar & Hoffmann 2002; Song 2003).

Ports are a critical link in these networks, handling over two thirds of world trade, and facing increasing demand for maritime transport services (Carbone & de Martino 2003; Kumar & Hoffmann 2002; Park & De 2004; Paixão & Marlow 2003; Song 2003). Ports are no longer merely gateways for national trade; they are complex institutions, with an increasingly significant role in global trading networks (Carbone & de Martino 2003; Paixão & Marlow 2003; Rodrigue, Slack & Comtois 1997). Port organisations, then, are facing an increasingly dynamic environment that impacts significantly on the creation and maintenance of their competitive advantage and strategic development. For their continued strategic development and increased efficiency in these trading networks, the ability to value their networks and manage their performance within each network is critical.

Valuing networks and performance management within them is difficult to achieve. This paper studies key features of networks and the skills required to effectively manage them in today's dynamic environment. Some implications for port organisations are discussed, with an overview of some more recent management tools included. These tools may facilitate the process of valuing networks and aligning business strategy with key relationships, and highlight vital skill requirements for senior management's decision making.

2. Networks

Port organisations are interacting with a diverse network of organisations in both the macro- and microenvironments. Challenges for a port organisation in this new competitive paradigm include collective strategy development, creating positive benefits for all participants in the network, process integration, managing open, transparent communications and developing relationships within their network (Christopher 1998). Port organisations' networks include customers, suppliers, marketing intermediaries, competitors and other stakeholders, such as governments, the local community and citizen action groups (Christopher 1998; Kotler 1997).

The value of any network for each individual organisation is dependent upon the network's size; a bigger network creates more positive externalities, which benefits all members (McGee & Sammut Bonnici 2002; Shapiro & Varian 1999). Networks facilitate the development of key relationships - the significance of these and a market orientation for firms' success have been highlighted (Achrol & Kotler 1999; Bengtsson & Kock 1999; Helfert, Ritter & Walter 2002; Jaworski & Kohli 1993; Narver & Slater 1990; Slater & Narver 1994).

As networks evolve a relationship approach is increasingly required for effective management in this networked environment (Kotler 1997; Ritter 1999). For example, some of the key relationships to manage are those with customers (McKenzie 2001). These benefit an organisation through lifetime customer value, with ongoing sales, and opportunities for product development and identification of new opportunities (Burger & Cam 1995; Kotler 1997; McKenzie 2001). These relationships raise performance management and appraisal issues, such as how to measure customer relationship profitability; it is difficult to allocate costs and strategic outcomes to specific relationships (Johnson 1999).

Customers are also becoming better informed, making additional demands on their suppliers, with needs such as faster responses, better information, more transparency and greater reliability and quality increasing (Christopher 1998; Handfield & Nichols, Jr. 2002; Kuglin 1998; McKenzie 2001). These varied requirements impact upon a port's role as an integral part of each trading network.

Meeting customer needs, and managing key customer relationships is thus another imperative of today's networked economy. It is symptomatic of the importance of a market-orientation for success. Market orientation and network management need similar key tasks to be effectively achieved. These key tasks include the management of exchange, coordination, conflict resolution and adaptation (Hakansson 1990; Helfert et al 2002; McKenzie 2001).

But key relationships for an organisation are more than just those with specific customers. An organisation's performance is enhanced through new product development that can arise through cooperation and collaboration with other key stakeholders. These include parties such as suppliers, competitors and community groups (Ritter 1999). An organisation can thus no longer isolate each relationship, but needs to view it as part of the whole network in which the organisation is embedded (Ritter 1999). This adds further challenges to management.

These challenges are increased when the nature of emergent networks is considered. These are an integral element of any modern business, but are generally not found at the top of the organisation – where strategic decisions are determined. Combining strategic thinking with an emergent network thus adds complexity. The resource-based view of the firm adds clarification. It views any organisation as a unique cluster of physical resources, financial resources, human resources and organisational resources, such as reputation and relationships (Cummings 2002).

To develop strategies to maximise the advantages of these resources, and in particular, the organic growth of relationships, the organisation can be viewed as a web of relationships, with tacit knowledge embedded within. The tacit 'knowledge web' becomes, effectively, one of the organisation's key sources of competitive advantage (Burton & Pennotti 2003; Cavusgil, Calantone & Zhao 2003). With this advantage, it can realistically differentiate itself from other organisations that can easily re-engineer and copy many other sources of competitive advantage or benchmark best-practices (Cummings 2002; Porter 1985; Porter 1996). Cummings (2002, p.252) states, "historically determined inter-relationships and the knowledge embodied in them, are difficult to quickly replicate."

Close inter-firm relationships are not managed in isolation (Hakansson 1990) and are important strategic assets (Doyle 1995; Johnson 1999). They are an integral part of a dynamic environment, requiring different strategic skills and competencies to achieve competitive advantage and/or market leadership (Handfield & Nichols, Jr. 2002; Porter 1985). Each member of the network is also interconnected, adding to the complexity of strategically managing within this embedded environment.

An organisation's ability to manage its network has a positive impact on performance (Cummings 2002; Johnson 1999). Research demonstrates that network competence has a positive influence on innovation success, internationalisation, technological development and performance. It also identifies a high correlation between network competence and market orientation (Coviello & Munro 1995; Ritter 1999; Ritter, Wilkinson & Johnston 2002; Roy, Sivakumar & Wilkinson 2004). And as each network member increases in network competence, the network evolves (Wilkinson & Young 2002).

Network evolution changes the nature of the interactions, leading to a process of learning and systematising actions for each and every organisation within that network (Charan 1991). Each member firm is effectively co-producing its future network interactions (Wilkinson & Young 2001). For each network participant, then, this leads to the strategic issue of ensuring that these processes of network evolution lead to a positive outcome (Draulans, deMan & Volberda 2003). The ability of a firm to manage its network is thus a core competence (McKenzie 2001; Ritter 1999; Ritter, Wilkinson & Johnston 2002; Song 2003).

Network competence is organisation specific, and encompasses both the qualifications and the ability to utilise them for task execution related to inter-organisational relationships (Ritter 1999). Qualifications in this context, as Ritter (1999, p. 468-9) states, are skills that "allow a person to develop, to maintain, and to use relationships." Task execution has two components. Firstly, it includes the management of individual relationship-specific tasks, such as exchange and collaboration. And secondly it includes the management of cross-relational tasks in the network, such as planning and controlling (Ritter 1999; Ritter, Wilkinson & Johnston 2002).

Developing network competency and key relationship management are thus significant elements of a port organisation's strategic planning and management (Bengtsson & Kock 1999; Draulans, deMan & Volberda 2003; King 1997; Ritter, Wilkinson & Johnston 2002). In order to develop network competence, then, a port authority needs to continually audit its in-house qualifications and determine the specific relationship tasks that need to be undertaken. Being able to measure the value of relationships and the organisation's network competence skill set become critical to successful strategic decision-making for senior management.

3. Implications for port organisations

Ports are a key element of many diverse trading networks. They are complex systems, with multiple users interacting at various levels. Frequently they integrate activities for logistics, trade and supply channels (Bichou & Gray 2004; Carbone & De Martino 2003; Moglia & Sanguineri 2003; Paixão & Marlow 2003). In addition, they form part of their local community, so there is continuous interaction with government, regulatory organisations and householders. In essence a port is one of the few actual locations in the trading network/supply chain where all stakeholders may interact (Bichou & Gray 2004; Carbone & De Martino 2003). This results in the constant evolution of their role (Carbone & De Martino 2003; Moglia & Sanguineri 2003; Paixão & Marlow 2003).

From the port organisation's perspective it participates in multiple networks. Its ability within each network to not only shape the network but also drive strategy development for each network becomes of paramount importance to the port's success and long-term survival. Planning is significant to the successful development of strategy (Moglia & Sanguineri 2003; Paixão & Marlow 2003; Porter 1996).

One key element of planning is an understanding of all key stakeholders (Bartol, Martin, Tein & Matthews 1998; Moglia & Sanguineri 2003). This is facilitated by knowledge of key players; in modern supply chains, ports are in a strong linking position (Paixão & Marlow 2003; Song 2003). The heterarchy of port users in Figure 1 shows these links, which are also known as a knowledge web (Cummings 2002).

Management techniques inform strategic decision-making (Porter 1996). Successful adoption of new management techniques and attitudes, with their associated changes, requires that ports are learning organisations, with superior strategic management and organisational skills (Bryant 1998). Learning can be acquired through interactions such as relationships, networking, forming strategic alliances and benchmarking (Samli, Kaynak & Sharif 1996). A learning organisation generally achieves higher growth and/or profitability – and a key feature of a learning organisation is its extensive network of close relationships with key stakeholders (Slater & Narver 1995).

A broader perspective is required for port organisations when assessing their strategic directions. Traditionally, ports' performance is investigated in terms of efficiency metrics relating to throughput, such as cargo handling, storage and efficiency rates and the activities of

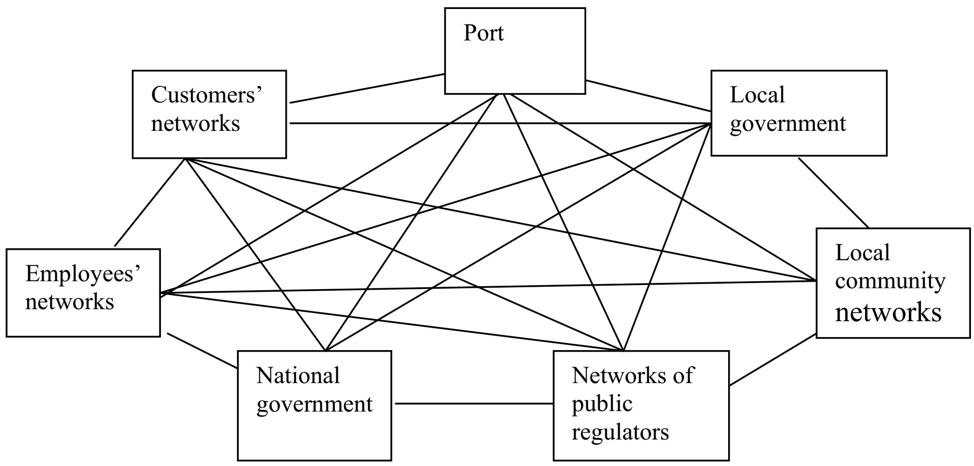

Figure 1 Heterarchy of port users, showing web of relationships
Based on Maccoby (2000).

their local, competing ports (Paixão & Marlow 2003). Nowadays, global trading networks require information visibility to be competitive (Handfield & Nichols, Jr. 2002). Ports, as an integral link in these trading networks, will thus be faced with a multitude of different real-time information sharing requirements for competing supply chains (Bichou & Gray 2004). With their increasing role in trading networks, performance measures need to include meeting these information requirements (Kavan, Frohlich & Samli 1994), particularly given that the collective knowledge of all its employees is a key strategic asset (Kaplan & Norton 2004). Additional metrics, relating to the port's significant role in these trading networks are increasingly necessary too. This entails developing expertise in measuring and managing intangible assets, such as information systems management and relationships, to consolidate the port's strategic role in trading networks.

4. Measuring intangible assets

Intangible assets are difficult to copy, giving an organisation a sustainable and unique competitive advantage (Cummings 2002; Kaplan & Norton 2004). But on their own they are not valuable and often cannot be directly linked with financial performance – it is their combination with other assets that gives the advantage (Kaplan & Norton 2004). As Kaplan & Norton (2004, p. 54) state "the measurement of the value they create is embedded in the context of the strategy the company is pursuing."

Kaplan & Norton (2004) propose that determining the value of these intangible assets relates to the congruence between the company's strategy and these assets. The authors propose that by developing a strategy map the link between intangible assets and creating organisation value becomes apparent. This process also permits the capturing of the value inherent in emergent networks. The strategy map is a framework based on four interdependent views of the organisation, namely its financial, customer, internal process and learning and growth perspectives (Banker, Chang & Pizzini 2004; Kaplan & Norton 2004). In a similar way another analytical tool, the enterprise map, visualises the critical dependencies between key activities for strategic decision-making and encourages team building (Burton & Pennotti 2003). Within each of these perspectives are the strategic processes and competencies required for the intangible assets to be "ready"; in other words, they are in alignment with the strategic objectives of the organisation.

Linking performance with business strategy is a key attribute of the balanced scorecard (Banker, Chang & Pizzini 2004; Morana & Paché 2003; Ritter 2003). Although originally a multidimensional performance measure, the balanced scorecard has "evolved into an organising framework for a strategic management system" (Banker, Chang & Pizzini 2004, p.2). Providing linked performance measures improves managers' ability to benefit from adoption of a balanced scorecard system (Banker, Chang & Pizzini 2004; Morana & Paché 2003; Ritter 2003).

Criticisms of the balanced scorecard have noted that it does not sufficiently include the significant contributions of groups such as suppliers, the community or stakeholders, does not have a very long-term view for strategic development and has not been empirically validated sufficiently (Malz, Shenhar & Reilly 2003). Malz, Shenhar & Reilly (2003) have taken these identified limitations into account and developed the Dynamic Multi-Dimensional Performance (DMP) framework in conjunction with "Success Dimensions". Success Dimensions views organisational effectiveness within a matrix of time frames and organisational levels.

This has produced the DMP model based on five dimensions, namely Financial, Market, Process, People and Future (Malz, Shenhar & Reilly 2003). This framework has scope for the inclusion of relationships and their contribution to strategic performance. It is integrative of key performance indicators and is able to demonstrate an organisation's value creation over time (Malz, Shenhar & Reilly 2003).

Given the dynamic nature of relationships, the requirement for a non-static model to effectively capture costs and benefits of the relationship (Storbacka, Strandvik & Gronroos 1994) may be met by these models. This is in contrast to models such as Business Process Reengineering (BPR), which has been applied in small to medium ports in Europe. This model highlighted key operational processes that could be made more efficient, and brought tangible savings (Giannopoulos & Papageorgiou 2002).

Models such as the balanced scorecard and DMP may also help develop port organisations' understanding of supply chain management concepts and the application of techniques to manage and measure channel performance. This lack of understanding is highlighted by Bichou & Gray (2004).

5. Conclusion

Trading networks are an integral part of today's business environment. Ports play a pivotal role in diverse networks. For port organisations to effectively manage their strategic development, an understanding of the value of relationship management within these networks is vital. Each relationship is different for a port organisation; it is thus difficult to actually quantify its strategic value. Yet relationship management needs to be built into strategic planning.

Innovative modelling tools such as the balanced scorecard and DMP provide the link between the selection of multiple performance measures with business strategy planning and performance. Incorporating these performance models in strategic planning may assist port organisations to manage their intangible assets, such as key relationships in multiple trading networks. They also provide measurement techniques for the more traditional metrics port organisations associate with efficiency, such as cargo handling. These models will also highlight deficiencies in the hinterland, such as insufficient road access.

By effectively linking business strategy and intangible assets, port organisations can value their networks and highlight key skills required. This will assist port organisations with future strategic planning and the development of a unique competitive advantage.

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The Impact Of European Union's Port Policies On Maritime Transport

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ABSTRACT

The transportation policies of European Union have been objected at removing obstacles at the frontiers between member states as a way of contributing to the free movement of persons and goods. For many years, European Community (later the European Union) did not have a maritime transport policy. Starting from the year 1986, some common policies are formed. These policies can be classified in four axes:

- freedom to provide services competition, unfair pricing practices and free access to ocean trade,
- taking measures to improve the safety of international shipping and prevent marine pollution,
- conditions of transport of goods and passengers and navigation rules by inland waterway,
- requirements concerning seaports and maritime infrastructure, quality of services in seaports, market access to port services, and regulations related with port reception facilities for ship generated waste and cargo residuals.

As for a comprehensive maritime transport policy, the lack of a port policy created problems for the interpretation of the maritime policy since ports are natural focal points in the sea freight and shipping world. In 1997, the European Commission's Green Paper opened a debate on how to improve the position of ports in the European transport network and confirmed that the efficient functioning of ports as part of the intermodal chain is an essential prerequisite to stimulate the development of maritime transport. The union action for the seaports is described as an establishment of clear rules to increase the efficiency of ports and port services as well as the intermodal connections between ports and inland transport networks.
On the other hand, there are some projects being carried out by European Union for the maritime transportation in Europe. Some of them are related with Pan-European Transport Corridors and the other is for renovating the ancient Silk Way, which is, called Traceca.

- The Corridor VII, the Danube, passes through 11 countries and the synergy effects of using its route together with upgraded transport via Black Sea ports can be significant.
- Corridor VIII, is an important link between the Black Sea and the Adriatic. Its development will be an important factor for economic development of the involved countries.

The whole discussions given above, confirmed that the efficient functioning of ports as a part of the door-to-door intermodal chain is an essential prerequisite to stimulate the development of maritime transport, in particular as a sustainable alternative to land transport.

The European Union's key port policies can be summarized in 4 headings.

- quality services in sea ports: improvement and modernization of port's infrastructure and their inclusion in the trans-European transport network,
- pan-European maritime transport corridors,
- market access to port services: to increase the free and fair competition among ports,
- advance of research and development for ports.

Ports play an increasing role for transfer of goods and passengers to the environmentally less damaged, less costly and less congested maritime transport. They have an essential contribution to the efficient use of maritime transport infrastructure. By having the above- mentioned policies and measures the whole system is expected to be reinforced.

1. The history of European Union maritime transport policies

From the day Treaty of Rome in 1958 has been signed, the transportation policies of European Union have been objected at removing obstacles at frontiers between member states as a way of contributing to the free movement of persons and goods.

Until1970, European Union could not get enough development about transport. For many years, European Community (European Union) did not have a maritime transport policy. Starting from the year 1986, some common policies are formed (Hart et all, 1993). These policies can be classified in four axes (EU Commission, 2004):

- freedom to provide services competition, unfair pricing practices and free access to ocean trade,
- taking measures to improve the safety of international shipping and prevent marine pollution from ships,
- conditions of transport of goods and passengers and navigating rules by inland waterway,
- requirements concerning seaports and maritime infrastructure, quality of services in seaports, market access to port services, and regulations related with port reception facilities for ship generated waste and cargo residuals.

Nowadays, of globalization, the European Union is still very dependent on maritime transport:

- over 90% of its external trade and some 43% of its internal trade goes by sea; more than 1 billion tones of freight a year are loaded and unloaded in EU ports.
- maritime companies belong to European Union nationals control one third of the world fleet, and some 40% of EU trade is carried on vessels controlled by EU interests.
- the maritime transport sector - including shipbuilding, ports, fishing and related industries and services - employ around 2.5 million people in the European Union.

The EU maritime policy should have two objectives (Kiriazidis and Tzannidakis, 1995):

- to complete the internal market in shipping,
- to enable the shipping to be competitive in the world economy.

Since 1992, the Commission has published a number of important policy papers, which have tried to call attention to the need for further legal moves. The same year, it put forward freedom of maritime transport services for passengers and freight within Member State (maritime cabotage), granting that this freedom was carried out in a phased way. Maritime cabotage to the islands was liberalised in 1999 with the exception of Greece (Paixao and Marlow, 2001).

In March 1996, the Commission presented a Communication, entitled "Towards a new maritime strategy", which made a global analysis of the problems faced by the Community maritime sector in the context of EC policy. It suggested a range of actions aimed at maintaining open markets; improving the competitiveness of EC shipping and addressing flaws in state aid policy. A second Communication, in March 1996, called “Shaping Europe’s maritime future”, highlighted the importance of shore-based industries for employment and economic development in the EU, notably with regard to shipbuilding and repair but also relating to ports and marine resources.

Two other papers, in July 1995 and June 1999, looked exclusively at short sea shipping, and outlined a strategy for helping coastal shipping to compete effectively with long-distance road transport. In the first, the Commission focused on action to counter problems such as inadequate infrastructure, cumbersome administrative procedures, and poor integration with other transport modes, and long transit times. In the second paper, the Commission noted that, between 1990 and 1997, short sea shipping had grown by roughly 23% in terms of tone kilometers. Efforts to create round tables and promote debate within industry, for example through the Maritime Industries Forum, had proved relatively successful since the strategy was introduced.

2. White paper: common transport policy

For a long time, the European Community was unable to implement the common transport policy provided for by the Treaty of Rome. The Commission’s first White Paper on the future development of the common transport policy was published in December 1992. The guiding principle of the document was the opening-up of the transport market. The first real advance in common transport policy brought a significant drop in consumer prices combined with a higher quality of services. Personal mobility increased from 17 km. a day in 1970 to 35 km. a day in 1998. White Paper pointed out unequal growth in the different modes of transport. Road makes up 44% of the goods transport market, compared with 41% for short sea shipping, 8% for rail and 4 % for inland waterways.

The White Paper proposes some 60 specific measures to be taken at Community level under the transport policy. It includes an action programme extending until 2010.The measures presented in the White Paper are aimed at a sustainable transport system that will ideally be in place in 30 years’ time (EU Commission, 2004).

2.1 Short sea shipping and inland waterway transportation in White Paper

Transport by sea and inland waterway is promoted in the White Paper. Short- sea shipping and inland waterway transport, which are underused, are presented as two modes, which could provide a means for coping with the congestion of certain road infrastructure. (EU Commission, 1995)

Short-sea shipping carries 41% of goods traffic within the Community. Sea motorways are suggested to revive short-sea shipping within the framework of the master plan for the trans-European network. This will require better connections between ports and the rail and inland waterway networks together with improvements in the quality of port services. Since Community has a very huge potential, 35000 km. coastline and hundreds of sea and river ports, a trans-European shipping network can be established by giving priority to national ports, which have good connections to inland network.

Inland waterway transport is also encouraged as a complement to sea transport since there is a very dense network of rivers and canals within the European Union. Technical requirements for inland waterway vessels, boatmaster’s certificates and social conditions for crews will be readapted. Very recently Rhine -Main -Danube link is established. Six member states can use this network where 9% of goods are carried by this way. By the accession of new countries, the Danube Basin will reach up to Black Sea. Some of the countries, which are not connected up to the northwest European network, have their own systems such as the Rhone, or the Po, which are becoming important at regional level. Since 50 tons/km can be carried by 1 liter of fuel, this figure is 97 tons/km for rail and 127 tons/km for inland waterways; this system is very energy-efficient and quiet. Apart from this it is very safe mode especially for carrying dangerous goods.

2.2 Maritime safety

Although maritime transport and travel has a relatively low death and injury rate when compared to road travel, the consequences of a bad accident are very real, sometimes far-reaching and very costly (Table 1).

Table: 1 Transport accident costs and the value of safety (ETSC, 2001)

Mode	Total socio-economic costs per fatality (million)
Road	3.6
Rail	2.1
Air	2.7
Water	9.8

In March and December 2000, the commission came forward with a specific package of safety measures known as Erika I and Erika II. Some of these are (Lyons, 2000):

- strict checks on vessels using EU ports;
- penal and financial sanctions on those who contribute to major oil pollution;
- the accelerated phase-out of single-hulled oil tankers, replacing them with double-hulled vessels;
- a ban, in the mean time, on carrying heavy fuel oil in single-hulled tankers;
- the establishment of an European Maritime Safety Agency;
- the establishment of an EU monitoring, control and information system;
- the creation of a fund for compensation for pollution damage.

3. European Union port policies and Green Paper

Maritime transport is a system sector, which is made up of shipping, sea and ports. Quality vessels need high quality ports. With the growing volume of freight and growing demands for speed and tight schedules it becomes necessary for the road, rail and water transport systems to be linked both physically and operationally. Within the EU over 600 ports exist (Pallis, 1997). The port sector handles more than 90% of the Union's trade with third countries and approximately 30% of intra-EU traffic, as well as over 200 million passengers every year. More than 1 billion tones of freight a year are loaded and unloaded in EU ports.

The dominance of the North Sea Ports is already well established. They handle 50% of EU port trade. Mediterranean handles 27%, the Atlantic 15% and the Baltic 9%. The chances of the Mediterranean challenging the northern dominance are not great (Whitehead, 2002).

The sector shows great diversity between regions in terms of structure, operation, organization and legal framework.

Maritime companies belong to European Union nationals control one third of the world fleet, and some 40% of EU trade is carried on vessels controlled by EU interests.

The maritime transport sector - including shipbuilding, ports, fishing and related industries and services - employ around 2.5 million people in the European Union.

3.1 Green Paper: Policy on ports and maritime infrastructure

The Commissions first attempt to make a clear policy on ports and maritime infrastructure was by Green Paper in 1997. The principles and policies proposed by the Green Paper was aimed at to increase port efficiency, improve port and maritime infrastructure by integrating ports into the multimodal trans European network and to ensure free and fair competition in the port sector. These suggestions are summarized in the following paragraphs:

- quality services in sea ports: improvement and modernisation of port's infrastructure and their inclusion in the trans-European transport network,
- pan-European maritime transport corridors,
- market access to port services: to increase the free and fair competition among ports,
- advance of research and development for ports.

3.1.1 Quality services in seaports: improvement and modernization of port's infrastructure and their inclusion in the trans-European transport network

The Commission considers the full integration of ports into the trans-European transport network (TEN-T) desirable for the establishment of the multimodal network taking into account, in particular, the need to ensure links to the peripheral areas and to encourage short sea shipping. The Green Paper notes that ports have so far not been at the center of the common transport policy. However, they have a role to play in the TEN-T as follows:

- increasing the efficiency of the European transport system;
- encouraging growth of EU trade with third countries,
- overcoming congestion of the main land-corridors;
- enhancing maritime links with island and peripheral regions
- strengthening the multimodal aspect of the TEN-T.

To connect the TEN-T with networks of Central and Eastern Europe and the Mediterranean, the Commission proposes that standards be promoted in these ports comparable to those found in Community ports.

Despite the increasing turnover in European ports, intra-European maritime traffic has not yet increased its market share that of the road transport sector. The promotion and integration of short sea shipping into environmentally friendly multimodal transport networks has become an objective of the Union's transport policy. Priority will therefore be given to short sea shipping projects in the TEN-T. Furthermore, the commission recognizes that the pricing policy for other modes of transport is an important factor for the development of short sea shipping.

In order to optimize the role of ports in the door-to door transport chain proper infrastructure links to the TEN-T are vital. However, equally important are other measures such as standardization of loading units, integration of telematics etc. The Commission will support actions to improve the port's position as intermodal transfer points including financing of research and demonstration projects in the area of management systems, and measures to foster innovation and support the development of a competitive intermodal transport system (EU Parliament, 2000).

3.1.2 Port safety, security and environmental considerations

Although primarily focused on ships, nevertheless services offered at ports also has a direct impact on ports, as it requires port authorities to co-operate in the implementation or enforcement of the legislation and to ensure a high level of port services such as pilotage, mooring and towage that are intrinsically linked to the safety of ships.

Commission recognized that ports are located close to populated areas where habitats and living species are put in danger and makes suggestions for improving the integration of environmental considerations in the planning of port development. A Code of Conduct provides a quality of framework programmed action with respect to the protection of the environment within port areas (Goulielmos, 2000). It is stated by Directive 2000/59/EC of the European Parliament that the policy on prevention of pollution by ships are the same as 73/78 Marpol Convention. However, in contrast to the Convention, which regulates discharges by ships at sea, the Directive focuses on ship operations in Community ports and addresses in detail the legal, financial and practical responsibilities of the different operators involved in delivery of waste and residues in ports stating that Member States must ensure that port collection facilities are provided which meet the needs of the ships using them without causing abnormal delays. These facilities must be tailored to the size of the port and to the categories of ship calling there. A waste reception and handling plan must be drawn up in each port. These plans must be checked and assessed by the Member States and approved by them at least every three years.

For security issues Commission presented a directive based on three elements (Trestour, 2003):
This directive makes compulsory provisions from part B of the ISPS Code. An inspection procedure is also proposed. As a second element the directive extends the principles of the ISPS code to the entire port area. An assessment of the efficiency of the port security organization and its communication links with all parties involved will be part of the Port Security Assessment. A port security committee will assist the port security officer in implementation of plans. As a third step the commission is planning to propose a Directive on Intermodal Transport Security to tackle the security risks faced by the freight and their transporters on the route between supplier and consumer. As an addition to the above measures the Commission (EU Commission, 2003) declared a communication paper stating that additional action should be rapidly taken in order to support the work of ILO with regard to the identification of seafarers for the purposes of immigration control and anti-terrorist action.

3.1.3 Market access to port services: to increase the free and fair competition among ports

Ports provide a range of services and facilities: pilotage, towage, mooring, cargo handling, storage, etc. They also offer ancillary services, such as fire fighting, bunkering, water supply and waste-reception facilities. Depending on the port, these services are provided either as a comprehensive package or separately, either on request or automatically.

As to cargo-related services, cargo handling has been one of the activities most profoundly affected by technological development and inter-port competition. The market trend is towards capital concentration, specialization and vertical integration. The provision of these services is gradually being transferred from the public to the private sector in order to increase efficiency and reduce public expenditure on port labor costs.

According to the Green Paper, these port services are to be seen as an integral part of the maritime transport system. Treaty rules, notably in the field of competition, should therefore be applied more systematically. This is consistent with the European Union’s policy to encourage modernization and efficiency of the sector, taking into account structural developments in worldwide competition.

In conclusion, a regulatory framework should be developed at Community level aiming at a more systematic liberalization of the port services market in the main ports with international traffic. The aim of this framework would be to establish a level playing field between and within Community ports while ensuring compliance with port and maritime safety standards.

3.1.4 Pan-European maritime transport corridors

The Corridor concept is part of the Trans-European transport infrastructure development, created in the past 10 years. The 10 Pan-European Transport Corridors endorsed by the transport ministers on Crete in 1994 and in Helsinki in 1997 form the system backbone. Among these 10 corridors those, which are related with ports and maritime, are as follows:

- Corridor VII, the Danube, passes through 11 countries and the synergy effects of using its route together with upgraded transport via Black Sea ports can be significant.
- Corridor VIII is an important link between the Black Sea and the Adriatic. Its development will be an important factor for economic development of the involved countries.
- Corridor IX, the longest of the Pan European Transport Corridors from Finland (Helsinki) to Bulgaria and Greece, with a branch to Odessa, is a historic and important European Corridor, traditionally serving high freight flows, in a north-south direction, serving both the Mediterranean and the Black Sea basins.

In parallel to the TEN-T process, the concept of the Pan-European Transport Corridors and Pan-European Transport Areas (PETRAs - Four European transport zones covering sea basins of the Mediterranean, Black. Adriatic / Ionic seas and the area of the Barents sea ," the European part of Arctica) as evolved at the Crete and Helsinki Pan-European Transport Conferences, are already well established. The ten multimodal transport Corridors and the four PETRAs, that have been defined, provide an important focus for investment by the international financial institutions, and significant progress has been achieved in their development. These transport Corridors and Areas of transnational character, play a very important role in the European transport and economic integration. There is not only the infrastructure linkage between regions, but also the interoperable operational - institutional framework along these arteries that help to bring together the various economies and societies.

Today, when the combined transport techniques have progressed so much, inland waterways can be used in the most efficient way. Their low external cost of transport, including the environmental benefits, can provide the critical factor to make an inland waterway route attractive. In this respect, Corridor VII, the Danube, can be seen as a very important transport route, efficiently incorporated in the logistics chains of many alternative origins/ destinations, from the Black Sea to the heart of Europe and the Atlantic, and vice-versa. Although there seem to be many problems still existing, the free and efficient navigation of the Danube currently is rather more a political issue than a technical one. The efforts therefore should focus on a political decision to re-establish all the necessary conditions for free and efficient navigation on the Danube, after which technical solutions can be implemented (Schwetz, 2001).

3.1.5 Traceca Project (Transport Corridor Europe-Caucasus-Asia)

The Traceca Programme is a series of EU funded technical assistance and investment projects aiming towards the development of the transport corridor from the Europe across the Black Sea through the Caucasus and the Caspian Sea to Central Asia.. At the Pan-European Transport Conference in Helsinki (1997) it is decided to integrate TRACECA with the Pan European Transport Area (PETRA) of Black Sea Basin.. In order to support the agreements, investment projects costing ECU 15 million have been incorporated within the TRACECA programme. The main links related with maritime transportation is as follows:

Black Sea ports to Baku as the central corridor through the Caucasus,
A ro-ro link from Poti in Georgia to Ilyichevsk for Corridor IX,
A ferry from Ilyichevsk to Varna in Romania linked to Corridor IV,
A ferry from Poti in Georgia to Varna in Bulgaria linked to Corridor VIII.

4. Research and development programs

In the context of R&D programmes, the Commission supports maritime and port projects, including cargo tracking and tracing and electronic chart display and information systems. EU policies are targeted at research and development on transshipment equipment, standardized loading units and freight integrator, which is expected to emerge as a new profession specializing in the integrated transport of full loads. These freight investigators need to be able to combine the specific strengths of each mode at European and world level to offer clients the best service in terms of efficiency, price and environmental impact in the broadest sense.

There exists a great variety of EU funding programs which could be exploited for port projects.

Most funding is not paid by the European Commission directly but through the national and regional authorities of the Member States (European Sea Ports Organization, ESPO, 2002). These are summarized in the following paragraph:

a) Grants in the field of transport: Commission promotes the objectives of common transport policy. Projects may cover maritime safety, environmental protection,etc.

b) Marco-Polo: This program supports commercial actions in all segments of the freight market Within this program three types of projects are available:

- Modal shift actions: start up aid for new non-road freight transport services.
- Catalyst actions: The objective is to tackle existing structural market barriers, which hinder the further development of non-road freight services (e.g. motorways of the sea)
- Common learning actions: Support for stimulating co-operation and sharing know-how.

c) TENs: Since seaports, inland ports and intermodal terminals are included in the TEN they can benefit from this type of funding. Ports included in the TEN should be within one of the following categories:

- International seaports with an annual transshipment volume of no less than 1,5 million tones or 200000 passengers (A ports),
- Seaports with an annual traffic transshipment volume of no less than 0.5 million tones or between 100000 and 199000 passengers and are equipped with installation for short sea shipping (B ports),
- Regional seaports not fulfilling the criteria of A and B situated on islands or in peripheral regions (C ports).

The funding may cover development of short sea shipping and sea-river shipping in A ports, access infrastructure for A, B, C ports, and infrastructure for water surfaces, port surfaces, transport links, dredging, ITS and navigation systems.

d) Regional development programs: The aim is to improve the economic situation of the least favored areas.

- Helps the regions whose development is lower than the 75% of community average. (GDP per capita less than 75%),
- Supports fisheries - dependent areas for facing structural difficulties.

e) Environmental projects:
Life III: This is a financial instrument for 3 major areas of actions: Environment, nature, and third countries. The specific priorities are preparatory actions to support community legislation and policies, conservation of natural habitants of wild fauna and flora, technical assistance in the establishment of environment administrative structures, nature conservation actions etc.

f) Leonardo Da Vinci: This program supports innovative trans-national initiatives promoting vocational training

g) 6th. Framework Program: Integrated projects and Networks of Excellence are promoted under 7 thematic areas. Among these information society technologies and sustainable development exist as well.
h) ERAMAR European Research Area Application in the Maritime Domain:
) PACT: Short sea projects in the framework of trans-European networks are supported through the new PACT programme.

The European Maritime Industry has developed an R&D Master Plan for the technology areas of the Maritime Transport Chain and the Maritime Resources. The Master Plan was used by the industry to initiate various Thematic Networks, which have served as launching platforms for over 130 project proposals within the first, and second call of FP5. These projects have served current & short term technological needs in some areas of the maritime spectrum leaving other areas "uncovered".

5. Conclusion

Seaports are vital to the European Union both in terms of trade and transport. The principles and policies proposed by the Green Paper is aimed at increasing port efficiency and to improve port and maritime infrastructure by integrating ports into the multimodal trans European network which should meet the Community's responsibilities under the Treaty to ensure free and fair competition in the port sector.

The Commission considers the full integration of ports into the TEN-T for the establishment of the multimodal network taking into account, in particular, the need to ensure links to the peripheral areas and to encourage short sea shipping. A proposal to adapt the present guidelines for the development of TEN-T accordingly is being presented in parallel to this Green Paper.

The Corridor approach should, therefore, be pursued as a central element of the strategy for the development of transport infrastructure in Wider Europe and beyond. However, as the existing Corridor layout may become obsolete after the EU enlargement, it may have to be adapted to the new situation. This would mean that some existing Corridors, or parts thereof, would disappear and others would need to be extended or newly created.

While the future new Corridors will focus primarily on links between the EU and its neighboring countries, the Euro-Asian transport links should be taken into account, because of the foreseeable increase of trade with Asia, particularly with China.

There is one further aspect of integration-must provide fitting between national policy and policies at other levels like employment, training, planning, regeneration, nature conservation and safety. For the implementation of directive, the Commission gives no indication on determination of individual countries' consistency with the policies and requirements of EU apart from the persuasion (Farrell, 2001).

The Commission is particularly interested in: market access to port services like pilotage, towage, mooring, cargo handling, storage, etc. They also offer ancillary services, such as fire-fighting, bunkering, water supply and waste-reception facilities. Depending on the port, these services are provided either as a comprehensive package or separately, either on request or automatically.

As to cargo-related services, cargo-handling has been one of the activities most profoundly affected by technological development and inter-port competition. The provision of these services is gradually being transferred from the public to the private sector in order to increase efficiency and reduce public expenditure on port labor costs. Nevertheless this directive is rejected with 209 votes in favor and 229 votes against in 2004. This showed that European Parliament is not in favor of liberalization of all economic activities linked with transport. Fearing that manpower with low costs would be hired in third world and developing countries, European Transport Workers Federation had previously delivered a petition rejecting that directive signed by more than 16000 port workers from European ports to European Parliament (Mettle, 2004).

Research and development will help to improve the efficiency of ports and make maritime transport a more attractive option. The development of new transportation corridors and port infrastructure will increase the sustainable transportation in EU and the peripheral countries.

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The Establishment of Logistics Service Providers as a Mean to Developing Trade in the Egyptian Economy

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Student Presentation

SUMMARY

Logistics Service Providers (LSP) have significantly emerged during the past few years. The reason behind this astonishing growth is the rising concern of business managers to relieve frustration in managing non-core competencies, cut down costs and improve customer satisfaction. Logistics outsourcing continues to transform companies as they focus on core competencies to meet corporate objectives. Being a logistics service provider, whether a freight forwarder, warehouse, carrier or other type of provider necessitates an ongoing effort to maintain and gain customers in a very competitive environment.

In particular, Logistics Service Providers in Egypt barely exist, where in other countries; they have already outgrown this preliminary level and now moving to a more sophisticated level i.e. 4PL and LLP (Lead Logistics Providers). In order to be successful in a market where, local and international competitors exist, some essential requirements are needed such as excellent management, qualified staff, application of the latest technology, effective marketing, absolute understanding of the market's needs, etc.

Therefore, we decided to draw the attention of the Egyptian market to the great role that LSP can play towards the prosperity of the Egyptian economy. The reason behind selecting this topic is because we believe that Egypt has a need for LSP to enhance trade, whether locally or internationally by following the international service standards, which will guarantee the success of such services. Aside from quality services provided, minimizing the cost of the product is another reason for the existence of LSP since transportation and logistics services constitute a considerable percentage out of it. If the logistics cost decreases, so will the price for the product and therefore profit will increase since the low price will encourage demand.
Moreover, the market trends are now moving towards "the services business" where they continue to grow enormously, not only in the real market but also in the virtual one, where competition becomes very intense. Hence, it is time for Egypt to take a positive step towards change that will contribute in fixing its current economic status.

In addition, we have chosen to go in depth in how effective marketing could contribute to the development of the Logistics Service Providers in Egypt. Marketing is an issue of crucial importance, which can greatly contribute to the success of many businesses, and unfortunately it is not well developed in the Egyptian community. In Egypt, marketing is thought of as a method to sell products and make profit, regardless of quality and customer satisfaction, which in turn lead to short-term profits. However, successful marketing allows companies to reach targeted

customers more efficiently and to build stronger relationships with them, which in turn, lead to more profit.

Data will be collected by conducting a questionnaire targeting local businesses with the intention of providing a thorough analysis of the reasons behind choosing the type of activities they are willing to outsource if there were Logistics Service Providers in the Egyptian market. In addition to the questionnaire, a checklist will be designed for various types of businesses in order to emphasize the marketing mean that attract them to deal with a particular Logistics Service Provider. Moreover, a case study will be included for an international Logistics Service Provider for the purpose of benchmarking in terms of marketing strategies.

Besides the qualitative and quantitative primary data collected through the questionnaire and checklist, secondary data will also be collected by means of reviewing books, magazines and online references for the purpose of providing us with basic fundamentals regarding our research topic.

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