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RECOGNIZING AND IMPLEMENTING TRAINING ONBOARD: IMPLICATIONS FOR PROMOTING A SAFETY CULTURE AT SEA

By

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DECLARATION

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

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ABSTRACT

Title of Dissertation: **Recognizing and implementing training onboard: Implications for promoting a safety culture at sea**

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Training plays an important role in furthering human learning and development. Training in the maritime industry is the key in producing competent seafarers. Training onboard has been put under the spotlight due to the advent of information and communication technology and its applications in the maritime industry. This research systematically analyzes the need for training, existing & future availability of training onboard, and further examines its implications for promoting a safety culture at sea.

Changes in the maritime environment justify the need for regular seafarer training. The fundamental changes are thus examined both technically and legally. Training is particularly highlighted in the STCW 95 and ISM Code, through which the option of training onboard is confirmed. Modern technologies such as Internet, satcom, and multimedia tools open up new windows for facilitating seafarer training onboard.

The modern training media available for training onboard are comprehensively surveyed. Furthermore, the role of training onboard, and major factors and issues that affect training outcomes are carefully analysed. The lack of suitably qualified seafarers threatens the very existence of the shipping industry. Training onboard holds a strategic position in renewing and maintaining seafarers' skills, and further shaping their professionalism, where the safety culture takes root.

It is concluded that training onboard holds a positive and important role in the seafarers' training and development of shipboard safety culture. Cooperation between maritime training institutions and shipping companies are strongly recommended.

Keywords: Training, Training onboard, Environment changes, Training media, Safety, Safety culture at sea, Quality issues, Fatigue, Cooperation.

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LIST OF ABBREVIATIONS

AIS	Automatic Identification System
CBT	Computer-based Training
CD-I	Compact Disk-Interactive
CIIPMET	China, India, Indonesia and Philippines Maritime Education and Training
DGPS	Differential Global Positioning System
DR	Dead Reckoning
ECDIS	Electronic Chart Display and Information System
ENC	Electronic Nautical Chart
FOC	Flag of Convenience
GAN	Global Area Network
GMDSS	Global Maritime Distress and Safety System
HCI	Human Computer Interaction
HEP	Human Error Probability
HLA	High Level Architecture
IALA	International Association of Lighthouse Authorities
IBS	Integrated Bridge System
ICT	Information Communication Technology
ICS	International Chamber of Shipping
ILO	International Labour Organization
IMO	International Maritime Organization
IMLA	International Maritime Lecturers Association
IMTC	International Maritime Training Centre
INS	Integrated Navigation System
INMARSAT	International Mobile (formerly Maritime) Satellite Organization
ISDN	Integrated Services Digital Network
ISF	International Shipping Federation
ISM Code	International Safety Management Code
IT	Information Technology

ITSO	International Telecommunications Satellite Organization
KMSS	Kongsberg Maritime Ship System
LAN	Local Area Network
LMS	Learning Management System
LTA	Lost Time Accident
MEH	Marine Electronic Highway
MET	Maritime Education and Training
MPDS	Mobile Packet Data Service
MSC	Maritime Safety Committee
NI	Nautical Institute
OOW	Officer of the Watch
PC	Personal Computer
P & I Club	Protection and Indemnity Mutual Insurance Club
PSC	Port State Control
SMS	Safety Management System
SOLAS	International Convention for the Safety of Life at Sea, 1974 and Its Protocol of 1988
STCW 95	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, as Amended in 1995
TRB	Training Record Book
U.K.	United Kingdom
U.N.	United Nations
VLCC	Very Large Crude Carrier
VMTC	Virtual Maritime Training Centre
VSAT	Very Small Aperture Terminal
VTS	Vessel Traffic Service
WBT	Web-based Training
WEMS	Web Education Management System
WMU	World Maritime University
WWW	World Wide Web
WAN	Wide Area Network

CHAPTER ONE

INTRODUCTION

1.1 Background

Training has been an eternal theme throughout human history. Probably no one doubts that human resources are the key to the future success of any organization. Training has played an important and integral part in furthering human learning and development. As Buckley and Caple (2002) state, "the greater rewards will come to an organization which regards training as for everyone at every level of the organization".

Since employees need to acquire new knowledge, skills, attitudes and perspectives on a continual basis in order to adapt to environmental changes, the main purpose of training is to transfer these. Training in the maritime industry has been evolving over centuries. During recent decades, seafarer training has been concerned unprecedentedly with the increased sophistication of onboard technology and ship size. This is particularly highlighted by the International Maritime Organization (IMO), viz, "to make sure people manning the world's ships today are alert, motivated, educated, trained and qualified to the proper standards and in fact possess the skills necessary to perform properly" (O'Neil, 2001, p.5). The international convention STCW 95 and the ISM Code are two effective tools that support for achievement of this goal.

It is universally accepted that modern technologies are the engines for social and industrial development having a tremendous impact on shipping. Computers entered into the marine sector in the early 1980's with the result that today, most vessels are equipped with computers. According to a report from *Lloyd's List*, the Nautical Institute's survey found that less than 1% of vessels do not have computers onboard; while a survey conducted by INMARSAT puts the figure at about 5% (Speare, 2000). Furthermore, advances in technology facilitate the ongoing development of the high-tech ships, which have been transformed into the well known “Information Technology (IT) Office”, “Floating Office” or “Virtual Classroom Afloat” at sea, with built-in Local Area Network (LAN) systems linked directly to shore networks.

As Muirhead (1994, p.8-11) argues, “the advent of onboard computers and modern satellite technology opens new avenues for seafarers’ training. Many practical training programs previously carried out ashore can be transferred to the workplace”. Thus the opportunities for the shipping industry to provide onboard technology-based training programs are limitless. This will set the trend of maritime training onboard throughout the next decades.

1.2 Justification of the Research

Historically, seafarers have long been denied access to effective education and training opportunities at sea. The new developments of technologies such as Internet, satcom, data exchange and multimedia tools changed the manner in which ships were managed and seafarers were trained. Provided that training takes place onboard ships, direct benefits that save on costs and time can be achieved.

It has been recognized by the maritime industry that human error is the governing cause of most maritime casualties. The lack of suitably qualified seafarers threatens the very existence of the shipping industry. Veiga (1998, p.109) states “the implementation of the STCW 95 and ISM Code are two tools to establish a safety culture in the shipping industry.” Both of these tools put a considerable emphasis on seafarer education and training. The way they are trained and educated will play an important role in the implementation of a safety culture. The quality operator sees the benefits of a trained workforce. It only takes one serious incident involving a significant loss of life or an environmental disaster to damage corporate identity (Graveson, 2000, p.49). “Even in well-educated crews we can find a need to refresh the phrases at regular intervals" (Newton & Douglas, 2001). Training onboard has opened the window for the continuous professional development of seafarers, and this can be the opportunity to input more positive contributions for a safety culture at sea.

In carrying out the research, some of the following key questions have been raised.

1) What is the basic concept of training, particularly training onboard in the shipping industry?
2) What are the unique features and advantages of training onboard?
3) What are the fundamental maritime environment changes in terms of technological and legal aspects?
4) How do these changes impact on seafarer training onboard?
5) What are the available resources and routes that deliver training activities onboard?
6) Why is training onboard conducted and what are the implications of training onboard for promotion of a safety culture at sea?
7) What are the crucial issues and factors that influence training onboard?
8) How can training onboard be improved in the future?

These questions are considered and answers offered in this dissertation.

1.3 Objectives

The research aims were set to achieve the following objectives:

- ♦ To recognize the importance and benefits of training, with particular focus on training onboard in shipping industry
- ♦ To identify fundamental maritime environment changes which justify training needs
- ♦ To examine available shipboard training media that are used for training onboard

- To provide practical examples in relation to training practical applications onboard
- To examine the implications of training onboard for the promotion of a safety culture at sea
- To analyse and assess major issues and factors that affect training onboard
- To recommend the measures required for the purpose of improving training onboard in the future.

1.4 Organization of the Research

This dissertation is divided into seven Chapters. Chapter one sets the background of this study, and the key issues related to the research such as objectives and methodology are identified. Chapter two describes the concept of training from an industrial point of view, and training for the shipping industry; particularly training onboard ships is highlighted. Chapter three identifies fundamental maritime environment changes, interpreted from the technological and legal aspects, which further prove the need for training. The modern shipboard training media on which all the training activities onboard are based are sorted out and elaborated on in Chapter four. The implications of training onboard for promotion of a safety culture at sea are analyzed and evaluated in Chapter five. Major issues and factor that influence quality and effectiveness of training onboard are listed and examined respectively in Chapter six. The limitations of training onboard are also identified. Chapter seven summarizes the study and provides recommendations for the improvement of training onboard in the future.

1.5 Methodology

A literature search of mainstream topic resources (including relevant books, conference proceedings, journals, periodicals and electronic academic publications, etc.) and Internet based resources was undertaken by the author. The source of information used in this study also included handouts provided for lectures and materials collected during the author's field studies. Email contacts with the industry were referenced as well, such as regular newsletters, which to some extent provided the latest industrial developments.

Exchanges of views, discussions among colleagues and interviews with professors at the World Maritime University (WMU) also provided the author with precious fresh ideas and fruitful thinking, which importantly gave a broadened view and enriching experience. All the sources of information in this study are carefully selected, credible and updated.

1.6 Limitations

It is a matter of fact, as we can see from news releases and various reports from the industry that more and more onboard training activities are conducted under support of both training service providers and companies. In relation to this research, a lack of partnership with them means that on-scene surveys are difficult to conduct. The time factor and financial issues were also the obstacles in completing this study. For these reasons its scope is limited.

CHAPTER TWO

TRAINING : AN INDUSTRY CONSTANT

2.1 Background

It has been witnessed that tremendous change and development were the story of the whole 20th century, and will inevitably be the mainstream throughout the 21st. Globalization, knowledge economy, continuous advances in Information and Communication Technology (ICT) are just examples of particular changes which affect us all. For the purpose of self-development, organisations need to respond in a timely and flexible way to social, technological and economic changes. This implies that an organization's survival and growth will to a great extent depend on its ability to cope with the external and internal requirements that these changes demand. "They must benchmark continuously to achieve best practice, and nurture a few core competencies in the race to stay ahead of rivals" (Porter, 1996, p.62).

It can be said that in order to increase flexibility and remain competitive, organizations must look towards developing a more highly skilled workforce, towards cultivating specialist skills in new areas and towards attaining a higher level of systematic and effective training.

Training is often included as an essential element of an organization strategy to gain a competitive advantage. If training is ill-directed and inadequately focused, apparently it does not serve the purposes of the trainers, the learner and/or the organisation.

2.2 Training versus Education

In order to have a comprehensive understanding of the role of training, we cannot ignore its close interrelation with education.

Kuo (1998, p.171) states that the basic objectives of training and education are the same and can be regarded as "to achieve or enhance the competence of individuals for doing a specific task".

Doctor Kline (1985) expresses his view that training is generally at the knowledge level and lower part of the comprehension level, while education concentrates on higher cognitive levels. Similarly, but from different standpoint, McAnally's (1997, p.47) gives a brief description that training leads to specific/objective destination, while education leads to non-specific destination. On the basis of these views, the major interrelations between training and education are presented in the following points.

- Training aims to provide knowledge and skills which are needed to perform specific tasks. Education usually provides more theoretical and critical abilities.

- Training tends to focus more on specific forms of competence while education normally has a much wider scope. In general training tends to achieve results more quickly, i.e., short-term, while education tends to take much longer to achieve a more fundamental outcome.

- The ability of an individual to acquire knowledge, skills and attitudes in a training context may depend directly or indirectly on the quality of previous educational experiences. In a similar way, education may be influenced by the skills which an individual has acquired through training.

- Training tends to be a more mechanistic process which emphasizes uniform and predictable responses to standard guidance, while on the other hand education is a more organic and systematic process which brings about less predictable changes in the individual.

2.3 Identification of Training Needs

Identification of training needs is a prerequisite for training arrangements, so it becomes particularly crucial in planning of training activities. According to Dalziel (1991, p.182), "a training need exists when there is a gap between the present skills and knowledge of its employees, and the skills and knowledge they require or will require for an effective performance". It helps to make considered decisions and take thoughtful actions.

Boydell and Leary (1996) recognize that training needs arise from three levels of performance:

- Implementing (doing things well)
- Improving (doing things better)
- Innovating (doing new and better things).

They further identify three areas of needs:

- Organisational needs: Concern the performance of the organisation as a whole
- Group needs: Concern the performance of a particular group
- Individual needs: Concern the performance of one or more individuals.

In identifying needs, it is important to take account of the national and organizational contexts within which organizations are working, and in particular, current developments affecting training. These may include the effects of legislation and national policies on the organization, the pace of technological development, the need of organizational continuous development and staff self-development, etc. So, we need good processes of identifying training needs, so as to provide the right decision-making information and training opportunities required to achieve the goals of the organisation.

2.4 Reactive & Proactive Approaches

2.4.1 Reactive Approach

There are many occasions when training is very clearly the solution to the performance problem, which is to be identified and confirmed quickly. However, this process is also likely to be paralysed due to improper and sometimes unnecessary analyses. Thus it is important for the management to ensure that thorough analyses are undertaken, consequently the problem can be identified and accordingly remedied. This approach is evidenced as a reactive, or problem-solving approach. It involves working methodically through a number of logical stages of investigation. The major stages are identified by Buckley & Caple (2000, p.34) as follows:

- Problem identification and definition
- Determination of terms of reference and methodology
- Causal investigation, data analysis and conclusions
- Generation and evaluation of solutions
- Reporting and feedback.

For example, if a problem is caused by inadequacies as a result of poor training, the solution is believed to be obvious. Apparently what has been described in this approach seems to be reasonably straightforward. There is a clear, rational outline of the important stages to be gone through. Management personnel therefore can understand how they should be carried out against this guideline. Consequently, the training programme to solve problems will cohesively and directly help to achieve the goals of the organisation.

2.4.2 Proactive Approach

Another important approach into training comes from a variety of proactive procedures and future-orientated considerations. It makes up part of an organization's activities. Unlike the methods used in the problem-solving approach, these processes are not initiated for specific performance problems. They may come about because there are going to be internal organizational changes. These changes may demand remarkably different performances from employees in the future. Or they may come about because of changes that will occur outside the organization. These will have implications for individuals or groups on how they perform their jobs.

Lynch (1986) notes that this proactive approach should ensure an organization to have the right numbers of employees, with the right level of talent and skills, in the right jobs at the right time, performing the right activities and achieving the objectives to fulfil the corporate purpose. It should also be noted while going through the proactive processes for future considerations, the solutions other than training might emerge from this proactive approach.

2.5 Benefits of Training

There are many ways in which the modern business can benefit from training of the people it employs. The three areas identified by Adair (1983) are: tasks, teams, and individuals. There are also numerous potential benefits to be gained from well-planned and effectively conducted training programmes. Training to the recognized standards and qualifications is the route to quality performance, and quality performance equals profit. "For businesses to be successful they must train and motivate their main resource" (Johston and McClelland, 1991).

Training can contribute to the organization achieving its current objectives. However, it can also play a longer-term strategic role either directly or indirectly. The direct role is pursued through the nature of the actual training content. In this respect training not only focuses on the individual skills, but also deals with leadership, group and organizational issues. Training can also affect an organization's culture in a more indirect way through the management of individual and group training. This, as a result, can help to create a "learning organization" that is more flexible and responsive in coping with present and future internal and external demands.

Training is also regarded as an essential method to help people with change. Change itself may be necessary for survival; but change can also lead to increased productivity or reduced costs. Training can also help to implement a quality approach, to promote discussions and a general attitude to seek quality, and to help employees improve their expertise and thus the quality of the service.

Furthermore, when mistakes are made in business, the potential costs are threefold. First, there is the cost rectifying the mistake. Second, there is the loss to company's image or reputation. Third, there may be a claim for compensation of somebody who has suffered injury or damage to property or environment because of the mistake. Training can not only help to reduce the chance of mistakes, but also to instruct employees on the action they should take when a mistake comes to light. Often, the costs resulting from a mistake can be reduced if correct action is taken early.

Individual trainees may gain greater job satisfaction from performing a task well, being able to exercise a new repertoire of skills, and further enhancement of career and promotion prospects.

In all, if the training is proved appropriately to fit the needs of an organization, there will be enormous benefits derived from training. As the world becomes more interconnected, business becomes more complex and dynamic and work must become more demanding, there will be a crucial and demanding role for training in the future.

2.6 Corporate Training Policies and Strategies

If there is any training plan to be developed, it should be related closely to and built into a training policy. The policy should describe in detail the organization's commitment to training, the needs of both the business and the individuals, together with opportunities for individual development. Additionally, details of budgeting, priorities, roles and processes should also be included. Decision-makers should make positive contributions to the implementation of plans. Training objectives should also be reviewed periodically by them, especially when a major change is in plan.

There is no doubt that a sound training policy basically depends on the utilization of a good strategy. Porter (1996) defines Strategy is “the creation of a unique and valuable position, involving a different set of activities”. The essence of strategic positioning is to choose activities that are different from rivals. The process of developing a training strategy can begin with an analysis of the training outputs, namely, the human resources to develop. Other factors to be considered include available resources, the competition, cultural, national policies, priorities etc. Reid (1991, p.144) grouped the possible training strategies into following five main categories, which are all good reference for decision-makers, i.e.,

- Training within the present job environment
- Other planned in-company activities
- Planned external activities
- Internal courses
- External courses.

2.7 Training for the Shipping Industry

In the context of shipping industry, the determination and preparation of a company’s training policy and strategy will depend upon a variety of factors, including the type and size of the fleet, the equipment carried, the skill of the existing work force, the number of the crew on each vessel, changing legislation and the budget available for training.

The main channels for delivering training are through maritime colleges, company’s own in-house programs/training centres, or independent professional training service providers. Maritime training could also be run by a consortium of maritime partners bringing industry and training services together. A typical shore-based training establishment is illustrated as figure 1 (on the next page). Shore-based training is approved and supervised by the educational authorities and/or maritime administrations. The training establishment is responsible for development and organization of the training. Certificates are issued to the qualified trainees by the authorities/administrations or training providers authorized by them.

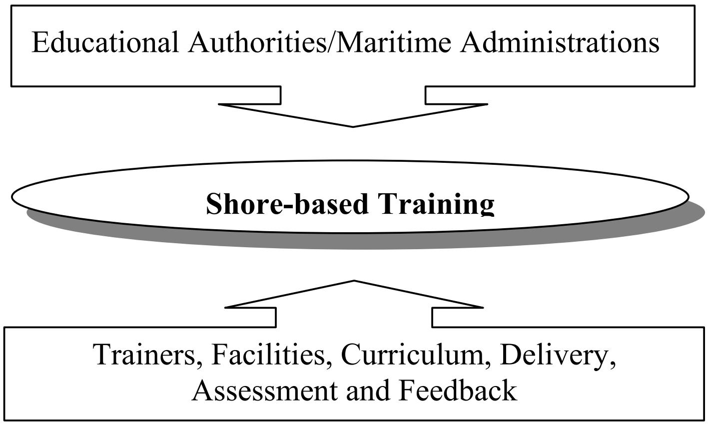


Figure 1 Shore-based Training Establishment

Source: The Author.

Sea staff's training requirements can be classified into two categories: mandatory training and voluntary (non-mandatory) training. Mandatory training comes from national and/or international regulations; while voluntary training mostly comes from individual company training practice and seafarers' will.

The statutory requirements imposed by the STCW 95 have had a strong impact on the whole maritime education and training system across the world. The obligations and responsibilities of shipping companies relating to recruiting and training seafarers have been identified in the Convention. STCW 95 requires that candidates for certification as navigation or engineer watchkeeper, and whose seagoing service forms part of an approved training program, must receive systematic training, with the process supervised and monitored by qualified officers onboard.

A company may require a ship's crew to undertake refresher or upgrading training covering onboard equipment, operations, group work, etc. at regular intervals. Both programs and individuals can be monitored to ensure that onboard safety standards and levels of skill are maintained. "Train the trainer" programs can be developed for interactive use among company management personnel, training service provider and onboard trainer. The importance of this kind of training is highlighted by the professor Chauvel (1997). His comment is that "it is often assumed that training for certificates of competency is all the training needed for seafaring. This is a great mistake. Teams can only exist in a team environment and companies must carry out their own team building" (p.171).

Morrison explains (1997, p.91) necessity of conducting training from two aspects. One is that the issuing parties should consider requiring completion of short updating courses of a practical nature whenever international or national competence requirements are significantly changed. Another is that they should also consider requiring completion of refresher training whenever the findings of an investigation into a marine incident or a reported incompetence give reason to believe that the certificate holder has demonstrated weakness in performing his/her duty.

Generally, training material can be developed as either a generic programme, that is training can be delivered and used over a wide range of companies or organisations. Alternatively it can be commissioned for a specific use and bespoke where the developed training programme is produced for a specific area of interest or an individual company's internal procedure or operation.

An example is given in the following with regard to the company's own in-house training programs. Anglo Eastern Group, based in India & Hong Kong, is one of the largest and most reputable ship management companies in the world. The company continuously carries out Training Needs Analysis and Identification of Training Needs for each seafarer as part of the Appraisal Report made by the master, chief engineer and superintendents visiting the ship. The Anglo-eastern training programme is based on the following elements:

- Skill-based courses using simulators
- Knowledge-based courses to fill in the gaps in the mandatory courses as well as those required due to the trade or vessel type, e.g., navigation in ice, specialised course for bulk carrier operations etc.
- On-board training for gaining practical skills
- Desired behaviour attitude training.

(Anglo Eastern's Report, 2002, p.11)

2.8 The Basic Concept of Training Onboard

According to Lyras (2000), one of the greatest shortcomings of traditional classroom training is that there is little attention paid to linking the training to the final job or tasks of the trainee. On the contrary, training onboard is an effective means to overcome this. Figure 2 illustrates the basic concept of onboard training scheme.

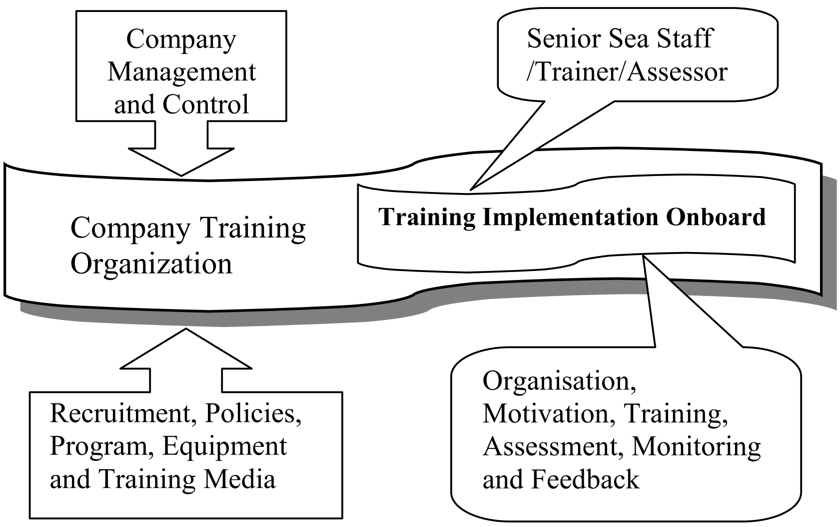


Figure 2 Onboard Training Scheme

Source: The Author.

Without doubt, both knowledge and skills can be acquired either ashore or onboard, but experience is a special training need, which one can only achieve by on-the-job training, especially for the seafaring profession. Training onboard is to incorporate knowledge and skills at the workplace, and accumulate experience in order to make one competent at his/her job.

Maritime practitioner should understand that while training process currently takes place ashore in the maritime training establishments, where the monitoring of performance can be more readily observed, it is onboard in the ship's environment that the most effective training relating to the operations of the ship takes place.

Generally, all the subject matters can be trained in the onboard environment. Muirhead (1994, p.10-11) prioritizes onboard training activities into three categories:

- The need to meet onboard training obligations of ship operators under the revised STCW Convention and associated quality control measures,
- When new technical or operational skills are required and the communications and technology medium demonstrates its potential to provide more effective training in situ onboard, as against ashore, and
- The increased desire for access to further education and knowledge by shipboard personnel, whether leading to a formal award or for leisure purposes.

In Anglo-Eastern's view, onboard training is also an extremely important part of an overall training strategy. Besides standard emergency drills, it follows a multi path strategy with knowledge-based training carried out by its sea staff. On-the-job training methods are used. Strong emphasis is placed on Computer-based Training (CBT), with every ship equipped computers dedicated to training. A PC-based ship-handling simulator is also supplied to every ship. Additionally, the company also runs courses designed to motivate crew towards a desired behaviour in the workplace. The courses cover topics such as motivation, work ethic, and teamwork, and the results are said to show improved teamwork and harmony on board (Anglo-Eastern's Report, 2002, p.11).

U.S. Coast guard is ready to approve a training scheme that the required training period of time is reduced to between 9 and 11 weeks on-site (onboard ship) by the use of CBT/internet training for knowledge based elements. Presently it takes 17 weeks to attend traditional program at schools (Rogde, 2001).

Another example, the weakness of Chinese seafarers in English has been recognized by the world shipping industry. It has been a bottleneck for the exportation of workforce to other countries. According to the survey conducted by Doctor Minghua Zhao (1999), to address this particular issue, English classes are organised onboard and taught by the captain or other senior officers during seafarers' off-duty hours. In some companies, plans are being made to employ English-speaking foreign officers in order for Chinese seafarers to practice English through daily contact aboard. Money and promotion are used as effective incentives to encourage seafarers to improve their English.

Ideally seafarers will follow a learning path that is defined by the knowledge and skills strategically important for their company's success and is an integral part of the company's competence management system. Self-paced training, instructor-led training, virtual classroom training, on the job training, etc., each training element in the path is connected and compatible, to provide continuity, leading to a strategic competence.

2.9 Unique Features and Advantages of Training Onboard

Noel (1982, p.1) advocates conducting training onboard for the following reasons:

- Training can be related directly to the particular ship and its equipment, thus providing considerable realism.
- Training can be focused on observed weak points, either in operational procedures or in general safe practices.
- Instructions are provided for all onboard, while it is seldom possible to send everyone on courses ashore. Instructors may present to suit the different levels of understanding.

- Training in emergency response procedures is designed to develop teamwork as well as techniques. The ship's emergency organization is trained and exercised as a total entity.

His idea was based on the on-scene instructions which to some extent meant to move traditional classroom onboard ships. However, with the modern technological advance, training onboard today can be conducted through wireless link to shore, to share training resources and services.

The advent of high-tech ships and the increased reliance on computer based technology to assist the watchkeepers in performing routine functions, has changed the previous concept of training. Shipping companies are more in need of professional operators to manage the various computerised functions onboard, in assuring safety and protection of the environment. The new technology is capable of helping the maritime industry to raise the skill levels of personnel onboard and consequently improve safety standards without adding significantly to overall operating costs. Transfer of many aspects of practical training from shore institutions to the workplace is a desirable objective since on-the-job training and verification of skill acquisition is best carried out by those at the workplace.

As to training onboard, Kembery (2000) insists that the "blend of technologies" needs to be considered. This is the blending or perhaps more appropriately the blurring of technologies, bringing together not only various forms of educational and training technology but also blurring the lines between learning and working, consuming and creating, being entertained and being educated. Therefore, the blending of technologies may be such that where sea staff will be unable to distinguish between when they are working and when they are being trained. It remains to be seen how this will be received by the target audience, the sea staff themselves.

Based on Spalding's (1997) idea, the following advantages of training onboard assisted by modern technology are summarized by the author.

Technology assisted training provides training for seafarers without the risk of placing a vessel, people or the environment in jeopardy. This provides the ideal environment to carry out emergency procedure testing and preparation. On-line tutorials, virtual training centres etc can add to the community/human interaction and support aspects of studying.

Technology assisted training can shorten the training of competence and can highlight problem areas that need to be trained, at a very early stage, which contribute in no way to the safety of seafarers, owners, vessels, customers, cargoes and the environment.

The shipping company reduces the costs involved in sending the trainees to shore based establishments. Traditionally the cost of training to the shipping industry is very high. Specialist training courses ashore for experienced personnel are expensive. Rayner (2001) notes that only about 40 percent (or less) of the total cost of a course attended at a shore-based training centre is spent on the training itself. Seafarer salaries, accommodation, meals and travel account for the remaining 60 percent. Presently Computer-based Training, Web-based Training and other onboard training possibilities are already established. So there is a very strong incentive to have a means of providing training to personnel onboard ships.

Training onboard becomes affordable for the companies as well as individuals with consideration of cost-effectiveness. It is a fact that telecommunication costs are continuously being reduced because of the fiercely competitive market forces in the telecommunications industry.

Trainees themselves benefit from training onboard. They are actually in service and on pay as well as a long period stay at training establishment can be avoided.

Muirhead (1994 p.8-11) points out that there is no reason why such training cannot be carried out on the ship and individuals monitored for standards. The immediate benefit to the maritime community is the greatly reduced cost of such programs and the ability to transfer many training aspects back to the shipboard environment.

Thus training onboard, especially with the assistance of modern technology, is an ideal vehicle for enhancing seafarers' knowledge and skills.

CHAPTER THREE

FUNDAMENTAL MARITIME ENVIRONMENT CHANGES

3.1 Technological Aspects

3.1.1 Satellite Communications

Since their introduction in the mid-1960s, satellite communications have grown from a futuristic experiment into an integral part of today's "wired world". Compared to cable solutions, satellite technology offers the advantages of ubiquitous coverage, point-to-multipoint transmission capabilities, seamless transmission, independence from terrestrial infrastructure and rapid deployment. As digital modulation and transmission replace analogue techniques, and as satellites in non-geostationary and lower-altitude orbits open the way to new applications, satellite communications continue to grow in use and importance. It is important to note that over 70 countries, which account for more than 60 percent of the world's population, are today satellite dependent for their national and international telecommunication services (ITSO, 2002, p.2).

Significantly, communication satellites are beginning to emerge as an attractive solution in providing broadband connectivity to a variety of users. The satellite industry already has developed all of the components needed for a global broadband satellite infrastructure. Thus, satellite technology can bring broadband Internet services to represent a powerful means to support vital telecommunication. The global broadband satellite infrastructure initiative proposed by the International Telecommunication Satellite Organization (ITSO) presents an opportunity to allow Internet access to all mankind and offers the telecommunications industry important new business opportunities.

In order to share a satellite broadband connection over a network a computer is usually required to act as a “host” computer. The host has direct access to the satellite modem. A LAN switch is typically used to allow other clients on the network to access the host computer whenever access to the Internet is required.

In the past decade, the Internet has experienced considerable growth in contents with on-line gaming, streaming video, multimedia and interactive applications. Recent advances in technology coupled with decreasing costs for communications circuits have enabled the exploitation of satellite communications for continuous shipboard connectivity to the global Internet. The capability of ships to access aboard, even in the high seas, almost any information from ashore poses new and exciting opportunities for onboard training.

Satellites already do and will continue to provide backbone telecommunications connectivity around the world. These dramatic developments and trends have tremendous implications for seafarers both personally and professionally.

Satcom Systems in GMDSS

The Global Maritime Distress and Safety System (GMDSS) is a new international system using improved terrestrial and satellite technology and shipboard radio systems. GMDSS was developed through the International Maritime Organization (IMO) and represents a significant change in the way maritime safety communications are conducted (GMDSS, see IMO website). It applies to all cargo ships of 300 tons gross tonnage and upwards and to all passenger ships on international voyages subject to the SOLAS Convention, as amended in 1988. The introduction of the GMDSS marked the most important change in maritime communications. Satcom plays a major role in the GMDSS.

GMDSS adopts two sub-systems: INMARSAT and COSPAS/SARSAT. INMARSAT system is used for distress, urgency, safety and routine communications, while COSPAS/SARSAT system is used for detection of emergency alarms. There are dozens of satellite operators around the world. The main players are those such as VSAT, TELEDISC, IRIDIUM & INMARSAT to name just a few. However, only INMARSAT system is covered by SOLAS Convention (Chapter IV).

INMARSAT is renowned for delivering innovative reliable and cost-effective communication solutions to the maritime industry. It supports links for phone, fax, data and telex communications to more than 250,000 movable terminals. It operates a constellation of geostationary satellites designed to extend phone, fax and data communications all over the world. INMARSAT's business is to provide communications services to all maritime users, which inevitably means covering a wide range of requirements. Due to the global reach of INMARSAT network, communication technology can be provided to any ship virtually anywhere on the open sea ("Crew calling", 2002, p.9).

The services provided by INMARSAT, since its establishment, are INMARSAT-A, INMARSAT-B, INMARSAT-C, INMARSAT-E, and INMARSAT-M. The first INMARSAT Fleet service, Fleet F77 launched in 2002, provides both the high quality and speed of mobile Integrated Services Digital Network (ISDN) service and the flexibility of the INMARSAT Mobile Packet Data Service (MPDS), where users are charged for the amount of information sent and received rather than the time for which they are connected (Smith, 2002). The keystone of its strategy is the new INMARSAT I-4 satellite system, which from 2005 will support the INMARSAT Broadband Global Area Network (B-GAN) – mobile data communications at up to 432kbit/s for Internet access, mobile multimedia and many other advanced applications (INMARSAT, 2002). This combination provides cost – effective, virtually global communications, with immediate and secure access to business critical information, image transfer and video communications – wherever it is needed.

3.1.2 Integrated Bridge System (IBS)

Shipping, in common with other modes of transport, is undergoing profound changes both commercially and technically. Recent advances in computer and digital based technology are having a huge impact on the operation of a ship. Increasing integrated systems are being designed to reduce the amount of time an officer spends in gathering information, processing it and then executing the action. So how, then, will all these factors affect future development of a ship's basic nerve centre-its bridge?

> The ideal in advanced bridge electronics is to bring together all the multiple electronic systems that are proliferating today, to look like one. Thus they could all share the same "bin" of information (database), the same screens (as, for instance, in ARPA radar/ECDIS fusion), the same configurable multi-mode control panels, the same configurable multi-mode control panels, the same data circulation system (local area network), a powerful common processor, many of the same hardware modules, the same software language and a common power supply. Technology, even if it has not yet fully delivered on this vision, is well on the way.
>
> ("Integrating Bridge Electronics", 2002, p.22)

Annex 1 of Resolution MSC.64 (67) adopted on December 4 of 1996, writes that "an integrated bridge system (IBS) is defined as a combination of systems which are interconnected in order to allow centralized access to sensor information or command/control from workstations, with the aim of increasing safe and efficient ship's management by suitably qualified personnel". Furthermore, with regard to the system requirement, the IBS should support systems performing two or more of the following operations:

- Passage execution;
- Communications;
- Machinery control;
- Loading, discharging and cargo control; and
- Safety and security.

The purpose of IBS is to provide all kinds of information the bridge officers need to operate the ship properly and safely in easily accessible display forms, to assist ship's officer to understand the present situation around the ship and determine the right decisions to maneuver or control the ship. The systems composing the IBS are classified as follows: Integrated Navigation System (INS), navigation Sensor Interfacing System, Steering Control System, Integrated Propulsion Control and Monitoring System, Local Area Network System. Among these, the INS is the backbone of the whole systems.

An INS is a combination of systems that are interconnected to increase safety and efficiency of navigational operations by suitably qualified persons. The aim of INS is to enable one person to gain a fuller overview of navigational and ship-keeping functions so that he/she can exercise better and more reliable control. The bridge watch-keeper would then be primarily responsible for the visual lookout and vessel seamanship, assessing the safety of navigation and the routines. This relieves the Officer-of the-Watch (OOW) of tactical information overload.

Today, the standard integrated navigation and communication system is typically built around and ECDIS, which acts as the integrating component. It collects all information from various sensors, distributes the information and performs various control tasks (figure 3).

The advent of the "modern bridge" allows navigation decision-makers to execute, with a glance, the data collection and collation functions that formerly consumed majority of the watch (Luniewski, 1999, p.10). The modern bridge effectively exploits the revolution in computing power by integrating multiple sensor systems for display on a single console. With the intensive use of automation a new era of ship control is being entered. Nowadays one man bridge control is being more and more generalised in the shipping industry.

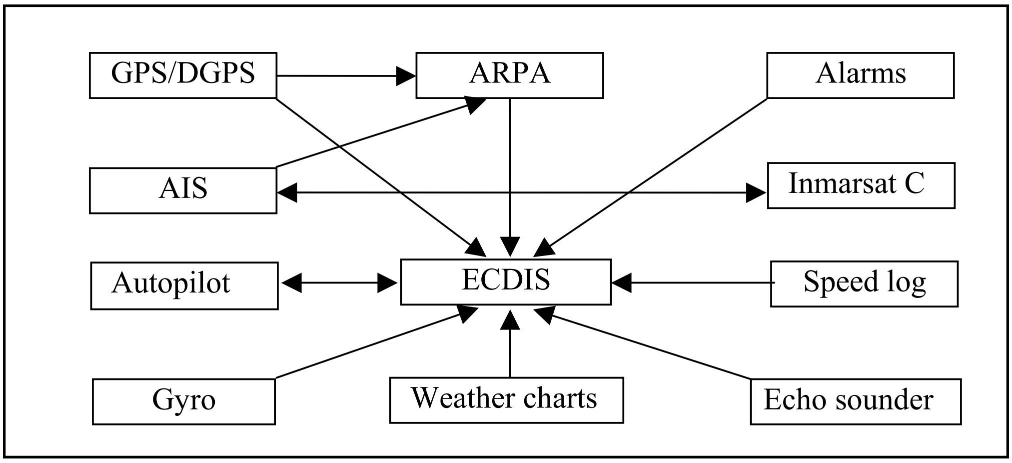


Figure 3 Integrated Navigation System Flowchart

Source: Keboo, K. N. (2003, January). Integrated systems: Value for money? *Seaways. 5-9.*

As far as the manufacturers are concerned, a global survey conducted by Tang and Liu (1999) shows that the representative products of IBS available in the present market are:

- NACOS 45-2, 55-2 series of STN ATLAS (Germany)
- BridgeLine 2020 of NORCONTROL (Norway)
- MIRANS 4600 of Racal-Decca (England)
- VISION 2100 of Sperry (America)
- SUPER BRIDGE of Mitsubishi (Japan).

The importance of operational use of IBS was further confirmed by MSC/Circular 1061 (see appendix 1) in January 2003. The circular provides a guideline which defines the basis for minimum criteria on the operation, training and quality control for IBS. It calls for the company, in co-operation with the relevant manufacturers, to establish a training program for all officers who have operational duties involving the IBS.

Future Bridge System

Multimedia acquisition and presentation of data using a finite or selective number of dedicated workstations with improved graphics functions will be an important aspect of the next generation of integrated bridge assemblies ("Towards the Future", p.17). At the same time, we can expect to see significant reductions in equipment downtimes by tele-monitoring and remote maintenance onshore using a ship's own data network. Similarly, diagnostic functions will become an integral feature of equipment, with direct connection via INMARSAT to specialist shore-based customer support centres.

Future bridge systems are likely to incorporate voyage data recorders, the functional purpose of which can be regarded as two fold. Firstly, it provides a definitive historical account of all event data. Secondly, its replay facilities covering events such as, navigational manoeuvre and engine control operations, can also be used for onboard training operations.

3.1.3 Vessel Traffic Service & Marine Electronic Highway

Vessel Traffic Service

Since the first VTS guidelines, issued by IMO in 1985, VTS systems have been improving comparatively. "A VTS is a service implemented by a Competent Authority, designed to improve the safety of vessel traffic and to protect the environment. The service should have the capability to interact with the traffic and respond to traffic situations developing in the VTS area" (Kruuse, 1998). It can be addressed in different titles: VTMIS (Vessel Traffic Management and Information Services), VTM (Vessel Traffic Management) and VTIS (Vessel Traffic Information Service), all of which are nearly identical to the VTS. There are mainly three types of VTS: coastal, estuarial and harbour VTS. Coastal VTS is structured for surveillance purposes, which is used in sensitive areas where some form of traffic management is required to ensure the ships safe passage by complying with traffic separation schemes. Estuarial VTS is provided to ensure the safe transit of vessels in rivers or estuaries, on their way to and from a port. Harbour VTS is provided for vessels entering or leaving a port with pilotage or no pilots onboard.

VTS services may be provided as follows (IALA, 2001, p.102):

- Information service: To ensure that essential information concerning the area, the governing circumstances and the traffic situation is, in time, available to the shipboard navigational decision making process.
- Navigational assistance service: To contribute or participate in the navigational decision making process onboard and to monitor the effects.
- Traffic organisation service: To provide for the safe and efficient movement of traffic and to prevent the development of dangerous situations within the VTS area by the forward planning and monitoring of movements.
- Cooperation with allied services and adjacent VTS: To integrate the effects of VTS and to coordinate the information flows for the collection, evaluation and dissemination of data.

There are two important aspects which should not be neglected with consideration of use of the VTS. One is when a VTS centre is authorised to issue instructions to vessels, these instructions should be exclusively result-orientated, leaving the details of execution to the master or pilot onboard the vessel. Another is that participation by vessels in VTS areas may be either voluntary or mandatory, depending upon local laws (Peermohamed, 2001, p.19).

The new Chapter V of SOLAS Convention requires contracting state governments to establish a VTS whenever, in their opinion, the volume of traffic or the degree of risk justifies such services. Although the establishment of a VTS is not mandatory, as a matter of fact, the number of countries that have introduced the VTS has increased dramatically. This is particularly true for areas frequented by ships and for countries which are vulnerable to any oil spill or such incidents that can cause irreversible damage to the environment. Since 1990, 19 Vessel Traffic Service centres with 42 radar stations have been established along the coastline and the Yangtze River, which cover the major ports and waters with heavy traffic and provide assistance and information for safe navigation of ships (VTS in China, website).

VTS plays a key role in the safety of ships navigation, effectiveness of traffic flow management, and the protection of marine environment. Furthermore, in the case where an accident occurs, the VTS can manage the area to ensure that other vessels do not result in nuisance to rescue, salvage, and clean-up operation. In light of scientific and technical developments, it is possible to predict more clearly the consequences of our decision-making by using computer-assisted techniques, by analysing casualty data and by offering safety assessment. The systems are still evolving, and the use of VTS will certainly expand in the future.

Marine Electronic Highway

The development and advancements in information technology are changing the way information is used by the maritime sector. The use of information is more mature, and expansive applications will definitely result in improved performance. Over the last several years, a new concept has been making its presence, which is known as the Marine Electronic Highway (MEH), sometimes referred to as an "Information Super Highway".

> Essentially, the MEH will be build upon a network of Electronic Nautical Charts (ENCs) using Electronic Chart Display and Information Systems (ECDIS) and environmental management systems into an integrated system in the region, allowing the maximum of information to be made available to both ships and shipmasters as well as shore-based users such as vessel traffic control systems.
>
> ("IMO Press Briefing", 2001)

The MEH has two components, namely maritime safety, and environmental protection & management (Sekimizu, et al, 2001). With respect to maritime safety, three categories are recognized, i.e., navigational safety, precision navigation and emergency response. The backbone of the MEH is precision navigation and will utilize a network of Electronic

Navigational Charts (ENCs) in conjunction with ECDIS, Differential Global Positioning System (DGPS) and other maritime technologies.

Coast radio stations and ships can exchange real time information through Automatic Identification System (AIS). Even hydrographical and oceanographic data including weather conditions can be transmitted/received, so as to facilitate ship movement, particularly in restricted or congested waterways.

As to the environmental protection and management, four categories are identified, namely, environmental monitoring, protection and management, emergency response and risk/damage assessment. The foundation of MEH is the integration of maritime safety components with environmental protection and management technologies. Some of the possible systems within the MEH are illustrated in figure 4.

MEH provides many potential opportunities and benefits not only for the shipping industry but also to a variety of users with different requirements. The application of MEH can be extended to environmental management and its impact assessment, search and rescue operations, anti-piracy programme, and even fisheries/aquaculture management.

IMO has submitted an initiative to the United Nations organization which was named "Development of a Regional marine electronic Highway (MEH) in the Straits of Malacca and Singapore" early this year. The expected date of initiation for this project will be January 1, 2004 (UN, website). Captain Raja Malik Saripulazan, Director-General of the Marine Department of Peninsular Malaysia ("IMO Press Briefing", 2001), envisage that "with the inception of the MEH, safety and efficiency of navigation will increase and manoeuvring a VLCC in the Straits will no longer be a nightmare to shipmasters".

Chua & Ross (1999, p.7) note that a marine electronic highway in the Malacca and Singapore Straits can be a WIN-WIN opportunity for the people of the littoral States and the shipping industry.

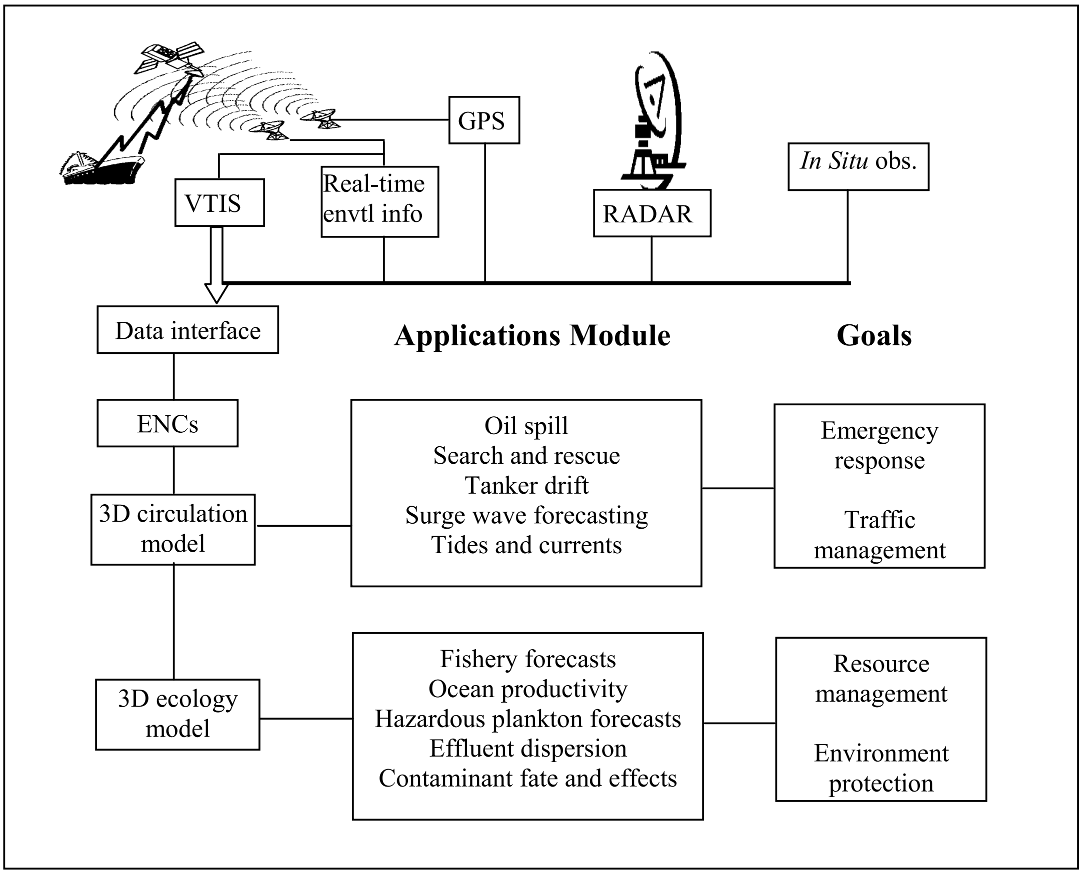


Figure 4 Marine Electronic Highway Functional Diagram

Source: Based on (Sekimizu, et al., 2001, p.27).

3.2 Legal Aspects

3.2.1 STCW 95 and Training Onboard

As the critical date of 1 February 2002 has passed, the revised STCW 95 Convention has become mandatory. The revised Convention, as its name indicates, establishes basic requirements on training, certification and watchkeeping for seafarers. The Convention has first time ever changed the scenario of world maritime industry. It consists of Articles, Regulations and the new STCW Code.

At the core of the revised STCW 95 Convention lies the concept of competence. The concept of competence can be considered in the context of what knowledge and skill an seafarer needs to have in order to apply that knowledge and skill to the workplace situation. In the tables of competence, the methods that may be used to demonstrate competence are specified. It should be noted that in most cases the reference is to examination and assessment of evidence from approved training and experience using methods such as approved sea-service, simulator training, laboratory equipment training, workshop training, practical experience and tests, and training ship experience (Fisher & Muirhead, 2001, p.8).

There are no short cuts to competence. Onboard training is proved to be one of the most effective ways to achieve this purpose. Personnel involved in all three levels of responsibilities, i.e., management, operational and support level, can be trained to develop operational skills through this option. A variety of onboard training schemes and programs have been developed by various maritime training practitioners or shipping companies themselves, so as to meet the industrial needs.

In regulation I/6 of the Convention and provisions of Section A-I/6 of the Code, which are related to Training and Assessment, clear emphasis on conducting onboard training are laid down. The normal methods of training, which include shore-based training courses, followed by practical training at sea, will be needed (Holder, 2002, p.2).

When training programmes involve onboard training, the training record books shall be used. The coordination and interface of onboard training with shore-based training should also be reviewed (Morrison, 1997, p.181). International Shipping Federation (ISF) provides Onboard Training Record Books for the trainees, which are used to satisfy the new training requirements of STCW 95.

In China, onboard training for cadets comprises three phases, one month and six months during the study periods in the institutions and a third phase after graduation. The second and third phases are sponsored by the shipping companies and monitored by the institution (CIIPMET report, 1998, p.26). A training record book is based on the model recommended by IMO.

Circular 853 of May 22, 1998, issued by IMO's Maritime Safety Committee (MSC), further recalls the provisions of section A-I/6 of the STCW Convention and stipulates that the process of onboard assessment is to be carried out through a quality standard system. The above Circular and the Annex not only underscore the importance that IMO attaches to shipboard training and assessment, but they also highlight the roles of the shore establishment and shipboard personnel. It is therefore conceivable that the quality standards referred to are either those of the shipping company or of an MET institution contracted for providing onboard training and assessment services.

Besides, STCW Resolution 8 gives emphasis on the promotion of technical knowledge, skills and professionalism of seafarers. It is appreciated that "the overall effectiveness of selection, training and certification processes can only be evaluated through the skills, abilities and competence exhibited by seafarers during the course of their service onboard ship" (IMO, 2001), thus companies are required to make arrangements to:

- Monitor the standards exhibited by ship's personnel in the performance of their duties;
- Encourage all officers to participate actively in the training of junior personnel; and
- Provide refresher and updating training at suitable intervals as may be required.

(IMO, 2001, p.60)

It is clear that seafarer's training is highlighted during their in-service activities. The refresher and updating training can be conduct onboard ships in light of the development of Information and Communications Technology (ICT). The methods of conducting onboard training are discussed in Chapter four in detail. In all, the principles should be to ensure the maintenance of international standards and the development of a safety culture.

3.2.2 Impact of the ISM Code

The adoption of the International Safety Management Code (ISM) is one of the most important developments in maritime safety of the last decade. The Code is a guideline document regarding safety and pollution prevention management for shipping companies, covering both vessel and shore-side operations. It was adopted in 1993 by Resolution A. 741 (18) and was given effect in 1994 when SOLAS Chapter IX – Management for the Safe Operation of Ships, was adopted. The ISM Code can be considered revolutionary, in a way, in that it is the first formalized initiative by IMO to provide a universal standard for the safety management statutorily linked to the ship (Hutton, 1997, p.67).

The Company is required to "continuously improve safety management skills of personnel ashore and aboard ships, including preparing for emergencies related both to safety and environmental protection" (IMO, 2002, p.7). Furthermore, Part 6 of the ISM Code elaborates issues regarding Resources and Personnel. It places great emphasis on training and it requires that every member of the crew is aware of what his responsibilities are within the Safety Management System (SMS), and training should be provided where required. The role played by the seafarers is paramount to successful development, implementation and maintenance of the Code.

The Company should in fact have procedures in place for identifying training needs. In addition to on-going training needs, all new or recently promoted seafarers will need familiarisation training on the ship itself, shipboard operation procedures and in the use of any special equipment they would be expected to use (Kidman & Anderson, 2002, p.30). The extent of familiarization will be dependent on the company's own training experiences, frequency of crew changes and turn-over of personnel, sophistication of vessels and their equipment. Through various records the company has to demonstrate that training, where necessary, has been provided.

The International Chamber of Shipping (ICS) and the International Shipping Federation (ISF) provide a number of suggested methods which a company may consider to ensure that new personnel or personnel transferred to new assignments are made aware of their responsibilities under the SMS, both during normal operations and during emergencies. These methods are to:

- Send information on the Company's SMS and ship details to the seafarer onboard ships;
- Provide familiarisation information on the ship, relevant equipment and the SMS upon joining, under the direction of an appropriate officer;
- Require the seafarer to complete a guided programme which entails self familiarisation with the ship, its equipment and the SMS;
- Allow a period of "hand-over" between seafarers joining and leaving the ship and make use of developed checklists; or
- Develop video familiarisation packages for use onboard conveying the concept of the SMS and its specific requirement.

(Anderson, 1998, p.179)

The Company not only has to provide necessary training, but also requires having a defined system for the identification of training needs in support of the SMS. This may include updating of knowledge in fire-fighting, planned maintenance systems, navigation equipment, machinery operations, computers, communication systems, oil spill response, bridge team management etc. Training needs may also be identified as a result of accidents, near-miss situations, internal audits, performance appraisals, legislation, new technology or new ships.

Good and comprehensive training records should be kept both onboard by individual seafarers and the Company. Personal training records should also be regularly inspected and assessed for new training needs.

At the very root of the ISM Code are the safety of life (and property) and the protection of the marine environment. It is clear that shipboard environment would be an ideal place for much of the anticipated training. Therefore when considering what training is needed, it will be necessary for the company to be aware of what knowledge and training the individual seafarer possesses, and from that position the company provides the necessary facilities, opportunities to conduct training. So the individual seafarer can perform his/her own job more safely and competently. If possible, a seafarer can participate as part of a team for the common goal of safety and effectiveness. In these ways, there is high possibility of significantly minimising the risk of accidents and pollution or other damages to the environment.

CHAPTER FOUR

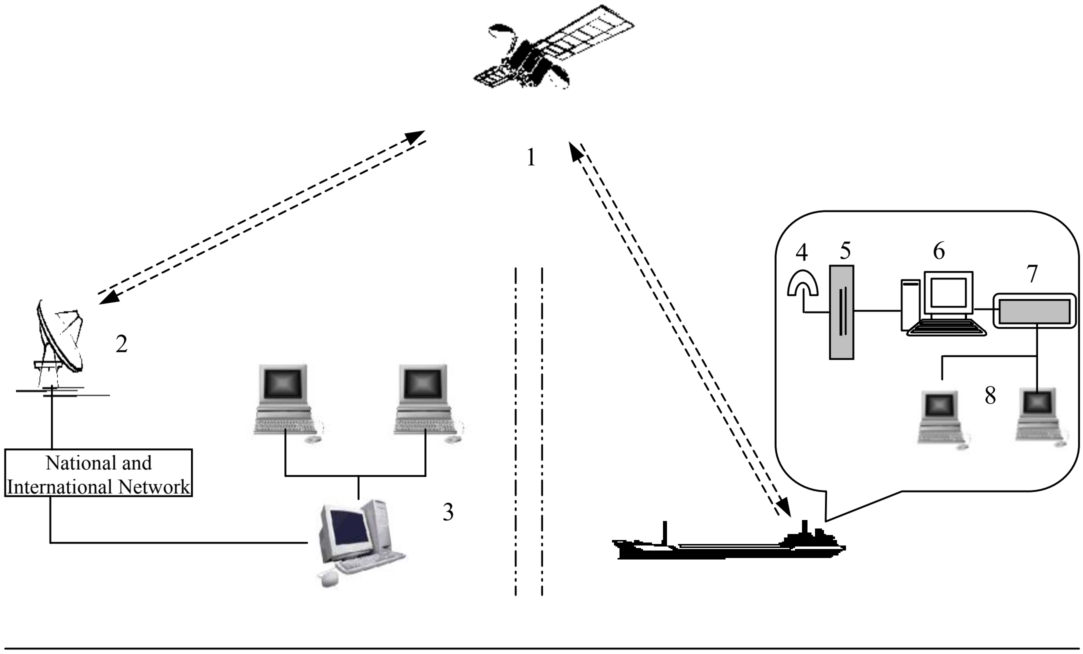
MODERN SHIPBOARD TRAINING MEDIA

4.1 Shipboard Training Configuration

"It is evident that new technology is opening up a broad vista of opportunity for new approaches to be made in maritime education and training at sea" (Muirhead, 1994, p.9-11). Therefore, technology to a large extent dictated the type of training that could be done onboard ships as opposed to shore-based training institutions. It is not difficult to find the concepts of "Floating Office", "IT office" or "Virtual Classroom Afloat" at sea, which imply modern onboard environment in today's maritime journals.

Many companies which started with single, stand-alone computer-based systems, have now developed complex and sophisticated systems, incorporating LANs on ships designed and built with fibre optic connections, and linked to Wide Area Networks (WANs) through satellite communication. According to Tan (1999, p.112), many ships today have LANs onboard (26% from his own survey and 43% in the Nautical Institute study).

The combination of growing availability of PC onboard ship, shipboard LAN, IT, and existing and emerging satellite services allows seafarers to roam the Internet, leaving no doubt as to the technical capability of setting up training onboard via satcom. The model of shipboard training configuration is illustrated in figure 5.



1. Maritime Satellite; 2. Coast Earth Station (CES); 3. Training Service Provider; 4. Ship Earth Station (SES) Antenna; 5. Satellite Modem; 6. Host Computer; 7. LAN Switch; 8. Training PCs.

Figure 5 Shipboard Training Configuration

Source: The Author.

4.2 Web-based Training

4.2.1 General Description

Web-based Training (hereafter called WBT) marshals web technologies to the task of training. Many educational and training institutions are offering various value added courses across the globe using Internet or web access. WBT and technologies on which it is based are advancing rapidly and growing exponentially. Horton (2000) defines WBT as "any purposeful, considered application of Web technologies to the tasks of educating a fellow human being". It is the confluence of three social and technical developments: distance learning, computer-conveyed education and Internet technologies.

WBT is part of the biggest change in the way people conduct training since the invention of the chalkboard. The development of computers and electronic communications media has removed barriers of space and time. We can obtain and deliver knowledge anytime and anywhere. It is just as professor Muirhead's (2000, p.60) statement that as a result of advancing broadband technology in the 21st century, sophisticated simulation training programs will be capable of being accessed onboard (and ashore) via Web Education Management Systems (WEMS). WBT does not change how humans learn, but it does change how we can teach them. What WBT does change is the economics and capabilities of delivering training. WBT makes it easier and less expensive to produce certain kinds of learning experiences for people at a distance.

Training courses can be offered to trainees across the globe using the World Wide Web (WWW) making standard training packages/programmes easily accessible anywhere. This feature allows seafarers onboard to access online training courses via satellite links. Internet has the added benefit of ensuring platform independence with respect to the software used for web-based training. Internet also allows trainees and trainers to easily collaborate with each other as individuals or in a group.

Flexibility in training development and delivery is the key to meeting trainee needs when and where it is required and in a form that suits the learning preferences of the trainee, while the general concept of WBT is based on a training module and additional tools for administrating the training process with great flexibility. The training system usually includes user interface/user dialogue, course registration, courses and content, communication module, reporting and tracking, payment and security.

Training development needs to address the issue of standards, not only to meet any externally set standards as in safety critical training but also the internal learning objectives of the training. The sequence of training design, development, delivery and evaluation has been described as a series of cyclical activities embedded in a "training wheel". WBT should not only provide the platform for these activities but also enable the marketing of training products and services as part of an integrated service. The Internet can therefore offer a superior and centralised service for the corporation, which are:

- Enable content to be remotely deployed and managed from one location with continuous update without extra distribution costs;
- Provide a learning platform that is accessible to learners with Internet access;
- Enable authors to upload content and publish it on the web;
- Support learning through tutoring, mentoring and peer group communities using the Internet communication tools of email, discussion forums, chat and conferencing; and
- Provide a personalised learning experience for individual learners through course administration and tutoring tools.

(Newton & Douglas, 2001)

It is clear that Internet technology will become an important tool in closing the gap between the ship, shipping company and the "competence sources", such as the academies and manufacturers.

According to Julie Lithgow (2002, p.23), Manager of Nautical Campus, The Nautical Institute's (NI) online resource centre has developed some exciting new initiatives which aim at more services directly relevant to members online. A mentoring scheme is being developed to allow members to tap into the huge vat of experience we have within our membership base. Online debates and conferences will be a valuable asset to the site. Regardless of location and time zone of members, they will be able to log into a live debate and make their comments. Noticeboard, where course providers can advertise is also available, for the purpose of placing courses list, conferences and other events.

4.2.2 WBT Application: KMSS Maritime –eCampus Solution

Kongsberg Maritime Ship Systems (KMSS) has designed and delivered a full range of realistic maritime simulation tools worldwide for many years. KMSS has launched Maritime-eCampus, an Internet portal service for maritime training. It was asserted by them that the system has revolutionised the traditional maritime education and training stream. The delivery of online simulator-based interactive learning activity provides flexible study programmes for effective learning and course management (Maritime-eCampus, 2002). The KMSS provides this effective training solution with its training course content directly related to the STCW standards and the IMO Model Courses. On the basis of Internet connectivity, the solution offers a realistic opportunity to deliver effective online simulation training.

"Maritime-eCampus is the first maritime online training portal that combines the highest fidelity simulation software with complete courseware" (Maritime-eCampus, 2002). It provides trainees anywhere in the world an effective tool for the advanced distance training. Currently (2003, June) the available training modules online from KMSS Maritime eCampus are as follows.

Table 1 – Training Modules

Marine Engineering	Navigation
Electricity Supply	Radar Basic Operation
Steam Boiler	Radar Plotting
Fuel Oil Handling	Radar Navigation
Refrigeration	ARPA
ME Lube Oil System	Autopilot
ME Fresh Water System	GPS
ME Sea Water System	Nautical Instruments
ME Fuel Oil System	Basic Manoeuvre Tests
ME Turbo Charger System	Basic Ship Handling
Steering Gear System	Search and Rescue

Source: KMSS. (2003). *Maritime – eCampus. com*

Under such circumstances, traditional training method has been changed to a larger scope, viz., to extensive communication with people and direct interaction with modern technology. The system consists of on-line real-time simulator models, a Learning Management System (LMS) and course content. A local Internet browser enable system is able to use real-time simulator models running in a ship LAN, or on a local PC. This allows the course content to be available to all trainees with access to the onboard local network. Trainees, instructors and administrators access to a LMS via the Internet with a user-name and password. It gives the unique opportunity for the instructors to track and monitor the progress and results of the trainees.

4.3 Computer-based Training

4.3.1 General Description

In 1960s, two Norwegian academics, Ole-Johan Dalhl and Kristen Nygaard developed what was arguably the first of the marine environment simulation and Computer-based Training (CBT) packages. This was component or "object oriented" technology in its infancy (Kembery, 2000, p.2-7). While the marine industry has been undergoing significant changes over the last several decades, although CBT has been generally available, technological constraints make it slow to catch on in popular application. Today, due to accelerating processing speeds, increased memory capacity and the decreasing cost of hardware, computer based training and assessment can be found in training centres, onboard ships as well as in the seafarer's home.

The Nautical Institute (2000) in *Guidelines for the Development of Computer Based Training for Use at Sea* regards the Computer-based Training as "a broad, generic term to describe how computer run software can be used in support of training applications. These may include initial training, or for imparting or reinforcing underpinning knowledge". The application of CBT can be grouped as "Inquiry, Tutorials, Drill & Practice, Simulation, Instructional Games and Assessment" (Muirhead, 2002).

From a seafarer's point of view, CBT at sea could come in two forms. Firstly, it could be designed to offer quick and effective just-in-time training for those under pressure. A programme can be designed to allow a master to ensure that he has covered all the basics required by law and by his company. There would be no formal exam. Secondly, it requires far more thought to develop this type of CBT than the previous one, because it involves in in-depth training and many other factors. In this case programmes would be designed for topics of STCW compliant training. Such a programme would lead to an assessment at the end which complies with STCW and with national guidelines.

To make CBT more effective, a number of important aspects should be addressed (Muirhead, 2001):

- CD-ROM and other learning materials need to be instructionally designed;
- Effective links must be established between visual materials and the trainee;
- Interactive materials must engage the attention and involvement of the trainee and provide motivation; and
- Thought must be given as to how the Internet and the WWW can be used for training purposes.

CBT has been developed as a library covering a lot of different topics, as in the STCW 95 convention structure, with modules including navigation, cargo handling and stowage, control operations, health and safety, engineering, maintenance and repair, communication, language and IT skills etc. Shipping companies can also use CBT as a tool to conduct familiarizations training. This has been developed with the aim of letting the personnel get familiar with the specific ship, its equipment and the procedures for handling safety situations, like fire, evacuation, etc. At the same time the companies are using CBT to "shorten the distance" between the management in the company and the crew onboard the ship, which to some extent will improve quality and safety.

Vanstone (1997, p.63) believes that CBT can be very effective within the marine industry and ships at sea which significantly increases its effectiveness in refresher, revision and "just-in-time" training. He further notes that the process of CBT can be shown to be a cost effective and highly efficient training delivery solution and as a consequence can reduce the time required for company training, allowing a more effective allocation of training personnel.

Computer-based techniques for training and assessment have advantages and disadvantages. The Sub-Committee on Standards of Training and Watchkeeping, at its thirty-thirds session (January 21-25, 2002), recognized that advice on integrating computer-based technologies into training and assessment should be developed and given the widest possible dissemination (STCW.7/Circ.13, 2002). In the annex page 5, the potential advantages and disadvantages are identified (table 2, on the next page).

Computers are increasingly becoming more compact and powerful, being able to handle numerous applications with the increased storage capacity. The growing availability of CBT will further enhance the capability for the trainees to fully utilise the concept of onboard training. CD-ROM and Interactive Compact Disc (CD-I) allow the development of training packages that combine a high degree of reality with hands-on interactive involvement on the part of the user. It lends itself to skill acquisition in many ways particularly in relation to emergency response training.

4.3.2 Simulation

STCW 95 was perhaps the most effective catalyst in getting simulation more accepted as a training tool within the shipping industry. This means that simulators are not only used in nautical colleges as a training tool but also during the sea service. The last few years have seen an influx in simulator-based training in the maritime industry.

Simulator based training basically caters to intelligent/interactive computer based training where an actual onboard situation is simulated and action needs to be taken. With consideration of onboard environment, single-task and part-task simulators are the most suitable ones for mariners on-the-job training. The application of onboard simulation should not be limited for familiarization, but also for further advanced training on the simulators ashore.

Table 2 – Potential Advantages and Disadvantages of CBT

	Potential Advantages of CBT	Potential Disadvantages of CBT
1	Computer-based training is convenient as it can be available at any time either onshore or at sea.	This can be 'too convenient' leading to a reduced emphasis on making the training event as effective as possible.
2	Trainees can work at their own pace.	There is an optimum pace for most training. If trainees are allowed to progress too quickly they will retain less knowledge. If the course is too slow trainees will get bored. The pace of training must therefore be a course design feature.
3	Trainees can often go back over course material to reinforce their understanding of the material in question.	Trainees lacking in confidence may not progress as quickly as they otherwise should have.
4	Training material is presented in a far more interesting way than with many other forms of training.	Course designers can be tempted to 'dazzle' trainees with impressive graphics which can detract from achieving the specified learning objectives.
5	Three-dimensional images of equipment and structures e.g. an engine or an evacuation route, can be depicted to very clearly explain matters to the trainee.	The course designer must assume that the target audience can assimilate the information displayed.
6	Professional presentations by highly experienced tutors can be distributed on a world-wide basis using high quality voice over to clearly convey their training messages in many languages.	Care must be taken in translating training material to ensure that the intended message does not become changed through the translation process which poses a significant risk.
7	The training course can be designed for multi-level training so that the same course is suitable for a range of target audiences or to let trainees progress to higher knowledge levels in controlled stages.	
8	Exactly the same training material content is given to each trainee until the content is deliberately revised by the trainer, providing a mechanism for greater control over course delivery than non-automated training.	
9	Training records are very easily stored, transmitted to other locations, and managed for audit and verification purposes.	
10		Trainees cannot ask computers questions and so are limited to the pre-determined help facilities designed into the training course.
11		Computer equipment and software can have compatibility problems and some means of providing user support is required.
12	Long-term knowledge retention can be higher with CBT than many other means of training delivery.	
13		Computers can only provide training where the objective is to transfer knowledge; computers cannot transfer skills regarding psychomotor aspect to trainees.
14	Where the trainee is having a difficulty the computer can provide additional training input as a function of the trainee's responses to questions automatically.	There is limited ability for group learning.

Source: STCW./Circ.13. (May 29, 2002, p.5). In *Issues to be considered when integrating computer-based technologies into the training and assessment of seafarers*. London: Author.

Various simulators are available for simulation of different navigational manoeuvres like collision avoidance, watch keeping, restricted visibility, reaction to emergencies etc. Simulators are also available to simulate navigational aids like Radar, ARPA, GMDSS, engine room systems including main engines, generators, turbochargers and other machineries. Cargo handling simulators are also in place today to guide and help trainees to master the art of cargo handling on tankers, gas carriers etc.

Leading Danish shipowner AP Moller ordered 16 SimFlex On-board Training Systems, which were all installed onboard ships for cadet training at sea. The On-board Training Systems are used for training in rules-of-the-road and general ship handling so as to improve their proficiency and skills. By using the built-in e-mail system, cadets can be supervised by an external instructor – with the student offshore and the instructor onshore ("Moller Onboard Training System", 2001, p.15).

Transas has implemented the multi purpose High Level Architecture (HLA) interface that allows full integration between the various simulators providing the trainee with an integrated simulator complex instead of the typical stand-alone simulator solutions available these days.

4.3.3 Virtual Reality

In general, interactive training delivered via a computer has been reported to be more effective than traditional classroom lectures, leading to reduced training time and costs when compared with traditional classroom lectures. There is a form of simulation which, with appropriate software and delivery systems will shortly make available the concept known as "Virtual Reality (VR)". VR is a medium which allows the trainee to participate in a three dimensional computer generated simulation – "the virtual world". Within this virtual world are displayed three-dimensional objects which are the most important part of the system. It is unlike animation where a sequence of graphical representations is played concurrently with slight adjustments to each frame.

VR has rapidly evolved into a technology that today offers a cost-effective means of supporting the development of human skills in all types of applications in design, training and communication.

Is VR different from CBT? The answer is no. Stone and Paul (2001) point out that VR is a relatively new, but important form of CBT, sometimes placed into the category of "Computer-aided Instruction". VR brings a new dimension to CBT by allowing students to interact in a more realistic manner with the course content.

Vanstone (1997, p.65) asserts that VR is perhaps the leading edge of computer- based training where a combination of learning aids and techniques can be combined to cater for differing learning styles. He further says that persons trained using VR technology were shown to make fewer mistakes on return to the workplace than candidates who had been trained by more conventional methods. Candidates training in the virtual world have more freedom to experiment and perhaps making more initial mistakes than their workplace counterparts and as a consequence learning more quickly when the result of their action could be seen.

4.3.4 CBT Product Providers: Seagull and Videotel

Seagull (Norway), and Videotel (U.K.) are both the premier providers of work-related computer based training for the maritime industry.

Seagull Onboard library is an ever expanding collection of computer-based training modules that allows crews to study and be tested in a number of subjects. The library covers subjects such as navigation, cargo handling & stowage, operation & safety, marine engineering, electronics & control engineering, radio communications and maintenance & repair.

It is declared that nearly 1,500 vessels sail the seven seas with seagull's computer-based training modules onboard (Seagull News, 2002). Seagull customers include industry giants like Shell, Esso, Bergesen, TeeKay, V Ships, Stolt-Nielsen, and many maritime institutions.

Marine Training Catalogue published by Videotel contains over 350 computer-based and video-led training packages which seafarers can use onboard ships or offshore installations. Videotel has for many years specialised in producing and supplying them. Videotel also produces high quality computer programs and multimedia systems for training or/and assessment. Their Marine Training Catalogue is divided into the following ten sections:

- STCW-Navigation
- STCW-Cargo Handling & Stowage
- STCW-Controlling the Operation of the Ship & Care for Persons onboard
- STCW-Electrical, Electronic & Control Engineering
- STCW-Marine Engineering
- STCW-Radiocommunications
- STCW-Maintenance and Repair
- Other Subject Areas: offshore, oceanography, etc.
- Computer Based Training & Assessment Packages
- Computer Based (PC) Simulation Systems.

(Videotel, 2002)

4.4 Virtual Maritime Training Centre (VMTC)

Technology is available and especially better communication technologies between ship-shore are offered by satellite service providers. Thus there are no technological barriers to fully start the implementation of the so-called Virtual Maritime Training Centre (VMTC).

The VMTC is an environment where trainees can receive personalised learning material via their computer terminal, and where appropriate the software would contain exciting video streaming and simulation training. The program also has the capacity to simulate the facilities available at an actual MET institution ashore. Trainees can attend tutorials, look at notice boards and contact other trainees. Personal tutors can be assigned with direct communication to trainees. Furthermore the administrative side of a VMTC will be maintained with progress made and records of achievement. The VMTC does this by allowing the trainees to be in control of the software and for the software being easy to learn to use.

Mariners studying at sea could use this facility if they have access to broadband technology, and are connected to a VMTC link through a satellite transmission system. The training software has dedicated questions and experiences. The discussion topics are displayed against the author's name and the date when the topic was submitted. Trainees are able to view discussions and submit new topics for discussion for the promotion of new ideas. Trainees have to agree to a code of conduct before they can enter the discussion area. This reminds students about keeping their comments and activities legal, not to send junk mail through the discussion board and show respect for the other users.

As identified by Captain Mantel and Professor Pourzanjani (2000, p.5-10), a Virtual Maritime Training Campus must consists of the following basic components:

- Centralized training facility (Shore Based)

Remotely accessible:

- User Database
- On going training curriculum (IMO to get involved and to set standards for this?)
- Exercise databases (Ports and Mathematical Models)
- Exercise scenarios (Bridge, ARPA, Engine Room, Communication, Emergencies, or fully integrated exercises, etc)
- Evaluation criteria.

Its relationships are also indicated as in figure 6. Based on these requirements, they further point out that besides the necessary training programs and associated tools, it is important to be able to:

- View real data in real time from remote locations
- Control from the remote location
- Live feedback from the on line tutor (unlike the standard e-mail support which currently is widely used in distance learning programs)
- Interactive software
- Chat rooms for participants.

The concept of bringing the training centre into the seafarers cabin has been proven. The only barrier to its success now is the reluctance of shipowners to invest in providing the satellite dish and the computers onboard to allow the seafarers to have access to such training programs within a virtual training environment.

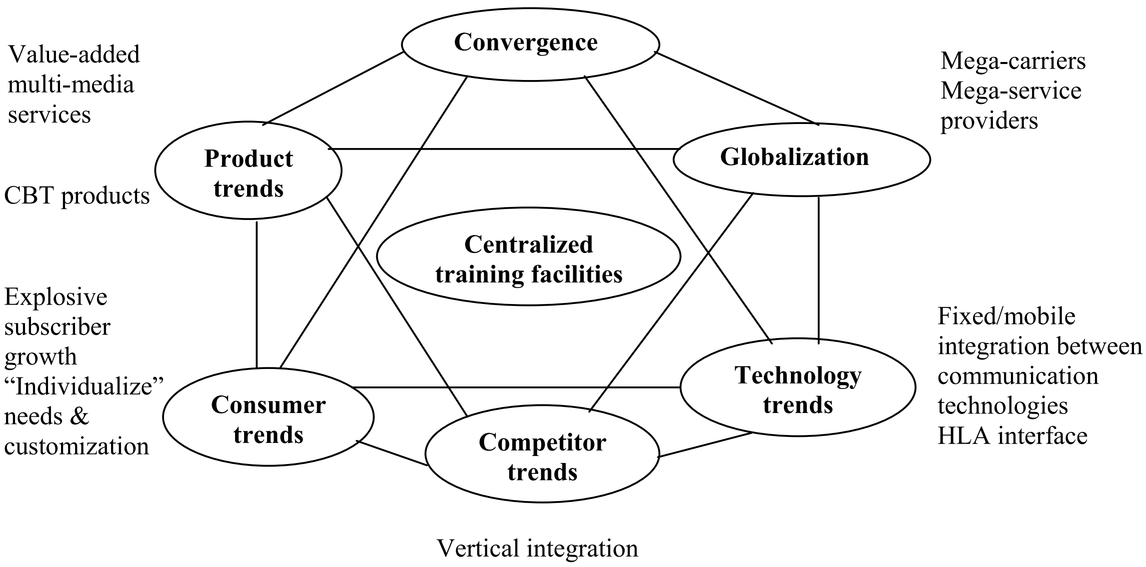


Figure 6 Virtual Maritime Training Centre

Source: Mantel, P. & Pourzanjani, M. (2000). The future of onboard simulation. In *CBT@Sea 2000: Onboard computer based training (CBT), 11-12 October, London* (pp.1.10-7.10). London: Nautical Institute.

4.5 Video-aided Training

Video-aided training programmes were probably the forerunner of the onboard electronic training facilities and the productions made are of high quality, informative and effective. Training videos, if used in an interactive way, can stimulate trainee learning, increase enjoyment and enhance information transfer. However, according to Holder (2002, p.23) training videos are an aid to training, not a substitute for it, and will only be partially effective unless properly used as part of a structured programme.

If training videos are used as part of a structured training programme, they can help to reinforce a message through visualisation. They can be used to introduce or summarise a topic or activity and to stimulate thought and discussion. If shown in clips or segments interspersed with activities and discussions, they can be a particularly powerful training tool. Videos can cover subjects from the very basic to the highly detailed ones with the benefits of moving images to support the learning points interspersed with animations, photographs and diagrams.

When using a training video, the purpose should be clear, i.e., why it is being shown and how it will contribute to the overall objectives of the programme or activity. A training video should be chosen which is both relevant and up to date – no videos for the sake of videos. It should be previewed to assess its content and comprehensive points should be made.

To support shipboard training, libraries of specific training videos are now becoming increasingly available for group and individual use which are developed by professional companies. Video training programmes can also be tailor-made specifically for a company for subjects such as introduction, company procedures and specialised equipment operations. Therefore, the makers of professional training videos should be able to draw upon experts in technology, ship operations, training and presentation and both trainer and trainee benefit from that input. Good videos are particularly useful for improving motivation and encouraging awareness of the need for safe and efficient operations.

Except for videocassettes, two important developments in video technology are DVD (Digital Video Disk) and VCD (Video Compact Disk). DVDs and VCDs are CD-based formats that are much easier to handle and store than cassettes. VCD is popular in the Far East, but is less widely used elsewhere. DVD will allow high quality full-screen video plus all the advantages of interactive computer programmes. They can play on both a standard TV screen and on a computer. For shipboard use, it is possible to supply videos in VCD format, but they are not normally interactive, they simply play the video in the same way as a videocassette. By comparison DVD can offer better quality images, choice from on-screen menus, interactive training, assessments etc, so most people see the next major step forward in training as fully interactive DVD.

4.6 Means of Communications

There are two primary forms of communications utilized in technology-based training onboard: synchronous and asynchronous. The main distinction between the two is whether the shore-based trainers and onboard trainees participate at the same time or not.

The major means of communications, on which tutoring, discussion etc. are based, can be: E-mail, Two-way Multipoint Chat and/or Audio & Video Conference, NetMeeting, Bulletin Board System, Listserv, Database Discussion Board, Telex, Wireless Telephone & Telex (Both available via Satellite or Coast Radio Station).

CHAPTER FIVE

TRAINING ONBOARD: IMPLICATIONS FOR PROMOTING A SAFETY CULTURE AT SEA

5.1 Introduction

It is well known that human error is the primary cause of shipping casualties (80%). Quite apart from causing unrecoverable expenses, an accident or casualty resulting from poor crew training can lead to non-compliance with the ISM Code as well as the STCW Convention and to problems with Port State Control (PSC). If individual crewmembers are not performing to the highest standards, the company's competitive position may be compromised.

> While these international standards have resulted in marked improvements in casualty records, greater attention on human resource development, in particular, training, to foster a stronger maritime safety culture is needed. At the same time, continual training of seafarers to up their proficiency is important given the advent of the technologically advanced navigational systems.
>
> (Kong, 2002, p.3)

It is recognized by the shipping industry and is not a new concept that for seafarers, if the environment changes, such as new ships or new technology used in modern equipment, being promoted to a higher position onboard, they will need further training. Otherwise, they could encounter difficulties in dealing with some situations that affect the safety at sea, prevention of pollution or safety of life.

IMO confirmed at the World Maritime Day 2002 that "safer shipping demands a safety culture", for which seafarers quality and competence are the essential components in a comprehensive safety culture at sea. On the other hand, IMO launched a new project in the same year, which contracted with WMU to develop "self-paced, self contained, interactive distance learning program on CD-Rom drawing upon IMO Model Courses and other international guidelines". It is expected that the software delivery platform (Html based) will provide "a model for further education and training outreach to the international maritime community by WMU and IMO in the future" (Muirhead, 2003). Thus the training packages can be eventually delivered by CDs or online via Internet for the seafarers training onboard.

5.2 A Brief Overview of the Safety Management System (SMS)

As addressed earlier in Chapter three, the ISM Code was established to promote a safety culture in the shipping community both among the seafarers and ashore. It incorporates a proactive approach to accident prevention or risk management by its requirement to have clear written procedures for many activities onboard. It requires contingency plans in place for identifiable emergency situations which might arise. There are also requirements with regard to the training and familiarization of people and the maintenance of the ship and equipment, so that a constant improvement on routine and emergency operation can be achieved. There is also a very clear reactive approach to accident prevention or risk management. Not only must they be reported but also corrective action must be taken and checks carried out to ensure that the corrective action is working.

The ISM Code is an international instrument to reduce or eliminate marine casualties with emphasis laid on preventing accidents due to human errors. It itself very briefly and deliberately sets out general guidelines on the requirements of a Safety Management System (SMS). The principal objectives of SMS (IMO, 2002) are:

- Safety of lives, ships and properties at sea, and protection of marine environment,
- Observance of relevant laws, regulations and rules,
- Observance of recommendations and guidance of IMO and other maritime organizations,
- Preparedness for emergencies,
- Improving safety management techniques and emergency responses, and
- Safety training, drills and safe environment.

With the ISM Code, we expect every ship to have the appropriate procedures and documentation to enable it to operate safely. It gives the shipping companies a tool to enable them to enhance the quality of operations. It ensures that processes are in place and implemented. A company that develops and implants an appropriate SMS, should have an important reduction in accidents that could cause injuries to persons, and damages to environment or to the property. Meanwhile human resource training, especially shipboard personnel training, is highlighted unprecedentedly for its role in achieving such SMS objectives.

On one hand, ISM Code requires that company shall establish and maintain procedures for identifying the training needs and provide the training of all personnel activities affecting quality, safety and pollution prevention. On the other, it also requires proper observation and analysis of seafarers' competency and arrangement of manning. As a result, the implementation of corrective action will in many cases require additional training. The training system adopted should generate objective evidence that individual staff have met the training requirements. On job training may frequently be appropriate in meeting this requirement (Chauvel, 1997, p.94).

To be effective, safety management onboard must be systematic and continuous. Safety is not a problem which can be solved and then put aside. It is a permanent feature of how everyone onboard works and lives. What this means is that every ship needs a properly functioning system for managing safety. Eventually, “The application of the ISM Code should support and encourage the development of a safety culture in shipping” (IMO, 2002, p.25).

5.3 The Role of Training Onboard in Safety Management

Prasad (1999, p.42) identified two factors due to which quality of the seafarers had gradually deteriorated. One is seafaring profession was no longer attractive for the young people in traditional shipping nations; another is due to the decline of “on-the-job” training which was prevalent on the ships belonging to the traditional ship owners for the purpose of keeping continuity and loyalty of employees. This depletion of the shipboard staff as well as their professional standards had an evident damaging effect on the quality of operations, which potentially threatened safety of the shipping industry. The advent of advanced technologies which renewed the methodology of training onboard, has come into spotlight in recent years. It brings great opportunities for improving seafarers knowledge and skills without absence from their job.

A seafarer learns his/her profession from training and experience. Although in the context of STCW 95, the issuance of a certificate of competence presupposes that a seafarer has both the knowledge and skill to perform specific tasks onboard ship, but the certificate does not guarantee that the seafarer would consistently exhibit proficiency of all shipboard operations and attitude of safety in all that he/she does. People working onboard ships have to realize that in a global industry, certificate of competency may get a job, but professionalism is what allows to keep it. Onboard training therefore is critical for maintaining their comprehensive knowledge and skills that are essential for accident prevention and safety in shipping.

Safety is defined as “a perceived quality which determines to what extent the management, engineering, and operation of a system is free from danger to life, property and the environment” (Pourzanjani, 2003). The standard of safety can, to a large extent, be improved through education and training (Kuo, 1998, p.170). In relation to matters concerning safety, seafarers onboard training can be of two distinct but interrelated kinds, i.e., reactive and proactive training. People who learn and gain experience from problems which occurred are regarded as reactive training, while training conducted before people need it is regarded as proactive training. Reactive training emphasizes problem solving; while proactive training is to be future-orientated. With regards to these two concepts, Chapter two will be helpful for your understanding. It can be incorporated into SMS as an effective means to facilitate onboard operational skills and promote safety consciousness.

The training methods above can be critical for SMS related training onboard. The system itself is dynamic and requires shipboard personnel to undertake safety related training as statutory or non-statutory requirements. A continuous improvement of knowledge and skills is needed in order to strictly follow the prescriptive onboard operational procedures. This is the proactive training approach. Furthermore, a reporting system in SMS is required so that accident precursors can be identified. Unsafe practices, near misses and potential causes must be identified in the report by the people involved with the work onboard. The system can gather, maintain, analyse, edit and distribute information on safety problems or situations. Subsequently, training should be taken to quickly address what has happened and how it can be prevented. This is the form of "lessons learnt", i.e., problem-solving or reactive training approach toward safety.

To particularly mention in terms of the role of reactive training, case studies can be used in this instance as a discussion topic to generate an understanding of how current training either failed or was inadequate for this particular example. Such case studies developed out of accident reports for training purposes could be used in shipboard simulators and such incidents should not necessarily be restricted to collisions or groundings but could also embrace cargo handling and/or main engine operations.

Establishment of onboard safety training scheme is critical in breaking the error chain that leads an accident, and risk is expected to be mitigated significantly. Sagen &

Mitchell (2002, p.4) draw the conclusion that the application of a properly designed action plan can reduce accidents by at least 50% over a three to four year period. By updating and implementing the plan again, further reductions of the same order of magnitude can be achieved until accident rates are reduced to a small percentage of their original levels.

Kong (2000, p.6) insists that the most effective way to enhance safety and reduce risk is the application of sound quality management principles and placing emphasis on people, both operators and managers of ships, enhancing their training and ensuring that they are properly qualified.

5.4 Training Onboard and Human Factors

As we know, in the shipping community there is a growing awareness of the role of the human factors in ship casualties. Success or failure of any operation will be dependent upon the human factors. It is commonly agreed that the great majority of seafarers are not sufficiently educated and trained for the safe operation of ships. This requires, quality seafarers for quality ships run by quality operators, as quality determines the level of safety for the ship and the protection of the marine environment.

Marus Hand's (2002, p.8) view is that the human factors have been identified as one of the most important in terms of ensuring maritime safety. To ensure the quality of seafarers and other skilled maritime personnel, training is a highly important factor.

It is true that mistakes are possible even after taking the required precautions, but the more that is done to guard against them the less likely they are to occur (Bist, 2000, p.18). IMO notifies that "the safety of life at sea, the marine environment and over 80% of the world's trade depends on the professionalism and competence of seafarers" (IMO website). The human factors are complex multi-dimensional issues that affect maritime safety, security and marine environmental protection. All need to co-operate to address human factor issues effectively, to provide effective means to educate seafarers so as to increase their knowledge and awareness of the impact of human factor issues on safe ship operations, so as to help them do the right thing.

Research into a number of marine casualties has, however, revealed that human errors are the governing causes. The statistics conducted by the United Kingdom (UK) P&I Club demonstrated that shipboard personnel (deck officer, engineer officer and crew) are listed as 44% of all in terms of main causes of major claims (figure 7). As a result, the importance of human factors when approaching safety in terms of software has increasingly become the centre of attention.

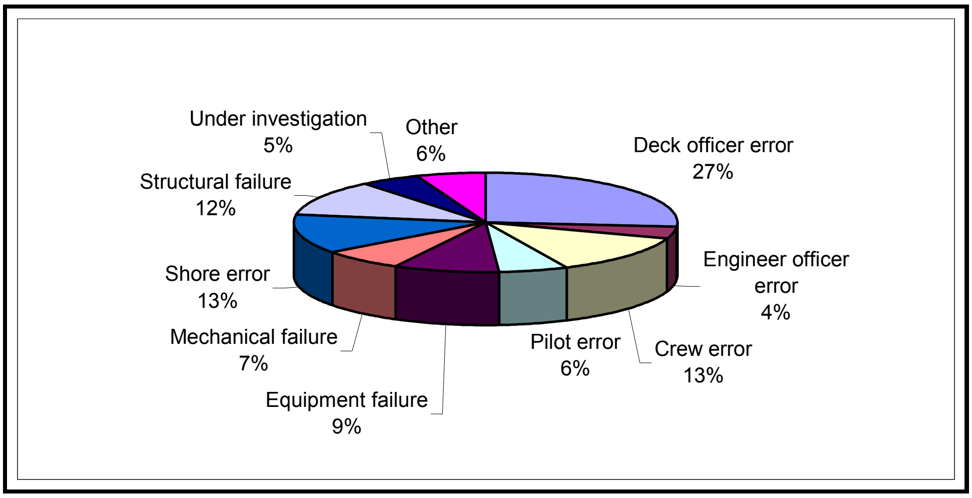


Figure 7 Main Causes of Major Claims (UK P&I Club)

Source: Chauvel, A. M. (1997, p.10). *Managing safety and quality in shipping*. London: Nautical Institute.

Human errors are classified into three categories: Knowledge-based error, Rule-based error and Skill-based error (Reason, 1990). Education and training play a unique role in reducing these errors. Obviously, errors can be caused by a lack of either knowledge or experience, or a combination of the two. Typical examples in the maritime context would be: an officer taking incorrect decisions because he is not fully familiar with the ship; or an instrument being incorrectly used or its information misinterpreted, because the operational procedure is not understood. In general, this type of error can usually be reduced by training and by exposing crew members to potentially difficult situations under supervision.

Confusion is often caused by poor or ineffective communication between various parties involved. Typical shipboard examples would be misunderstandings arising from a range of native languages among the crew, or different uncommunicated intentions among team members in decision-making. To a large extent this type of error can be overcome be careful adequate in-service training of crew members.

Everyone involved in shipping benefits from making the industry safer. Accidents cost money and can result in claims from customers, so shipping companies benefit from their reduction. Improvements in safety benefit customers by reducing the damage and delay which accidents create.

The weakness of the human factors has far more serious consequences if an accident occurs in the transportation industry. This is especially true in cases involving: high-speed performance, a great number of passenger and hazardous cargoes. Detailed analysis of marine transportation accidents shows that these accidents are often the results of multiple causes.

The negative effect due to the weakness of the human factors cannot be eliminated, but it can definitely be reduced to a minimum. Shipowners and operators can take measures in this respect such as implementation of a proper training scheme for the sea staff. These measures will greatly assist them in performing their duties efficiently and in avoiding or reducing the consequences of an accident if and when it occurs.

The method identified by Ioannidis (1996, p.6), is how to effectively reduce the weakness of the human factors in sea transportation. His research demonstrates that it can be achieved by proper initial and recurrent training, which should include but not be limited to:

- The importance and effectiveness of planning ahead;
- The importance and effectiveness of applying at all times the proper procedures during all phases of operation, according to the relevant manuals and/or checklists;
- The importance and effectiveness of briefing and de-briefing of the team which will participate in or which has anticipated in any specific operation, so that each participant will know what is expected from him in normal operation or in case an abnormal or emergency situation develops. During de-briefing, he will be able to assess his performance under normal, abnormal, or emergency, if any, situations;
- The importance and effectiveness of crew coordination and teamwork concepts, and of simulator training; and
- The importance of strictly complying with all national and international regulations.

Thus, in order to achieve good results, training should be incorporated into the overall developmental strategy, which aims at enhancing safety and efficiency at work at all levels within a company. Significant reductions in the numbers of casualties as well as cost savings through reduced premiums are hopefully to be achieved.

5.5 Risk Mitigation through Training

Lessons learned from past accidents show that safety is the fundamental issue to deal within the shipping business. It is proved that Formal Safety Assessment is essential for risk management in ship operations. However, risk control of ships is usually done by seafarers onboard ships. Therefore, seafarers need to be encouraged to become more involved in risk management and suitably trained.

> Identification of risks cannot be considered a static one-time process. This has to be a continuous and dynamic process requiring involvement of the persons best suited for such identification, i.e. the persons onboard. They should be educated and

> trained to act proactively to deal with potentially critical situations. Special skills are to be developed to get to the real cause rather than the immediate cause or the usual blame on material failure.
>
> (Prasad, 1999, p.46)

Accidents onboard are much more likely if policies are unclear, responsibilities are undefined, procedures and controls are absent or only exist on paper and training is inadequate and inappropriate.

If an accident does actually happen then it usually involves loss or suffering of one description or another-frequently financial, sometimes environmental and often personal loss or suffering. It is perhaps possible to adopt a much more positive response and learn from the incident by analysing the events and situations which culminated the accident, identifying the mistakes and other contributory causes and implementing procedures which will reduce the chances of such a set of circumstances coming together. Subsequently the chance of such an accident happening again is therefore reduced.

Risk is defined as "a measure of hazard's significance involving measurement of its consequence and probability of occurrence", and the well-known risk equation is "Risk=Probability x Consequence" (Pourzanjani, 2003). To improve safety, risks should be reduced as low as reasonably possible. We can reduce risks, which could be achieved by either reducing the probability and/or the consequence, but to do so we must understand the underlying causes and factors which contribute to the two elements of the risk equation.

Bahr (1997, p.155) states that Human Error Probability (HEP) is measured by observation and it is the relation of the number of the observed errors to the total number of chances for errors, i.e., HEP = number of errors that occurred / number of opportunities for errors to occur = n/N. This simplistic calculation really entails much more work to be done. In developing HEP, it is important to consider data probability distributions, data dependence, and uncertainty limits.

Kuo (1998, p.81) identifies three types of methods that may reduce risk: management methods, engineering methods and operational methods. Except for engineering methods which involve design or construction of the ship or equipment, the other two methods directly address the real problems involving human factors. The management methods highlight effective communications amongst crew and willingness to put resources into training of staff specifically in safety matters in order to enhance the safety competence of each individual. The input of corporate safety culture is particularly addressed from management ashore. Operational methods involve devising appropriate procedures for doing safety-critical tasks and improving the competence of personnel in these tasks by regular practice. Human issues, particularly training of seafarers, are the central points. In practice, it is usually necessary to employ a combination of the above three methods. In a typical example, risk reduction can be achieved by introducing a modified piece of equipment in the ship or system, providing required operational procedures for its use and devoting resources to training crew members so that they reach the desired level of competence in using that equipment safely. In addition, it may be useful to educate the crew so that members develop a positive attitude to the use of the modified equipment.

It is impossible to ascertain with a reasonable degree of confidence exactly which of the incidents reviewed might have been averted if the ship's personnel had taken onboard training programs, or if some other special trainings were followed. However, it is clear that more emphasis on this requirement would reduce the general level of risk on an average basis.

Many shipping companies require each ship to have a designated Safety Officer, Safety Supervisor and a Safety Committee. This is an effective scheme of which one of the commitments is to address crew training needs and implementation of just-in-time training. Their tasks include ensuring the onboard staff receiving the required familiarization, instruction, training and practice. The training concerning safety matters should relate the particular risks faced by each individual concerned. It should aim to help make the ship a safe and healthy environment for all members of the crew to contribute actively to make safety an integral part of training. The ultimate purpose is to reduce risk (both possibility and consequence) through onboard training. That is a goal well worth aiming for in the shipping industry and on every individual ship.

5.6 Implications for a Safety Culture

An organization with a safety culture is one that gives appropriate priority to safety and realises that safety has to be managed like other areas of its business. For the shipping industry, it is in the professionalism of seafarers that the safety culture must take root in. That culture is more than merely avoiding accidents or even reducing the number of accidents, although these are likely to be the most apparent measures of success. In terms of shipboard operations, it is to do the right thing at the right time in response to normal and emergency situations. The quality and effectiveness of that training will play a significant part in determining the attitude and performance - the professionalism - the seafarer will subsequently demonstrate in his/her work. The attitude adopted will, in turn, be shaped to a large degree by the safety culture of the shipping company.

The concept of safety culture may vary in different books. One frequently used definition describes the safety culture of an organization as "the product of individual and group values, attitudes, perceptions, competencies and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organization's health and safety management". It is further broken down into three constituent parts, which are: 1) the health and safety management of an organization, 2) commitment, style and proficiency, and 3) values, attitudes, perceptions, competencies, patterns of behaviour ("Safer Shipping," 2002, p.10). Safety culture at sea is further identified by Valkonen (2001, p.10) as "the way in which the maritime community acts in various seafaring situations, by common consent and with the strong approval of community, for the purpose of avoiding risks to human life, ships and cargo and for the protection of marine environment". It is common sense that safety culture is a prerequisite for profitable business.

"The implementation of the STCW 95 and ISM Code are two tools to establish a safety culture in the shipping industry" (Veiga, 1998, p.109). Both put a considerable emphasis on education and training. The way seafarers are trained and educated will play an important role in the implementation of a safety culture. Hanson (1997) also points out that any training that seeks to construct behaviour, or create a culture, is a long process that requires continuous reinforcement to be successful.

Safety culture is very important to all personnel onboard and emphasises that it is not simply business as usual but depends on the individuals onboard ship and their personal behaviour. Individuals must take responsibility for their own actions and should be held accountable for those actions. However, development of onboard safety culture is a team effort and should be the desire of every person onboard.

The establishment and maintenance of a safety culture is only possible through the continuing efforts and commitment of the people involved. On ships, that means the seafarer. The essence of a safety culture is taking the safe approach rather than necessarily the quickest, easiest or cheapest (Winbow, 1998, p.3).

The research made by the International Shipping Federation (ISF, 2001) shows that:

> For approximately every 330 unsafe acts, 30 are likely to result in minor injury. Of these 30 minor injuries, one is likely to be a Lost Time Accident (LTA) with a cost implication for the company. Thus every time 300 unsafe acts are prevented an LTA is likely to be prevented. More to the point, however, statistics have shown that if 30 LTAs are prevented a life will probably be saved (p.2).

Thus the challenge for the trainers and training managers ashore and afloat, is how to minimise these unsafe acts, how to instil not only the skills but also the attitudes necessary to ensure safety objectives are met. The aim should be to inspire seafarers towards firm and effective self-regulation and to encourage personal ownership of established best practice. Internationally recognised safety principles and the safeguards of best industry practice have to become an integral part of an individuals' own standards.

With most casualties resulting from man's imperfect nature, the need to fill the gap between advanced technical standards and better, more responsive, safety-conscious management became self-evident (Eriksson & Mejia, 2000, p.20). Essentially there is a need for respect of skills, experience and abilities of the workforce. Respect must be earned, and this requires a major training investment on the part of the organization. Reason (1998, p.196) identified four critical subcomponents of a safety culture: a reporting culture, a just culture, a flexible culture and a learning culture. Together they interact to create an informed culture – the one in which those who mange and operate the system have current knowledge about the human, technical, organizational and environmental factors that determine the safety of the system as a whole.

Promoting a safety culture within the shipping industry is a key objective. To a large extent this should be achieved through proper implementation of the ISM Code, which effectively requires companies to embrace a safety culture through a commitment to continuous improvement of their safety records. Seafarers' education and training will hold a strategic position in shaping seafarers professionalism, and the professionalism of seafarers will further help to build up a sound safety culture in the shipping companies. Many ships' officers and crews need more training if they are to fully embrace the safety culture which is so important.

5.7 Focus on Training: A Case Study of the *Royal Majesty*

Accident Overview

Although the casualties examined in the case studies are indicative of the multiplicity of things that can go wrong in a ship, the great majority of the cases are an unfortunate combination of factors that lead to an accident. The *Royal Majesty* accident is also not an exception.

The Panamanian ship *Royal Majesty* grounded on June 10 of 1995 on Rose and Crown Shoal about 10 miles east of Nantucket Island, Massachusetts. She was about 17 miles from the position fixed by the Officer of the Watch (OOW). The ship was en route from St. George's, Bermuda, to Boston, Massachusetts with 1,509 persons onboard. Damage to the ship and lost revenue were estimated at about $7 million. However, there were no deaths or injuries on account of this accident.

After the accident, the United States National Transportation Safety Board conducted investigation from the following major safety issues: performance of Royal Majesty's integrated bridge system and global positioning system, performance of the *Royal Majesty*'s watch officers, effects of automation on watch officers' performance, training standards for watch officers aboard vessels equipped with electronic navigation systems, integrated bridge systems, design installation, and testing standards for integrated bride systems. It was found that they all had contributory factors that led the accident. Since the ultimate resource of any organization is its personnel and human factors are heavily involved in the accidents, with reference to previous discussion and the subject matter of the thesis, the author will highlight technical problems as well as seafarers training problems from this accident.

Technical Factor

Automation has become more prevalent on commercial ships, affecting such areas as engineering, bridge, and cargo operations. When designed properly and used by trained personnel, such automation can be helpful in improving operational efficiency and safety. However, when designed poorly or misused by undertrained or untrained personnel, automated equipment can be a contributing cause to accidents.

In the case of the *Royal Majesty,* the failure of the GPS antenna connection and the subsequent failure of NACOS 25 autopilot to recognize the GPS data as invalid are basically the technical factors that led the accident.

Deficiency in Staff Training

The most frequently cited problem was the misuse or nonuse of automated equipment. Lack of training can be a great problem. The watch officers, in particular the second officer and the chief officer, abandoned the good watchstanding practices of properly monitoring and cross checking the progress of their vessel. Instead, they relied almost solely on GPS and the ARPA display to provide them with information about the vessel's movements. They failed to detect the ship's errant navigation for more than 34 hours. None of them determined that the GPS had switched to Dead Reckoning (DR) mode or that the *Royal Majesty* had been on an errant course throughout the trip from St. Geoge's. Further, the chief officer and the second officer, who stood the last two watches before the grounding failed to recognise that the *Royal Majesty* was on an errant course.

Based on these facts, the Safety Board further identified that although the manufacturer of the NACOS autopilot, STN Atlas, had simulator training available to purchasers of the system, the owner of the *Royal Majesty* has not purchased any training. The investigation determined as stated in the report that:

> The watch officers on the *Royal Majesty* during the grounding were familiar with the basic operation of the automated navigation equipment, but that no one, with the possible exception of the navigator, appeared to be fully proficient with the system, as evidenced by the lack of knowledge about the GPS receiver's DR mode capability.
>
> (National Transport Safety Board, 1995, p.40)

An example is that the second officer's training and familiarization to automated navigation system was conducted by reading the operational manuals himself and observing bridge operations by the other officers. As a result of this limited scope of training, he probably had very little experience in recognizing and coping with malfunctions.

The Safety Board concludes that "the on-the-job training program employed by Majesty Cruise Line to train the *Royal Majesty*'s watch officers in the operation of the integrated bridge system did not adequately prepare the officers to identify and respond to system malfunctions" (p.40).

Therefore, the Safety Board believes that Majesty Cruise Line should "provide initial and recurrent formal training on essential technical information, equipment functions, and system operating procedures to all bridge watchstanding personnel on all of its ships that are equipped with integrated bridge systems" (p.40).

The accident consequently raises concern that the inadequacy of training given to the crew of the *Royal Majesty* may be typical of the industry. The grounding of the *Royal Majesty*, however, shows the need to address procedures for training not only for automated navigation system, but also for all the safety related operations and issues.

CHAPTER SIX

MAJOR ISSUES AND FACTORS AFFECTING TRAINING ONBOARD

6.1 Computer Literacy

Although STCW 95 does not specifically lay down computing as a required topic, the requirements of the functions for various levels of certification demand familiarity with computers today. Personnel in the shipping industry both at sea and ashore will however need to have a fundamental grounding in computing skills.

Computers invaded the marine sector in the early and mid 1980's and since then seafarers have grown tremendously dependent on these machines. "The growing use of computers onboard for communication and marine applications is now becoming the norm. Presently some 3000 ships use ship management applications" (Tan, 1999). Since the complexity and sophistication of shipboard systems on modern vessels are computer based, the need for computer skills based application is indeed necessary.

There is a general gap between technological advances and training where changes are imminent prior to designing compatible training programs, and the Human Computer Interaction (HCI), is now at its widest gap (Huggins, 1998). Furthermore, the major source of officers today has swung to the Asia-Pacific region. Current surveys (CIIPMET, 1998) show that many institutions in the region lack modern computing resources and traditional teaching methods hold sway. A survey conducted among Nautical Institute's members revealed that 83% of responding seafarers had no IT training at all and claimed to be self-educated (Speare, 2000). Thus the skills of seafarers employed from this region, particularly computer skills which most shipboard automation is based on, have become a critical issue.

The good thing is that due to the automation onboard, computer literacy of an average seafarer has improved over the years, but it still is far beyond the optimal situation. Thus using computers as an onboard training tool for transferring knowledge and skills to the seafarer is within a limited scope.

6.2 Quality Issues

While considering a training program onboard, the objectives and scope of any training programme needs to be defined clearly. A training strategy should be established, identifying who needs training to what level and how these training needs should be met. An analysis should also be made concerning the most effective form of delivery. The means of training delivery needs to be appropriate to the training objectives and intended outcome of the training.

A good planning obviously symbolises a good start. If a training program is under consideration, the reliability and validity of the programme should be focused. If training is involved in certification, the approval and acceptance of the authorities and the overseeing of assessment should all be taken into consideration. Besides, some other factors, which dominate the training quality, cannot be neglected at all.

6.2.1 Training Packages

“Educational research indicates that we learn 20% of what we see, 40% of what we see and hear, and 70% of what we see, hear and do” (Muirhead, 2000, p.60). In line with this finding, the combination of computers, networks and multi-media capabilities, is clearly a formidable training tool. It is also indisputable that the right training packages (including online and offline delivery), used at the right time, must improve the quality and efficiency of seafarers' training.

No matter what kind of training that is to be developed, all programs need to be based upon proven principles of instruction which conform with training objectives and standards. With reference to Holder's (2000, p.17) idea of identifying the right CBT products, the author outlines the key points of developing a training package, i.e.,

- Improve the performance of all trainees
- More challenging, interesting and effective training materials are preferable
- Make training more flexible including progression, appraisal, updating, etc.
- Provide assessments, records and evidence of performance
- Wider access via Internet to shore-based database is preferable
- Online tutoring is desirable.

Although the training should look appealing and engaging, it doesn't mean to produce an "entertainments package", which will certainly undermine the very serious nature of the message it intends to convey.

6.2.2 The Role of IMO Model Courses

IMO Model Courses have been written to cover the minimum competences identified in STCW 95. The courses provide a convenient example of how education and training may be structured. In all cases the contents of IMO Model Courses reflect a recommended core curriculum. The courses could be a method to harmonisation of education worldwide.

Originally, "the Model Courses are meant to suggest and help professors, lectures and instructors in their teaching" (Horck, 2003). However, their use subsequently expands to seafarers who are in need of updating their knowledge or preparing for mandatory courses. The latest development is the Model Courses are the ideal reference for developing training packages.

With the emergence of technology based onboard training activities, more and more professional training package providers aim at this potential huge market. According to keynote address made by Secretary-General Mr William A. O'neil (2000) at the Nautical Institute Conference, "more than 100 companies around the world are now developing and marketing IT solutions tailor-made for the shipping industry". If all the training packages are developed based on the Model Courses, the validity and reality of training outcomes could be assured.

6.2.3 The Role of Shipboard Trainers

A shipboard competent trainer should be an experienced instructor as well as a good practical seaman. Thus, he/she may be from a maritime training institution or shipping company. He/she will be selected on the strength of his/her up-to-date experience and ability to communicate. Normally, he/she held a senior position during sea-going career.

No matter whether training activities are conducted on a training ship that belongs to a maritime training institute, or a shipping company's ship, the trainer plays a key role. A good trainer will be well prepared, use appropriate training aids to best effect, and will carry out a de-brief at the end of the session, to make sure everyone has "got the message"(Holder, 2000). The core of the training officer's role is still in guiding and encouraging trainees, indicating what they should learn and what they can do to become more proficient. Nothing will de-motivate the trainees more than being stuck on a point in their training process and have no recourse for help.

India Maritime College (Onboard training, see website) as well as International Maritime Training Centre (IMTC) (Onboard services, see website) which is located in northeastern part of Mumbai, can offer onboard training instructor who can board and sail on the vessel to impart training. The training contents and training duration can be discussed and customised as per owner's requirements.

An onboard trainer should also consider trainee's different learning style type. They are named as accommodator, diverger, converger and assimilator (Muirhead, 2002). The understanding of his/her learning-style type, including its strengths and weaknesses, is a major step toward increasing his/her learning power and getting the most from his/her learning experiences.

Furthermore, onboard training should be regarded as a continuous learning process and treated as an important part of the ship's day to day operation for the seafarers who are willing to receive training for the purpose of continuous professional development. A trainer may stay ashore to offer tutorial support via modern communication technology – he/she may be at a training centre or maritime college. This is to facilitate onboard training instruction, particularly in case of seafarer's need of instant troubleshooting onboard.

Assessing and Training the Trainer is an area that is often overlooked in all industries. Unfortunately, it is probably accurate to say that Masters, Chief engineers and other senior officers do not always make the best trainers. Nobody can deny their competences in knowledge and skill, but often their management abilities have not been fully developed especially in terms of the pedagogic understanding and execution of training programmes. The book *Practical Teaching Skills for Maritime Instructors* written by Fisher & Muirhead (2001), can be of great help for converting an experienced seafarer to a competent trainer.

6.2.4 Trainee Attitudes

When executing training program, the trainee must know what the performance criteria is. Thus prior to commencing training, it is necessary to brief him/her on the tasks and skills by which trainee's competence is to be determined.

Holder (2002) recognizes first priority in successful onboard training is motivation. Chauvel (1997, p.167) also insists that the will is the determination and desire to do and succeed in an undertaking. Without willing, knowledge remains a necessary but inadequate condition of success. It is a fact that if a trainee does not want to receive training, nobody else can make him/her do that. If a trainee demonstrates willingness to training, other people will be more inclined to help and advise him/her. Factors affecting the trainee's motivation to active participation of training may come from many aspects, family issues, trainee's physical and mental status, salary level, to name just a few. The company cannot neglect these potential problems overall, and should be supportive to solve them.

Besides motivation, the trainee should also understand that the ship and crew safety onboard rely on those who are being properly trained, so does trainee's own safety. The trainee's future employment and promotion will also depend upon effective training, so the trainee must hold a positive attitude to training.

6.2.5 Measuring Outcomes

Section A-I/6 of STCW 95 lays down specific requirements for any person conducting in-service assessment of competence of a seafarer. Assessors shall ensure that assessment criteria have been selected with optimum objective measurement and evaluation in mind, keeping subjective judgements to a minimum. This is normally leading towards a STCW standard of competence and national certification. The assessment methods should be efficient, not only in setting the correct standards and performance criteria, but also in terms of availability, time taken and cost.

IMO model course 1.30 covering onboard assessment contains very useful advice and guidance for personnel responsible for assessing the level of competence of trainees. IMO MSC Circular 853 issued on May 22, 1998 further provides with guidance on shipboard assessments of proficiency. This is designed to allow evidence of having achieved proficiency in certain competencies through onboard experience to be used in conjunction with the Training Record Book (TRB) to contribute to the overall assessment process.

It should also be remembered that there are also growing demands for continuous professional development such as refresher and updating training. The Nautical Institute conducted a survey among British seafarers on this type of onboard training (Giddings, 2000, p.3). It was found that the objectives of the training usually clearly defined, but the performance standards for successful completion were seldom or sometimes clearly stated (see figure 8 and 9). The results demonstrated that onboard training, on the whole, did not involve assessment.

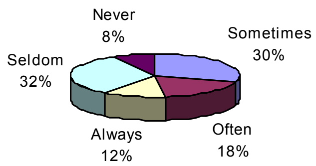


Figure 8 Training Objectives

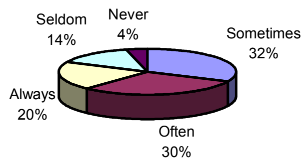


Figure 9 Performance Standards

Source: Giddings, I. C. (1999). Onboard training: An overview. *Seaways,* 3-5.

Based on the new technology development, Muirhead (1998, p.221) states that "onboard training activity can be monitored from ashore either by company training officers or by arrangement with a MET institution". Technological developments also provide possibility for the assessment of an individual's competence to perform the necessary skills in the workplace. An effective training assessment scheme is expected to be in place for improving and strengthening this non-compulsory but important training to the seafarers. The methods should be suitable not only for new entrants but also for mature and experienced persons wishing to upgrade or broaden their vocational qualifications.

6.3 Cooperation between Training Institutions and Shipping Companies

A survey among shipping companies conducted by Veiga (1998) demonstrates that the majority of them expect to improve cooperation with nautical academies with regard to seafarers' training. He concludes his survey stating that today, more than before, cooperation among nautical academies and shipping companies is necessary. It does not make sense that when the demand for quality in the industry is higher, the present and future seafarers are not trained to respond to such needs. If there is no relationship and cooperation among both of them, the implementation of a safety cannot be successful.

Onboard training will be greatly improved by cooperation between maritime institutions and shipping companies. The excellent trainers can be fostered through cooperation. Experienced sea staff have chance to lecture at the maritime academy to gain pedagogic knowledge, while lecturers from the nautical academy can work onboard company's ships to gain practical experience. With this kind of exchange program, the process of training the trainer, as a by-product of cooperation, can be accelerated and excellent trainers can be produced. Trainees onboard will definitely benefit much more from these trainers.

Veiga's (1998) survey demonstrates that eighty percent of the responders from shipping companies thought trainee's training was lacking in real practice. It was said that trainee's education and training ashore were against a background of the perfect ship in the ideal world rather than teaching them how to deal with the practicalities of real life at sea. If partnership is established between them, the attendance of company's senior sea staff to academic activities is feasible, and those problems can be addressed and trainee pre-sea education and training can be more objective-orientated. Morrison (1997, p.181) also highlights the importance of reviewing the coordination and interface of onboard training with shore based training. If trainee's pre-sea training is successful, it can be of great help for his/her onboard training, and the possibility to commit errors, which sometimes brings huge loss, will be significantly minimized.

Hence cooperation is a win-win policy, from which seafarers, shipping companies and maritime institutions will get obvious and direct benefits.

6.4 Investment and Cost Control

Though the initial capital investment incurred in setting up a shipboard training system which includes obtaining necessary equipment of software, hardware etc., is considerable, but all these can contribute to increased profits in the long term if right training programs are subsequently transferred onboard. Such profits can be realised in replacing the need for ship's personnel to attend institutions for similar training, reducing tuition and other institutional expenditure associated with provision of the required training. Huggins (1998) presents his view that the shipowner must first recognise the beneficial aspect of importing onboard training, which is dependent on managerial policies and objectives.

"Everyone responsible for training should remember that optimal training is not necessarily the cheapest training. Neither is it necessarily the most expensive" (Rogde, 2001). Training cannot be achieved cheaply: it requires a constant financial support. The outlay on training should be at par with other major investment decisions. Some companies failed to set aside adequate resources for the training function. Their plans for expansion and development would have been severely hampered by the unpreparedness of staff. Training cannot be seen as only a marginal influence over a company's present and future economic health.

A prevailing view among some ship operators is that maritime satellite communication is expensive. "The use of web-based training onboard ships was limited due to the high cost of satellite links" (Bievre, 2001). Whilst costs of transmission are high at present, the economies of scale resulting from the growing volume of use of the system together with high speed data transmission techniques, will be such that even the individual will be able to afford it to undertake onboard training at sea. For instance, INMARSAT F77 online chat applications take full advantage of the cost-effective Mobile Packet Data

Service (MPDS), which charges only for the amount of data sent and received, not the time online. Competition will force user charges down to levels that will encourage owners to consider using IT for a wider range of activities.

A further reduction in the call charges can easily be achieved by calling during “off-peak hours”. Many coast earth stations offer substantially reduced rates when calling during “off-peak hours”. By utilizing “off-peak rates”, satellite communication is also rapidly becoming a viable choice for seafarers paying for their own calls. Another economical approach to data transmission is to make use of data compression techniques. This is of particular value when sending large amount of files to trainees at sea. Pre-programming to take place during off-peak periods is also an economical way of sending messages.

As to standalone CBT training, one measure to significantly cut cost is to encourage sharing of CBT module with other trainees boarding the same ship and enrolled in the same course. Tan (1999) notes that if two or more trainees share the same CBT module, it will bring down the material cost to about 50% or more thus further reducing overall training cost.

Actually many companies are willing to pay for crew’s onboard training fees, at least part of them. A survey conducted by Mcdermot et al (2000) among British marine engineers demonstrates that half of Continuous Professional Development was paid for by employers, 20% by individuals themselves and 20% by both. Company sponsorship is encouraged, because after all the company is the one who benefits from having well-trained, competent and efficient mariners to safely manage and operate its ships and prevent marine pollution.

If training is conducted as an investment, it is not expensive. The cost of training is usually recouped almost immediately through savings from improved performance and fewer errors. It will certainly be recouped in the medium and long term. The opposite approach – poor training – will undoubtedly cost more in the long run.

6.5 Fatigue Aspects

Modern shipping has by far increased the frequency of fatigue amongst seafarers, especially officers and ships' masters. Time in port becomes shorter; shipping traffic becomes much denser; automation places more demands on the crew than conventional ship. Furthermore, Ships run under Flags of Convenience (FOC) do not – in many cases – comply with internationally accepted regulations, because the flag state does not enforce them. As a result, the crews on FOC ships are often insufficiently trained, too small in number, overworked and under permanent fear of being fired at any instant, all of which causes fatigue.

Professor Andy Smith, Director of the Centre for Occupational and Health Psychology at the Cardiff University, holds a view that when a person is fatigued performance may deteriorate and the body's physiological functioning may be affected. The three outcomes, subjective perceptions, performance and physiological change are usually recognised as the core symptoms of fatigue (1999, p.63). Marcovitz on the eighth IMLA Conference (1994, p.17-3) points outs that "fatigue results in the degradation of human performance, the slowing down of physical and mental reflexes and/or the impairment of the ability to make rational judgements."

Under such circumstances where the seafarers face constant fatigue on their job, one can imagine what the outcome of training onboard would be like. Even if the training scheme of a shipping company has been in place, training may be a heavier burden to the seafarers rather than improving knowledge and skills which the scheme initially aims at. Fatigue may come from working hours, short sea trades, conditions of work and/or service, mental & physical status (Pourzanjani, 2003). Thus everyone involved in ship operations should be alert to the factors which can contribute to fatigue, including, but not limited to those identified by organization. The fatigue factors, like any other contributor to maritime casualties, should be eliminated – as far as possible – by the combined efforts of all the maritime community.

Seafarers' Hours of Work and the Manning of Ships Convention (No. 180) was adopted in 1996. Article five in Part II of the Convention states that the minimum hours of rest shall be 10 hours in any 24-hour period; and 77 hours in any seven-day period (IMO/ILO Guidelines, 1999, p.8). While Section A-VIII/1 of STCW 95 (2001, p.148) also states that all personnel who are assigned duty as officer in charge of a watch or as a rating forming part of a watch shall be provided a minimum of 10 hours rest in any 24-hour period. However, it may be reduced to not less than six consecutive hours provided that any such reduction shall not extend beyond two days and not less than 70 hours of rest are provided each seven-day period.

IMO and ILO have worked together to provide a *Guidance for the Development of Tables of Seafarers' Shipboard Working Arrangements and Formats of Records of Seafarers' Hours of Work or Hours of Rest*, which is a important tool to assist shipping companies to develop their working schedules. It is believed that the fatigue issue can be dealt with through the formation of mandatory requirements with regard to maximum hours of work and minimum mandatory rest periods and their strict enforcement.

6.6 Limitations of Training Onboard

As stated previously, it is recognized the importance of training institutions and shipowners to work more closely together to meet the new challenge. However, the cooperation may be difficult to achieve due to their respect independent status and unwillingness of mutual interference. If a training institution is financed by a shipping company, it is possible for the company to impose an educational and training system according to its needs.

The quality of onboard training is more difficult to define, because it is complicated by the inter-relationship between company policies and shipboard practices. If there is no commitment from management ashore, very little will be achieved onboard. The monitoring and verification of performance standards onboard also pose grave considerations.

Regarding training quality issues, the following questions should be carefully considered. Have the training programmes been subjected to independent review for reliability and validity? Have the test programs been accepted by relevant education and training authorities? Who is going to oversee assessment programs – ship's officers, company training managers, academic institutions or maritime authorities?

Although the provision of minimum rest hours is in place from the conventions, it is common for seafarers onboard to have frequent additional workload, which is always related to the safety and cannot be delayed. Consequently shipboard officers and trainees may not have sufficient time to devote to the onboard training activities.

Communication costs have dropped significantly over the years, but they are still not a small amount which can be simply dealt with. Broadband Internet access has been technically feasible, but the popular application onboard ships still needs some times to go.

Shipping companies in general are hesitant in considering additional expenses which are not mandatory. It is quite often the case that with reduced numbers of crew, the shipboard training often does not get beyond the statutory safety minimum of drills and exercises. It is also not rare that training is at the bottom of most company's schedules and easily interrupted by other priorities. They may even refuse to place training tools onboard ships, claiming that they will interfere with duties and create an additional and unwarranted workload. This is perhaps most applicable to vessels with short voyages or with reduced crewing levels. Not many companies have a culture that encourages development of new skills and the refreshing of existing skills.

The technology gives us a freedom of choice, concerning how we should or could train, but the technology cannot solve all our challenges. Technology in itself is not the solution – it is merely the tool. Technology based onboard training tools are fairly powerful and effective, but not all the subjects can be trained by them. They are well suited for cognitive skills training, but not well suited for psychomotor skills and attitudinal skills training.

CHAPTER SEVEN

EPILOGUE

7.1 Summary and Conclusions

Training plays an important and integral part in furthering human learning and development. In order to increase flexibility and maintain competitiveness, a company must look towards developing a more highly skilled workforce, cultivating specialist skills in new areas and attaining a higher level of systematic and effective training.

Both knowledge and skills can be acquired either ashore or onboard, but experience is a special training need, which one can only achieve by on-the-job training, especially for the seafaring profession. Thus training onboard, especially with the assistance of modern technology, is an ideal vehicle for enhancing seafarer's knowledge and skills.

Satellite communications have grown from a futuristic experiment into an integral part of today's "wired world". With application of digital compression technology, data content can be reduced considerably which result in the significant reduction of the communication cost. The introduction of the GMDSS marked the most important change in maritime communications. Satcom plays a major role in the GMDSS.

IBS is the core part of modern automated ship. It provides all kinds of information that the bridge officers need to operate a ship properly and safely. VTS plays a key role in the safety of ship navigation, effectiveness of traffic flow management and the protection of marine environment. The recent development, which is known as the Marine Electronic

Highway, or Information Super Highway, is a WIN-WIN solution for people of the littoral States and the shipping industry.

STCW 95 deals with seafarers and the standards to which they must be educated, trained and certified, while the ISM Code deals with corporate management and sets out how shipping companies must establish effective structures that create and promote a safety culture. The purpose of both, the STCW 95 Convention and the ISM Code is to improve the safety onboard ships. Both of them have direct impact on the seafarers training onboard.

Satellite and computing technology is well placed to provide an important link for training onboard ships. Web-based training, Computer-based training, video-based training, etc., as effective training delivery tools at our disposal, have opened up new avenues of knowledge and skill acquisition for seafarer's training onboard.

The standard of safety can be improved through education and training. Seafarers onboard training can be of two distinct and interrelated kinds, i.e., reactive and proactive training. They can be incorporated into SMS as an effective means to facilitate onboard operational skills and promote safety consciousness.

Success or failure of any operation is dependent upon the human factor. There is no difference in shipping. This requires, quality seafarers for quality ships run by quality operators. Training also plays an important role in reducing human errors.

An organization with a safety culture is one that gives appropriate priority to safety. Seafarers' education and training will hold a strategic position in shaping seafarers' professionalism, consequently professionalism of seafarers will further help to build up a sound safety culture in the shipping companies.

The impact of reduced and multinational crews, short ship turn round time and strict operational practice demands on the training at sea as a solution. Most specialised training like emergency response or cargo management can be better undertaken onboard than ashore. This suggests that any really effective way that might be found to transfer some of this training effort from ashore to ships is likely to be attractive.

The use of sophisticated and costly media and technology may detract from the cost-benefit relations, but this does not change the overall picture of training onboard as being economical. Though training onboard via satellite is quite expensive, it still boils down to the fact that the overall picture is nevertheless favourable if the indirect costs of the conventional courses are considered. Thus it can be said that shipboard training is a cost-effective way of improving and then maintaining standards of operational safety.

Cooperation between MET institutions/training service providers and shipping companies can improve the training quality and efficiency as a whole. It is also an effective way to train the trainer. Well-designed and user-friendly training packages help to promote training efficiency and effectiveness. Trainees' motivation and attitude directly affect training outcomes.

Modern shipping has by far increased the existence of fatigue amongst seafarers, especially officers and ships' masters. It is believed that the fatigue issue can be dealt with through the formation of mandatory requirements with regard to maximum hours of work and minimum mandatory rest periods and their strict enforcement.

Although all kinds of communications and interaction tools such as email, chat room and net meeting can help to reduce the distance, obviously psychological distance as well as feeling of isolation still exist and are difficult to totally eliminate. Modern technology cannot entirely overcome disadvantages of training onboard, in terms of seeking shore-based tutoring. However, it can be used to narrow the gaps.

Quality and efficiency are the key issues that affect success of any training activities. The major inhibiting factors that affect training onboard are recognized as lack of time and lack of experienced trainer support. Thus, presently training onboard cannot entirely be a substitute for shore-based training courses.

7.2 Suggestions

Cooperation between MET institutions/training service providers and shipping companies is a strategic measure in achieving success of training activities. The cooperation is anticipated to be strengthened, in particular in the area of training the trainers, the curriculum and training package development.

Traditional MET institutions are highly recommended to develop and deliver training packages commensurate with their expertise and competent professionals. They are also recommended to actively participate in shipping company's training program development as well as onboard service. In the latter, seafarers will be motivated in the organization of training activities while the senior officer act as a professional trainer as well.

Shipbuilders or manufacturers of equipment are preferred to develop their customized training packages for the convenience of crew's familiarization, other than just offer self-taught manuals or handbooks. It will greatly help in terms of seafarer's shipboard operations and maintenances onboard.

The available training methods should be as part of a more holistic concept of blended training. The means of training delivery needs to be appropriate to the training objectives and intended outcome of the training. Training should be designed for a target group and be appropriate to the needs of the trainees. It is recommended that training facilities or systems should be standardised so that the trainees can transfer between ships without having to learn different operating systems and also for ease of maintenance.

Some of the training packages incorporates informal self-assessment of knowledge or documented formal assessment leading to statutory evidence of theoretical competence.

The authorities and/or administrations are expected to recognize and acknowledge these training activities conducted onboard through collaborative efforts of official departments, shipping companies, MET institutions/training service providers. The expected results should be that either seafarer's shore-based training requirements are shortened optimally or the specialized training directly leads to certification with reference to these onboard training records.

Improvement of current training systems needs shipping companies to change their attitude to invest in people, to well consider training cost versus loss in accidents and to retain highly qualified seafarers. Their investment will contribute positively to the companies who wish to keep their trained and skilful seafarers employed in the long run.

The companies must play a major role in dealing with the financial issues and "operational cost" which are related to training activities. In the author's opinion, the initial investment and renewal and maintenance costs should be borne by the companies, while communications cost should be shared by the company and individuals. A dedicated training fund should be established. The fund should be from the company's annual budget, and also preferred from shipowners/manning agencies.

The companies are recommended to set up a sound training policy and scheme to keep the seafarers updated. It should not be the case that training delivery is only for the sake of training itself. A proactive safety-orientated attitude must be established in the company. Seafarers training and work time should be seriously concerned when the company decides manning for its ships. The standards of manning should not be to meet the minimum requirement, but to make a "happy ship". To sum up, an effective safety culture requires the active collaboration among all those involved with the operation and running of ships.

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GUIDANCE FOR THE OPERATIONAL USE OF INTEGRATED BRIDGE SYSTEMS (IBS)

1 The Maritime Safety Committee, at its seventy-sixth session (2 to 13 December 2002), adopted the annexed Guidance for the operational use of Integrated Bridge Systems (IBS), which has been developed to support the safe operational use of an IBS by promoting procedures necessary to ensure adequate knowledge of system functions for Mode Awareness, Situational Awareness and Workload Management in addition to traditional seamanship.

2 The aim of the Guidance is to define the basis for minimum criteria on the operation, training and quality control for Integrated Bridge Systems. This Guidance is applicable to the operation of ships fitted with Integrated Bridge Systems (IBS), which include Integrated Navigation Systems INS (B) or (C), as per resolution MSC.86(70).

3 Member Governments are invited to bring this Guidance to the attention of all parties concerned.

ANNEX

GUIDANCE FOR THE OPERATIONAL USE OF INTEGRATED BRIDGE SYSTEMS

Introduction

This guidance supports the safe operational use of an IBS by promoting procedures necessary to ensure adequate knowledge of system functions for Mode Awareness, Situational Awareness and Workload Management in addition to traditional seamanship.

The aim is to define the basis for minimum criteria on the operation, training and quality control for Integrated Bridge Systems.

1 Scope

This guidance is relevant to the operation of ships fitted with Integrated Bridge Systems (IBS), as per resolution MSC.64(67), annex 1, which include Integrated Navigation Systems INS (B) or (C), as per resolution MSC.86(70).

2 Definitions

For the purpose of this guidance, the following definitions apply.

2.1 Mode awareness

Mode awareness is based on the knowledge and purpose of various operation modes included in the IBS. Use of different operation modes should follow bridge procedures based on company automation policy.

2.2 Situational awareness

Situational awareness is the mariner's perception of the navigational and technical information provided at the INS workstation, the comprehension of their meaning and the projection of their status in the near future, as required for timely reaction to the situation that can be expected from his/her trained skills in the operation of the INS.

2.3 Failure analysis

The failure analysis aims to demonstrate that the system has a fail-to-safe functionality. The failure effects and their consequences are assessed for the installed components.

3 Bridge procedures

The bridge procedures, provided for the ship, should implement the functions, capabilities and limitations of the installed IBS. Especially the documentation should include clear instructions about conditions under which automatic control functions may be used or not.

Note: Automatic steering may only be useful where precise manoeuvring is required, if the automatic control system supports the required precision, e.g. by considering speed through water for rudder control.

The Company should have personnel ashore capable of supervising, training and evaluating the company Operational Procedures and operational use of the Integrated Bridge System.

3.1 Vessel Operating Manual (VOM)

The Vessel Operating Manual (VOM) should incorporate the Company policy for implementing and using automation and the Integrated Bridge System.

The operational manual consolidates and abbreviates the manufacturer's operational manuals to a comprehensive operational manual without detailed technical information.

The VOM should clarify the integration and the priority of sub-systems within the control system. Special emphasis should be laid on the effect of sub-systems on the total outcome of navigation control. Advantages and disadvantages between control and automation modes should be explained in a clear form. It should be clearly indicated for which situations, the different modes are designed.

The VOM should indicate corrective actions to be taken when the system gives alarm.

Operating limitations and their reasons should be thoroughly explained.

A description of the checklists and purpose of the specific items should be included in the VOM.

Terminology for standard Call-Outs should be developed by the Company and presented in the VOM.

Note: Where the VOM includes other items connected to the IBS, such as cargo handling or other vessel sub-systems the resulting functions, capabilities and limitations should be addressed.

3.2 Normal procedures

Standard Operating Procedures for normal situations should cover normal operation at different stages of the passage including the vessel's operational limits, manoeuvring trial data and ship's data including squat and anchoring.

The route should be divided into zones according to the nature of navigation, as follows:

- Sea passage;
- Shallow waters, pilotage waters and fairways; and
- Harbour areas.

The standard operating procedures should be documented in the form of checklists demonstrating transition from one zone to another. The items to be listed are e.g. manning of the bridge and the use of automated equipment including the selection of subsystems and their modes of operations.

Manual or automatic heading, track and speed control modes and the required actions for changing modes should be clearly presented in the graphical or checklist flow chart form, if not clearly indicated by the equipment itself.

3.3 Emergency and abnormal procedures

Emergency and abnormal procedures are essential for optimum Workload Management.

The emergency procedures refer to SOLAS Conference 29.11.1995 'Decision support system for masters on passenger ships (SOLAS/Conf.3/46, Annex, page 14, regulation 24.4). Operation of Integrated Navigation, Control and Communication systems should be considered in the following procedures:

- Blackout;
- Fire;
- Stranding;
- Collision;
- Man-over-board situations;
- Unlawful acts threatening the safety of the ship and the security of its passengers and crew;
- Emergency assistance to other ships;
  (the list is not complete)

All emergency procedures should be presented in a logical structure, e.g. by listing each emergency control mode in the form of a checklist, and by providing appropriate overviews.

The abnormal procedures should focus on alarms and items not generally needed in normal operation. Typical situations are sub-system failures that require decisions regarding the level of automation to be used.

Both emergency and abnormal procedures should carefully consider the failure analysis of the system.

A list of alarms of different subsystems should be harmonized to cover the whole Integrated Bridge System (IBS). Special emphasis should be laid on operational procedures in case of an alarm to switch the system on a lower automation level, manual mode or to switch sensor.

Note: All checklists based on Standard Operational Procedures should be provided in an easy-to-handle, concise and durable form.

3.4 Passage plans

The Passage Plan should be programmed in the Integrated Navigation System. The normal procedures related to the route should be programmed in the waypoint data. The procedures should contain at least the following information:

- Speed and track limits;
- Control mode (e.g. heading, course, track and speed);
- Compulsory radio communication; and
- Reference to the checklists.

The route should be programmed with a safe practice taking into account routeing systems, fairway lines, channel marks, shallow waters and oncoming traffic.

The track limits should be sufficiently large to avoid operationally unnecessary alarms.

Passage planning should conform to resolution A.893(21) - Guidelines for voyage planning.

3.5 Records

The bridge procedures should include clear instructions on marking, starting, ending and storing of records and passage plans provided by the IBS.

Recording should conform to resolution A.916(22) - Guidelines for the recording of events related to navigation.

4 Implementing new technology

A modified IBS should only be put into normal operation after successful functional testing.

During all new equipment or new version tests, the procedure to switch to manual or emergency control should be obvious. The minimum requirement to conduct the procedure is one command per device. The procedure should be documented. A new system should not be operated before new manuals have been delivered and studied.

The test should start in a safe area with the technically simplest mode. The technical level can be increased when the crew is familiar with the mode and when the crew has ensured that the desired operational safety is achieved.

The officers should be aware of which area and which mode testing is allowed. Regular meetings should be held to plan and decide fixed time periods for the proceedings of the technical tests and operational training within the Company limits documented in the Vessel Operating Manual (VOM).

5 Training programme

The company, in co-operation with the relevant manufacturers, should establish a training programme for all officers which have operational duties involving the IBS.

5.1 Knowledge-based training

In designing theoretical training packages, the following items should be amongst those to be considered:

- Manoeuvring characteristics of the ship;
- Operational limitations;
- Propulsion and control systems, both manual and automatic modes of operation and emergency controls;
- Communication systems;
- Integrated Navigation System; and
- Navigation and communications procedures for normal, abnormal and emergency situations.

5.2 Skill-based training

In designing theoretical skill-based training packages, the following items should be amongst those to be considered:

- Handling the ship in normal, abnormal and emergency situations;
- Using all available levels of automation relevant to the operational situation;
- Failure mode control; and
- Adherences to the Company's Standard Operating Procedures (SOP).

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