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Role and importance of the simulator instructor

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ROLE AND IMPORTANCE OF SIMULATOR INSTRUCTOR

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: **Role and Importance of Simulator Instructor**

Degree: **Master of Science**

Traditional concept of seafarers' training was based upon theoretical teaching in class room followed by the practical training onboard ship. Subject experts used to impart instructions ashore for creating a basic understanding of marine profession and then it was unto the professional seafarers onboard ships who were to actually groom the new comer into a perfect seaman armed with practical knowledge and experience.

This concept underwent profound changes in 80s due economic and practical reasons emanating from new face of the marine industry. New measures were required as size of crew reduced, technology improved and more practical training opportunities were available ashore through simulator based training without an immediate need to board the ship. Simulator based training had obvious advantages of being economical, safe and redundant. But it had its own implications as well. How perfect a simulator may be, it still was far away from real ship experiences. Instructor became more and more important and he is actually responsible to connect up the simulator experience with real ship experiences through his visualization and does not let the trainee get into a discourse or fall into a game mood. Training concept of the STCW Convention is based upon the show of competency by the trainees at all levels and functions. This means that simulator based training has new dimension to cope with added responsibilities of the instructors employed at simulators.

This study examines the use of marine simulator and future perspective; and in parallel how the importance of simulator instructor is on the rise. Present tools available for the qualification of the simulator instructor need to be augmented with new measures so as to show the quality of the simulator based training. Only through these measures, effective and efficient training of the seafarers can be achieved in line with training objectives of the STCW Convention.

Keywords: Simulation, Competency, Assessment, Skill-based Training, Instructor Qualification, Training Exercises,

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LIST OF ABBREVIATIONS

AIS	Automatic Identification System.
ARPA	Automatic Radar Plotting Aid.
CAORF	Computer Aided Operations Research Facility.
CBT	Computer Based Training.
FOV	Field of View.
GMDSS	Global Maritime Distress and Safety System.
ICERS	International Conference on Engine Room Simulators.
IMEC	International Maritime English Conference.
IMO	International Maritime Organization.
INSLC	International Navigation Simulator Lecturers Confernece.
ISC	Integrated Simulation Centre.
ISM	International Safety Management Code.
KUP	Knowledge, Understanding and Proficiencies.
MARPOL	International Convention for Prevention of Pollution from Ships.
MARSIM	International Conference on Marine Simulators.
METIC	Maritime Educational Training Institutes and Centers.
MSTC	Maritime Simulator Training Centre.
MLIT	Ministry of Land, Infrastructure and Transport, Japan.
NMD	Norwegian Maritime Directorate.
OOW	Officer of the Watch.
OPRF	Ocean Policy Research Foundation.
PMA	Pakistan Marine Academy.
QSS	Quality Standard System.
RADAR	Radio Aided Detection And Ranging.
SHS	Ship Handling Simulator.
SOLAS	International Convention for the Safety of Life at Sea.
STCW	Standards of Training, Certification and Watch-Keeping Convention.
UMS	Un-manned Machinery Spaces.
USCG	United States Coast Guard.
USMMA	United States Merchant Marine Academy.
VADM	Vice Admiral.
VTS	Vessel Traffic System.
WMU	World Maritime University.
MIWB	Maritime Instituut Willem Barentsz.

TERMS AND DEFINITIONS

Distance Learning. Distance learning is the proces of learning whereby instructor and trainee are spatially separated and communication between them takes place through a combination of resources like written material, correspondence, radio, TV, audio/video aids and internet.

Feedback. It is the response achieved or the information about the result produced by the actions; any kind of return information which is useful in regulating behavior for subsequently better results.

***Fidelity*.** Fidelity is the measure of the accuracy and precision of the simulator equipment to faithfully reproduce the ship's behavior.

Measurement. With measurement, we are concerned with getting a statement of performance (i.e. how much?) against some established scale or rule, usually expressed in a quantitative form although it may be non-numerical.

Paradigm. An example or pattern created for the sake of understanding the real situation or scenario onboard ship.

***Perspective*.** It's the ability of the visuals of the Ship Handling Simulator (SHS) which make the user to quickly perceive and comprehend the scenario being simulated. Quality of the visuals can be so good that you easily forget or don't recognize the truth of simulation.

Psychological. Those features of the simulator which act through your mind and make you feel at real ship working environment.

Physiological. Those features of the simulator which affect you physically; or are perceived through your physical senses to take you to the real world feelings.

Practicality. With respect to training and assessment, practicality means that you may desire to have a high standard of such procedures, only practical solutions can be adopted which are systematic, valid and reliable in different scenarios.

Reliability. Reliability is the consistency of the measurement procedure. Reliable assessment has well defined conditions, administrative procedures, performance measures, standards and scoring scheme.

Testing. Testing is the procedure to measure a sample of behavior in order to discover how well a student performs usually in comparison with others or compared with identified performance criteria. Testing procedure has to be valid, reliable and practical.

Training. Training is the systematic development of the skill behavior pattern required by an individual in order to perform adequately a given task or job.

Uniformity. Uniformity of the simulator based training means that when same simulator exercise is run for multiple trainees at different times, it has same training value with respect to basic learning out comes.

Validity**.** Validity of the assessment method is the characteristic of the measurement, specifically the extent to which a measure represents what was intended to be measured.

CHAPTER ONE - INTRODUCTION

What I hear, I forget
What I see, I remember
What I do, I understand
Confucius, 451 B. C.

This chapter of the research work acts as the door into a domain of discussion on the subject of simulator instructor, his role as an individual who has to do much more than any traditional instructor and his increasing importance due to the technological advancement in the field of marine simulators. First an attempt is made to establish the definition of simulator and simulation; then the need of simulation for the purpose of training and education of seafarers is discussed; what are the questions that can be addressed through this research paper and what can be the modus operandi adopted for finding the answers to these research questions.

1.1 What is 'SIMULATION'?

The word simulator along with simulation and simulate or simulant has been defined very closely by various sources. New Oxford Dictionary of English defines these words as under;

> SIMULANT (noun), 'imitate the appearance or character of'
> SIMULATE (verb), 'imitate the appearance or character of'
> SIMULATION (noun), derived from simulate
> Latin word 'simulat' means 'copied or represented'
>
> (New Oxford Dictionary of English. Oxford University, 2001, Oxford, UK.)

Webster's Third New International Dictionary also defines these words with almost same meaning effect, as under;

SIMULATE ‘to give the appearance or effect of’
SIMULATION ‘the act or process of simulating’
SIMULATOR ‘one that simulates’, ‘a device in a laboratory that enables the operator to reproduce under test conditions phenomena likely to occur in actual performance’

(Webster’s Third New International Dictionary)

The use of simulation technology for the training purposes has been a feature of several industries for many years. The aircraft industry is one outstanding example, an area where some electronics manufacturers can claim long experience with various simulators manufactured for the training purposes. It was therefore a well established science even before the application was utilised in the marine field.

1.2 Training Value of Simulators

Like other fields of training, use of simulation in the marine industry is owing to the multiple factors covering technological, financial and training needs of the time. Some of these factors are as discussed in the following lines;

1. Owing to technological advancements, simulation technology is available for multiple ships operations at a very cost-effective price.
2. Simulators are coming closer to the real thing; in fact, whole of the system fitted onboard ship can also be installed as simulator in a purpose built scenario.
3. One can plan a training schedule as per his convenience and simulator will be available for use; unlike ship where multiple factors like time and space need to be taken into account.
4. One can run and speed up his ship on simulator as per training requirements without worrying about fuel cost or time constraints.
5. Training scenarios beyond ship’s safety are possible like close quarter situation, excessive turns and high speed.
6. Conditions and environment in a simulator can be repeated again and again to improve the learning outcome of training; unlike ships where all situations are new ones and no repetition is available.
7. Simulation gives chance to apply the theoretical concepts to demonstrate their practicality; for example, operation in shallow water effect area or modification of the entering / leaving harbour route plan can be tested on simulators.

8. Familiarization with modern equipment fitted onboard ships is possible in simulators. It gives added confidence to officers and ships' crew before actually boarding the ship. In purpose built simulators, one can actually feel his ship in harbour before boarding it at sea.
9. One can choose his area of operation for maximum training value and increasing confidence and morale of the trainees. For example, trainees can practice English Channel and Tokyo Port Operations in same day training module, which is not imaginable in real life.
10. Multiple types of ships are available on simulators for boarding and operation by the trainees. They can actually feel the difference between behaviour of medium size general cargo ships and VLCCs.
11. Performance on simulators can be recorded and played back to the trainees for carrying out analysis, providing feedback and pointing out mistakes done during the exercise.
12. One can jump over the exercise or run the exercise at accelerated pace as and when demanded by training requirements and time constraints.
13. Conditions in simulators are known and repeatable so that performance in these conditions can be graded and assessed with uniformity. Exercises can be stopped and delayed so that particular learning points may be emphasised by the instructors.
14. For propulsion and auxiliary machinery, now we have UMS operations and it is frequently difficult for the staff to achieve sufficient familiarity with even routine operations. Many voyages may bring out some of the obscure fault conditions one has not experienced before. It's only through simulators that one can train the ship's staff to go through these experiences.
15. For OOW and bridge team, one can manipulate weather conditions and visibility with day / night operations for real time experiences and training.
16. One can develop situations onboard simulators which are much more complex and grave when compared with real ship operations. Such situations are difficult to create onboard ships.
17. One can design tailor made courses, e.g. introduction of ships operation to new comers or specialized course for Pilot operations.

Much work has already been done on the advantages and disadvantages on simulator based training and its comparative value vis a vis real time experiences. Now, the only discussion is when to have and how to have the Simulator Based Training (SBT) for the ship's crew for better, efficient and speedy ship's operations.

1.3 Introducing the Research Questions

There are many questions and associated issues to be addressed with regards to Simulator Based Training (SBT) of the seafarers. Trough this research work, efforts will be made to analyse some of these issues and find out the answers to the question involved.

1.3.1 Research Title Theme: Title theme of this research work is 'A study to evaluate and highlight the importance of simulator instructors in training of seafarers and achieving the desired results of competency based training of STCW Convention'.

1.3.2 Dissertation Objectives: Main objectives of this research work on Simulator Based Training (SBT) are as under;

1. To discuss the history of development of simulators for training of seafarers, its need and advantages.
2. To examine how technological advancements are effecting the future trends in simulator manufacturing and how they can best be utilized for optimum training value.
3. To study the increasing importance of instructors in marine training centres due to induction of simulators in training.
4. To make proposals and recommendations so as to benefit maximum out of Simulator Based Training (SBT) under the guidance of a competent instructor.

1.3.3 Reasons for Proposal: Reasons for the choice of this area of marine field to carry out research work can be summarised as under;

1. Pakistan Marine Academy (PMA), mother institute of the researcher, has long history of using simulators for training purposes. Maritime Administration in Pakistan has always set the national standards for the competency and certification of the seafarers well above the minimum requirements of STCW Convention. Now proposal is under active consideration either to refurbish or replace the simulators with best available choice; and streamline and improve the conduct of competency based training on marine simulators.

2. During the course of diverse career as seafarer spread over a time of twenty years, researcher had number of opportunities to undertake multiple training and instructional assignments on simulators. These simulators were built for both, the

naval ships and merchant marine, ranging from one-man simulator to a team-work simulator. When looking back at his experiences of simulators meant for various levels and purposes, researcher strongly feels that the most important element common to all is simulators instructor. Simulator being just another machine and however best they may be designed and manufactured (1), it is the instructor who through his well planned and well conducted training exercise can make the simulator session a real time experience for the trainee.

3. STCW Convention has very rightly stressed the competency based training for the seafarers and encouraged the use of simulators as one of the means to demonstrate competency. Researcher has the conviction that apart from the high tech simulators in use and under design phase, it is ultimately the instructor who can make the real difference in achieving the competency standards as desired in the Convention.

1.3.4 Research Proposal Description: Traditional concept of seafarers' training was based upon theoretical teaching in class room followed by the practical training onboard ships. Subject experts used to impart instructions ashore for creating a basic understanding of marine profession and then it was unto the professional seafarers onboard ships that were to actually groom the new comer into a competent seaman armed with practical knowledge and experience. This concept underwent profound changes in 80s due economic and practical reasons. During this time, size of ships' crew was reduced, marine technology got improved exponentially and more practical training opportunities were available ashore through Simulator Based Training (SBT) without an immediate need to board the ship.

Simulator training had obvious advantages of being economical, safe and redundant. But it had its own implications as well. However perfect a simulator may be with respect to design and manufacturing process, it was still far away from real ship. Instructor became more and more important. He is actually responsible to connect up the simulator experience with real ship operations through his visualization and must not let the trainees get into a discourse or fall into a game mood.

Simulators became more and more common around the globe and they were taken as symbol of quality training being imparted by an institute (2). STCW Convention has listed down multiple competencies in details for seafarers and in parallel the requirement to demonstrate the same through working on training ship or simulator.

During the course of research on the subject topic, numerous questions were raised as under and efforts were made to find out some worthwhile replies to these questions;

1. How does the history of the use of marine simulators prove their effectiveness and their expanding use for the training purposes in future also?
2. What are the future trends and requirements in design and manufacture of simulators, work in progress world wide and problems being faced by the manufacturers?
3. What is the role / importance of instructors employed for conducting training using simulators?
4. As of today, what are the tools available to ensure the quality of simulator instructors and how to improve the same?

In the efforts to make the research directed towards the laid down objectives and complete the same within the available time, following were not taken up during the course of research:

1. Simulator based training for shore staff working in ports, MRCCs, VTS centre and other related organisations.
2. Technical design parameters and mathematical problems with respect to internal working of the simulators.
3. Maintenance problems associated with simulators and financial aspects of day to day running.

1.3.5 Research Plan: Research commenced with the literature review through library and internet to find out the relevant issues connected to simulators, simulation training and role of the instructors who use these simulators as tools to achieve the objectives as laid down in STCW Convention. Contact was made with the manufacturers to draw up a general list of simulators available for use by the maritime training institutes.

Two surveys were conducted to have an insight into the practical problems associated with the simulator based training of the seafarers. First survey was conducted using the students of World Maritime University (WMU) as the population. Purpose was to find out their experiences of training at simulators, and its relevance and use in practical field. Second survey was conducted using the member institutes of International Association of Maritime Universities (IAMU) and some of the other Maritime Educational and Training Institutes and

Centres (METICs). Purpose was to find out the qualification and experience of instructors employed on simulators.

Two Case Studies have been under taken during the research to show the level of complexity involved in present day marine simulation; and how heavy demands are made out of simulator instructors in terms of knowledge, competency, instructional techniques and simulation expertise for effective and efficient training of the seafarers. Ship Handling Simulator (SHS) was used for Case Study One. System details in general have been provided and it has been discussed in details how it resembles a ship and gives real time feelings to a trainee; what are the grey areas whereby a trainee can develop wrong attitude and simulator experience can become a liability onboard ship if instructor is not putting a check to the negative tendencies of the trainees. Marine Simulation Centre (MSC), Warnemunde, Rostock in Germany has been taken up as Case Study Two. By giving the details of various simulators fitted in the MSC and how various exercises have been designed in integrated mode of simulators, modern trends in marine simulation have been highlighted. This reflects the high responsibilities of the simulator instructors and shows the level of complexity involved in the marine simulation.

Researcher had the chance to attend the 14th International Navigation Simulator Lecturers' Conference (INSLC) in Genoa, Italy (3) held from July 2-7, 2006. This provided the opportunity to compare / discuss the findings of this research work with delegates from around the world to fine tune the conclusions and recommendations. Training visits and field study trips to multiple simulator manufacturers / users during the course of study at World Maritime University (WMU) have also been taken into account during the research. List of the facilities visited is attached and major facilities have been enumerated with detailed discussion on research value of the visit in Appendix 1. Visiting professors at WMU on the subject have also been consulted for the purpose in details so as no area of concern is left unattended or overlooked during the course of research. List of visiting professors and marine professionals consulted on the topic of simulator instructor is also attached.

1.3.6 Outline of the Dissertation: For the convenience of the researcher and reader / user of this research work, it has been divided into various chapters. After the first introductory chapter, historical perspective of the simulators and simulator based training will be discussed in Chapter Two with special relevance to the STCW Convention. Various simulators used for the training of the seafarers with the associated competencies will be enumerated.

Technological advancements are continuously changing the face of the marine simulators. Shape of the future developments in marine simulators with associated impact on the role of the instructor will be discussed in Chapter Three. Two Case Studies will be taken up in this chapter. First Case Study is on Ship Handling Simulator (SHS) along with a second Case Study on the concept of integration of the simulators. Through these Case Studies, it will be analyzed what are the special requirements out of simulator instructor and why his importance is on rise in the field of education and training of the seafarers. Increasing emphasis on assessment of competencies through use of simulators will also be touched upon in parallel.

Instructor or teacher (4) has always been given due respect traditionally in any learning activity. Importance of an instructor in achieving the learning objectives will be analyzed in Chapter Four. Efforts already taken up at various levels to improve the competence of maritime instructor and IMO Model Course 6.09 for Instructors will be discussed along with technological effects on instructional techniques.

Chapter Five will open with a debate on the requirements of being a simulator instructor. It will be analyzed how simulator instructor needed additional competencies and techniques to be effective in training of the experienced adults. Various efforts put in for the improvements of the simulator instructors will be debated to see how these efforts can be used as baseline in the future.

Based upon the discussion and analysis in Chapter One to Five, some conclusions will be drawn in final Chapter regarding the role and importance of the simulator instructor. This will be followed by some recommendations arising out of the conclusions.

NOTES

1. A series of conferences have been held under the banner of International Conference on Marine Simulation and Ships Manoeuvrability (MARSIM) for the last twenty five years with the help of simulator manufacturers. These conferences bring quite a diverse number of people concerned with simulators and are a good source of information on new technologies being developed and introduced. Last conference was held on June 25 – 30, 2006 in Terschelling, the Netherlands. Proceedings of these conferences provide good insight into latest problems and opportunities for simulations and have been used frequently in this research work.

2. Netherlands and Norway requested and got approval from IMO to conduct simulator training instead of mandatory sea service by the trainees. This again adds to importance of the instructor to have quality training on simulators commensurate with actual sea service.

3. A series of conferences were held under the banner of International Navigation Simulator Lecturers Conferences (INSLC). These conferences discuss the navigation simulators with special emphasis on problems being faced by the instructors to ensure the validity and reliability of training and assessment of the trainees. Last conference was held in July 2-7, 2006 in Genoa, Italy and was attended by the writer of this research work to have updated experiences on the subject.

4. The Nautical Institute of London has published a book, ‘Maritime Education and Training – A Practical Guide’. This book contains detailed papers by various writers of diverse backgrounds and is also a good source of detailed insight into problems and advantages of marine simulators and their use for efficient results.

CHAPTER TWO - SIMULATOR BASED TRAINING

Tell me and I forget. Teach me and I remember. Involve me and I learn.
Benjamin Franklin

What we have to learn to do, we learn by doing.
Aristotle

Purpose of this chapter is to review the historical use of simulators for training of seafarers and their successive development and improvement. Various simulators being used in the training institutes and their use with respect to competencies required out of a seafarer will be discussed. After a brief summary of the simulator manufacturers available worldwide, it will be discussed in details how STCW Convention is relevant in this regard, what are the requirements in the convention and what it says about the simulator instructor. Through this chapter, efforts will be made to achieve the first objective of the dissertation.

2.1 Historical Perspective of Simulator Usage

A glance at the historical perspective always helps in understanding the real issue and related problems. The historical perspective of simulator usage will be discussed in the following few paragraphs.

2.1.1 Early Usage of Simulation: Simulation usage (1) was encouraged in the aviation industry due high cost of fuel and safety risk involved in real time training. Early World War II was tough for military aircraft flying due short supply of training aircrafts and high demand of proficient pilots (US Deptt of Commerce, 1980). This led to shift of pilot training on simulators instead of real aircrafts. This was also the time of high cost of simulators. Now technological advancements have reduced the manufacturing cost of the simulators and they can be used for ship's simulation as well while still being cost effective. Table 2.1 shows the availability of various marine simulators with the timeline.

Apart from financial benefits, simulation also improves the safety of operations. Flight safety gains significantly from simulation techniques. NASA maintains safety standards in manned space adventures through simulator based training and no alternative is available to simulation training. The nuclear power generation industry also makes extensive use of simulation for training and qualification programs of reactor operators to ensure safety and competency.

Table 2.1 – History of Simulators

1959+	Radar Simulator.
1965+	Radar and Navigation Simulator.
1967+	Ship Handling Simulator.
1976+	Liquid CargoHandling Simulator.
1980+	Engine Room Simulator.
1992+	GMDSS Simulator.

Source; Muirhead, 2003)

Simulators can also be used for re-qualification and refresher courses to ensure that individual trainee maintains minimum level of knowledge and working experience of the system even when he is away from real working on the system.

2.1.2 Simulation For Warships: Working onboard naval warships is becoming more and more hazardous due usage of multiple types of equipment and ammunition in limited space. This puts high burden on the quality of training and need for simulator based training is rising continuously (Woodrow, 1998). Virtual proto types can improve naval safety by allowing personnel to gain experience of naval equipment and procedures before they are exposed to actual equipment in potentially hazardous conditions. Scenarios can be replayed with different crew positions and operating conditions such as potential safety risks. Different means and ways to mitigate these risks can be understood by the ship's crew. Interactive training simulators can be developed which can allow several crew members to practice operating the equipment and performing the procedures together, as demanded by the working life style onboard naval ships.

2.1.3 Simulation Based Research: New technological developments have made simulation very cost-effective and attractive not only for training purposes but also for research purposes (2). Innovative simulation systems are purposefully designed to carry out research on specific problems. For example, an autopilot system was designed and developed for fast- time simulation in confined water ways by University of Ghent in Belgium, specifically meant for research purposes (Burns, 1985).

2.1.4 Automation Of Ships: It was the increasing level of automation which made the new demands on maritime education and training (Damkjaer, 1992). STCW 78 Convention became out-dated due main reason of paper based qualification. Trainee was required to go through class room instructions and then sit in some written examination. Fact remains that changes demanded new stress on competency and the way it can be demonstrated by the trainee. Simulators can be the best source to demonstrate the competency of a seafarer individually as well as when forming part of a team working onboard ship. It is widely acknowledged that majority of all accidents or casualties at sea are caused by the human element. This shows high demand on part of METICs to ensure competency of the individuals.

2.1.5 Increase in Demand of Simulators: There can be many reasons for justifying the use of simulation for training. Prof Peter Muirhead (2003) while discussing the simulator training philosophy says that the inexperienced mariner is likely to make errors of judgment early in any real ship training. The consequences of such errors could be costly and catastrophic. On simulator, mariner can make multiple errors, and receive extrinsic feedback to assist in improved performance onboard ships. Rapid repetition of difficult situations allows a review of tactics until a satisfactory conclusion is reached. Some tasks cannot be experienced at sea. Emergency procedures, maneuvering in difficult conditions or geographical locations, are readily available only on the simulator.

When properly used, supported by well trained and experienced instructors, simulator training, through its risk free environment, can contribute to a reduction in accidents at sea and improve capability and efficiency, by providing trainees with the necessary experience and self confidence to carry out their onboard roles, functions and tasks.

In order to find out what trainees feel about simulators when compared with a real ship environment, seafarers were asked during survey a question as under;

> What were your feelings when you for the first time acted as operator / trainee on simulator?
>
> 1. It gave a feeling of a real ship environment.
> 2. It was just a good effort to mimic the real ship.
> 3. It was too artificial when compared with real ship.

In response to this question, majority of the respondents said, as shown in Figure 2.1, that a simulator was neither like a real ship experience nor it was too artificial to be useless. So a simulator instructor has well enough equipment to start with; but fact remains that finally it is

the instructor who has to bring it as close to real experiences as possible through his handling of both the equipment and the trainees.

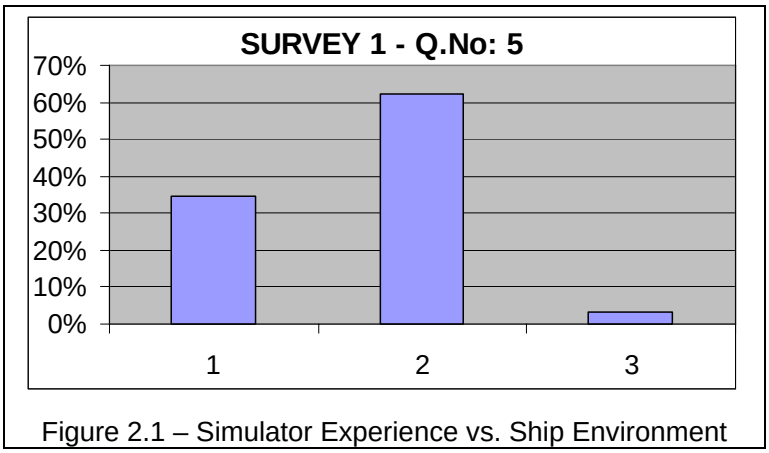

Figure 2.1 – Simulator Experience vs. Ship Environment

2.1.6 Technologies Favouring Simulation: Advent of the computers, integrated electronic navigation systems, monitoring equipment, data collection and presentation, and satellite communication have produced a change in the traditional role of the ship's crew in bridge operations and machinery control. Faster turn around time in ports and reduced crew onboard ships has put extra burden on seafarers to have appropriate competencies. Only then they can ensure that assigned task is completed with safety and efficiency. Changes in design, size and speed of the ship also puts new demands on the training and education of the seafarers. Economic and environmental consequences of a casualty involving large vessels demand a high level of crew training to deal effectively with the situation.

Manning reduction may prevent the availability of additional trained manpower to increase the strength of the watch keepers in adverse weather and heavy traffic conditions. An array of inter-connected equipment and information output devices require a team-approach to permit rapid and effective responses to difficult circumstances.

In order to deal effectively with the changing operational scene, new approaches are needed in training. Whole of the training can not be carried out onboard ships. Navigation and handling of the new generation of vessels in all environments and situations is an important facet in the competence of the masters and watch keepers in modern ships of today. Many of these skills can be acquired and evaluated on simulation technology without risk to ship or danger to life. Confidence in their use and application can only come through experience and not just via any textbook. The ship handling simulator for example provides both the situations and conditions to expose the seafarer to such experiences.

Simulator training can be used to improve the level of proficiency in those tasks or aspects in which sea experience proves to be inefficient or deficient. Simulators cannot replace the real ship experiences, it being no substitute for the depth of skills made possible through the ship operations in the real environment over a period of time. This cost in time however is relevant, and the simulator can provide the opportunity for the mariner to improve his skills in certain seamanship and navigation tasks over a very short period of time.

2.2 Major Features of Simulator Based Training

Simulator Based Training (SBT) has its own unique features and problems associated with it. There is a need to discuss these issues in order to understand the real meaning of simulator based training and to handle it effectively.

2.2.1 Fidelity VS Validity: Fidelity and validity are the two features which depend on each other in simulation. There is a direct relationship between fidelity and validity. Fidelity, the inclusion of the real world elements, contributes to validity. The omission of real world elements may make the valid system performance on the simulator impossible. It is not appropriate to consider the provision of high fidelity a substitute for validation of the system. However, there is generally more confidence in a high-fidelity system than a low-fidelity one.

Fidelity adds to the validity of simulation; in the past it may have added to the cost considerably. This relationship has changed due to recent micro-processor developments. Therefore, it is necessary to examine exactly what fidelity is adding to the effectiveness of simulation.

Validation is an ongoing process and therefore when components of a system are changed they should be validated to insure the fidelity level is consistent. This is usually done as part of acceptance testing and trials of the simulator.

Following question was raised to the METICs during the Survey on Simulator Instructor as given in Appendix 7;

> What is the major problem being faced by the instructors with respect to the simulator trainees?
>
> 1. They feel difficulty to overcome the simulation artificiality.
> 2. They get into a mood of playing game on simulators.
> 3. They just pass the simulator time without being concerned.

Majority of the respondents indicated, as given in Figure 2.1, that they feel difficulty to overcome the simulation artificiality. So, one of the major disadvantages of the simulator based training is the artificiality of the equipment involved. It's the psychological environment created by the instructor which can reduce the negative effects of the in-built artificiality of the simulator based training.

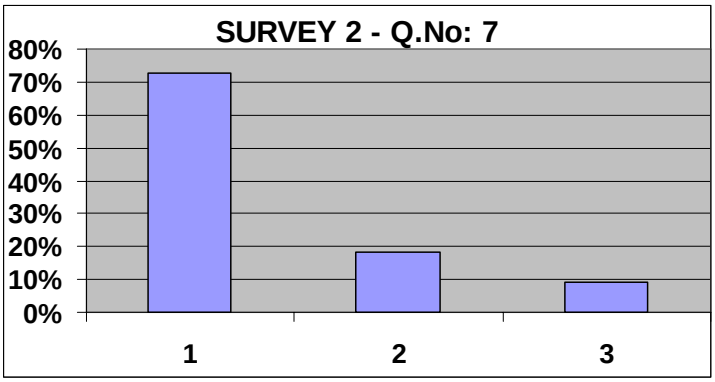

Figure 2.2 – Major Problems Faced By Simulator Instructors

2.2.2 Reliability vs. Uniformity: Reliability of simulator based training means that instructor was able to impart all the performance standards to the trainees as he planned in the exercise or were part of the training objectives. Uniformity of the simulator based training means that when same simulator exercise is run for multiple trainees at different times, it has same training value with respect to basic learning out comes.

An exercise on simulator can be very good, effective and reliable but then the problem of uniformity is required to be addressed. Best exercise is the one which has both, reliability and uniformity in parallel.

2.2.3 Simulators vs. Onboard Training: Simulator based training is steadily replacing the in-service training of seafarers. STCW Convention also gives weightage to the training conducted at a simulator with experience of in-service training. Over the time, simulator based training has started having more face value and weightage. Training needs to have validity and reliability both in parallel. Now simulators can simulate a diverse range of ship's types, scenarios and situations which in actual life may be rare to occur. This increases the validity of the simulator training vis a vis in-service experiences. Also with regards to reliability, simulation can be very effective due positive control and training environment in METICs; whereas in-service experience may have difficulty in controlling training conditions and administrative procedures.

Following question was posed to the seafarers during first survey on simulators.

What were your experiences when you practically worked on the system after simulator training?

1. You felt much more confident on the system than before.
2. Training made no difference in your working efficiency.
3. Training adversely affected your performance on the system.

Responses to our survey, as given in Figure 2.2, over-vehemently supported the use of simulators for training purposes by highlighting that the seafarers always felt much more confident on the real equipment after the training session on simulators. It shows the effectiveness of the simulators.

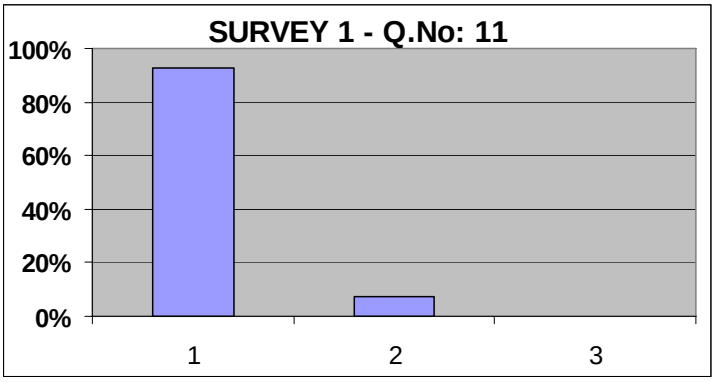

Figure 2.3 – Effectiveness of Simulator Training

2.2.4 Certification Of Seafarers: Although STCW Convention has made only RADAR / ARPA simulator training mandatory for the seafarers, almost all the practical competencies mention simulator based training as one of the options to demonstrate the functional competency for the sake of certification by the administration. Just to have few examples, Table A-II/1 mentions the competency of " maintain a safe navigational watch" with Knowledge, Understanding and Proficiency (KUPs) table having points like rules of road, basic principles of navigational watch keeping, effective bridge team work procedures and use of ships routing. This puts high responsibilities on the METICs to ensure reliability and uniformity of simulator training exercises and to develop performance and assessment criteria for different levels of trainees.

2.2.5 Computer Based Training (CBT): Brian Thomas (1997) had described the Computer-based Training (CBT) as a learning process in which the conduit is the micro chip with lessons supplied in the form of compact or floppy discs. Learning process is interactive; it encourages the student to become involved, to make and indicate choices and to formulate answers. Learning can either take place at a fully equipped learning resource centre or it can be undertaken by an individual at sea in his cabin with his lap-top computer and CD-ROM. The difference between the Simulator-based Training (SBT) and Computer-based Training (CBT) is that simulator provides the physical environment also to test the man-machine interface and give the trainees a feeling of working in real environment with psychomotor actions being taken.

One of the new dimensions with respect to simulation is the introduction of computer based simulation software systems for training of the seafarers. Major draw back of marine simulators is the financial burden they have on the budget of METICs and these computer simulation softwares mainly rely on this aspect of simulators for their existence. Major manufactures of these simulation programs are Sindel, Transas, Poseidon, Seagul, SSPA, and MarineSoft. Spread of these softwares has forced even the major simulator manufactures to produce these less costly systems in parallel. For example; Kongsberg Maritime has produced Polaris system in line with full mission simulators. Apart from the advantages and disadvantages of the simulation softwares, main question arises whether these software can be the effective replacement of the traditional simulators. Even a short practical experience on both systems will easily convince the user that if the first system is called simulators, maximum one can call the second system is simulation and not simulators. Computer softwares have all the components of simulation but the core element of man-machine interface and feel of working on real ship is missing. For the purpose of this research work, computer based simulation has not been discussed whereby role of instructor may have different requirements.

2.2.6 Financial Dynamics: While the benefits of the simulator based training are proven and accepted, cost analysis will give true and complete picture. Simulator cost can have three main components, namely;

- capital cost,
- maintenance cost, and
- staffing cost or running cost.

These costs differ for different simulators and places of training. It is difficult to put price tag on per hour of simulator training. In final analysis, it can be said that practical training on simulators is peak of any training program and it is instructor who will prepare the trainee in theoretical and class room instructions before bringing them onto simulators for practical training. This will ensure maximum effective use of simulator time and will keep running cost low and affordable.

As the finances of the simulator based training is major issue under debate during any research or discussion on the subject, efforts were made to find out the views of seafarers on this issues. A question was raised during the survey as under;

In your opinion, what is the major problem you faced in getting the simulator training as per your needs?

1. Simulator of the requisite capabilities is not available.
2. Waiting time is very long for joining the course.
3. Training course expenses are very high.

In response to the above question, majority of the seafarers indicated that expenses of the simulator based training are very high and financing is a major problem on the subject. Same result is indicated through a graph shown in Figure 2.3.

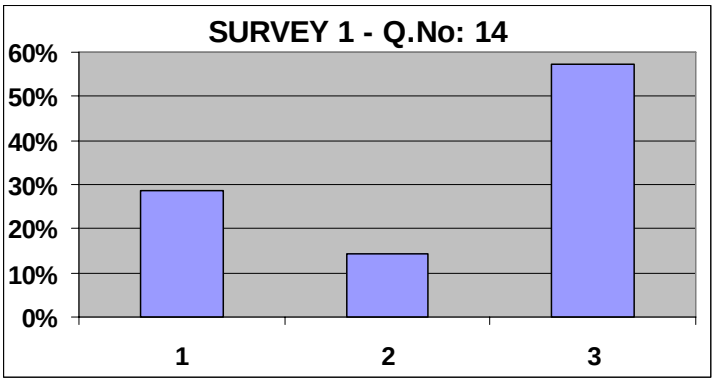

Figure 2.4 – Major Problems with Simulator Based Training

2.3 Design Problems of Simulator Based Exercises

Designing and developing an exercise to be run on simulators is a complex process and involves many important features. Some of these features have been discussed in the following paragraphs;

2.3.1 Objectives of the Exercise: How to design an exercise for running on simulator will be governed by the objectives of the exercise. Who are the trainees, what their qualification is and what are the competencies they need to learn. While running a course as laid down in STCW Convention, this may not be a problem as the convention lays down all the competencies required. Simulator instructor will be required to brain storm on deciding the objectives of the exercise when running any special course on simulator which is not given in the STCW Convention. Deciding objectives is very important as it is the foundation stone on which all the variables will be decided and objectives will govern the successive stages one after the other.

2.3.2 Monitoring by the Instructor: It is very important that simulator has the features of a comprehensive monitoring system in order to observe the trainees properly form the Instructor Control Station. Instructor should have multiple ears and eyes and easy control over whole of the working area so that he can perform in a peaceful manner. This monitoring system should include audible microphones, well positioned on the bridge to hear

conversation of all the members of the watch team; watch officer, navigator, radar observer and helmsman. In addition, there should be enough TV cameras on the bridge and monitors at the control station to observe the working of the trainees on various duty places like chart desk and bridge wing repeaters. A monitor displaying radar should be in control room to observe how the radar is being operated and also monitors for rest of the equipment like telegraph, gyro, anemometer and communication sets. A bird's eye view of own ship at different ranges should be available for control, and future reference and debriefing. Finally, recording of whole exercise including audio / video should be available for re-running in the de-briefing of the exercise and analysis. These will also help in subsequently re-designing and improving the exercise for future running for same level or composition of the trainees.

2.3.3 Briefing before Session: A briefing has to be conducted before commencement of the exercise by the instructor for the trainees. It is advisable to have briefing in the simulator room itself when explaining various parts and equipment. When more than one instructor / staff is involved, all instructors should be present during the briefing session, thereby giving chance to the trainees to raise questions if any and also to recognise and develop mutual relationship with instructors / staff that will be conducive in achieving the exercise objectives.

Briefing should include all the set conditions of the exercise and exercise objectives; number of trainees involved, trainee leader if any or the team composition, instructors involved and their respective tasks, time duration, break time and duration in the exercise.

All charts and publications such as Sailing Direction (Pilots), Tide Tables (TT), Notices to Mariners (NTM), Radio Navigational Warnings and ships routing information are supplied in the simulator room. Own ship's characteristics and that of the equipment fitted should be discussed so as trainees feel they are well used to and accustomed to the ship and don't feel being strangers or passengers onboard for the first time.

2.3.4 Exercise Conditions: Before commencing the active training session on simulator, it is recommended that exercise design should include all the conditions to be set on simulator at start time. This will increase and ensure the validity of the training session. Conditions include listing of all the equipment that will be used during the exercise and also the equipment which is not fitted or not available during the session. Conditions also include;

1. Equipment not fitted / available.
2. Equipment fitted / available.

3. Equipment made defective as per settings.
4. Equipment having any error.
5. Initial simulator settings, scenarios.
6. Weather conditions.
7. Traffic conditions.
8. Weather and Visibility.
9. Ship's position, course, speed.
10. Manpower available.

Standardising these conditions for subsequent exercises will give reliability of the training being conducted for multiple classes at different times.

2.3.5 Feedback on Simulators: It is well recognised fact now that simulator based training has the potential of providing knowledge which other wise could only be gained through years of real world experiences. Realization of this potential, however, depends upon the ability of simulator training program to take into account the special cognitive needs of the trainees and ability of the instructor to properly provide the feedback to the trainees.

Feedback to the trainee on simulator regarding standard of his performance is very important for maintaining interest, keeping morale and improving performance of the trainee (Stephen, 1985). With regards to effectiveness of the feedback provided to the trainees, Stephen said that two factors are important to be considered while providing feedback;

a. **Timing** of the feedback is very important. Some errors can change the subsequent run of the exercise and need to be corrected immediately. While, there are errors which take time to produce results and instructor will be more prudent if he waits and delays the feedback. Delayed feedback also helps the trainees with time to think and analyse their actions and consequences.

b. **Redundancy** is another factor influencing the performance feedback's effectiveness. Studies indicate that repetition of same feedback may reduce interest and motivation of the trainees.

While discussing the process of training on simulators, **Feedback** provided to the trainees was divided by Stephen into three sub-categories;

a. **Intrinsic feedback** where trainee will come to know appropriateness of his actions through consequences achieved. This is the simplest form of the feedback and is always present in simulator based training. Still, it is duty of the instructor to ensure trainee has the perception of high standards to compare his performance.

b. **Augmented feedback** can be provided to the trainees, e.g. on Ship Handling Simulator (SHS), through providing him an overview of his track followed and changes made. This bird's eye view will help him in understanding his successive inter-related actions with regards to ship's movements, and this will even improve the intrinsic feedback's quality.

c. **Supplemental feedback** is highest form of feedback that can be and must be provided to the trainee. When trainee is on task, his mind is pre-occupied with so much of information that he can come under stress and unable to grasp altogether new idea or approach. When he is over from exercise situation, then providing him with complete picture of the exercise will be of great value and trainee's mind will be free for self criticism and true analysis of the actions taken during the simulator session.

2.4 Marine Simulators and Manufacturers

A look at marine simulators in use for the training of the seafarers and their manufacturers will help in the subsequent discussion on the topic of role and importance of simulator instructor.

2.4.1 Simulators in Use for Training of Seafarers: There are multiple types of simulator in use for the training and assessment of the seafarers and their number is on the rise. Over the time it has become difficult to draw a clear line of division between their purpose and competencies to be learnt on them. Even their nomenclature changes with time and source of production. Simulators can be divided into three classifications (Muirhead, 2003) with regards to their tasking;

- Single Task – trainee can practice and learn single task.
  e.g. radar simulator.
- Multi Task – trainee can learn multiple competencies using same simulator.
  e.g. navigation simulator.

- Full Mission – simulator encompasses all possible functions of a simulator.
e.g. Full Mission Bridge Simulator (FMBS).

Table 2.2 gives classification of simulators in details.

Table 2.2 - Classification of Simulators

Single Task	Multi-Task (limited fidelity) (medium cost)	Full Mission (high level of fidelity) (higher cost facility)
Work Station with single instrument Radar / ARPA GPS / SATNAV Rules of the Road	Systems with control accessories Bridge (with helms, engine control, limited visuals, equipment) Engine Room (with simulated panels) GMDSS Simulator Liquid Cargo handling simulator (LCHS)	Ship handling including berthing capability Main engine and auxiliary operations Visual navigation with full manoeuvring Emergency response training Teamwork management

(Source: Muirhead, 2003)

A list can be drawn of major simulators which are currently in use for the training of seafarers to prepare them for efficient work onboard ships. Appendix 2 lists down five major simulators along with level of trainees and competencies that can be learnt on them. These are;

1. RADAR / ARPA Simulator.
2. GMDSS Simulator.
3. Liquid Cargo Handling Simulator.
4. Ship Handling Simulator.
5. Engine Room Simulator.

In addition to the above simulators, following additional simulators are also available for training of the seafarers at different levels of their career and responsibilities;

6. Refrigeration Plant Simulator.
7. AIS Simulator.
8. Container Loading Simulator.
9. ECDIS Simulator.

These simulators are very diverse in nature and complexity of the system varies from simulator to simulator. Same is the case with the types of exercises run on these simulators.

During the survey, a question was asked from the seafarers with respect to their experiences on simulator training as under;

What was percentage of the simulator training time to total instruction time or duration of the course?

1. >50% 2. 20-50% 3. <20%

Different theoretical to practical ratio was reported by the responses from survey as given in Figure 2.3. Simulator courses are generally designed as a mixture of both theoretical and practical training. As an instructor, one should be able to co-relate these two aspects so as they augment and support each other for achieving the training objectives.

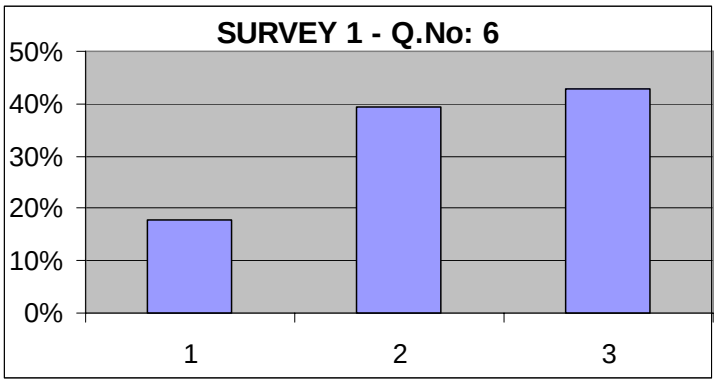

Figure 2.5 – Composition of Simulator Based Training

2.4.2 Major Suppliers of Marine Simulators: Suppliers or manufacturers are very important in any discussion on the simulators. Availability of simulators; basic training to run that equipment; operational features and maintenance strategy; all this is governed by these manufacturers and the competition between them. One of the main hurdles in the spread of the simulation based training is the cost of the simulators which converts into training cost. Our survey on simulator also supports the existence of this problem by highlighting that major problem observed by the seafarers with respect to the simulator based training is the financial cost of the training course.

Purpose here is not to provide an exhausted list of all the manufacturers of marine simulators. This task can be very time consuming and never ending. An effort has been made, in Table 2.3, to provide only a small list of major suppliers of marine simulators whose names are commonly heard in the industry. Most of these suppliers maintain comprehensive websites

Table 2.3 – List of Major Manufacturers

KONGSBERG (Horten, Norway)
www.kongsberg.com

SSPA (Chalmers, Sweden)
www.sspa.se

TRANSAS (Portsmouth, UK)
www.transas.com

STN ATLAS Elektronik (Bremen, Germany)
www.atlas-elektronik.de

ARI Simulation (India)
www.arisimulation.net

which not only provide information on their products but also the major issues involved in simulator based training. Facilities available on present day Instructor Control Station and developments in visual effects can easily be witnessed on these websites with frequent updates.

2.5 Surveys for Feedback from Seafarers and METICs

In order to have real time feedback and some statistics on the subject of discussion, two surveys were carried out during the course of research.

2.5.1 Survey Report One – Simulators: Survey Form 1 was designed to find out the training experiences of the seafarers on simulators as trainees and its relevance with subsequent job description. WMU students of varying background and sea service were used as population for this survey. Approximately, thirty responses were received and analyzed; results achieved have been discussed during the discussion on relevant point in the research work.

Question No 12 and 15 were kept open-ended with the intention to get new thoughts and suggestions on the topic of simulator training and it will be of interest to mention here some of the comments received from the seafarers.

a. Comments on Q.No.12;

1. Scenarios of the exercises on simulators are not created realistically.
2. Results of your actions are always below the standards, so you never get the confidence out of simulator training.
3. Sometimes, you get extra confidence through working on simulator, which may not be the case in real life.
4. Simulator exercises are held in calm situations as compared to rough nature of the sea.
5. There is a lack of availability of qualified instructors for effective training on simulators
6. Less time is spent on simulators and more on class room instructions.
7. There is repetition of same exercises and absence of unpredictable events in simulator soft wares.
8. Experienced professionals are not trusting young trainees on simulators.
9. Lack of presence of other human contribution to your work as on real ship.

10. You still had the ‘not a real engine’ in your mind during the exercise.
11. Sea conditions are not there in the simulators, e.g. rolling and pitching.
12. Simulation exercises make you over-confidant in your working.
13. There are not enough instructors available in the training complex.
14. You develop an attitude of playing a game through simulators based training.
15. Simulation is just a simulation, and it cannot be a real experience.
16. Real working has much more variables than a simulation run.
17. Too much time delays and pauses in exercises, making it boring event.
18. You have perception that it’s just training and not a real situation.
19. Not enough time available for familiarization on the equipment.
20. Simulator will never replace the training on real equipment.
21. Trainees feel no risk or any consequences on simulators.
22. Spontaneous actions on simulators do not effect immediately like on real equipment.
23. There is still an atmosphere of ‘it’s only a game’.
24. Instructors have to be good at role play to make the situation look real.
25. Social, commercial and sea environment can not be simulated adequately.
26. Simulation response in maneuvering is different than real ship at sea.
27. Real environment is different than simulator and many factors are not included in the simulation.
28. Human behavior and response is different to an emergency situation in real life environment.
29. Providing false imagination on simulators for beginners is not good.
30. Reduced sense of critical events and emergency during simulator run.
31. Ship’s maneuvering characteristics are different than that of simulators.
32. It’s hard to invoke real situation during simulator exercises.
33. For effective training on simulators, self-discipline is required by the trainees.
34. Simulator training will not be very effective if the instructor is not so familiar with the equipment himself or he cannot teach effectively because of lack of expertise on the subject matter.
35. Without proper briefing, exercise will de-generate into something similar to a video game, and will generate less training value for the seafarers.

b. <u>Comments on Q.No.15;</u>

1. IMO Model Courses on different and new topics will be helpful to METICs.

2. As new technologies are emerging, concept of integrated rules / regulations by IMO will be helpful in true implementation.
3. Simulators need to be as close to real ship as possible for true training value.
4. Sea training has no substitute at all.
5. Simulator training is an effective qualifying tool to enhance seafarers' skill and knowledge on a particular equipment or system.
6. It's better to commit a thousand errors in a simulator than do one fatal mistake while in the actual work onboard.
7. Diversity in simulator based exercises is required.
8. Only the appropriate use of simulator by a qualified instructor can be beneficial.
9. Appropriate simulator training under the supervision of a qualified instructor has many advantages. Key advantages include the absence of same level of risks as in the real environment and the ability to train in different scenarios within time frames and feasibility levels not possible for training in reality. The benefits certainly overweigh the disadvantages.

,

2.5.2 Survey Report Two – Instructors: Survey Form 2 was designed with the aim to get feedback from METICs regarding the qualification and experience of simulator instructors and associated problems being faced. IAMU member institutes and other METICs were surveyed. Approximately 20 responses from different parts of the world were received and analyses. Results achieved have been discussed during the discussion on relevant points in the research work.

Question No 14 and 15 were kept open-ended with the intention to get new thoughts and suggestion on the topic of simulator instructor and it will be of interest to mention here some of the comments received from the METICs;

a. <u>Comments on Q.No.14;</u>

1. Standardization of simulators is required for the ease of the instructors.
2. Minimum requirements of simulator instructors need to be defined.
3. Extended time frame of simulator based courses is required in order to have effective training.
4. Inclusion of human behavior e.g. stress factor, emergency responses etc. should be part of exercises design.
5. There is need of having specific mandatory qualifications for the instructors.

6. Specifically define the categories of the simulators and suitability to the training objectives of the STCW Convention.
7. Create an adequate global paradigm for funding of required simulators.
8. Define minimum standards for marine simulators to be used for training.
9. Compulsory training for simulator instructors is required.
10. Focus on human factors like Crew Resource Management.
11. Focus on modern electronic navigation.
12. Simulator training is must at all levels of the seafarers' career.
13. ECDIS Simulator training is must for actual working on the equipment.
14. As with aviation pilots, Deck Officers should be required to do a set number of hours of simulator time in a three years cycle in order to maintain his / her certification.

b. Comments on Q.No.15;

1. Many national administrations do not appreciate the training value of simulators as compared to their price tag.
2. Simulators are considered very expensive to be purchased and maintained.

2.6 STCW Convention Requirements on Simulator Based Training

STCW Convention addresses the usage of simulators for training of the seafarers under three important headings (Ali, 2006);

a. Training and Assessment.
b. Use of Simulator.
c. Minimum Standards of Competencies.

2.6.1 Training and Assessment; STCW Convention mentions possibility of using simulators as a tool during the discussion on *Training and Assessment* of seafarers as under;

Regulation-I/6-Training and Assessment.
Section A-I/6-Training and Assessment (Mandatory).
Section B-I/6-Guidance regarding Training and Assessment.

Regulation-I/6-Training and Assessment.

This regulation demands all parties to ensure that training and assessment of seafarers is in accordance with STCW Convention (Code A) and all instructors and assessors are appropriately qualified and competent to carry out their tasks.

Section A-I/6-Training and Assessment (Mandatory).

This section stipulates that if training is being conducted using simulators,

- instructors employed should have received appropriate guidance in instructional techniques involving the use of simulators, and
- have gained practical operational experience on the particular type of simulator being used for training.

Also, when assessment is being done using simulators, assessor should have gained practical assessment experience on the particular type of simulator under the supervision and to the satisfaction of an experienced assessor.

Section B-I/6-Guidance Regarding Training and Assessment.

This section is meant for providing the guidance on how to comply with the corresponding section of Code A, and mentions IMO Model Courses for Instructors and for Examination and Certification of Seafarers.

2.6.2 Use of Simulators: There is dedicated part of STCW Convention which highlights the *Use of Simulators*, as under;

Regulation-I/12-Use of Simulators.
Section A-I/12-Standards governing the Use of Simulators (Mandatory).
Section B-I/12-Guidance regarding Use of Simulators.

Regulation-I/12-Use of Simulators.

This regulation gives legal cover to the performance standards of marine simulators being used for the training and assessment of seafarers and their certification in compliance with STCW Convention.

Section A-I/12-Standards governing the Use of Simulators (Mandatory).

This section has two parts.

- **Part 1** provides the performance standards of the simulators that can be used for the training and assessment of seafarers. STCW Convention desires physical and behavioural realism of the simulators appropriate to the training and assessment objectives. Capabilities and limitations of the original equipment along with possible errors should form part of the simulation. Simulators should be able to produce the emergency, hazardous and unusual conditions for the effective training value. The most important aspect of the performance standards in STCW Convention is the requirement of simulators to provide the simulator instructor with control and monitoring facilities along with recording equipment for effective debriefing to the trainees.
- **Part 2** provides the other provisions whereby training and assessment procedures have been discussed for the simulator trainers and assessors to have standard conduct of simulator training. STCW Convention foresees briefing, planning, familiarisation, monitoring, and debriefing to be part of any simulator based exercise. It also highlights the importance of guidance and exercise stimuli by instructor during monitoring and use of peer assessment technique during de-briefing stage. Simulator exercises are required to be designed and tested by the simulator instructor to ensure their suitability for the specified training objectives.

Section B-I/12-Guidance regarding Use of Simulators.

STCW Convention has made only the RADAR / ARPA simulator training mandatory for the seafarers and in this section, it gives the detailed guidance how to use the RADAR / ARPA simulator for the training and assessment purposes.

2.6.3 Performance Standards of Simulators: As there are multiple types of simulators available in the market with varying level of efficiency and control (Ali, 2006), STCW Convention mentions the minimum performance standards of simulators especially for Radar / ARPA simulators.

RADAR Simulator. STCW Convention highlights following areas of the radar simulator when being used for the training and assessment of the seafarers;

- Factors affecting performance and accuracy.
- Detection of misrepresentation of information, including false echoes and sea returns.

- Setting up and maintaining displays.
- Range and bearing.
- Plotting techniques and relative motion concepts.
- Identification of critical echoes.
- Course and speed of other ships.
- Time and distance of closest approach of crossing, meeting or overtaking ships.
- Detecting course and speed changes of other ships.
- Effects of changes in own ship's course or speed or both.
- Application of the International Regulations for Preventing Collisions at Sea.

ARPA Simulator. STCW Convention highlights following areas of the ARPA simulator when being used for the training and assessment of the seafarers;

- Possible risks of over-reliance on ARPA.
- Principle types of ARPA systems and their display characteristics.
- IMO performance standards for ARPA.
- Factors affecting system performance and accuracy.
- Tracking capabilities and limitations.
- Processing delays.
- Operational warnings, their benefits and limitations.
- System operational tests.
- Manual and automatic acquisition of targets and their respective limitations.
- True and relative vectors and typical graphic representation of target information and danger areas.
- Information on past positions of targets being tracked.
- Setting up and maintaining displays.
- Obtaining information from the ARPA display.
- Application of the International Regulations for Preventing Collisions at Sea.

Non-mandatory Simulators. STCW Convention mentions following non-mandatory simulation system, with possibility of more systems, used for the training and or assessment of the seafarers;

- Navigation and watch keeping simulator,
- Ship handling and manoeuvring simulator,
- Cargo handling and stowage simulator,
- Radio communication simulator, and
- Main and auxiliary machinery operation simulator.

STCW Convention then briefly mentions the performance standards for these non-mandatory simulation systems. Here it is important to note that while STCW Convention has discussed the RADAR / ARPA simulators in details with separate heading for training and assessment, all other simulators has been discussed with respect to general provisions only. RADAR / APRA simulators are very basic form of simulation when compared to, for example, Ship Handling Simulator (SHS) in respect of equipment fitted, complexity of operations and responsibilities of instructor. While discussion on RADAR / ARPA simulators is spread over a dozen pages, five non-mandatory simulators have been discussed in around four pages. This clearly implies that as far as simulator instructor is concerned, he has to put in a lot to design and conduct the training and assessment exercises on these simulators because of only few details available in the Convention.

2.6.4 Minimum Standards of Competencies: STCW Convention mentions the simulators as one of the means to prove competencies by the seafarers. Chapter II, III and IV of Code A list down the competencies in the forms of tables required of deck, engine room and radio personnel at management and operational levels. These competency tables enumerate multiple means to prove the competency. Approved simulator training is mentioned at numerous occasions in parallel with in-service experience and training ship experience. This parallel between real ship and simulator itself puts heavy responsibilities on the simulator instructor. He has to ensure that simulator based training is designed and conducted in such a manner that it gives real time experiences to the trainees. Simulator training is required to put the trainee in almost the same working environment, mental scenarios and physical stress as onboard the real ship.

To have a grasp of the level of work and expertise involved for the simulator instructor, any of the competency table can act as reference. For example(3), following are few of the extracts taken out of competency table A-II/2 Page 48 where Convention is describing the competence to ‘Manoeuvre and handle a ship in all conditions’;

- Manoeuvre to pilot station with due regard to weather, tide, head reach and stopping distances.
- Handle the ship in rivers under the effects of current, wind and restricted water effect on helm response.
- Application of constant rate of turn techniques.
- Manoeuvre in shallow water effect, squat, rolling and pitching.
- Understand cushioning and canal effect.
- Ship and tug interaction and berthing / un-berthing.
- Ship handling in heavy weather, towing operations, SAR of aircraft.

- Launching rescue boat and survival crafts.
- Ice navigation and dense traffic areas.

These are some of the competencies a simulator instructor (4) is required to handle in training exercises. These competencies are reflective of the professionalism desired and expertise required out of simulator instructor to comply with training standards of the STCW Convention.

It may also be of relevance here to mention, as Prof. Muirhead (2003) discussed in his notes, that STCW Convention lists down seven functions of seafarers at three different levels of responsibility. Competency tables are divided on same lines and simulator based training has also to be structured on same basis.

STCW Convention enumerates Performance Standards (physical realism, behavioural realism, minimum errors, instructor control, suitability for training objectives and man-machine interface),Training Procedure (briefing, familiarization, exercise stimuli, monitoring, debriefing, peer assessment) and Assessment Procedure (performance criteria, assessment criteria, briefing, grading methodology) to be adopted on simulators.

STCW Convention also desires instructors and assessors on marine simulators to be appropriately qualified and experienced. As STCW Convention has made only RADAR/ARPA simulator training mandatory, instructions are available on these simulators in more details for use by the training centres. STCW Convention also has competency tables along with KUPs for Deck and Engine Room both (5), in Chapter II, III and IV (Code A) for Management and Operational levels. These tables also contain a column for method for demonstrating competencies where simulators are listed as one of the means that can be used for demonstration of competencies. Thus, STCW Convention is very important with respect to the use of simulator usage.

While investigating why a seafarer underwent some simulator based training during first survey, following question was asked from the population of first survey;

Why did you undergo the training on simulator?

1. It was mandatory due to the IMO/Administration's requirements.
2. It was required as a company policy for career progression.
3. Any other reason._____

As Figure 2.6 indicates, one of the major reasons for undergoing simulator based training is that it was made mandatory by the Convention or the company policy. Due financial cost involved and other reasons, simulator training with all of its advantages will not become common practice until and unless it is given mandatory weightage in the Convention. Now when we have travelled a long way with respect to the simulation for training of the seafarers, there is a strong feeling of the seafarers' community for making more of simulator training mandatory in addition to the existing Radar / ARPA and GMDSS. Same was also supported by the second survey on instructor. A question was raised as under;

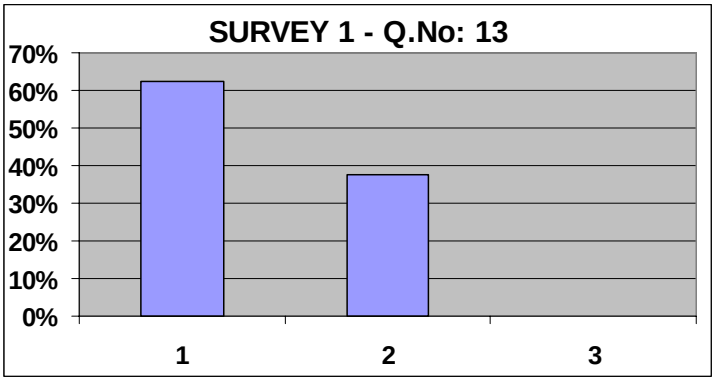

Figure 2.6 – Reasons for Undergoing Simulator Based Training

> In your opinion, which one of the following simulator should be made mandatory in the STCW Convention for the training of seafarers in addition to RADAR / ARPA?
>
> 1. Ship Handling Simulator (Management Level).
> 2. Ship Handling Simulator (Operational Level).
> 3. Engine Room Simulator (Management Level).
> 4. Engine Room Simulator (Operational Level).
> 5. Cargo Handling Simulator (CHS).

Responses, as given in Figure 2.7, indicated that large portion of seafarer community is in support of the simulator based training being made mandatory; it will help us all in our efforts to raise the competence level of the seafarers.

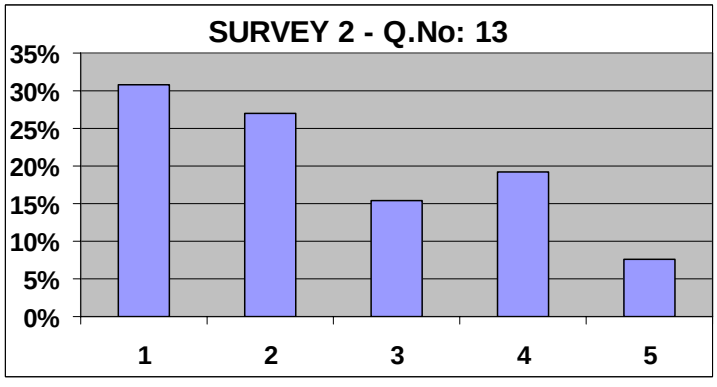

Figure 2.7 – Simulator Training to be Made Mandatory

2.7 IMO Model Courses

In addition to the STCW Convention, IMO Model Courses are also the major sources which discuss the training and education of the seafarers. With regards to simulator-based training, two model courses are very important to be considered here;

-IMO Model Course 1.07 Radar Navigation and Plotting, and Use of ARPA.
-IMO Model Course 1.09 Radar Simulation.

Course 1.09 was prepared by IMO in 1987 with the assistance of its consultant Norcontrol Simulation A/S, Horten, Norway. Course 1.07 was prepared by IMO in 1999 with the assistance of Norwegian Maritime Directorate (NMD); it has two parts. First part refers to a 8-day course on Radar Navigation and Plotting and second part to a 4-day course on use of ARPA.

These two courses successively discuss simulator based training in addition to the class-room lectures and discussion. Though not systematically and in details, these model courses discuss some of the aspects of exercise design and running. Basic concepts of familiarisation and successive build up of exercises have been proposed. Situations like open sea and Traffic Separation Scheme (TSS) scenarios for radar operations during the exercise have been discussed and highlighted. It is desired that simulator instructor should monitor the exercise continuously. Courses demand that exercise should follow up with de-briefing to the trainee where instructor can use his check off list or a summary made during the exercise, the X-Y plotter for exercise over view and a group discussion among trainees.

These two courses are good examples of simulator instructional techniques at their early stage. Conduct of simulation exercise has been discussed in very simplistic manner and an overview has been given of an emerging science of simulator instructional techniques.

This should also be noted that Radar and ARPA are the two inter-connected equipments at bridge. Their use, although very important for the safe operations of the ship, is of very basic nature when compared with ship handling or engine room operations (6). This clearly implies that if there can be a model course for Radar / ARPA simulator based training , there is surely a strong need for such a model course with respect to conduct of training on Ship Handling and Engine Plant Simulators.

In addition to the above, there are three IMO Model Courses on simulators as under;

-Model Course 1.22 Ship Simulation and Bridge Teamwork
-Model Course 2.06 Cargo and Ballast Handling Simulator
-Model Course 2.07 Engine Room Simulator

Contents of these courses indicate that these courses have laid added stress on the systematic use of simulation for the competency based training of the seafarers. Again these courses mention about the exercise designing, briefing, familiarization on the equipment, monitoring, and finally de-briefing the participants. Simulator exercise to class lecture ratio is higher. Model courses themselves indicate that training for these equipment and competencies will not become valid without the use of simulator based training. Still it can be said that these three courses also have been written with the intention to provide basic frame work for training on these equipment and machinery, and not for addressing the problems and functionality issues being faced by the simulator instructors.

2.8 Increased Use of Simulators

At the time of major revision of STCW78 Convention in 1995, only Radar and ARPA simulator based training could be made mandatory for the seafarers. One of the major hurdles in this regards was the availability of simulator facilities especially in developing countries. However the IMO Compendium of Maritime Training Institutes shows that a rising number of METICs have the facility of at least basic types of simulators like GMDSS, Navigation Simulator and Engine Plant Simulator (7). This implies that after a lapse of a decade from the adoption of STCW Convention, world scenario has totally changed with respect to the availability of marine simulator for the training purposes. Any future amendment to the Convention may also consider, with new facts and figures in mind, the issue of mandatory simulator based training of the seafarers at various levels.

CHAPTER SYNOPSIS

This chapter of the research work opened the discussion on the simulators and their use for training of the seafarers. It is seen that usage of simulators has its origin in the aviation industry for the training of pilots, the driving force being the high cost of training in the field. Further, the technological advancements have made simulations very cost effective and diverse in nature. This led to the introduction of simulator based training in all fields especially the marine field. From Radar and ARPA simulators to present Full Mission Bridge

simulator (FMBS), marine industry has travelled a long distance on the road and now the simulator based training has become the common phenomena in majority of METICs. Demand for the large number and types of simulators for the use in industry has attracted multiple manufacturers and competitive market has brought in various cost-effective solutions. It was discussed how the simulator based training is conducted and what are the unique features of this mode of training. This discussion also reflected the role and importance of the instructor conducting training on the simulators and how he differs from any other instructor.

STCW Convention provides the standards for the competency of the seafarers and lays stress on the competency based training and use of simulator as substitute for practical work onboard. Convention also accepts the importance of the quality training and lays demands on the qualification of the simulator instructors. We have seen that STCW Convention demands compulsory training on Radar / ARPA simulators but only recommends the usage of other simulators for training. IMO Model Courses cover five major areas of simulator based training with some details on how to conduct the training on simulators. These efforts themselves reflect the increasing role of simulator based training in marine profession and the need to address any anomaly that may be encountered while working in this field.

NOTES.

1. A dissertation for the award of PhD degree was written by Joseph J Puglisi and was submitted to the Department of Maritime Studies and International Transport, Cardiff University of Wales, UK. This write up discusses the instructional technologies and associated training and assessment problems with special relevance to USMMA, Kings Point, NY, USA. Chapter 5 of this dissertation gives a detailed history of the development of the marine simulators and simulation.
2. Computer Aided Operations Research Facility (CAORF) at National Maritime Research Centre, Kings Point, NY, has conducted multiple innovative research projects on simulations, training and instructions for seafarers and these project reports are a good source of understanding the issue of simulator instructor.
3. Although there are multiple types of marine simulators in use, this research paper gives reference to Ship Handling Simulator (SHS) only due to limited time available and to maintain flow of the discussion. It is believed that such examples can easily be super imposed on rest of the simulators for use by instructors.
4. IMO Model Course 6.09 – 'Training Course for Instructors' Volume 1 gives good insight into the topics to be covered in a course designed for providing instructional techniques to the instructor and same has been discussed in the Appendix 1 to compare it with the needs of a simulator instructor.
5. Amendments of 1995 in STCW Convention added competencies in the curriculum and demands proving those competencies by the trainee through some means like simulators. This puts heavy responsibilities on instructor and his importance becomes manifolds.
6. A number of conferences have been held as International Conference on Engine Room Simulators (ICERS). As the name suggests, emphasis is on the ships propulsion plant and auxiliary machinery and how to effectively train the engineering
7. The classification society DNV has prepared a reference booklet 'Standards for Certification of Maritime Simulator Systems' whereby a simulator can be graded depending upon the capabilities and limitations of the system vis a vis other systems available for same purpose.

CHAPTER THREE - FUTURE OF SIMULATORS

It is expectation that makes a blessing dear;
Heaven were not heaven if we knew what it were.
Sir John Suckling

Yesterday is not ours to recover, but tomorrow is ours to win or lose.
Lyndon Baines Johnson

From 50s onward after the introduction of the Radar simulator, technological advancements in simulation have been there at continuous and steady pace effecting the simulator design and operations. Close to the end of the 20th century, computer technology gained exponential rise and major advancements have been made in the simulators also. Now it will be analysed what advancements are being made in the marine simulators and its impact on the role and importance of the simulator instructor. This will be augmented by the Case Study on Ship Handling Simulator (SHS) and how the instructor has to play a major role to achieve the training objectives. It will be followed by a second Case Study on the concept of Integrated Simulation Centre (ISC) which is becoming common world wide. Subsequently, we will look at the traditional concept of assessment and how it can be applied to the simulator based training of the seafarers. Through this chapter, efforts will be made to achieve the second objective of the dissertation.

3.1 Technological Advancements

A continuing growth in maritime simulation technology is readily apparent when the specifications of existing and new generation simulators are examined with the objective of comparison. From simple to sophisticated, much of that development has concentrated on bringing an even grater sense of reality to the seafarers in terms of both visual scenario and the operational responses. All types of marine simulators with extensive hardware equipment and inventive software features have lead to very complex and expensive installations in various METICs.

Marine simulation started with the induction of Radar / ARPA Simulator in the METICs. With time, availability of all types of simulators is on rise and simulator based training is becoming a common practice. To have appropriate feedback on the issue, following question was asked from the METICs of various region working under public and private sector;

What are the various types of simulators available for seafarers' training in your organisation?

1. Ship Handling Simulator.
2. RADAR / ARPA.
3. Engine Room Simulator.
4. Cargo Handling Simulator.
5. GMDSS.

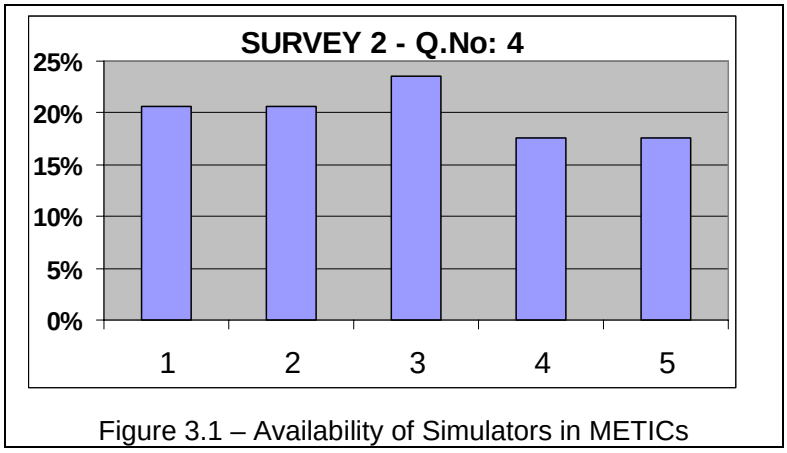

Figure 3.1 – Availability of Simulators in METICs

It was surprising to note that, unlike the common perception, various types of simulators are available in the METICs at almost same frequency as Radar / ARPA Simulator. In fact, in contrast to the previous trend of having a dedicated Radar / ARPA Simulator, now this simulator is merged with Bridge Simulator at most of the large institutes. This reflects that any progress to make the Bridge or other simulators mandatory in the Convention will have smooth implementation in the METICs.

3.1.1 Replica Simulation System: One of the trends in simulator manufacturing is the use of a complete replica of an actual system for simulator training. This gives added validity to the simulation system with provision of training the seafarers for a particular ship system in line with traditional practice of aircraft pilot training. Example is SHS in Maritime Simulation Centre (MSC), Warnemunde in Germany whereby a replica bridge assembly based on the proprietary Ship Control Centre (SCC) was developed by STN ATLAS for commercial shipping operations(Benedict, 2000). Designed primarily for single manning, the automated SCC permits a complete range of navigation, communication, engine control and ship management functions and is augmented by a new type of emergency management system for advice on measures to be adopted in the event of fire, water in-rush, evacuation and man overboard alerts.

3.1.2 Visual Effects of Ship Handling Simulator: One of the fidelity issues in simulator training was the visual effects generated in SHS Simulators. Visual effects were far from real in display, lacking in sound system and movements of objects were sluggish (Muirhead, 2003). All the efforts put in rest of the bridge equipment and software to ensure fidelity were totally undermined by visual effects having much artificiality.

New display equipment available and techniques used have removed this anomaly to maximum possible extent. Now simulation can provide 360 degrees panoramic views of ultra-realistic scenarios in both day and night modes with varying visibility and weather conditions. All this is further backed up by an efficient sound system and trainee onboard these simulators can comfortably sink himself into a mood of real working in bridge of a ship at high seas.

3.1.3 Case Study 1 – Ship Handling Simulator (SHS): As the simulator technology is advancing from basic Radar / ARPA to modern Ship Handling Simulator (SHS), importance of the instructor is rising with added responsibilities and additional tasks required of him. Out of the multiple simulators now available in the METICs world wide, SHS has been chosen as a Case Study. Purpose is to discuss in details as to what a simulator is capable of and how an instructor becomes important when we have such complex equipment being used for the training purposes. Case Study on Ship handling Simulator (SHS) is attached as Appendix 3 to this research paper.

3.2 Integration of Simulators

Technological advancements and operational requirements brought in multiple simulators in the METICs for the training of seafarers around 70s and 80s. These simulators were stand alone equipments and in most cases, manufactured by different companies and installed in METICs at different dates. In Bridge Simulator, engine parameters were simulated and in Engine Plant Simulator (ESP), bridge actions were simulated separately.

3.2.1 Concept of Integration: With Integrated Navigation System (INS) and Integrated Bridge System (IBS) now becoming common in shipping industry, simulator technology has also undergone profound changes whereby all the simulators can be mutually integrated, giving out an effect of a complete ship model having bridge and engine plant teams working together and communicating with VTS station or MRCC ashore on GMDSS simulator in emergency. Also, two or more bridge simulators manned by different teams at same time can simulate ships operating in close proximity. This can give more

realistic and interesting scenarios whereby trainees will feel much more involved and responsible and competitive behaviour will flourish.

These possibilities of mutual integration of various simulation systems lead to the establishment of various Integrated Simulation Centres (ISC) around the globe for the training of seafarers. This healthy trend not only reflects new opportunities for the quality and realistic training of the seafarers but also indicates added responsibilities of the simulator instructors. Integrated simulation exercise means that there will be number of instructors working together as a team in various simulators. This integrated simulation demands much high standards of knowledge, expertise and team work out of simulator instructors and puts heavy burden on their shoulders while providing new opportunities as well.

3.2.2 Case Study 2 - Maritime Simulation Centre (MSC): To provide an overview of of the concept of integration of simulators, a Case Study has been provided on the Maritime Simulation Centre (MSC) Warnemunde in Appendix 4. This Case Study indicates the possibilities of equipment fitted, design features of the centre and operational concept behind the design of such an MSC. Also, this case study highlights how such an ISC can be and is being utilised for not only the training of seafarers but also for the benefit of shore industry in the form of various courses and training opportunities offered (Benedict, 2000). Research and development (R & D) is one area hallmark of such training centres. Such Integrated Simulation Centres, with some difference of equipment and design, have also been established in Singapore, the Netherlands and Kings Point.

As Muirhead (2004) discussed, these advancements can have many questions raised. Does this means that the seafarers will respond in a more effective and realistic manner to training and assessment programs? Will the highly sophisticated simulator raise the threshold of learning and skill acquisition? Will the mariners be more effective performes on real ship after training experiences on modern simulators? These questions may have different answers but one aspect will surely be common to all, increased importance of simulator instructor and his contributions in the exploitation of simulator capabilities and his role to minimize the effects of limitations of the simulations.

3.3 Assessment on Simulators

Technological advancements have made it possible to use the simulators for assessment of the trainees in a reliable manner. That is the reason the STCW Convention also gives due weightage to assessment using simulators.

3.3.1 Traditional Assessment Methods: Like all the other fields of Education and Training, mariners were also assessed based upon some form of written examination at various stages of their training. Various techniques have been developed to increase the validity and reliability of the written examination so that it could be ensured that the examinee had learned what was intended to be learned. Huge research work is available on the subject of assessment tools on the traditional concept of written examination and same has been modified and improved over the time. New concepts were also developed and implemented e.g. introduction of oral interview and presentation in front of subject experts to show knowledge and understanding.

3.3.2 Competency Based Assessment: Amended STCW Convention requirements have changed the traditional concept of written assessment for the seafarers by introducing concept of proving competency in the field (Muirhead, 2003). This concept is one stage above the knowledge- based assessment whereby not only one has to prove that he has the requisite knowledge of the subject but also that he is competent enough to perform the same. This concept is particularly valid for the seafarers. Onboard ships, all crew members have their own area of concern whereby one needs to work and perform practically with no or very little help from outside. Seafaring profession can comfortably be termed as a practical one and seafarers are the men who actually perform practical tasks.

Maritime training academies and institutes are struggling all around the globe to come to terms of the new requirement of STCW Convention. In fact, Convention demands from these METICs to have valid and reliable performance based testing measures, standards and procedures while there is very little historical guidance and experience available on the subject in written form.

3.3.3 Literature Scarcity: Books are always very good friends whenever one has some professional or academic problem to solve. When we carry out the literature review to search for concepts, theories, advantages and problems of competency based training and assessment of seafarers, fact of the matter is there is very little available in the form of a comprehensive, detail book. Instructors and academicians have been writing on the subject but only short articles, research papers or brief summary of their experiences and problems being faced. Mostly their write ups are meant for some conferences and forums being held under the auspices of some university, association or simulator manufacture. Obviously, these write ups have limited scope and directed aims and actually lack that scholarly depth and expertise that is the hallmark of other aspects of instructional techniques.

3.3.4 Assessment Problems and Issues: Assessment process involves two concepts. Performance Measures identifies how a trainee's performance is observed and recorded for evaluation by the instructor. While Performance Standard is the level of performance that is established as acceptable and commensurate with the course objectives (Muirhead, 2003).

Both measures and standards can be subjective or objective. 'Objective measures or standards are the one that rely upon equipment that is able to give consistent and accurate measurement result. Subjective measures or standards rely primarily on the examiner's observation and interpretation of the performance.

Subjective evaluation and assessment of the trainee's performance is very delicate issue and needs special consideration. When using subjective measures and standards, it is very important to have Subject Matter Experts (SMEs) as assessors to maintain validity and to use checklists and grading guidelines to maintain reliability.

Point to be noted here is that objective assessment was the traditional concept and always looks attractive and reliable. But with new requirements of competency based training and assessment, efforts to become more and more objective reduces the validity proportionately. This problem can be minimized by having qualified and experienced mariner as simulator instructor.

Example of the objective assessment can be the "Ability to determine errors of the magnetic and gyro compass using terrestrial means". This assessment is objective because this exact error is known in the simulator. But when it comes to "Thorough knowledge of the basic principles to be followed in keeping a navigational watch", this assessment is very broad and much more subjective. A detailed check off list is required and it is imperative that experienced mariners conduct the assessment. Assessment of this proficiency is continuous and is conducted during the whole range of scenarios simulated during a course and may require more than one assessor. Best description of such assessment can be "Successfully completed performance measures to the satisfaction of a qualified assessor".

3.3.5 Simulators and Assessment: STCW Convention has the provision of assessment of seafarers using simulators (Muirhead, 2006). Training and assessment on simulator can go in parallel over multiple exercises or there can be a dedicated assessment

exercise(1). But in both cases, instructor has to ensure that assessment is based upon a laid down performance standards criteria having elements of;

- Subjective and
- Objective assessment(2).

Also assessment criteria should be a mixture of;

- Quantitative and
- Qualitative parameters.

Assessor should judge the trainees in respect to;

- Performance based upon assessment criteria,
- Team work and interaction as per behavioural objectives, and
- Performing safely and efficiently.

After a long history of the use of simulators for the training purpose, still there are many problems and limitations in carrying out assessment on simulators, for example;

- Availability of training simulators,
- Fidelity of system design,
- Validity of training exercise,
- Competency of simulator assessor,
- Uniformity of performance standards,
- Consistency of working procedures.

It may be mentioned here that it's the practical performance of the trainee which form basis for his assessment in simulator based training for suitability to work onboard ship. This view was supported by the survey also as given in Figure 3.2, when following question was asked from the METICs;

What is the weightage of practical performance of the trainee on simulator towards his final grades?

1. 50% 2. 20-50% 3. <20%

To conclude the above discussion, one can say that importance and use of marine simulators is on the rise and future is brining new challenges to simulator instructors and assessors both.

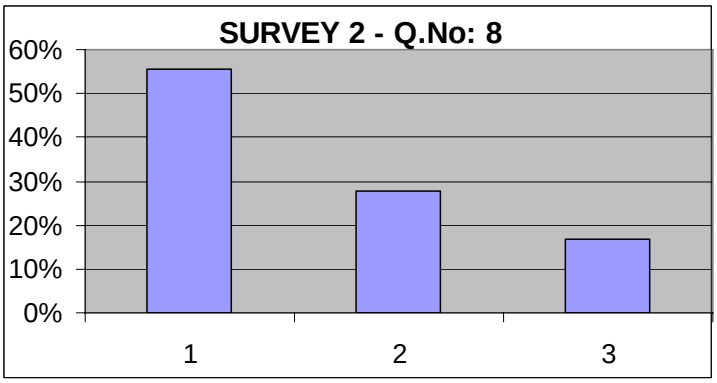

Figure 3.2 – Weightage of Practical Performance on Simulators

3.4 EU Concept of Assessment

MASSTER Project of the EU was aimed at harmonizing simulator training within EU. Within the project, a lot of attention was devoted to systemizing training objectives and scenarios. One of the project objectives was to develop and adjust training assessment tools and to validate those through demonstration on simulators.

As discussed by Butter (2000), use of simulators as training and assessment tool in METICs for operational level can have three broad areas;

a) the level of skills
b) the correct application of the procedures
c) the attitude of the trainee

For assessment of competencies at management level, i.e. mainly procedural and attitudinal aspects, an assessment tool was developed comprising five categories of behavior dimensions that are to be judged by two assessors;

1) situational awareness
2) communication
3) decision-making
4) delegation of the authority to act
5) dealing with stress

As an example, following are the behaviors mentioned under ‘situational awareness’;

a) taking initiative to obtain information from all appropriate sources
b) confirming the information as quickly as possible
c) detecting deviations from course or action plan
d) making valid interpretations of all evidence/ information available
e) re-assessing and re-verifying the diagnosis if required

f) reviewing potential outcomes of the deviation, assessing potential hazards

g) continuing operations by repairing malfunctioning equipment, using of back-up systems or improvising in the use of equipment

h) avoiding to be distracted by unimportant events

Looking at the scope of the issues brought forward by the MASSTER Project, it may again be emphasized here that validity and reliability of such simulator based training much depends upon the instructor and how he conducts the training session to achieve the exercise objectives.

CHAPTER SYNOPSIS

This chapter highlights the rapid pace of scientific and technological advancements and their effects on the design and capabilities of the marine simulators. Realism, redundancy and response of the simulators have increased close to virtual reality. Case Study on the Ship Handling Simulator (SHS) proves the importance of the instructor for the effective training value of the simulators. Fact is that with all the facilities available on the instructor console, still he will be over-burdened with the multiple tasks he has to perform. Marine Simulator means a very complex equipment he has to handle for conducting the training of the seafarers.

Concept of simulator integration has given rise to a virtual ship available for the training purposes as highlighted by the Case Study on Maritime Simulation Center (MSC), Warnemunde. Team work by the trainees was the main stress of simulators and now even the instructors need to have training on how to conduct exercises as a team of instructors employed in an integrated environment. This has put heavy responsibilities on the shoulders of the instructor to conduct quality training on a system which is complex, unique and demanding. Competency based training demands assessment to ensure that transfer of competencies has actually taken place during the training. In addition to the traditional concept of assessment, simulator instructor needs to have added qualification and experience to conduct valid and reliable assessment on simulators.

NOTES

1. International Multi-Conferences on Instructional Technologies organised by US Merchant Marine Academy (USMMA) and sponsored by CAORF, was held at USMMA, Kings Point, New York from July 3-7, 2000. This conference covered major aspects of instructional technologies including marine simulation, and training and assessment by simulator instructor.

2. Engine room simulators are designed for the tasks and competencies that can be laid down and can have objective assessment by the use of simulator itself. Whereby navigational simulators are designed for the tasks and competencies which are very subjective in nature and involves instructor when it comes to specially assessment of the trainees.

CHAPTER FOUR - ROLE OF INSTRUCTOR IN TRAINING

A teacher affects eternity; he can never tell where his influence stops.
Henry Brooks Adams

He that nothing questioneth, nothing learneth.
Thomas Fuller

This chapter will discuss some of the aspects of role played by an instructor and how important his personality , experience and competence is when it comes to achieving the desired learning objectives, in any training activity, effectively and efficiently. Intention is not to provide an exhausted list of functions and duties of an instructor as this subject has already been a subject of research and now it is almost a proven and agreed fact that an instructor is most important in any learning activity. This chapter will show what it means when we say instructor needs to be qualified; what are the qualities agreed to be in an instructor and his importance; and finally how technological developments have been adding on to his responsibilities. IMO Model Course is under discussion in an Appendix to check for its contents and measure its utility with respect to simulator based training. This discussion will serve as base for the next chapter where we will be discussing the simulator instructor and how he differs from traditional concept of an instructor while requiring additional qualities to be effective on simulator based training. Through this Chapter, a base will be set-up for subsequent discussion on the role and importance of the simulator instructor in Chapter Five.

4.1 Relationship between Instructor and Trainee

There is always a particular relationship between an instructor and his trainee. Traditionally, a teacher has an overwhelming influence and effect on how the training is conducted. It is the teacher or instructor who is directly in contact with the students or the trainees and who arranges the contingencies of re-enforcement under which they learn; if he fails, the whole establishment of education and training may fail. Skinner (1968) asserted that importance of instructor is clear in the frequency with which he is blamed when new policies or systems of

administration or method of teaching fails to improve the education and training. Also, any weakness on part of the instructor with respect to knowledge, confidence and commitment will be noted by the trainees and will adversely affect the learning outcome. Same was highlighted by the responses to the first survey as shown in Figure 4.1.

To find out their observations regarding the qualities and capabilities of the instructors they came across during simulator training, question was posed to the seafarers as under;

> What was the major observation you had during simulator training about the instructor/s with respect to his/their handling of the simulator exercise?
>
> 1. His/their knowledge of the subject was not up to the desired level.
> 2. He/they were not confidant on the simulator equipment fitted.
> 3. He/they were not committed to the training requirements.

Responses from the trainees indicated that they were observant of the actions and attitude of the instructor during the training process, and they put up their observations indicating that either the knowledge of the instructor was below the required level or they did not feel confidant on the simulator equipment. Same is indicated in Figure 4.1.

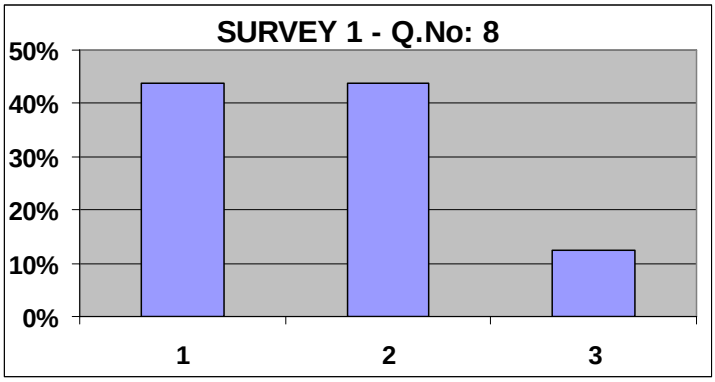

Figure 4.1 – Instructors' Performance on Simulators

4.1.1 Hidden Curriculum: Whenever we discuss any activity of education and training, it revolves around the curriculum i.e. the planned learning opportunities offered to the learner by the educational institution. Print (1993) argues that curriculum includes those activities that educators have devised for learners which are invariably represented in the form of a written document and the process whereby teachers make decisions to implement those activities given interaction with context variables such as learners, resources, teachers and the learning environment.

This implies that even a well structured curriculum when implemented will have additional and important elements attached which add to or degrade the value of the training objectives achieved. Planned learning that students were deliberately exposed to by the institution will always have multiple learning experiences which were not planned. Unplanned learning

experiences can be called as ‘hidden curriculum’. The phenomenon of this hidden curriculum occurs in any institution offering an educational program and learner will acquire planned and intentional learning as well as unplanned, unintentional learning. Hidden curriculum has been a major topic of research and writing (Apple, 1983; Anyon, 1980; Jackson, 1968) and literature on this subject proves the importance of the qualified instructor in any training activity. Hidden curriculum can have positive or negative effects on the learning objectives achieved and ultimately, it is the instructor who will control the direction of the hidden curriculum(Print, 1993).

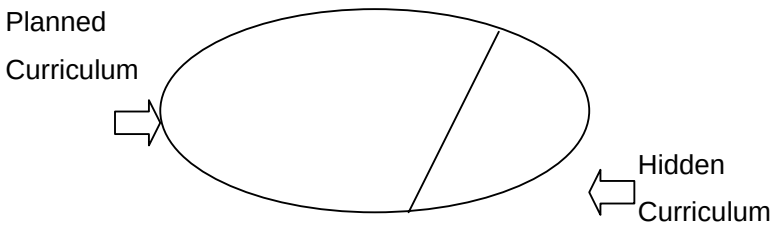

Figure 4.2 - Education and Training Activity

4.1.2 Development of Attitude: Purpose of the education and training is to develop capabilities in the trainees. These capabilities vary in nature but are interdependent and are present in different proportion in all forms of education and training activities. Gagne (1970) listed these varieties of learned capabilities as under;

- Intellectual Skills,
- Verbal Information,
- Cognitive Strategies,
- Motor Skills, and
- Attitudes.

Attitude is the mental state that a learner acquires and it influences the choices of personal actions. These choices can also be termed as tendencies and these tendencies are responsible for opting for one particular solution out of so many available due knowledge and experiences.

Development of attitudes and shaping the behaviour is one of the important elements of any education and training activity and largely depends upon the quality and characteristics of the instructor. ‘Role Model’ or ‘Ideal’ are frequently used by the individuals to opt for certain attitude and one of the task of instructor is to provide for a role model either through self

experiences or through the description of a 'right action' done by the others. This role modelling gives the motivation and confidence to the trainee to act in real situations with positive results.

4.1.3 What is the Instructor? When we discuss an instructor (1), his role is not limited to knowing the subject matter, coming to the class room, delivering a lecture for a period of 40 minutes or so and all is over. An instructor has to take the responsibility of various stages of the training process which include but not limited to the following;

- Knowledge of the subject matter,
- Course design,
- Selecting appropriate learning activities,
- Preparation and use of instructional media,
- Assessment and evaluation of the trainees, and
- Course evaluation and amendments.
-

The diverse areas demands active and consistent involvement of the instructor at all stages of the learning process, and put heavy responsibilities on his shoulders. All areas, including the basic one of subject matter or curriculum, have their own competency demands and any instructor needs to have appropriate qualification in order to be effective and efficient to achieve the learning objectives.

4.1.4 Course Design and Implementation: Any instructor has to follow certain curriculum in the training area to have some organised and planned learning activity (Fisher, 2006). Literature gives us three basic types of curriculum;

-What you planned the curriculum to be	-the intended curriculum
-What you actually teach	-the implemented curriculum
-What your student actually learn	-the attained curriculum

While discussing the same issue of curriculum, Muirhead (2006) gave six types of curriculum;

-Ideal	the original vision
-Formal	the vision is elaborated in a curriculum document
-Perceived	the curriculum is interpreted by the users
-Operational	actual instructional process in the teaching situation
-Experiential	actual learning experiences of the students
-Attained	learning outcomes of the students

Finally, it is the instructor who has to follow the curriculum at various stages and ensure that it conforms to minimum requirements of the training objectives.

4.1.5 Training Objectives: Instructor has to decide upon what are the learning objectives of the whole course and also its various sub sections and modules. One of the saying is that 'if you don't know, where you are going, you may not reach there'. Applying same principle, an instructor has to clearly lay down training objectives so as to achieve them in the stipulated time frame to make the training activity effective and efficient.

Prof Muirhead (2005) while discussing the learning objectives gives five basic requirements;

1. Learning objectives need to be specific and to the point.
2. They should be comprehensive and cover all of the subject matter.
3. They should be consistent and should complement each other.
4. They should be suitable to the requirements of the trainees.
5. Attainable by the trainees within the timeframe available.

Above discussion on the training objectives also proves the point that an instructor has to do much important tasks before he actually faces the trainees in the class room or starts the learning activities in the training area.

4.1.6 Learning Activities: Running of an actual course will comprise of multiple learning activities for the trainees and there are various theories presented by many scholars as discussed by Fisher (2006);

1. Piaget (1963) advocated learning from practical experiences and from each other i.e. social interaction.
2. Gagne (1970) saw learning process as a step by step approach and you need to ensure proper sequence of various steps.
3. Ausubel (1968) demanded building up on existing knowledge of the trainees.

Though postulated by different scholars at different times, all of the above approaches towards learning process are used in parallel and it is the instructor who has to amalgamate these theories into one approach and go ahead with his own training activity. Which theory needs to have more stress will depend upon learning objectives, trainees' qualification and time frame available and instructor will be the best judge to decide.

4.2 Tools for Improvement of Instructor

Having elaborated upon the importance of an instructor in any learning activity in the preceding paragraphs, following paragraphs analyze some of the areas where teachers and instructors need to improve themselves and qualify for their job.

4.2.1 Improving the Teacher: Basics of teacher training have traditionally been class room experiences and even today, class room performance is one of the basic measures of competence of teachers. Over the time, huge research on the art of teaching has identified or promoted 'Pedagogy' i.e. the explicit instruction on how to teach effectively and efficiently (Muirhead, 2006). Scientific analysis helps in two ways; it provides standard materials and practices, and it helps in understanding of human behaviour which is essential in improving solutions to new problems arising with the passage of time. New science of pedagogy classifies the variables the teacher is manipulating as well as their effects. It improves the role of teacher and may open the teaching profession to those who would otherwise not be able to move along.

Teacher training allows you to teach more than what you know. Originally, teacher was subject matter expert and specialist which may no longer the case. Skinner (1968) says that in the performing arts, sports and other non-verbal skills, we do not expect the teacher to be able to do what he teaches his pupils to do; or even to have been able to do so at some time in the past. Is it not the case of simulator instructor whereby he is training the trainees in scenarios and situations which he may not have faced in real life? So technology of teaching helps in increasing the productivity of the teacher and permits him to teach more – more of a subject, in more subject and to more students.

4.2.2 Qualifying the Instructor: It has been discussed and analysed how important an instructor is in any learning activity. Now its time to find out how to add to the qualification of the instructor. When one goes through the literature and various qualifying training opportunities available for the instructor, he can see a more or less common approach; an instructor need to know; the learning process, course design, delivery and assessment followed by course evaluation. Main stress is laid on actual delivery of the course and the learning activities. Main areas of concern are;

- Preparing a lecture;
  - Topic
  - Subject matter
  - Time available
  - Objectives
  - Outline
  - Handout
  - Beginning/ending
  - Summary
- Delivering a lecture;
  - Appearance
  - Confidence
  - Voice / gesture
  - Body language
  - Use of media
  - Eye contact
- Additional Tasks;
  - Demonstration
  - Assignment
  - Group work
  - Feedback
  - Practical work

Table 4.1 - Making of Slides

Following points need to be kept in mind while making up slides / transparencies for the class room lectures;

-Font / colour selected
-Amount of data
-Hand made / Print out
-Top / bottom / side margin
-Overlays
-Pointing the write ups
-Graphs or statistical charts
-Contrast / back ground
-Sentence / block case
-Charts / diagrams
-Readability / visibility
-Material of Slides
-Equipment to be used

Above are the major areas which an instructor has to learn and master the art of class room delivery. Even till date, all METICs may not have capacity to provide for the formal training in these areas to its instructors and only through experience, an instructor may be able to understand, if not all, some of the techniques, attributes and tasks listed above and need of overcoming them.

Each of these headings may have sub heading with some very finer points being discussed by various writers. Example is given in the Table 4.1 on making of slides for presentation.

4.2.3 IMO Model Course 6.09: Realizing the importance of instructors in achieving the aim of quality training of the seafarers, IMO Model Course 6.09 Training Course for Instructors was developed to provide a framework for any training imparted to an instructor

of METICs. This course is the first step for having quality simulator instructors. This model course has been discussed in details in Appendix 5 for its contents. It can easily be realised through its contents that its basic aim is to provide fundamental instructional techniques to a maritime instructor and no strong emphasis has been laid for use of simulators and its associated problems.

4.3 Technological Effects on Instructional Techniques

There were times when instructional techniques meant effective use of training aids and class room environment. What was the training aids available; Black / White boards, overhead projector, handouts/ slides and sometimes audio / video players. Class room environment meant layout of class, seating arrangement, lighting condition, time management and face to face interaction with the trainees. Detailed discussion on the IMO Model Course 6.09 has strongly supported this idea. One should imagine how technological developments have effected the training aids availability and how new environmental issues are affecting the behaviour and learning process of the trainees in the class.

4.3.1 Technological Developments: Now-a-days, when everyone frequently talks about computers, information technology (IT), distance learning (DL), computer based training (CBT), and world wide web (www), following paragraphs will discuss only some of the aspects of technological developments with its effects on instructional techniques;

a. Black / White Board; Once being the most widely used item, if not the only one, by the instructor, now only finds a hanging place on wall superimposed by some OHP screen or multimedia. Use of white board; area distribution, colour coding and usage techniques; have become redundant at maximum places or least utility at all. Now it is only in exceptional circumstances that an instructor turns towards white board as he is always busy with other aids available.

b. Handouts / Reference Books; With less availability of printed material and subject matter, handouts / extracts were common features of an educational institute and an instructor was known by the quality of his handouts. Over the time, published material has increased with less cost involved; parallel sources of information are available to the trainees; and fast pace of development makes the handout redundant more often than before.

c. Presentation Skills; While an instructor has to present his theories and discussion extempore, much emphasis was laid on instructional techniques; how an instructor faces the class and what his body language conveys to the trainees. Appearance was important and esteemed institutions meant some sort of uniform or standard appearance of all faculty members. Now comes the stage when instructor has to act as co-worker with the trainees in skill learning classes with less and less formal appearance and bearing.

d. World Wide Web (www); Internet access is increasing and availability of net is common feature at homes, work places and training institutes. This has altogether changed the learning environment and now trainee is not only affected by what is happening in the class and close social proximity but also all around the globe. This has put heavy responsibility on the instructor and extra efforts are required in ensuring knowledge transfer to the trainees in this complex environment.

e. Computers; Those times have gone when instructors used to get tired of speaking or presenting facts or writing on boards. Now we have computers with much more storage capacity and speed of display. Most of the time the trainees are over-burdened with amount of information or speed of display. Now we need new skills to be imparted to an instructor to be effective and efficient without rendering the trainees fatigued and bored.

Above discussion brought in only some of the many issues which show that new scenarios and issues have emerged and there is a need to add or delete many items from the curriculum of a standard Instructional Techniques Course. It is a dynamic science and continuous efforts are required to remain abreast with the new developments.

4.3.2 Administration and Facilitation: Mouton (1984) says that from the traditional concept of a teacher and an instructor, new concepts have evolved in the field of 'education and training and now main stress is laid out on the role of administration and facilitation. This is particularly true when handling or dealing with the experienced and grown up trainees with diverse background as in marine field. Now a facilitator or administrator, as Mouton said, has to relinquish the idea of being someone who is the main source of knowledge in the class. He will encourage discussion and action by the trainees, direct whole activity towards learning objective and monitor the progress in parallel. Thus now the role of instructor has changed a lot from the traditional concept and it has become a very complex activity with multiple variables. This then implies that instructional techniques have become very complex

and we need much more competent and qualified instructor than the case was few years before; only then we can ensure the achievement of learning objective of a training models and ensure quality of the trainees passed out from a training program.

4.4 Is the Instructor Indispensable?

With the vast availability of learning material and development of user friendly software, there is a notion of self learning or teacher-less education. In the following few paragraphs, problems and difficulties associated with this concept of education and training(2) will be discussed.

4.4.1 Skill Based Training: One major area in the field of education and training is the skill based training. Cotton (1995) discussed the skill based training and highlights three basic components involved in any skill, whether surgeon, actor or cook, and these components are;

a. Psycho Motor Skills
b. Perceptual Skills
c. Cognitive Skills

These three components of skill based training has distinct features;

a. Psycho Motor Skills; All types of skill based training involve some body movement. Part of the skill is movement of some body part and very active skills, like ballet dancing, these movements are highly complex and controlled.

b. Perceptual Skills; All skills are controlled, practised, precise and accurate. They require very sophisticated control mechanism which is carried out by the senses. For example, a musician has to listen for tell-tale changes in tone of speech or in note. All the cues for action and the checks for correct performance need trained perceptual skills.

c. Cognitive Skills; Every subject, occupation or process has a language which may consist of words or symbols and the skilled person has to understand and operate in that language. Plans, patterns, codes, symbols and technical words are all used within problem solving and operation of a skill. Standard Marine Communication Phrases (SMCP) is one example of a particular professional language.

4.4.2 Practical Thinking: Learning process involves a parallel thinking process and Edward de Bono (1986) in his book, Six Thinking Hats, says that 'The main difficulty of thinking is confusion' (Pretty, 1995). We try to do too much when we think. Emotions, information, logic, hope and creative thoughts all pour into the process and we end up with confusion. This brings in the importance of instructor who can control the learning process and makes the trainee wear one hat at a time while teaching us when to be emotional, confidant or sceptical before taking a particular action in real situations.

Twenty first century has brought in the new dimensions to the learning process. During the last decades of twentieth century, developments took place whereby more and more learning opportunities were provided through other means than the traditional concept of class room with teacher-trainee composition. Increased availability of training aids like audio / video and computer CDs in parallel with spread of broad band internet brought in the concepts of Computer Based Training (CBT), Distance Learning (DL), and Web based Learning. Initial successes of these modes of education beyond expectations brought in the notion of instructor-less-instruction; one can simply get away with someone known as instructor or teacher.

Self training or education has its own advantages / disadvantages with inbuilt limitations imposed due different requirements in different fields. Even the philosophical discussion flourishes fully when there is some mentor or moderator. When it comes to skill- or competency-based training of an individual, role of an instructor becomes multifolds; one cannot simply learn a competency by looking at a diagram or clicking on the computer screen using a mouse. This will be going back to older version of STCW78 whereby one has to write down his mind over a piece of paper and can qualify.

When we go through the course structure of any distance learning program, majority of them are a mixture of distance learning and traditional learning process. One actually learns the basics of the course and then final refinement or polishing is done through interaction with peers and instructors. This composition also demands heavily on part of qualification and competency of the instructor. An individual instructor needs to have special competencies in addition to the traditional instructional techniques in order to be an effective and efficient instructor in CBTs and DL.

CHAPTER SYNOPSIS

In this chapter, it was analysed that any learning activity means a special relationship between the instructor and a trainee which ensures positive outcome of the learning activity. One as an instructor not only achieves the learning objectives while controlling and directing the hidden curriculum but also tries to develop an attitude in the trainee. This attitude will decide the future personality of the trainee and his professional work ethics in the real life. Over the time, science of pedagogy has developed and progressed and now it is almost proven and accepted fact that any learning activity revolves around an individual, the instructor. Science of pedagogy is dynamic and one needs to adjust to the new developments to remain abreast and up-to-date. And finally and foremost, an instructor is not a dispensable commodity especially in the skill or competency based training. Rather one needs additional competencies to be effective and efficient competency-based trainer.

NOTES

1. It will surely be of interest to mention here that old edition of IMO Model Course 6.09 along with its compendium discusses the instructional techniques and associated problems in much more details. Many of the topics discussed in that edition, have been used in the course of this research also and are recommended readings whenever any work is undertaken on a model course for simulator instructors.
2. IMO Model Course 6.09 highlights the importance of instructor by saying that in all training endeavours, the knowledge, skills and dedication of the instructors are the key components in the transfer of knowledge and skills to the trainees. This implies that the presence of instructor cannot be substituted with audio-visual or programmed material.

CHAPTER FIVE -ROLE AND IMPORTANCE OF SIMULATOR INSTRUCTORS

Learning teaches the more in one year than experience in twenty.
Roger Ascham

A little learning is a dangerous thing.

In this Chapter, analysis will be made of role and importance of the simulator instructor in conducting the quality training on simulators. First, it will be discuss how the instructor has to link up the simulation with real life experiences and create an environment whereby the trainees feel being at sea and overcome the fidelity problems with the equipment. This will be followed by a discussion on the requirements and problems of the simulator based training and how various efforts have been made in the past to address competency of the simulator instructors to meet these requirements and overcome the problems. In the end, it will be discussed how some of the techniques are being used on the simulators to have some form of performance standards for the trainees. Through this chapter, efforts will be made to achieve the third objective of the dissertation.

5.1 Requirements for being a Simulator Instructor

In the following few paragraphs, the attributes and the requirements to make a simulator instructor an effective and efficient trainer, will be discussed.

5.1.1 Teaching and Learning: Simulator instructor has different role to play than a normal maritime instructor. If we look at the learning process, we can say that simulator instructor is not teacher rather he is a trainer who has to ensure transfer of competency to his trainees.

Teaching is what we all are used to in school or college time. One person, the teacher, stands at the front of the row of the students or children. This one person knows something and is trying to encourage the others to know it too. It is formal and often has little to do with learning.

Learning is not usually an outcome of teaching. Instead it comes from a process of self-development through experience. How a trainer can impart skills and enhance the knowledge of the trainees is altogether different science than teaching. This process becomes further complicated when the trainees are adults, have practical experience and are active professionals like seafarers.

Teaching is mostly teacher-centred and is manipulation. Teacher is in charge of the learning activity and everybody knows it. Teacher himself rarely learns. On the other hand, learning is trainee-centred and is facilitation. Teacher is helping others to learn while he is also learning at the same time.

Guiding trainee groups and acting as facilitator without imposing or steering too much is very difficult task to perform. Lack of self-confidence, ignorance of the environment or nervousness can lead a trainer for a tight control over the proceedings. He will start deciding what, when, how, where etc. A rigid top down training approach can be efficient and re-assuring for the trainer, but it may lead to lack of learning and knowledge transfer process gets slowed down.

5.1.2 Good Qualities for a Trainer: Good simulator instructor means good trainer and thus simulator instructor has to inculcate in himself all the qualities of a good trainer. To be a good trainer needs time and experience and trainer needs to learn the science to expedite this training process. Some of the good qualities in an effective trainer, as discussed by Jules Pretty (1995) are;

- A warm personality, with an ability to show approval and acceptance of trainees.
- Social skills, with an ability to bring the group together and control it without damaging it.
- A manner of teaching which generates and uses the ideas and skills of participants.
- Organising ability, so that resources are booked and logistical arrangements smoothly handled.
- Skill in noticing and resolving participants' problems.
- Enthusiasm for the subject and capacity to put it across in an interesting way.
- Flexibility in responding to participants' changing needs.
- Knowledge of the subject matter.

Some of these qualities can be attributed to peoples personalities; some are learned and improved with experience; and still there are some which need to be developed through some practical training experiences.

5.1.3 Process of Feedback: During the simulator based training, feedback is one of the important requirements to make the learning process directed, result-oriented and efficient. A trainer should be pro-active and involved in the exercise and provide the feedback to the trainees. This feedback has multiple uses; it will keep the exercise directed and will not let the trainees go off track; it will act as correcting signal at the spot; it will keep the instructor involved in the exercise; it will also keep the trainees motivated as they know that they are not far off from the performance standards set for them. There are multiple points a trainer need to keep in mind while providing feedback to make the process effective. Some of these points are listed in Table 5.1.

Table 5.1 – Trainer's Feedback Checklist

- Do you use several ways to offer feedback to learners; written comments, general progress discussions, comments on each performance and action plans?
- Does every learner receive feedback during each session?
- Do you always give feedback immediately?
- Do you always praise the good points before criticising the bad?
- Do you criticise the performance not the person?
- Do you always give reasons for your feedback?
- Do you check that the learner has understood the feedback by asking open-ended questions?
- Do you concentrate on just a few criticisms at a time?

Do you create an atmosphere where trainees can give constructive feedback to each other?

(source: Pretty, 1995)

5.1.4 Adult Learning Process: Simulator training involves the adults who most of the time also have the working experience onboard ships. Adults have different learning attitudes than the others and this needs to be taken into account by the simulator instructor. If the instructor can use it positively, adults' attitude will help him in achieving the learning objectives out of the exercise; otherwise it can be counter-productive resulting into total failure and chaos in the simulator which is not desired. So simulator instructor is needed to keep the psyche of the adults in the class room. Table 5.2 provides a useful guide for the trainer to regulate and control the training process while handling a class of adults with practical experience in the field of training.

Table 5.2 – Trainer's Checklist – Adult Learning

- Is the atmosphere of your sessions friendly and encouraging?
- Have you made plans to relieve any anxieties your trainees might feel?
- Will your teaching methods allow learners' previous experiences to be acknowledged or used?
- Will learner be 'rewarded' for their contributions?
- Does the work allow participants to measure their own progress?
- Do you make it clear that you are available for additional help if individuals have difficulties?
- Are the first few minutes of your sessions always attention-grabbing?
- Do you build in frequent opportunities for reinforcement and practice?
- Are you avoiding lectures, or at least limiting them to 10-20 minutes?
- Have you built in regular feedback session?

(source: Pretty, 1995)

Learning process of the adults is altogether different than others. Robert Smith (1983) gave a good discussion about the subject and a list of variations was drawn for an instructor dealing the adults as given in Table 5.3.

Table 5.3 – How adults learn?

- Adults are voluntary learners. They perform best when they have decided to attend the training for a particular reason. They have a right to know why a topic or session is important to them.
- Adults have usually come with an intention to learn. If this motivation is not supported, they will switch off or stop coming.
- Adults have experience and can help each other to learn. Encourage the sharing of that experience and your sessions will become more effective.
- Adults learn best in an atmosphere of active involvement and participation.
- Adults learn best when it is clear that the context of the training is close to their own tasks or jobs. Adults are best taught with a real-world approach.

(Source: Smith, 1983)

5.1.5 Team of Trainers: With technological advancements in the field, simulators are becoming more and more complex in operation and conducting an exercise on simulator can be very hectic and full of efforts on part of instructor. Integrated operations are becoming normal feature and demand a team of instructors working together instead of traditional

concept of one instructor at a given time. This concept of integration puts yet additional responsibilities on the simulator instructors to learn team-work and run the exercise in a cohesive manner.

Working with another trainer for conducting of an exercise can have many advantages;

- During the training session, you are performing many tasks at the same time. Sharing the sessions gives you the opportunity to catch your breath and be more effective in next session.
- One can add up to his creativity and experience to deal with any problem.
- By complementing each other, instructors are less likely to overlook some key learning point in debriefing session.
- Changes in style and rhythm between trainers will keep the trainees more concentrated.

5.1.6 Life Cycle of a Group: Simulator training is carried out in groups involved in an exercise together. When a group of people work together, they pass through various stages and Charles Handy (1985) has characterised them as;

- Forming,
- Storming,
- Norming, and
- Performing.

The challenge of every group trainer is to help their trainees move through the various phases of group formation until they reach their final stage and start performing as a group.

5.1.7 Group Conflict: When people work in a group, there will surely arise some conflict in between them. As a trainer, one should not ignore this conflict as it will affect the overall working and learning efficiency of the group. It is not a must that conflict will be destructive in nature all the time. If one can control and redirect the conflict, it can be converted into constructive competition. There may not be a single solution to conflict resolution but still the trainer can be educated on how to address the issue of conflict. Some of the examples are;

- Some participants create conflict just for show off and to get extra attention.
- An individual is trying to hide his weaknesses.
- Some conflicts are just due to difference of opinion.

Conflict among group members can be evident from raised voices, tense faces and nervous body languages. Silence can also be used to show anger or difference of opinion especially by the group towards the trainer. There can be various techniques to deal with any type of group conflict. Table 5.4 highlights some of these techniques which can be used by a trainer in the class.

Table 5.4 – Dealing with Conflict

- talk to individual in private.
- talk to the person through his trustee.
- give the trouble maker some extra work
- go for an exercise whereby individual can raise their voices and opinions.
- have peer review discussion so as group can criticise each other behaviour.
- deal with problem publicly in exceptional circumstances.

(source: Pretty, 1995)

5.2 Training on Simulators

Training process on simulators has its own dynamics and requirements. There are various stages and elements of simulator training and an instructor needs to be well conversant with these stages and elements to be effective in training process. Following few paragraphs will be analyzing these aspects of simulator training.

5.2.1 Elements of Training on Simulators: Training is the systematic development of the skill behaviour pattern required by an individual in order to perform adequately a given task or job. Training of seafarers on simulators can be very effective provided it is properly validated. Simulator instructor must ensure following steps as part of training program to ensure validity;

- Task analysis,
- Training objectives,
- Selection of relevant tasks,
- Appropriate simulator training environment,

When we see how the training exercise is actually run on simulator, whole process of exercise can be divided into various parts and sub-parts. Different sources have enumerated different number and name of these parts. As a general guideline, we can distinguish four main stages of any exercise;

- Briefing
- Simulator familiarization
- Conducting & Monitoring
- Debriefing

When someone gives more stages of any simulator exercise, in fact, he is emphasising some of the sub-part of these four main stages. Professor Muirhead (2003) has discussed these stages in his writings in details and his version of these stages has been given in the four boxes on these stages. These boxes (Tables 5.5 to 5.8) list down the multiple tasks to be performed during these stages.

Table 5.5 – Briefing - Key Elements

- Participation and motivation.
- Preparation.
- Level of experience.
- Exercise complexity.
- Pre-planning activity.
- Exercise environment.
- Roles, responsibilities.
- Purpose and objectives.
- Use of equipment.
- Intervention.
- Demonstration.
- Repetition and queries.

(Source: Muirhead, 2003)

Briefing given to the participants has a key role in simulator training and will set the pace of progress. Main points to be covered in briefing are given in the Table 5.5.

After the briefing session comes the stage of simulator familiarization. All the trainees are to be given a walk round of the simulator area while explaining to them the various fixtures, equipment and their functions. This time can be compared with the overlap time watch keeper should have before handing / taking over the watch whereby they can explain the situation on watch and new comer can adjust to the scenario and understand the working. Important points regarding the familiarization process are given in Table 5.6.

Table 5.6 – Familiarization - Key Elements

-Main features, equipment and operations
-Limitation of environment
-Acceptance as a 'real ship' of typical behaviour
-The need for adequate familiarization time
-Support of pre reading material
-Use of Part–Task training devices
-Compensatory cues to overcome lack of reality
-Confidence in the transfer of acquired skills

(Source: Muirhead, 2003)

Familiarization stage is followed by the main stage of conducting the exercise on simulator and making the trainee go through the working on simulator as he would have done on real ship. Here he has to perform and show his basic competence while in parallel learning the new competencies. During the conduct of the exercise, important aspect on part of the

instructor is monitoring of the exercise and performance of the trainees. Key elements regarding how to conduct the exercise and monitoring process are enumerated in Table 5.7.

Table 5.7 – Conducting & Monitoring an Exercise – Key Elements

- A balanced interaction between trainee and the exercise
- The use of stimuli and cues
- The role of purposeful intervention in creating a 'real atmosphere'
- Avoidance of excessive intervention
- Avoidance of excessive stress
- Avoidance of 'gaming' atmospheres
- Instructor's role as mentor, moderator, facilitator
- Monitoring-purpose and intent of data collection
- Nature of the observational process
- Planned use of recorded data and information in the debrief

(Source: Muirhead, 2003)

Finally at the end of the training session, de-brief should be given to the participants covering various aspects in details as per the Table 5.8. A well conducted de-brief can itself be a source of learning for the exercise participants. Quality de-brief by the instructor is the show of good instructional techniques learned by him and will contribute toward the final objective of the effective and efficient training of the seafarers. De-brief is not the end of learning process, rather it can start a thought process in the mind of the trainees.

Table 5.8 – Debriefing – Key Elements

- Purpose and objectives of the debrief
- Exercise strengths and weaknesses
- Lessons learnt from errors / mistakes
- Use of peer review technique
- Use of supporting exercise data
- Real life examples for improvment
- Avoiding blaming individuals
- No 'lectures' on how to do it
- Use a tactful approach
- Good communication is important

(Source: Muirhead, 2003)

To look into the process of simulator exercises being run for the training process in practical field, seafarers were asked about the various stages of the exercise they went through. Question was framed like as under;

> Did you go through the following stages? What were your feelings? (Please strike out which is not applicable)

1. Briefing before the session. **SATISFACTORY / NOT SAT/ NOT HELD**
2. Instructions during the session. **SATISFACTORY / NOT SAT/ NOT HELD**
3. De-briefing after the session. **SATISFACTORY / NOT SAT/ NOT HELD**
4. Practical Assessment session. **SATISFACTORY / NOT SAT/ NOT HELD**

Responses indicate, as given in Figure 5.1, that practically there may be many instances whereby instructor misses out some of the main element of simulator exercise like briefing or de-briefing. There is a need to train the instructors to convince them the importance of these elements and their effective use to make the simulator training meaningful and result producing.

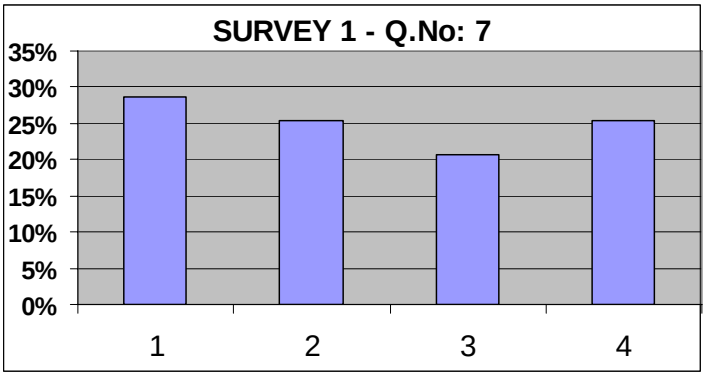

Figure 5.1 – Coverage of Main Elements of Exercise

Instructor is the pivot point around whom whole of the training program revolves and who has to verify the validity of the training program. He has to carry out task analysis process whereby he has to analyse such questions as;

- Was the exercise conducted as planned?
- Did it meet the training objectives?
- Were the system characteristics and levels of fidelity appropriate?
- Were there any variable factors distorting training outcomes?

Instructor can have assessment of the effectiveness of simulator training from the participants as under;

- Views on credibility, realism and achievements of exercise.
- Activities during the exercise,
- Response / attitude during planning, debrief and discussion session.
- Changes in attitude over the time.

5.2.2 Exercises for Motivation: Simulator exercises can themselves be used as a source of motivation among group member and developing a positive control over the group dynamics, especially for;

- relaxing the participants
- stimulating communication between strangers
- encouraging participation and learning attitude
- developing new skills
- exposing participants to new ways of judging their own actions and their impact on group work

5.2.3 Literature on Simulator Instructors: After many decades of simulator training available to seafarers, the major source of knowledge for simulator instructor is through individual articles, papers and at best proceedings of some forum and conference (1). There is an urgent need that maritime universities, METICs and experienced instructors should come up with their experiences in the form of some dedicated book on the subject of simulation and simulator instructor. This will surely help in sharing of experiences; motivate simulator instructors to update their knowledge and working; educate and train the new comers in the field; and also this will open some healthy discussion among marine professionals which is the basis of progress in any field.

5.3 Efforts to Improve the Simulator Instructor

Taking into account the importance of the simulator instructor in conducting the quality training on simulators and achieving the desired results of competency based training required by the STCW Convention, there have been multiple efforts in the industry for improving the qualification of the simulator instructors. Major efforts have been discussed in the following paragraphs.

5.3.1 World Maritime University: World Maritime University designed (2) a Professional Development Course (PDC) in 2004 with the aim to impart instructional skills to maritime simulator operators. As discussed during INSLC14 (Ali,2006), this one week course was meant to assist both experienced and new simulator instructors as well as maritime lecturers to better understand the application of the STCW95 convention in relation to the training and assessment of seafarers on marine simulators. The program was supported by the simulation facilities and instructor staff of the MIWB, Terschelling. A certificate of attendance was issued by the university to the participants.

Course objectives were as under;

1. To fully appreciate the application of the STCW Convention to simulator training and assessment.
2. To enable the instructor to understand the functions, role and use of marine simulators as learning, training and assessment tools.
3. To provide the instructor with practical skills and experience in the planning, operation and evaluation of simulation based training and assessment of seafarers.
4. To be aware of the limitations of marine simulators when used to assess practical skills and competence of seafarers.

Several practical workshops formed an important element in the program. Working in small groups, the participants developed and designed short training and assessment scenarios and exercises and conducted same on supporting simulator facilities. The groups participated in, monitored and debriefed the exercises in order to evaluate the different approaches and methods used for training and assessment purposes. The range and extent of the coverage of simulation in the program was adjusted depending upon the back ground of the participants and availability of the simulation facilities. Main points covered in the syllabus of this course are listed down in Table 5.9.

Table 5.9 – Syllabus for Simulator Instructor Course

STCW95 and use of simulators.
Competency based training.
Training process.
The role of instructor.
Course design.
Exercise development.
Pre-briefing techniques.
Simulator Familiarization.
Monitoring and recording activity.
De-briefing techniques / feedback.
Assessment process.
The role of assessor.
Feedback / performance evaluation.
Validation.

(Source: WMU, 2004)

5.5.2 Train the Trainer Course: With the active involvement of the IMO and regional industry players, 'Train the Trainer' Course has been conducted at the Integrated Simulation Centre (ISC), Singapore (Ali, 2006). This course was meant for improving the expertise of the simulator instructors in conducting the simulator based training. Participants were Nautical and Engineering officers both from the administration and METICs from South Asia, South East Asia and Far East.

Such a 'Train the Trainer' course was also conducted at Regional Maritime Academy, Ghana with the assistance of the IMO. Participants were from the African continent and aim was to

promote the simulator based training in the less developed countries and improve the quality of the simulator instructors.

To get a picture on the number of the trainees undergoing training in METICs, a question was posed in Survey 2 as under;

What is the total number of the trainees undergoing training on simulators every year?

1. < 2000 2. 2000-5000 3. >5000

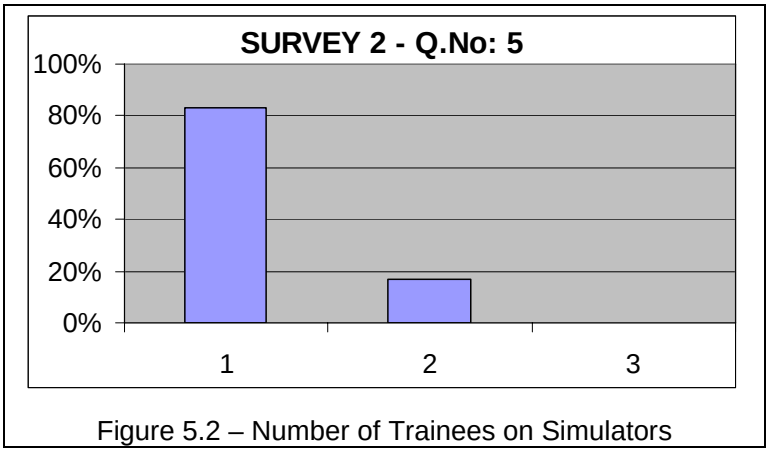

Figure 5.2 – Number of Trainees on Simulators

Also, a question was raised in same survey regarding the simulator instructors as under;

What is total number of the Instructors in your organisation imparting practical training on these simulators?

1. < 05 2. 05-10 3. >10

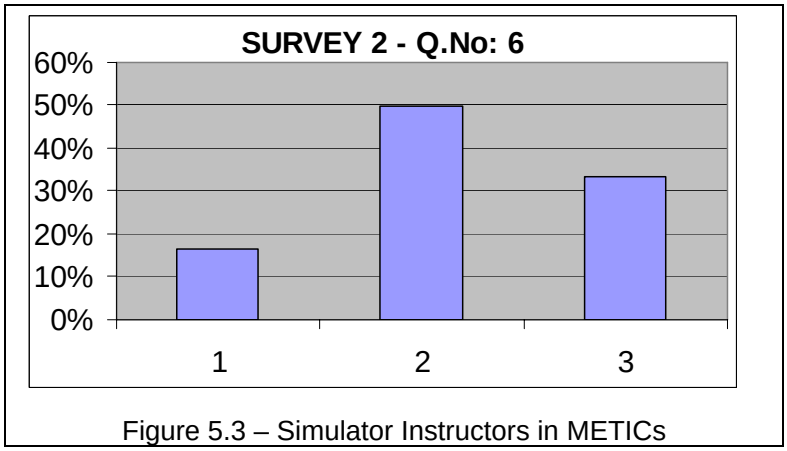

Figure 5.3 – Simulator Instructors in METICs

It is worthwhile to mention here that majority of the METICs have simulator trainees less than 2000 and only limited numbers of the simulator instructors are available in these

institutes as highlighted in the survey on instructors (Fig. 5.2 & 5.3 respectively). This clearly implies that unlike other fields of education and training, learning process from the peers and out of practical experience with respect to simulator training will be very slow and unreliable. Simulator instructors need interaction out of their own institute and some sort of formal training to master the instructional techniques involved in the simulator training. Only the dedicated training can ensure standard and effective training covering all the required aspects involved.

All educational fields have their own problems and there is a need to analyse these problems to find some suitable solution to these issues. To find the possible problems being faced by the METICs with respect to the simulator based training in their institutes, following question was raised in the survey;

> What is the major area of concern with respect to the future of simulator training in your training institute?

1. Availability of qualified and experienced simulator instructors.
2. Availability of the suitable trainees.
3. Maintenance and up gradation of the simulator facility.

Major problem being faced by any simulation complex after the maintenance and up gradation is the availability of the suitably qualified and experienced simulator instructors as shown in Figure 5.4.

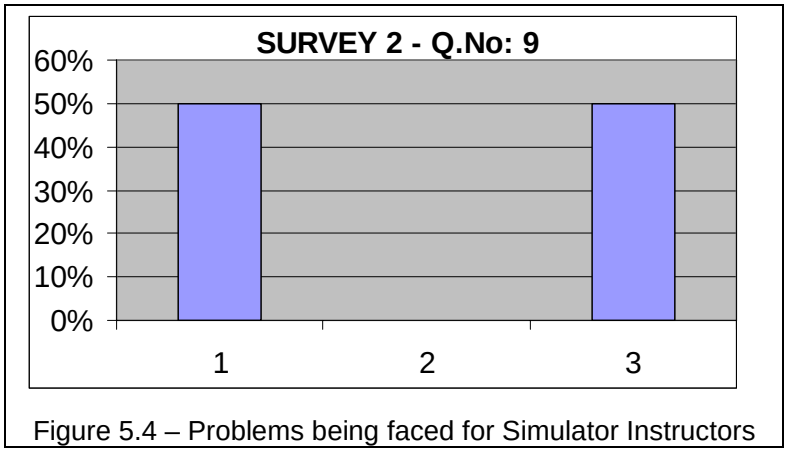

Figure 5.4 – Problems being faced for Simulator Instructors

Survey also raised a question regarding the source of qualification of the simulator instructors as under;

What is the major source of qualification for simulator instructors at your organisation?

1. In house training.
2. Training by the manufacturer.
3. Practical Experience.
4. 'Train the Trainer' course by some external agency.

It came to surface that not many simulator instructors have gone through a formal training course and major source of qualification is the in-house training with practical experience or training by the manufacturer whereby instructors are taught how to use the equipment. This has been highlighted by the responses to above question as given in Figure 5.5. There is strong need of the 'Train the Trainer' course independent of own organisation and manufacturer to ensure quality training of the instructor (3). Need of the training opportunities for the simulator instructors was have also been highlighted in the survey in response to following question to the METICs;

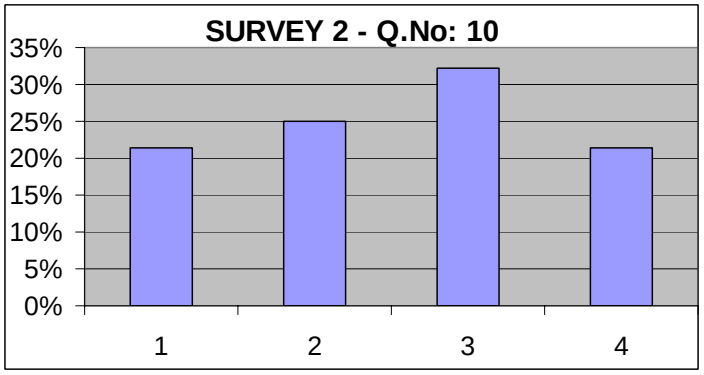

Figure 5.5 – Sources of Qualification - Simulator Instructor

What is the major problem being faced by your organisation with respect to the simulator instructors?

1. Availability of the simulator instructors.
2. Provision of training opportunities to these instructors.
3. Morale and commitment of the instructors.

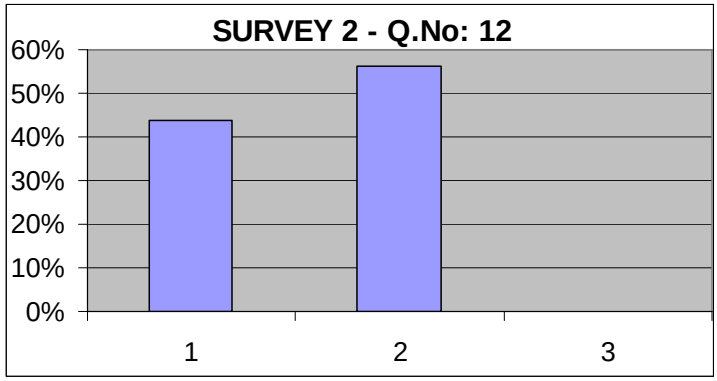

Figure 5.6 – Problems regarding Simulator Instructors

CHAPTER SYNOPSIS

In the discussion above, it was analysed that any level of realism in the equipment or simulator will be below the actual ship and it's the simulator instructor who has to bridge the gap between the simulation and reality. It was discussed that IMO Model course for instructor has main concern to improve the capabilities of the marine instructor in the conduct of the class room instruction and use of various training facilities like OHP, white board and class room environment. We in fact need some dedicated model course for the training of the simulator instructor whereby he can learn the various techniques required for the conduct of the simulator training (4). This is particularly true when we look at the design and conduct of the simulator exercise, its various stages and requirements of every stage. This requirement of dedicated training requirement was felt before also and some efforts were made in the form of simulator instructor course by World Maritime University and also Train the Trainer course run at other places. Still there is neither any requirement of across the board instructor qualification for conducting training on simulators nor any model course available on the subject validated by the IMO.

NOTES

1. A series of conferences were held under the banner of International Navigation Simulator Lecturers Conferences (INSLC). These conferences discuss the navigation simulators with special emphasis on problems being faced by the instructors to ensure the validity and reliability of training and assessment of the trainee. Last conference was held in July 2-5, 2006 in Genoa, Italy and was attended by the writer of this research work to have updated experiences on the subject.

2. This Professional Development Course (PDC) was developed and run by Prof Peter Muirhead of WMU and Prof Stephen J Cross of MIWB for simulator instructors. Instructors employed at MIWB underwent this PDC with the aim to qualify them for conducting training, in compliance with STCW Convention, on simulators being installed at Maritime Simulator Training Centre (MSTC), Terschelling.

3. AT USMMA, all assessors in the Bridge Watch Standing Course must have experience as Master of an unlimited tonnage vessel and have taken a Train the Trainer course for Simulator Instructors. In addition, checklists and grading guidelines have been developed for use by the assessors to ensure consistency and reliability of the assessment.

4. While discussing this issue very candidly, R J Meurn and G R Sandberg of USMMA in MARSIM93 highlighted the importance of having qualified and experienced mariners employed as simulator instructors after undergoing not only Simulator Instructor Course but also Training Course for Assessor on Simulator. A course outline for the same was also proposed by the writers in their joint paper.

CHAPTER SIX - CONCLUSIONS AND RECOMMENDATIONS

The beginning of knowledge is the discovery of something we do not understand.

Frank Herbert

There is no subject so old that something new cannot be said about it.
* Fyodor Mikhailovich Dostoyevsky

Role and importance of an instructor in imparting education and training to the trainees has been a topic for debate from ancient times. Having discussed this topic in details in the previous chapters with special reference to simulation and marine environment, this Chapter will consolidate our discussion and draw upon some conclusions. These conclusions then will help to formulate some recommendations regarding the simulator instructor for the seafarers to help him in achieving the perceived goals and standards of STCW Convention.

6.1 Conclusions

Based upon the discussions on the role and importance of the simulator instructor in previous chapters, it can be concluded that;

1. The field of simulation is very broad and diverse in nature with respect to technological advancements and practical usages in various fields. With regards to STCW Convention and training of the seafarers, we need to put limits to the meaning of the simulation. Marine simulator can be defined as a piece of equipment which imitates the appearance or effect of some real equipment fitted onboard ship. Trainees are given some working experiences on these simulators before putting them onboard ships as operators and users of real equipment and machinery.
2. Training value of the simulators has widely been proven and accepted by the marine industry. Simulator based training is cost-effective, convenient and diverse in scenarios. Simulator exercises can be designed, conducted and controlled as per user requirements; these exercises can be repeated with quality

control and ships' operational limits can be touched upon in risk free environment. Simulators have made available the multiple operating conditions anywhere, anytime without time and space barriers as applicable to onboard training process.

3. Traditional concept of training of the seafarers onboard ships became redundant with the introduction of high tech equipment and machinery. Reduced manpower, desire for ecnomic efficiency and speed of operations onboard ships also demanded all onboard to be properly qualified and 'experienced' in ships operations.

4. With the early usage of simulation for the equipment like Radar/ ARPA, simulators have successively advanced in complexity of operations and usage. Full Mission Bridge Simulators (FMBS) and Un-manned Operations of machinery spaces have made the marine simulation much more complex with no parallel even in recent history.

5. Issues like 'Fidelity vs Validity' and 'Reliability vs Uniformity' have made the design and conduct of simulator exercise a complex science. An instructor needs to be aware of these issues to conduct effective training while controlling the exercise conditions and providing the multiple feedbacks to the trainees on their performance standards.

6. IMO requirements on training standards of seafarers at various levels of the career have increased exponentially in recent times with strong emphasis on competency and quality control. STCW Convention mentions the use of simulators as one of means to ensure competency based training and envisages even the assessment of seafarers using simulators to ensure achievement of training objectives.

7. While recognizing the availability and use of simulators at all levels, STCW Convention have made only the Radar / ARPA simulator training mandatory for all seafarers while use of all other simulators is only desirable in the Convention.

8. Survey results indicate that the simulator based training is under taken only when it is made mandatory by the STCW Convention, national administration or through the company policy; otherwise simulator training will always be avoided due to added financial burden.

9. IMO Model Course 6.09 is meant for training of the marine instructors. Its main emphasis is on how to conduct the theoretical and class room instruction. While giving details on how to use boards, displays, training aids and handouts / notes, this model course lays very less emphasis on how to use simulators for effective training of the seafarers.

10. Marine simulators are increasing in complexity and reducing in cost. Technological advancements are bringing in Replica Simulation System and Integrated Simulators. One can virtually operate a ship in a training institute with much more added training value. Multiple Integrated Simulation Centre (ISC) established worldwide demand much more on part of instructors than envisaged few years before.

11. Role of an instructor has always been important in achieving the learning objectives. An instructor is always indispensable and he is the one who controls hidden curriculum, develops positive attitude and ensures directed training. Same is applicable to a simulator instructor also but with much more added responsibilities.

12. Simulator instructor is much more than an instructor. He is involved in skill based training of adult learners and is responsible for Psycho motor and perceptual skills while controlling the practical thinking in parallel. He is fighting a war on much more larger scale than any other instructor.

13. Recognizing the importance of the simulator instructor, STCW Convention desires him to be 'appropriately' qualified and experienced on the simulator training; but no specific requirement has been made to give some meaning to this appropriately qualified term.

14. Some individual efforts were made to design a suitable course for the simulator instructors. World Maritime University (WMU) designed and developed a Professional Development Course (PDC) in 2004 with the aim to impart instructional skills required for maritime simulator operators. Also 'Train the Trainers' courses were conducted at Integrated Simulation Centre (ISC), Singapore and Regional Maritime Academy (RMA), Ghana to train the simulator instructors of these regions.

15. Simulator Instructors need to have some formal training on how to conduct effective and efficient training on simulators. Responses to the Survey on Instructor also support this requirement when seafarers pointed out the need for training of the simulator instructors.

16. While any library is having multiple written material and printed books by world known authors on instructional techniques and teaching pedagogies, there is hardly any printed book on the subject of simulator instructor. Only available sources are the proceedings of the conferences on the subject but these proceedings handle the issue in fragmented papers and articles.

6.2 Recommendations

Based upon the conclusions drawn during the last few lines, it is recommended that;

1. Simulator based training should be made mandatory at various levels of seafarers to achieve the competency based training objective of the STCW Convention. A 'successive approach' can be adopted whereby simulators are made mandatory one by one in stages but there is strong need to move from position of 1995 when only the Radar /ARPA simulator training was made mandatory in the Convention.
2. There is a need for IMO Model Course for Simulator Instructors. This course can act as bench mark for the qualification of the simulator instructors to appropriately qualify them as per requirements of the Convention. Professional Development Course (PDC) on the subject designed by WMU can be taken as basic reference and modified / added to suit the world wide requirements of the simulator instructors.
3. Simulator Instructors employed in the METICs for training of the seafarers should undergo some formal training on use of simulation for competency based training. This training package for simulator instructors will better serve the purpose if it is designed and promulgated through IMO / STCW Convention. Only a qualified simulator instructor can ensure quality training as per the standards laid down in the Convention.
4. There is a need of concerted and dedicated effort to have printed books and material on the subject of simulator instructor. Now when we have simulators in use for decades and multiple maritime universities established worldwide, marine professionals and experts should come forward and document their experiences as simulator instructor. This will be a major contribution and service to our coming generations of maritime industry.

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International Maritime Lecturers Association /
International Navigation Simulator Lecturers Conference
Contact Person; Mr. Ragendra Prasad. Lecturer WMU

IMO (London) www.imo.org
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Malek Pourzanjani Ph D, Professor World Maritime University, Malmo, Sweden.

Max Majia Cdr, Lecturer World Maritime University, Malmo, Sweden.

Moin Ahmed Captain, Head Asia Pacific Section, Technical Cooperation Division (TCD), International Maritime Organisation (IMO), London, UK.

Nick Daltan Mr, Sales Manager (UK), TRANSAS, Portsmouth,UK.

Olivier Mornet, Head of International Affairs, Department of Maritime Affairs and Seafarers, Ministry of Transport, Paris, France.

Oyvind Tellefseen Mr, Product Advisor – Documentation, Marine Automation, Kongsberg, Horten, Norway.

Per Meek Capt, Director Gerneral, Norwegian Maritime Directorate, Oslo, Sweden.

Peter Muirhead Ph D, Visiting Professor World Maritime University, Malmo, Sweden.

Pipchenko Alexander Mr, M Sc Student, Deep Sea Navigation Faculty, Odessa National Maritime Acedemy.

Rajendra Prasad, Lecturer World Maritime University, Malmo, Sweden.

Ravi Shankar, Senior Maritime Surveyor and Examiner, Transport Canada, Ottawa, Ontario, Canada (e-mail; shankar@tc.gc.ca)

Reji George, Senior Consulting Manager, Cognizant Technology Solution, Chennai, India.

Robert Averin, Project Engineer Safety Equipment, TRC Marine Technology, Swedish Defence Material Administration.

Saleem Qasim Captain, Senior Nautical Instructor, Pakistan Maritime Administration, Karachi.

Sangameswar I G Captain, Assistant Director Investigation and Certification, Maritime and Port Authority of Singapore (MPA).

Sanjeev Soni, Master Mariner, Senior Manager, ST Education and Training, Singapore.
(e-mail; soni@stet.com.sg)

Stephen J Cross, Director Maritime Instituut,Willem Barentsz (MIWB), Terschelling, the Netherlands.

Sven Åke Wernhult Captain, Lecturer World Maritime University, Malmo, Sweden.

Thomas N Sorgjerd, Manager Sales and Marketing, SEAGUL, Horten, Norway.

Thorsten Thorstensson Mr, Sales Manager, Maritime Operations, SSPA, Sweden.

Ulf Leslie Hallenstvet Captain, Assistant Professor, Faculty of Maritime Studies, Vestford University, Horten, Norway.

LIST OF LECTURES, WORKSHOPS AND CONFERENCES ATTENDED

Following is the list of lectures, workshops and conferences attended by the researcher in course of research work on the topic of marine simulation and simulator instructor;

'*Legal Issues in Maritime Affairs of China*.' President Shanghai Maritime University, Shanghai, China. Lecturer gave insight into legal issues of Chinese maritime administration; how it effects the decision making process of various players of the maritime industry and governmental control is established over the training of the seafarers.

'*Curriculum Development and Design*.' One week workshop conducted by Professor Peter Muirhead at World Maritime University, Malmo, Sweden. Workshop highlighted various aspects, stages and current issues in the development and design of curriculum with special emphasis to STCW Convention, requirements of seafarers and role of instructors.

'*IMEC17*'. Conference organized by International Maritime Lecturers Association (IMLA) and hosted by Ecole Nationale de la Marine Marchande, from 04 to 07 October 2005 in Merseille, France. Main issues discussed were language barriers and multicultural environment of seafarers and how it effects maritime education and training and instructors.

'*Indian perspective on MET*'. A two days workshop conducted by Mr. Rajendra Prasad at WMU. Workshop discussed the organizational structure of maritime education and training; what are the problems being faced to comply with competency based training requirements of STCW Convention and the need of appropriately qualified instructors.

'*Marine Simulation*'. One week training module at WMU conducted by Mr. Stephen J Cross. History, technological developments and future of marine simulators was discussed at length. Role and importance of the simulator instructors was agreed to be pivot point in quality training and optimum utilization of the simulators.

'*MET System, Cost Control and Budget*.' One week workshop conducted by Captain George Angus at World Maritime University, Malmo, Sweden. Analyses were carried out of various aspects of requirements, cost control and budget problems of MET institutes and maritime universities in changing economic scenarios; and what are the responsibilities of instructors.

'*MET System in Philipines*'. A 02 days workshop conducted at WMU by Commander Max Majia of Philipines Coast Gaurds. Workshop discussed the complete MET structure in Philipines with an emphasis on ensuring quality through qualification of instructors and assessors in METICs.

'*Norwegian MET System; Examination and Certification of Seafarers*'. A presentation given by Director General, Norwegian Maritime Administration, Oslo, Norway. Presentation discussed in details the need of qualified simulator instructor to have a reliable and realistic simulator based training.

'*STW37 Meeting at IMO,London'*. Meeting had simulator based training and simulator instructor at its agenda with need to streamline the instructor station for the ease and positive control by the instructor. Delegates highlighted the importance of the instructor irrespective of any improvement in simulators and control station.

'*Teaching Padagogies'*. Three weeks training module conducted by Prof. Peter Muirhead at WMU. Instructional techniques, effective learning process, latest trends and theories, and introduction of modern technologies in METICs was discussed. It was highlighted how the role of instructor is becoming more important and need of instructor is indispensable in all circumstances.

'*Technological developments and new trends in Marine Simulation*.' A two days workshop with practical demonstration and hands on training conducted by Dr-Ing Harro G Kucharzewski, Director MarineSoft at World Maritime University.

LIST OF FIELD TRIPS

Following is the list of field trips undertaken by the researcher during the course of research on the topic of marine simulation and simulator instructor;

3. ABB Flakt Wood AB, Hydrodynamic Research Centre, Jönköping, Sweden.
4. CMA CGM Headquarters, Marseille, France.
5. Directorate of Maritime Affairs, Ministere de l.Equipment, des Transports du Tourisme et de la Mer, Paris, France.
6. Ecole Nationale de la Marine Marchande, Marseille, France.
7. IMarEST, Institute of Marine Engineers, Scientist and Technologist, London.
8. INMARSAT Ltd Headquarters, London, UK.
9. International Maritime Organisation (IMO) Headquarters, London, UK.
10. Japan Coast Gaurd (JPCG) Training School, Maizuru, Japan.
11. JPCG Training Ship 'Miura' stationed at Maizuru, Japan.
12. KM Marine Automation and Simulator Systems, Horten, Norway.
13. Kobe University, Department of Maritime Studies, Kobe, Japan.
14. KONGSBERG Maritime Ship Systems A/S, Simulator Division, Horten, Norway.
15. MAN B & W Training Centre, Fredrikshaven, Denmark.
16. Maritime Technical College (MTC), 'Kaigi-dai Gakkou', Kobe, Japan.
17. Ministry of Land, Infrastructure and Transport (MLIT), Tokyo, Japan.
18. Norwegian Maritime Administration, Oslo, Norway.
19. Oslofjord Traffic Services, Horten, Norway.
20. Rolls Royce Marine (ex-KaMeWa), Research and Testing Facilities, Gutavik, Sweden.
21. SEAGUL Headquarters and Training Centre, Horten, Norway.
22. Simulator Training Complex, Pakistan Marine Academy (PMA), Karachi.
23. SSPA Sweden AB in Gotenborg, Sweden.
24. The Nautical Institute, London, UK.
25. Tokyo Electric Power Company (TEPCO), LNG Terminal, Tokyo, Japan.
26. Taining Ship 'Shin-Tokyomaru', Tokyo Port, Japan.
27. TRANSAS Marine Simulation Systems, Portsmouth,UK.
28. University of Portsmouth (UPS), Portsmouth, UK.
29. Vestfold University, Department of Maritime Studies, Horten, Norway.
    Wärtsilä Sweden

Appendix 1

FACILITIES VISITED DURING RESEARCH.

Following is the list of the various facilities visited during the course of research on the topic of marine simulator instructor; same have been discussed in details in the subsequent paragraphs.

1. Maritime Simulator Training Centre (MSTC), Terschelling, the Netherlands.
2. Ecole Nationale de la Marine Marchande (ENMM), Marseille, France.
3. TRANSAS Marine (UK) Ltd, Porthsmouth, UK.
4. SSPA Gotenborg, Sweden.
5. Kongsberg Maritime AS, Horten, Norway.
6. Faculty of Maritime Studies, Vestfold University College, Horten, Norway.
7. Faculty of Maritime Sciences, Kobe University, Kobe, Japan.
8. Marine Technical College (MTC), Kobe, Japan.

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a. **S.NO**; 1

b. **Facility Visited**; Maritime Simulator Training Centre (MSTC), Terschelling, the Netherlands.

c. **Contact Person**; Mr. Wibbo Hofmann, Instructor MSTC.

d. **Date of Visit**; 9-13 April 2006.

e. **Discussion**; MSTC is national simulator centre whereby 300 full time students of MIWB and 1000 external students of other maritime institutes of the Netherlands come for the simulator training. So MSTC covers all the simulator training needs of the deck and engine room seafarers of the Netherlands at various levels. MSTC is a comprehensive simulator centre with the option of integrated operations of various simulators.

f. **Assessment**; This visit provided the opportunity to see the modern concept of Integrated Simulation Complex (ISC) for marine simulators. All of the instructors had undergone Simulator Instructor Course specially designed and developed in collaboration with World Maritime University (WMU), Malmo, Sweden. Frequent opportunities are provided to the instructors to attend international conferences and seminars relevant to their profession. MARSIM'06 was hosted by the institute to attract professional expertise from around the world which enhanced the knowledge and confidence of the simulator instructors of the MSTC. With all of the simulators operational and extensively under use for the training of the seafarers, opportunity was provided to take part in practical exercises as trainee and instructor both. This MSTC is a good example of how an advanced simulation complex having qualified and experienced simulator instructors can achieve quality training of the seafarers.

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a. **S.NO**; 2

b. **Facility Visited**; Ecole Nationale de la Marine Marchande (ENMM), Marseille, France.

c. **Contact Person**; Daniel Louedec, Director ENMM.

d. **Date of Visit**; 05-06 October, 2005.

e. **Discussion**; Visit started with a presentation on French MET system, its peculiarities and its compliance with the STCW convention. Presentation also included working concept of duel purpose training and how simulator based training is planned at various stages of career profile of a seafarers. This was followed by a walk round of the various training facilities available at the academy premises. Opportunity was provided to observe the trainees under going through competency based training on simulators and how instructor station controls and conducts the exercises. Bridge, Engine Room, ECDIS, GMDSS, and other simulators were all in operational and well maintained state and quality system was in place to ensure consistency of training standards.

f. **Assessment**; Visit provided excellent opportunity to understand the French MET system and concept of simulator based training for a duel purpose trainee. Discussion with the simulator instructors highlighted the importance of well equipped control station for all types of simulators and the need to have quality assurance system for a METIC.

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a. **S.NO**; 3

b. **Facility Visited**; TRANSAS Marine (UK) Ltd, Porthsmouth, UK.

c. **Contact Person**; Nick Dalton, Sales Manager (UK).

d. **Date of Visit**; 27 January, 2006.

e. **Discussion**; TRANSAS (TRANsport SAfety Systems) is an internationally recognised developer and supplier of marine and airborne equipment, integrated onboard systems, vector electronic charts, shore based technologies, aeronautical support systems and finally a broad range of simulators for the marine and aviation industries. This visit was specifically planned for marine simulator section. Visit commenced with a comprehensive briefing on TRANSAS organisation, simulator design requirements and role of simulator instructor for conducting training and assessment on marine simulators. This was followed by a tour of the workshop and simulator testing area whereby opportunity was

provided to physically see and run the simulators and discuss their design features and capabilities with the staff working on them. Special attention was paid to the Instructor Station of Bridge Simulator and how to effectively control any simulator exercise with specific training objectives. Also an insight was provided into latest computer technology available for simulator design and how the integrated operations of ship board equipment will become a common feature out at sea. This will also give rise to new requirements in simulator design and training of the seafarers.

f. **Assessment**; This visit provided an excellent opportunity to see for new developments in progress and how technological advancements have made available new opportunities in simulator based training. Now we can have a virtual ship with all segments of bridge, engine room, and other operations realistically combined together at a price tag which was not imaginable few years before. This visit also highlighted the need of marketing opportunities for the simulator manufacturers. The demand for simulators will surely raise the capabilities of marine simulators and subsequently this will lead to more safe and secure operations onboard ships. Also when such a high quality realistic training opportunity is available, not availing this opportunity can prove to be very expensive when some accident occurs due incompetence of ship's crew.

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a. **S.NO**; 4

b. **Facility Visited**; SSPA Gotenborg, Sweden.

c. **Contact Person**; Thorsten Thorstensson, Sales Manager, Maritime Operations.

d. **Date of Visit**; 17 October, 2006.

e. **Discussion**; Visit started with a presentation on the long history and industrial activities of the organisation with special emphasis on marine simulation. SSPA is among the pioneers for introducing the simulation training for the seafarers. Detailed discussion took place on PORTSIM and Bridge Simulator. This was followed by a walk round of the area and facilities like towing tank, cavitations laboratory, maritime dynamic laboratory and Bridge Simulator. Discussion also took place on the design of the simulation programs on the specific requirement of the customers and their operational needs.

f. **Assessment**; This visit proved out to be a good source of information on how various parameters of ships hull and underwater fittings are tested on models and computers before putting them in place. Simulation software uses multiple ships types and their mathematical representation is a complex process and needs detail testing and trials. Simulation in harbours, shallow areas and canal needs special care and simulator instructor becomes very important to overcome any shortcomings that a simulator may have.

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a. **S.NO**; 5

b. **Facility Visited**; Kongsberg Maritime AS, Horten, Norway.

c. **Contact Person**; Capt Arnstein Bugge, Product Advisor, Simulation.

d. **Date of Visit**; 19 October, 2005.

e. **Discussion**; Kongsberg Maritime is the new name given to an old organisation called NorControl. This organisation is a well known name in marine simulation and has been producing simulators for training of the seafarers for quite some time. Briefing was given on the various simulators design and manufactured by the organisation along with latest development and requirements of STCW. Visit was undertaken to Marine Automation system workshop and it was demonstrated how original hardware can be used in simulator as well for enhanced realism and maximum training value to seafarers. Guided tour was undertaken to Oslo Fjord Traffic Service to see the working of VTS system and inbuilt software for simulation based training. Video film was run to show the recording of a major oil spill exercise undertaken using VTS system.

f. **Assessment**; This visit gave insight into the changes in marine simulation that have taken place over the last few years and how the role of instructor has become very complex when using simulation techniques available for training and assessment of the seafarers.

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a. **S.NO**; 6

b. **Facility Visited**; Faculty of Maritime Studies, Vest fold University College, Horten, Norway.

c. **Contact Person**; Ulf Leslie Hallenstvet, Assist Prof.

d. **Date of Visit**; 18 October, 2005.

e. **Discussion**; Vest fold University was an old institution for the training of the seafarers and marine professionals. Due reduction in the number of trainees over the time, its status has been reduced to a faculty and has been attached to regional university. Faculty has excellent training environment along with marine simulators like Bridge, Engine Room, GMDSS, etc. It also has a real engine of a ship for the training of seafarers. Presentation was given on the Norwegian maritime education system and competency training on the simulators. This was followed by a tour of the simulator area where multiple classes were observed undergoing training on the simulators.

f. **Assessment**; Role of the instructor at various simulators and various controls at his disposal were clearly demonstrated. It was shown that how simulators are being maintained and updated with the close working relationship with the Kongsberg located in the same town.

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a. **S.NO**; 7

b. **Facility Visited**; Faculty of Maritime Sciences, Kobe University, Kobe, Japan.

c. **Contact Person**; Prof. K Ishida.

d. **Date of Visit**; 15 September, 2005.

e. **Discussion**; This institute originates from Kawasaki Merchant Marine School founded in 1917, raised to Kobe Nautical College and Kobe University of Mercantile Marine. Now after the re-organisation of the Japanese education system, it has been integrated into Kobe University. This faculty has large campus area, training ship 'FUKAE MARU' and sailing cruiser 'Kleiner Berg'. Various degree courses are run by the faculty as per need of the shipping industry, port organisations and shore industry. Ship Model Basin has Shallow Water Tank, Wave Generator, Wind Generator, Circulating Water Channel, and Anchor Dragging Tank for the experimental purposes. Bridge Simulator has Bridge Mode as well Wing Mode for the realistic learning of ship handling techniques.

f. **Assessment**; Visit to Ship Model Basin showed how model experiments are used for the design and construction of ships as well as for generating mathematical models in the simulation software. Over the time more reliance on simulator based training than the training ship speaks of the rising demand and importance of simulator and simulator instructors.

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a. **S.NO**; 8

b. **Facility Visited**; Marine Technical College (MTC), Kobe, Japan.

c. **Contact Person**; Mr Susumu Yoshida, President.

d. **Date of Visit**; 15 September, 2005.

e.

f. **Discussion**; Japan has two Marine Technical Colleges (MTCs) working under the Ministry of Land, Infrastructure and Transport (MLIT) with the aim to provide re-training, up-grading training, and up-dating training utilising the latest equipment for seafarers. MTC is running multiple courses for the training of seafarers in compliance with STCW and as per the needs of the industry. It has a complete set of simulators including Crude Oil Tanker Simulator, Diesel Propulsion System Simulator, Bridge Simulator and GMDSS. It also has the real machinery like Oily water Separator, Diesel Engine and Steam Boiler Plant for the training purposes. Multiple international courses are also undertaken by the centre with tailor-made training programs.

g.

h. **Assessment**; Visit to various simulators with multi-cultural trainees helped to understand the enhanced role of simulator instructor to carry out effective training of seafarers in such an environment. Trainees vary in practical experience, educational background and mental attitude and it is instructor who makes a team out of them and ensures transfer of knowledge and competencies to the maximum possible level as per training objectives set in the exercise.

Appendix 2

SIMULATORS IN SERVICE FOR THE TRAINING OF SEAFARERS

There are multiple types of marine simulators in use for the training of seafarers for various jobs onboard and ashore. To keep the research focused and directed, only the five basic types of simulators in service for the training of seafarers for various jobs onboard ships. List of these simulators is as under;

1. RADAR / ARPA Simulator.
2. GMDSS Simulator.
3. Liquid Cargo Handling Simulator.
4. Ship Handling Simulator.
5. Engine Room Simulator.

Now the level of trainees on these simulators along with the competencies that can be learned on them will be discussed in following paragraphs;

S.No: 1

Name of Simulator: RADAR / ARPA Simulator.

Trainees: Deck officers at operational level.
Prospective OOW.

Competencies to be learnt on the Simulator:

After going through the RADAR / ARPA training, trainee should be able to;

- Identify factors affecting performance and accuracy of radars.
- Detect mis-representation of information, including false echoes and sea returns.
- Set up and maintain displays.
- Calculate range and bearing of targets.
- Learn plotting techniques and relative motion concepts.
- Identify critical echoes.
- Calculate course and speed of other ships.
- Time and distance of closest approach of crossing, meeting or overtaking ships.
- Detect course and speed changes of other ships.
- Effects of changes in own ship’s course or speed or both.
- Learn possible risks of over-reliance on ARPA.
- Principle types of ARPA systems and their display characteristics.

- Factors affecting system performance and accuracy of ARPA.
- Tracking capabilities and limitations of ARPA.
- Processing delays of the system.
- Operational warnings, their benefits and limitations.
- System operational tests.
- Manual and automatic acquisition of targets and their respective limitations.
- True and relative vectors and typical graphic representation of target information and danger areas.
- Information on past positions of targets being tracked.
- Setting up and maintaining displays.
- Obtaining information from the ARPA display.
- Application of the International Regulations for Preventing Collisions at Sea.

NOTE: This is the only simulator training made mandatory for the training of the seafarers. Although this was the first marine simulator used for the training purposes, it is the most simplest of all simulators in use in METICs. Mostly, instead of stand-alone simulator, now Radar / ARPA simulator forms part of Ship Handling Simulator as bridge equipment.

S.No: 2

Name of Simulator: GMDSS Simulator.

Trainees: Deck officers at operational level.
Prospective OOW.

Competencies to be learnt on the Simulator:

After going through the GMDSS training, trainee should be able to;

- Understand the basic theory of satellite communication system.
- Know the various components of the GMDSS equipment.
- Handle the Search and Rescue (SAR) communication.
- Follow procedures in IMO Merchant Ships SAR Manual (MERSAR).
- Prevent the transmission of false distress alert.
- Mitigate the effects of false distress alert transmitted.
- Understand the ship reporting system.
- Carry out all types of communication efficiently and effectively.
- Use radio medical services.
- Use International Code of Signal.
- Use Standard Marine Communication Phrases for SAR operations.
- Transmit and receive information regarding abandon ship and fire onboard.

S.No: 3

Name of Simulator: Liquid Cargo Handling Simulator (LCHS)

Trainees: Deck / Engine Room Officers at Operational level.

Competencies to be learnt on the Simulator:

After going through the LCHS training, trainee should have;

- Familiarisation with the tanker layout, its machinery and control system.
- Training in the control of systems and plant.
- Study of the design and operation of the parameter monitoring and alarm system.
- Training in the correct performance of operations in standard and emergency situation.
- Capability to maintain ship stability and seaworthiness.

NOTE: LCHS can have specific programming for a LNG Carrier, Chemical Tanker (CHT) and LPG Carrier or may be same simulator is multiple purposes with options to choose any one of these configurations.

S.No: 4

Name of Simulator: Ship Handling Simulator (SHS).

Trainees: Deck officers at operational and management levels.

Competencies to be learnt on the Simulator:

After going through the SHS training, trainee should be able to;

- Carry out dead reckoning under wind and current situations.
- Determine ships position using landmarks, lighthouses, beacons and buoys, etc.
- Determine errors of magnetic and gyro compass and apply the errors.
- Use navigational equipment fitted on bridge, e.g. azimuth mirror, echo sounder.
- Use electronic navigational equipment for position fixing.
- Understand the use and working of ECDIS on bridge.
- Working of steering system, operational procedures and use of auto-pilot.
- Interpret and use the meteorological instruments at bridge.
- Knowledge and application of COLREGs.
- Principles to be observed in keeping a safe navigational watch.

- Implement effective team work procedure.
- Effective use of RADAR / ARPA equipment onboard.
- Initial actions subsequent to collision and grounding.
- Correct procedures in case of harbour emergencies.
- Bridge responses in case of SAR operations at sea.
- Understand the effects of deadweight, draught, trim, speed, under-keel clearance on turning circle and stopping distance.
- Effect of wind and currents on ship handling.
- Ship handling in restricted waters, reduced visibility and traffic separation scheme.

S.No: 5

Name of Simulator: Engine Room Simulator (ERS).

Trainees: Engine Room officers at operational and management levels.

Competencies to be learnt on the Simulator:

After going through the ERS training, trainee should be able to;

- Understand the handing / taking over watch procedures.
- Maintain a safe engineering watch onboard.
- Safety and emergency procedures in machinery spaces.
- Change over to and from automatic control of machinery.
- Operate main and auxiliary machinery and control systems.
- Operation of bilge, ballast and cargo pumping system.
- Preparing, starting, coupling and changing over alternators or generators.
- Fault finding and diagnosis in machinery and control systems.
- Maintain seaworthiness and water tightness of the ship.
- Operation and maintenance of electrical and electronic equipment.
- Ensuring team resource management.
- Control of trim and stability in case of flooding onboard.
- Start up and shut down procedures for main and auxiliary machinery.

Appendix 3

CASE STUDY 1 – SHIP HANDLING SIMULATOR (SHS)

Purpose of this case study is to discuss in details with system parameters and possible capabilities of a latest Bridge Operations Simulator available in shipping industry for the training and assessment of seafarers. This simulator carries all the features that are available from different manufacturers and is based upon field studies undertaken to such organization as TRANSAS, SSPA and Kongsberg.

In a series of experiments conducted by the CAORF, Hammel (1981) concluded that 'the instructor has the greatest impact on the effectiveness of the deck officer simulator-based training than any of the specific simulator characteristics investigated. Hence the training device should directly address and assist the instructor in conducting training'. This is one of the reason that SHS has been selected as Case Study for understanding the importance of simulator instructor.

Training on SHS. Ship Handling Simulator (SHS) is meant for the training of the seafarers at management and operational levels in individual and team work competencies as laid out in STCW Convention. Some of the aspects of the training on SHS are;

- SHS is designed to expose the mariner to a wide range of experiences in the navigational and seaman ship fields.
- Simulators provide practical experiences of skills that will allow the mariner to perform effectively and safely on workplace.
- The effectiveness of the simulator acquired skills on the real ship operations depends upon the level of training transfer that has taken place during the training.
- Level of training transfer will depend upon three component of the simulator training; trainee, simulator and instructor; and it is the instructor who has to ensure minimum standards to be achieved.
- Simulator training implies involvement of the trainees in practical experiences.
- A major attribute of the competent ship handler is 'confidence' and this can only be gained by the hands on experience of maneuvering the ship individually.
- Ship handling training demands active involvement of the trainees.

Bridge Equipment Fitted. Most Ship Handling Simulators (SHS) are comprehensively equipped with a full range of bridge instrumentations. Indeed the tendency is to have every available aid fitted on simulator to cater for any ship configuration that the customer may demand. Fact remains that what equipment is required to be used by the trainee depends upon training objectives of that particular exercise. Extra equipment fitted onboard and not under use may put the trainee under undue stress and deviate his attention and mental resources. If available, operational level training should be conducted on task simulator instead of using a full mission simulator. Still any equipment fitted and not available should be mentioned in briefing for ease and comfort of the trainee and concentration of his efforts in right direction.

Auxiliary Object Library. When creating an exercise, the instructor can add a number of auxiliary objects in the selected sailing area, placing them at his / her own discretion. Such objects include different types of buildings, vehicles, oil derricks and tanks. The instructor can define depth zones, add targets and own ships, and define all necessary weather conditions.

Accoustic Effects. The system creates an acoustic environment corresponding to the sailing conditions. It imitates the noise of the wind, engine operation depending on the speed, noise of the anchor line, and noises of the own ship and target ships (such as whistle, gong, bell.)

Ship Model Library. Bridge simulators now carry an extensive library of simulated ship models, comprising vessels of different tonnage, dimension and hull forms, including container ships, tankers, gas carriers, fishing and passenger ships, ferries, special purpose naval and commercial vessels. Mathematical models of ships and ship equipment, physical forces and effects have been based upon extensive research and all forces acting upon a ship at sea are realistically simulated for optimum training value.

Option are available whereby mathematical model of the ships and ship equipment can be audited using a model auditor program available in simulator. This program allows the user to correct the ship mathematical model, and thus to create individual models for specific needs.

Visualization. The visualization system allows simulation of the environment such as water surface, rough sea, coastline, aids to navigation, moving surface and airborne craft, coastal objects and structures. The system provides a realistic display of any weather conditions,

various atmospheric phenomena, time of the day, visibility and illumination effects, reflection and glare on the water. The visualization shows all the stages of mooring, towing and search and rescue operations, making the simulator an exclusively efficient means of training in specialist areas of seamanship.

Sailing Area Library. Bridge simulators now carry large sailing area library covering practically all the important shipping areas, straits, and ports of call, as well as extensive sections on inland waterways. This gives added opportunities to the simulator instructor to create a realistic scenario in the simulator with maximum interest of the trainee depending upon their area of operations and experience.

SHS Training Usage. Ship Handling Simulators can be used for multiple purpose; training of the seafarers; assessment to ensure knowledge transfer; for Watch Officers, Chief Officers, Captains And Pilots serving on different types of ships. Training areas include;

- ship control and maneuvering,
- radar surveillance / ARPA operations,
- ECDIS operations,
- AIS operations,
- VTS operations,
- SAR operations,
- Bridge team management, and
- Comprehensive crew training.

Instructor Station. The instructor station provides the instructing personnel with the necessary facilities for efficient exercise generation, fulfillment and debriefing. Through the instructor station, simulator instructor has the capability of;

- Planning of exercises and sailing conditions, dangerous situation scenarios, failures of equipment and systems, etc.
- Preview of created situations.
- Monitoring of the exercise process,
- Control of seaborne and airborne targets (course, route, speed, lights, signals, faults, etc.)
- Handling tug-boats (manually or automatically), mooring, towing lines, work with the anchors,

- Control of environment (illumination, visibility conditions, sea waves, wind force and direction, drifts, ice conditions, tides, currents, clouds, etc.),
- Input of faults and failures in any system for controlling and monitoring the environment and ship systems,
- Exercise recording, archiving , and documenting,
- Playback of any exercise episode on any time scale,
- Ability to 'replay' a situation from any moment with the initial conditions.

Perspective. Its limitation of the ship handling simulator whereby trainee can not perceive correctly the relative distance or position between visible objects outside the bridge. Correct perspective is important for making judgements of speed and line of approach in restrictive waters. Mariner cannot lean over wing or estimate whether there is 100 or 500 meter distance between his own bow and stern of ship ahead. Clearing distances from officer on fore castle are tools frequently used onboard ships but are not available in simulator. The use of transits, leading lines or local conspicuous objects to control position when swinging are second nature of mariners but not available in simulator. These all aspects are required to be kept in mind by the simulator instructor.

Parallax Effect. The closeness of the screen means that the observer standing away from the centre of curvature of the screen sees the apparent bearing of a ship or object from a distorted aspect. A vessel lying dead ahead will, when viewed from a point on port or starboard side of the simulator bridge, appears to be on the starboard or port side respectively. The fore body of own ship will also be distorted from the fore and aft line. Different simulator may have different parallax error but it can never be totally eliminated. Instructor should make the trainee aware of this problem on simulator and also advised them how to have least effect. This parallax effect becomes very important in crossing or overtaking situations at close ranges. Trainee OOW or Master of the ship needs to be standing on centre line of the simulator when taking bearings or making decisions about manoeuvring. New projection techniques, 3D technology and use of laser projection methods and hologram are bringing new visual effects in marine simulation.

Sea State. Most of the simulators have sea surface visual effects whereby you have the impression of a head or stern wind. In strong cross winds and heavy swells, the visual cues can be unrealistic. Also in reality, you can estimate sea state and its effect on ship without referring to some figure or digits in mind, given to you in briefing session. A notable omission in the visual scene can be the lack of tidal effect upon floating navigation marks and buoys within channels and harbour areas.

Field of View (FOV). In Ship Handling Simulator (SHS), overall cost depends heavily on the projection system of visual effects and FOV may vary from 3-projector system of 90 degree through to a full 360 degree field of view with 10-12 projectors.

Most ship handling manoeuvre such as turning the vessel or anchoring in day light conditions require at least 180 degrees field of view (FOV) if visual cues such as transit and lateral movements are to contribute towards positional judgement and control. Having these types of manoeuvres on simulators with only 90 degree FOV may over-stress the trainee, reduce fidelity of the system and minimize chances of meeting the exercise objectives. Whereas running a simulator exercise for OOW at operational level on a simulator with 360 degree FOV may not be cost effective as most of training objectives will be met by internal working on bridge, and visuals abaft the beams may never be used by OOWs. Researches (CAORF, 1981) have proved that providing simulator fidelity beyond the minimal needed for a set of training objectives does not necessarily produce more effective training.

CASE STUDY 2 – MARITIME SIMULATION CENTRE (MSC)

Maritime Simulation Centre (MSC) Warnemunde is situated in Rostok – Warnemunde in northern Germany at the Baltic Sea working under the Department of Maritime Studies of Wismar University. Opened in May 1998, and housed in a purpose-designed three story building occupying some 850 square meter, the centre accommodates six sophisticated simulators embracing a common network and comprising four ship-handling bridge systems with different levels of bridge equipment, a ship's engine simulator and a VTS facility (Benedict, 2000). It was specified by staff of the simulation centre and designed by Bremen based STN ATLAS Electronik.

The complete assembly sets new standards for training in all aspects of maritime safety by not only providing comprehensive simulation of all ship-handling procedures (including emergency measures and operation of machinery), but also by realistic simulation of operational inter-changes between navigators and VTS centers. The interaction of many components is a principal feature of the centre. At the same time, it additionally provides an ideal platform for a wide range of research, development and various risk-management issues affecting both port-based and sea-going environments.

Ship Handling Simulator (SHS).

All four bridge systems are able to simulate steering and maneuvering characteristics of different types and sizes of vessels. The largest of the four, Bridge 1 is capable of simulating a full range of ship handling operations from small tug to VLCCs. Bridge 2 can be specifically used for maneuvering of a ship from bridge wings during going alongside or tow boat operations. The remaining two units Bridge 3 & 4 are used mainly as radar cabins each having 120 degrees visual display screen.

All bridges and instructor stations are connected through GMDSS communication facilities. An additional feature of the system is a facility for computer-based instructor-less training, for which there are four separate exercise stations, equipped with handles for rudder and engine telegraph. These provide trainees with pre-programmed ship handling scenarios, with a secondary screen posing multiple-choice questions for assessment by a special scoring method. Additionally, Bridge 1, is capable of simulating an entire range of ship operations via

networking the SHS with a companion engine simulator and is therefore equipped with an engine monitoring and control system.

Ship Engine Simulator (SES).

Housed on the Center's basement floor and designed for training ship engineers, the ship engine simulator replicates a typical modern plant, representing a main engine of 22,000 KW by SULZER. Equipped with identical control panels and displays, it also simulates typical back ground noise effects and up to 300 different types of alarms / failures. The main engine control room accommodates monitoring facilities as part of a control system in addition to a series of consoles for the main engine, auxiliary engines and a primary switching panel. The complete assembly includes not only the main engine and supply systems, but also those for fuel processing, electrical supply, steam generation, container food refrigeration and loading areas. A key feature also is enhanced realism with the adoption of full thermodynamic process representation allows, for example, engine diagnosis via a real off-the-shelf system so that cylinder and injection pressures as well as crankshaft rotation can all be analyzed in details. Students initially undergo computer-based part-task training for individual elements prior to full machinery system training, while replay facilities enable assessment of results in parallel with simulated exercises.

VTS Simulator.

VTS Simulator covers all aspects of radar and AIS transponder-supported traffic surveillance and associated communication disciplines. Instructor Control Station consists of three main instructor consoles based on ECDIS presentation for designing exercises scenarios and supervision of exercises using supplementary CCTV displays as well. It is equipped with VHF facilities as per GMDSS standards.

Integrated Operations Mode Of Simulators.

Individual simulators can be operated either independently or collectively for given exercises so that, for example, all four ship-handling bridges can each be deployed;

- in separate exercises in different sea areas controlled each by one instructor station or
- for more complex scenarios, combined for operations in a given area under the direction of three instructor stations together.

In parallel to the exercises, briefing / debriefing can be done with part task training or full exercise replays. Similarly, the largest of the four, Bridge 1, can also be directly interfaced to the Ship Engine Simulator (SES) and so replace its own integral ship engine module with the equivalent of a full-mission SES. Finally, all bridge assemblies can in turn be directly linked to the VTS simulator in order to facilitate combined training of VTS operators, crews and pilots.

The complex operation mode enables the centre even for crisis management task, e.g. with the following set-up;

- the Bridge 1 is interfaced with SES to play the distressed ship,
- the other three Bridges 2-4 are supporting as assisting ship on scene and
- the VTS-simulator can be used as VTS centers involved and last but not least as Emergency Response Centers of the Coast Guard.

One of the greatest assets of the centre is its capability of networking for training, using simulators in integrated mode, especially using SHS and SES collectively. The benefits of this integrated mode are;

- better realistic training to achieve more insight in the processes onboard,
- higher levels of acceptance and situational awareness by the trainees.

This could be seen even in routine situations which seem apparently simple and dedicated for stand alone simulator use before, e.g. handing over the watches and preparing the ship for several operational modes. The trainees feel more responsible in integrated mode exercises, if they know that, when preparing the bridge for sea at the SHS, really an engine is with the ship. But most important benefit of integrated simulation are to realize scenarios for very complex situations especially for trouble shooting and emergency management and this can only be done by a competent simulator instructor with greater demands for structuring and preparing the simulator exercises. Integrated simulation also demands high standards of briefing and debriefing session to fully utilize the training and learning value of the exercises absence of which may totally put the extra efforts and resources put in integrated simulation down the drain.

Exercises for Integrated Operation Mode of SHS and SES.

Following is a list of examples and elements for complex scenarios using integrated Ship Handling (SHS) and Ship Engine Simulator (SES) collectively as discussed by Benedict (2000).

1. **Preparing for Sea.**
   Initial condition: operation mode in ports / standby-by stage.

   a) Agreeing of officers / students on navigational and technical operations.
   b) Preparing engine for maneuvering including all auxiliaries.
   c) Preparing navigational department / bridge for sea.

2. Port Departure, Maneuvering and Beginning of Sea Passage.
   Initial condition: ship in port is ready to sea in all respects (engine operation from ECR or on remote mode from bridge)

   a) Checking / reporting clearance of engine to bridge, ship to VTS.
   b) Un-berthing maneuvers.
   c) Disembarking pilot maneuver.
   d) Preparing for sea mode operation and for temporarily unmanned operations.

3. End of Sea Passage, Maneuvering Operation, Port Arrival.
   Initial condition: ship is in sea operational mode (engine operation from ECR or on remote mode from bridge)

   a) Preparing engine for maneuvering.
   b) Preparing navigational department for arrival.
   c) Embarking pilot maneuver
   d) Berthing.
   e) Finished with engine.

4. **Regular and Disturbed Operations at Sea and in Narrow Waters.**
   Initial condition: ship is in sea operational mode.

   a) Regular operations in complex traffic situation, demanding for engine maneuvers.

b) Disturbed operations / malfunction and troubleshooting,
c) Operating the ship / engine under extreme hydro-meteorological condition / heavy weather loads / winter conditions.
d) Supply operation / bunkering at sea.

5. **Emergency Management.**

Initial condition: sea operation mode.

a) Fire fighting in engine room in areas difficult to navigate.
b) Fighting water inrush / flooding.
c) Rudder engine failure / emergency steering.
d) Brake down of propulsion or black out / ship handling on sea and in narrow waters.
e) Emergency towing among cargo vessels.

Research and Development (R & D) on Simulators; One of the new dimensions of simulator training centre is the use of simulators for state and commercially-funded research projects for training and education, port design, traffic management and ships construction. Research and development of any form can be of great training value to simulator instructors apart from its financial benefits. These projects make one dig out, learn and practice the unknown, unexplored capabilities of his equipment with possibly huge MET value for the simulator trainees. It also gives confidence to the instructor over his control and use of the simulator and it may bring positive modification and up gradation of the soft and hardware. Simulator instructors have to be careful not to be over burdened by the research activity mentally and physically both as run of an exercise for MET purposes has distinct demands and requirements and theses are not to be mixed up with R & D.

Finally, knowledge of the set-up of the equipment and simulators in some MSCs like Warnemunde will clearly indicate the level of complexity that is available in marine simulation. Any instructor charged with instructional duties at such a complex set of equipment needed specific training in instructional techniques. Traditional concepts of instructional techniques as discussed in IMO Model Course 6.09 may also be required but will not be sufficient enough. Additional efforts are required to master such a complex set of equipment and use it effectively and efficiently to achieve the training objectives of the STCW Convention

Appendix 5

IMO MODEL COURSE 6.09 – TRAINING COURSE FOR INSTRUCTOR

IMO Model Course for Instructors was first prepared in year 1991 and was revised in year 2001 for IMO by the International Shipping Federation (ISF). Purpose of the Model Courses is to assist the training providers and their teaching staff in organising and introducing new training courses, or in enhancing, updating or supplementing existing training material so that quality and effectiveness of the training courses may therefore be improved. Thus the broad purpose of this model course is to support the implementation of STCW Convention and address the requirements of STCW Convention regarding the qualification of the instructors.

STCW Convention and Instructors; Regulation I/6 of the Convention requires that the instructors and assessors responsible for the training and assessment of the seafarers should be appropriately qualified for the type and level of training and assessment involved. Furthermore, Section A-I/6 explains the requirements of qualified instructors, supervisors and assessors conducting training and assessment as required in the convention. This section also highlights the need of simulator instructor to;

a. have received appropriate guidance in instructional techniques involving the use of simulators, and
b. have gained practical operational experience on the particular type of simulator being used.

Objectives; Objectives of the course include the planning and preparation of effective teaching and instruction; the selection of appropriate methods of instruction and teaching materials; and the evaluation of the teaching and learning process.

Discussion; This model course is of 10 days duration with 6 hrs of working time per day. Total time of 60 hours has been divided into 24 hours of class-room lecture time with 36 hours of activity. Main subject areas of the course are;

- STCW training requirements,
- Effective teaching environment,
- Appropriate training aids,
- Relevant lesson plans,

- Evaluation of learning, and
- Design of a course.

Under these main subject areas, multiple topics have been covered in details. Some of these topics are;

- Question / answer techniques,
- Use of Overhead Projector (OHP),
- Use of Board and Charts,
- Making handouts,
- Practical lectures,
- Various teaching methods,
- Use of slides and models,
- Use of video films.

One period of 1.5 hours duration on Day 6 has been kept for ‘Role Play and Simulation’. This session envisages availability of Radar / ARPA simulator and if that’s not available, then only role play by the trainee instructors for their education on how to use the simulators for the training of the seafarers.

Model course gives examples of different seating arrangements for example, u-shape, traditional school and lecture theatre depending upon no of trainees and space available. It requires trainee instructors to act as trainee and instructor at different times for learning various techniques to be used in class room environment. Verbal and non-verbal communication is important for the instructor. His facial expression, dress and outlook, speaking style and use of vocabulary affect the learning process. Model course gives practical examples of how to make lesson plan, handouts and OHP transparencies.

Any marine instructor who has undergone this model course will surely be a very good and effective class room instructor. He will be maintaining contusive class room environment, remaining focussed and directed. He will be proficient in preparing handouts and notes; and quality slides and transparencies will be produced. But he will feel handicapped once it comes to use of simulators for the training of the seafarers, as simulator use is not the main theme of this model course.

Appendix 6

SURVEY FORM 1 – TRAINING ON SIMULATORS

Dear Sir/Madam, I am a student of World Maritime University (WMU), Malmo, Sweden, specialising in Maritime Education and Training (MET). I am carrying out a research on '*Simulator Training of Seafarers and Role / Importance of the Instructor*' as part of my dissertation for Master's degree. I would be grateful if you could kindly take some time and complete the questionnaire below on the subject. All information provided in this questionnaire will be dealt with confidentially and will be used for academic purposes only.

General Information:

2. Name of respondent_____
3. Working Organisation_____
4. Designation_____

Simulator Training Experiences:

Please indicate your choice by marking a circle around a, b, c, etc. as applicable, or by brief text in the space provided.

5. What are the simulators on which you had the experience as a trainee?
   1. Ship Handling Simulator.
   2. RADAR / ARPA.
   3. Engine Room Simulator.
   4. Cargo Handling Simulator.
   5. GMDSS.
   6. Any other. _____

6. What were your feelings when you for the first time acted as operator / trainee on simulator?
   1. It gave a feeling of a real ship environment.
   2. It was just a good effort to mimic the real ship.
   3. It was too artificial when compared with real ship.

7. What was percentage of the simulator training time to total instruction time or duration of the course?
   1. >50% b. 20-50% c. <20%

8. Did you go through the following stages? What were your feelings? (Please strike out which is not applicable)
   1. Briefing before the session. **SATISFACTORY / NOT SAT/ NOT HELD**
   2. Instructions during the session. **SATISFACTORY / NOT SAT/ NOT HELD**
   3. De-briefing after the session. **SATISFACTORY / NOT SAT/ NOT HELD**
   4. Practical Assessment session. **SATISFACTORY / NOT SAT/ NOT HELD**

9. What was the major observation you had during simulator training about the instructor/s with respect to his/their handling of the simulator exercise?
   1. His/their knowledge of the subject was not up to the desired level.
   2. He/they were not confidant on the simulator equipment fitted.
   3. His/they were not committed to the training requirements.

10. How many times could the practical training on simulator not be held as per planned schedule due mal-function or any other reason?

    1. >50% b. 20-50% c. <20%

11. To what extent did your 'Performance on Simulator' affect your final grades of the complete course?

    1. >50% b. 20-50% c. <20%

12. What were your experiences when you practically worked on the system after simulator training?

    1. You felt much more confident on the system than before.
    2. Training made no difference in your working efficiency.
    3. Training adversely affected your performance on the system.

13. Having attended the simulator training and gained the experience on real equipment, what, in your opinion, are the three major disadvantages of undergoing simulator training as compared to practical working experience on the system?
    1. _____
    2. _____
    3. _____

14. Why did you undergo the training on simulator?

    1. It was mandatory due to the IMO/Administration's requirements.
    2. It was required as a company policy for career progression.
    3. Any other reason._____

15. In your opinion, what is the major problem you faced in getting the simulator training as per your needs?

    1. Simulator of the requisite capabilities is not available.
    2. Waiting time is very long for joining the course.
    3. Training course expenses are very high.

16. If you have any other comments regarding simulator training of seafarers, please write down briefly.

    _____
    _____
    _____
    _____

    Dated: _____

Appendix 7

SURVEY FORM 2 – SIMULATOR INSTRUCTORS

Dear Sir / Madam, I am a student of World Maritime University (WMU), Malmo, Sweden, specialising in Maritime Education and Training (MET). I am carrying out a research on '*Simulator Training of Seafarers and Role/Importance of the Instructor*' as part of my dissertation for Master's degree. I would be grateful if you could kindly take some time and complete the questionnaire below on the subject. All information provided in this questionnaire will be dealt with confidentially and will be used for academic purposes only.

General Information:

17. Name of respondent_____
18. Working Organisation_____
19. Designation_____

Simulator Instructors:

Please indicate your choice by marking a circle around a, b, c, etc. as applicable, or by brief text in the space provided.

20. What are the various types of simulators available for seafarers training in your organisation?
    1. Ship Handling Simulator.
    2. RADAR / ARPA.
    3. Engine Room Simulator.
    4. Cargo Handling Simulator.
    5. GMDSS.
    6. Others (if any). _____

21. What is the total number of the trainees undergoing training on these simulators every year?
    1. < 2000 b. 2000-5000 c. >5000

22. What is total number of the Instructors in your organisation imparting practical training on these simulators?
    1. < 05 b. 05-10 c. >10

23. What is the major problem being faced by the instructors with respect to the simulator trainees?
    1. They feel difficulty to overcome the simulation artificiality.
    2. They get into a mood of playing game on simulators.
    3. They just pass the simulator time without being concerned.

24. What is the weightage of practical performance of the trainee on simulator towards his final grades?

    1. >50% b. 20-50% c. <20%

25. What is the major area of concern with respect to the future of simulator training in your training institute?
    1. Availability of qualified and experienced simulator instructors.
    2. Availability of the suitable trainees.
    3. Maintenance and up gradation of the simulator facility.

26. What is the major source of qualification for simulator instructors at your organisation?
    1. In house training.
    2. Training by the manufacturer.
    3. Practical Experience.
    4. 'Train the Trainer' course by some external agency.

27. What is the percentage of practical simulation training time as compared to the total duration of the course?
    1. >50% b. 20-50% c. <20%

28. What is the major problem being faced by your organisation with respect to the simulator instructors?
    1. Availability of the simulator instructors.
    2. Provision of training opportunities to these instructors.
    3. Morale and commitment of the instructors.

29. In your opinion, which one simulator should be made mandatory in the STCW for the training of seafarers in addition to RADAR / ARPA?

    1. Ship Handling Simulator (Management Level).
    2. Ship Handling Simulator (Operational Level).
    3. Engine Room Simulator (Management Level).
    4. Engine Room Simulator (Operational Level).
    5. Cargo Handling Simulator.

30. As and when STCW is revised in future, what are the amendments you propose to be incorporated with respect to simulator training of the seafarers?
    1. _____
    2. _____
    c. _____

31. If you have any other comments, please write down briefly.

_____
_____
_____
_____
_____

Dated:_____