1995

Introducing simulators for practical training in the Saudi Coast Guard

Mohammed Soliman Al-Mobarak
WMU

WORLD MARITIME UNIVERSITY
MALMÖ, SWEDEN

INTRODUCING SIMULATORS FOR PRACTICAL TRAINING IN THE SAUDI COAST GUARD

BY

MOHAMMAD SOLIMAN AL-MOBARAK
Kingdom of Saudi Arabia

A dissertation submitted to the World Maritime University in partial fulfilment of the requirements for the award of the degree of

MASTER OF SCIENCE

in

MARITIME EDUCATION AND TRAINING
(Engineering)

1995

بسم الله الرحمن الرحيم

In the Name of Allah,
Most Gracious,
Most Merciful

DECLARATION

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

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

(Signature) ....

(Date) ..23-10-1995

Supervised by:

Name: Lieutenant Commander M.A. Swanson ....

USCG M.Sc. Mech. E., M.Sc. Mar. E.

Office: Lecturer Maritime Education and Training

World Maritime University

Assessed by:

Name: Captain Charles. E. Mathieu ....

USCG (Retired) M.Sc. Mech. E., M.Sc. Mar. E.

Office: Professor (Retired)

World Maritime University

Co-assessed by:

Name: Kenji Ishida PhD ....

Office: Associate Professor Maritime Education and Training (E)

World Maritime University

ACKNOWLEDGEMENTS

First, I would like to thank the **ALMIGHTY GOD** for all his blessings upon us.
A sincere gratitude to the Chief Director of the Saudi Coast Guard **General Moujib Mohammed Al-Qahtani** and **Rear Admiral Dakhilallah Al-Johani**, General Manager of the Marine sector in the Saudi Coast Guard for given me the opportunity to study at the World Maritime University in Malmö, Sweden.

I wish to express my gratitude and appreciation to my course professors
P. Muirhead, Dr. Kenji Ishida, and Lecturer **M. Swanson** and to the Visiting Professors who provided me with support and guidance throughout the preparation of this dissertation and during the two years study at the World Maritime University.

I would like to thank my father **Solaiman Mohammed Al- Mobarak** for his guidance in my life and to my mother for her love, and to both for the for their prayers.

Last but not least my special thanks to my wife for her support and patience and for providing a peaceful atmosphere during our stay in Malmö.

ABSTRACT

The dissertation is an introductory study of the application of simulation systems, in general, to engineering and nautical enlisted personnel of the Saudi Coast Guard and for courses for cadets at the Maritime Institute.

The possibility of having these alternative training devices for the development of necessary skills, professional refreshing courses and preparation for special examinations is discussed.

The underlying need for training is shown in the territorial distribution of Coast Guard units through out the country.

A review of the present training system and the need for future practical training is presented. The use of planning as a tool for making any change is also considered. In the present stage of development of the Saudi Coast Guard, practical training plays an ever increasing role. The use of simulator systems at the Coast Guard Institute as a tool to bridge the gap between theory and practice is presented.

The dissertation describes the types of simulators, and introduces a general programme for cadets, junior officers, refreshing courses for enlisted personnel for the development of new skills.

The conclusion reaffirms the Author's opinion that with a simulation system, enlisted as well as other new personnel can acquire the necessary skills and know-how required by most national and international regulations. The development of simulation tools, adapted to students, technicians, deck, machinery and maintenance officer's needs will accomplish the degree of competence that the present marine technology requires.

CONTENTS

LIST OF TABLES

Page

LIST OF FIGURES

Page

LIST OF ABBREVIATIONS

CGI	Coast Guard Institute
DPC	Dual Purpose Crew
H	The Arabic Year
MARPOL	International convention for the Prevention of Marine Pollution
OJT	On the Job Training
SCG	Saudi Coast Guard
STCW	Convention on the Standard of Training, Certification and Watchkeeping for Seafarers
SOLAS	International Convention on the Safety of Life at Sea
VR	Virtual Reality
WMU	World Maritime University

CHAPTER 1

INTRODUCTION

The development of theoretical training of marine personnel, around the world, has followed the rapid developments in ship building, operations, safety and pollution prevention requirements, thanks to the efforts of the International Maritime Organization and other international institutions. The general education and training requirements for officers' education and the training of ratings and marine personnel is being adapted to the rapid changes in the construction of ships, equipment, communication, handling and transport of cargoes and their propulsion. These areas, covered by the traditional educational programs are now been put to their limits by technological advances.

The revolution that has occurred in the maritime world, merchant and naval, is of such far reaching consequence that it has changed the ships and changed ship operations forever. Modern ship instrumentation has become increasingly complex with no end of new innovations in the foreseeable future. As a result of the installation of more electronic equipment and the reduction of personnel who carried out manually that which machines do now. This has led to a pattern of reduced engine room crews, from an average of 20 persons in 1959 to 4 in unattended machinery spaces of the 1970's and 80's, in the name of the cost of operation and increased competition. There is no doubt that the trend to more sophisticated machinery installations and reduced crews on-board ships will continue.

Modern technology requires today more than theoretical knowledge. The development of skills and know-how is an essential part of training in order to cope with the changes.

It is essential that the marine personnel be skilled in both automated and manual operations. In the opinion of the author simulators can bridge the gap between the traditional school and the ever increasing requirements presented to marine personnel and seafarers in particular.

Maritime training, licensing and certification of competence of marine officers evolved primarily from achieving competence through experience to the creation of sophisticated maritime academies. Today the training of marine officers is compulsory, but it takes years to obtain the required knowledge and about equally long or even longer to gain the necessary experience and skills for certificates of competency.

A situation that is not exclusive to the Saudi Coast Guard is that most of its newly certified officers approach their first assignment with adequate theoretical knowledge but few have the opportunity to apply a trial and-error approach to tasks that are vital to the development of skills. Most of the junior officer's training is being left to the responsibility of the senior officers. In this way, the practical training of the apprentice of marine pilot is conducted by an in-service pilot with all the risk that his abilities or lack of them implies.

In-service training conducted throughout the different districts and units of the Coast Guard varies in technique depending upon the region, instructional ability of the officers, vessel characteristics, and job assignments.

Although minimum requirements for training of marine personnel are specified by the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), this Convention does not apply to Coast Guards. Mastering it is important, however for Saudi Coast Guard officers, for they are routinely dealing with merchant ships during inspections.

The traditional system examinations to measure the competency of marine engineers lacks the measurement of skills and does not address the standard of competency required of engineer officers for the safe operation of the machinery of modern ships. Merchant marine licenses, of any type, are renewed periodically, based solely upon the officer's time in the grade and his knowledge of the "rules".

A simulator represents training by means of a piece of equipment using various mechanical and visual aids based on practical experience in order to get acquainted with its actual use in service or procedures. This can range from practical training with communication equipment in order to follow fixed procedures, via training with radar to navigate in mist, up to training to navigate a very large crude carrier (VLCC) with a mission bridge simulator.

Simulation is heavily relied upon in several industries as a cost effective means for the acquisition and improvement of skill. The airline industry and the nuclear power generation industry rely heavily on the use of simulation. The operating situation in the maritime field, however appears more akin to decision-making rather than to repetition of fixed procedures is also susceptible and it is been programmed in simulators.

This dissertation addresses the problem of developing a training program using the appropriate simulator technique aimed at students of the Saudi Coast Guard Institute, Saudi Coast Guard in-service personnel, with special emphasis in the training of engineers.

A maintenance simulator as such does not exist yet. It is hoped that the next generation of simulators using Virtual Reality (VR) technique can accomplish these important processes. This is the reason the author chose to describe simulators in general and shiphandling simulator in particular.

Chapter 2 of this dissertation provides the legal instruments that created the Coast Guard, its evolution, the departmental organization, the functions and activities carried out by different levels that require the most out of training.

A description of the operational subdivisions of the Coast Guard into regions, districts, units and checkpoints along the land and water frontiers and coasts of the country. This structure constitutes also the Coast Guard's alerting system in cases of accidents at sea, detection of oil spills and enforcement of laws. The chapter also presents in some detail the general responsibilities and functions of the Coast Guard.

Chapter 3 describes in detail the training system followed by classes and officers of the Saudi Coast Guard, and the educational possibilities available for ratings, technicians and workers in general. The nature of the Institute as a school for new recruits, cadets is explained. Although little is said about the possibilities for short-refreshment courses, the updating and further development of already acquired skills or the introduction of new technological processes for future training of technical personnel in ship operations, maintenance and repair as well as planning is seen by the author as one of the main challenges for the Saudi Coast Guard at this stage of development.

Chapter 4 is dedicated to considerations on planning for the establishment of a training program. Chapter 5 describes in detail the Coast Guard Institute, its objectives as well as requisites for entry and curriculum.

Chapter 6 presents the simulators as a training tool in general. The types of simulators available in the maritime industry, the basic advantages of simulators. The criteria for diagnosis of training to apply to in-service personnel, the weakness and the performance measurement.

Chapter 7 provides an analysis of particular maritime educational systems in different countries as reference. the STCW '78 convention as the instrument for the formulation of those systems. The study of the MET systems of various countries having trained personnel should in fact reveal certain elements of common ground. From those common features, a foundation for a new system may be laid or an existing system may be modified.

Chapter 8 makes an incursion into formulating a program for the coast Guard Institute. It describes the training objectives, the scenarios and some detail of the proposed contents. Chapter 9 is dedicated to summary and conclusion. It is expected that this dissertation could serve as starting point for other Saudi students doing research in the topic of simulators applied to training and education. It is only through continuous training and education that our technicians, engineers, officers, and workers can be efficient in their respective workplaces, as the country and the nation deserves.

CHAPTER 2

ORGANIZATION AND FUNCTIONS OF THE SAUDI COAST GUARD

2.1 Introduction

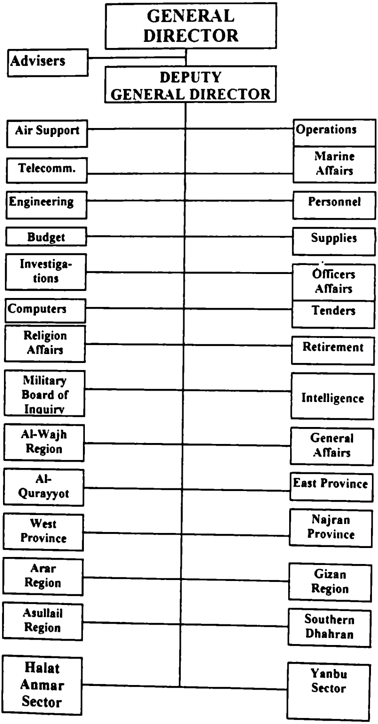
The Coast Guard of the Kingdom of Saudi Arabia was founded in 1353 H, (1934 AD). Royal Ordinance No. M/26 on Borders Security of 24 06 1394 H (1975 AD) and Royal Ordinance No. M/27 on Ports and Marine Lighthouses of the same date created the Frontier Forces, redefined and broadened the Coast Guard functions. Resolution No. 1407 places the responsibility to make rules and regulations in the Ministry of the Interior. His Royal Highness the Minister of the Interior in turn delegates these responsibilities to the Director General of the Coast Guard.

As Fig. 2.1 shows twelve departments report to the Director General of the Saudi Coast Guard. The Director holds the rank of General of the Armed Forces of Saudi Arabia.

1. The Operations Department
2. The General Service Department
3. Officers Affairs Department
4. Logistics Department
5. Marine Affairs Department
6. Financial Affairs Department
7. Aviation Department
8. Telecommunications Department
9. Engineering Department
10. Budget Department
11. Legal Investigations Department
12. Legal and Contract Department

Source: Coast Guard Work Documents 1/

Fig. 2.1 Organizational Chart of the Saudi Coast Guard



This chapter tries to identify, among the myriad of functions and activities carried out by different levels of the Coast Guard organization, those functions and tasks that require the most of training.

Each department is divided into sections to fulfil its responsibilities. Head of Departments, the Headquarters staff, advisers, the Military Board of Inquiry and the Security Unit assist the Director General in matters of planning, co-ordinating and evaluating the different activities carried out by regions, districts and unit commanders.

Operationally the Coast Guard is divided into eight region. Every region is divided into districts. Every district is further divided into units. Units are divided into stations these into checkpoints along the land and water frontiers and coasts of the country. This structure constitutes the Coast Guard's alerting system in cases of accidents at sea, detection of oil spills and enforcement of customs laws.

2.2 General Responsibilities and Functions of the Coast Guard

2.2.1 General responsibilities

Article 3 of the Boarder Security Royal Ordinance of 1975 defines the responsibilites of the Coast Guard as follows:

1. Security control of the Kingdom coastlines.
2. Early warning of unusual movements on border lines.
3. Marine search and rescue operations, assistance to shipping, navigational aids.
4. Rendering assistance to persons in border areas.
5. Surveillance of all border movements and its adherence to the laws governing such movements.
6. Co-ordination with other departments according to rules and functions of the Coast Guard.

7. Enforcement of fisheries regulations.
8. Security inspections to vessels in the territorial sea.
9. Detection and arrest of smugglers.
10. Casualty and criminal investigation onboard vessels.
11. Marine surveillance (long, medium and short range)

In order to comply with the responsibility the following functions are carried out:

2.2.2. Marine surveillance

The responsibilities and functions of the Saudi Coast Guard are carried out using long, medium and short range multipurpose vessels. The crafts are fitted with fire fighting and search and rescue equipment. Crafts are grouped into six types:

Fire fighting boats	25.05m	Patrol Boats	38.6m
Rescue boats	17.5m	Hovercrafts	
Small boats	8-12m	Training ship	

Source: SCG work documents.

Patrol crafts of different sizes carry out the responsibilities in the territorial waters.

a. Long range marine or territorial sea surveillance is carried out with long range crafts. Responsibilities include, among others:
   i) Early warning for any abnormal activity in the territorial sea.
   ii) Enforcement of security legislation.
   iii) Enforcement of fisheries regulations.
   iv) Search and rescue.
   v) Protection of marine resources.
   vi) Detection of oil spills and any other substance classified as pollutant to the marine environment.

b. Medium range surveillance is meant for the territorial sea and internal waters. Functions are similar to the long range surveillance.

c. Short range surveillance is meant for the internal waters surveillance.

Responsibilities include:

i) Security protection for vessels and facilities.

ii) Marine search and rescue, esp. in recreational areas.

iii) Enforcement of the security legislation.

These crafts have been designed for long operational endurance and high speed under the extreme environmental conditions of the Arabian Gulf and the Red Sea, i.e. high ambient temperature, high humidity, high sea water temperature and dusty winds. They operate in various missions in shallow as well as in deep sea waters.

2.2.3 Territorial Organization

2.2.3.1 The maritime regions

There are four regional Commanders reporting directly to the Director General. Each region has a structure similar to the Head organization. These regions are responsible for the regional plans, co-ordinating the activities carried out by the districts and unit commanders. Regional management and administration for districts and units are done by the headquarters concerned.

2.2.3.1.1 The Eastern Region: the eastern regions is responsible for the Arabian Gulf coast with its 537 km of coasts and islands and Saudi territorial waters.
Dammam Coast Guard Headquarters
The responsibilities are carried out by five districts, nine units and a hovercraft unit.

2.2.3.1.2 The Western Region: the Saudi coast on the Red Sea, 1777 Km of coasts and many islands.

a) Alwajh Coast Guard Headquarters

The function of this region is to carry out the responsibilities of the Coast Guard in the Red Sea territorial waters and along the coast, extending from Alaquahma, in the frontier with Jordan to the North of Yanbu. It is sub-divided in four districts and three units.

b) Jeddah Coast Guard Headquarters

It carries out the responsibilities of the Coast Guard from Yanbu to the North of Alquahma in the western coast on the Red Sea. It is divided in five districts, seven units and one hovercraft unit.

c) Gizan Coast Guard Headquarters

The responsibilities of this region extend from Alquahma to Yemen, Farassan's islands included. It is divided in three districts with four marine units.

2.2.3.2 Maritime districts

There are seventeen maritime districts, five of them are located on the eastern coast and twelve in the western coast. The districts are considered the fundamental unit to carried out field operations, coastal security in islands and coasts, as well as port security in some cases. A district generally has the following tasks:

1. Marine surveillance of the district territorial sea by patrol boats.
2. Surveillance of the district coastal area by patrol land vehicles.
3. Coast and internal waters surveillance by the coastal stations and checkpoints.
4. Port security units.

2.2.3.3 Units

Units are shaped according to specific requirements and characteristics of the area. The tasks of the units are in general:

1. Security

a. Security control on facilities.

b. Carry out the tasks assigned by the district.

c. District coast patrol inspections.

d. Surveillance and control of the coast.

a) Marine units

The main responsibility is the security and protection of the port concerned.

There are four marine units to carried out the responsibilites of the Coast Guard in the surveillance of the territorial sea as well as search and rescue operations.

Among the responsibilities of the marine units are:

1. Operation and maintenance of patrol vessels.
2. Training of personnel in
   - security operations
   - search and rescue.
   - security control on the internal and territorial waters.
3. Maintain and facilitate the required maintenance workshops to maintain vessels and marine equipment.
4. Carry out marine operations.
5. Provide the new navigational charts of the Saudi coast.
6. Surveillance and supervision of the territory assigned to the unit.
7. Training programs at different levels to rise the qualification standards.

b) Hovercraft

There are two hovercraft units for the territorial surveillance and marine search and rescue. They cover the eastern as well as the western coast and territorial seas.

2.2.3.4 Maritime stations and checkpoints

These are located on the coasts and islands.

They carried out the following responsibilities

1. Coast and internal water surveillance
2. Marine search and rescue assistance
3. Frontier security legislation enforcement
4. Fisheries rules and regulations enforcement.

REFERENCES

1/ Saudi Coast Guard work documents. In Arabic.

2/ The Organization in Brief. Promotional literature for high school graduates in Saudi Arabia.

CHAPTER 3

THE TRAINING OF TECHNICAL PERSONNEL

The Saudi Coast Guard has a variety of training tasks which it meets from within its own resources as well as from outside resources. Despite this it is not exempted from the difficulties experienced by the commercial and industrial job markets, such as

- changing educational standards and
- technicians and engineering's lack of popular appeal as a career.

The Saudi Coast Guard achieves its goals by allocating resources to training and managing them through an informal (not written) training system which closely integrates training with employment.

This chapter describes the way training is done for engineering and technical personnel in the Saudi Coast Guard. The core of the technical training occurred at the Coast Guard Institute, a technical an vocational training school which aim is to provide for the needs of the Coast Guard, and a few other training premises within the Saudi Armed Forces scheme.

3.1 The Technical Department of the Saudi Coast Guard

The Technical Department of the Saudi Coast Guard consists of officers, ratings and general personnel who serve mainly ashore in a variety of support tasks.

1. Ashore the technical personnel serve mainly in workshops in the maintenance of patrol boats, smaller vessels, high speed craft and supply vessels of the Saudi Coast

responsible for the maintenance and repair of equipment and systems, including hulls structures, main propulsion and auxiliary systems, power generation and distribution, weapons, surveillance and communication systems.

2. The Technical Department provides maintenance support to the different sections, including specialist services such as contract specification and management and software support.

3. Engineer officers and technicians in general are employed on instructional duties, ranging from new entry to advance courses, and on a wide variety of non-technical tasks such as recruiting, training and public relations.

The Technical Department has eight specialised sections: The Technical Office (Tech), the Mechanical Dept. (Mech.), the Welding Workshop (Welding), The Electrical Dept. (El.), the Electronics Dept. The remaining three departments are dedicated to Planning, Processing and administration of workshops.

The Mech., Welding, El., and Electronic sections further sub-divide into more specialised sub-sections. Officers, technicians and ratings remain in their specialist sub-branches throughout their career in the Saudi Coast Guard, although many jobs can be filled by personnel of any sub-specialisation. Most of the technicians are graduates of mainly the Coast Guard Institute and other vocational schools around the country.

3.2 Rational Behind the Training Organization

Because of the wide range and combinations of engineering knowledge and skills employed by engineering officers, technicians, artificers and ratings, and the additional requirement for military skills, the Saudi Coast Guard cannot recruit direct from industry. Over 200 men enter the Technical Department of the Coast Guard each year. At any one time some 3000 technical and engineering personnel are undergoing formal and short training at the Coast Guard Institute ranging from a two year technician apprenticeship to a one or two month course.

This demands comprehensive planning and management to ensure that adequate and suitably trained engineering and technical personnel are provided, in the most cost-effective manner, to meet the needs of the Saudi Coast Guard. Chapter two addresses the topic of planning in some detail. The integration of training and employment which is a feature of armed forces training is the responsibility of the Director of Personnel and Training of the Saudi Coast Guard.

The principal employers of engineering and technical personnel trained at the Coast Guard Institute are the Riyadh Coast Guard Head Quarters, responsible for planning and general management, the Navigation Sections of the Western Region (Red Sea) and the Eastern Region (Gulf area), responsible for the operation of Coast Guard vessels, and the workshops and mobile units which provide engineering and technical support at Coast Guard bases.

The requirements of these employers are stated in general terms in the operational yearly budget. The operational performance standards are still to be develop in order to define the task a man carries out in a particular job.

Formal training in the specialist engineering and technical subjects is the responsibility of the Coast Guard Institute, Universities and Polytechnics around the country as well as from the co-operation programs of the armed forces training schools. The formation of specialised personnel abroad is considered an essential component of the Coast Guard development plan.

Although full use is made of available instructional techniques, it is frequently neither feasible nor cost-effective to match the training needs to the operational needs. In such an event the employer (workshops and operations) is responsible for providing on job training (OJT) to bridge the gap. OJT is supported by senior officers where appropriate. In cases of new technologies it is the company delivering the new technology who has to provide the OJT. For this the personnel involved, either travel abroad or the supplier company organize practical courses in workshops or at the Institute for more theoretical training.

3.3 Professional Standards

It is Coast Guard policy that officers, ratings and workers in general assigned to the Technical Department be educated and trained to high standards in order that they may carry out their technical duties effectively and safely.

Engineer officers and artificers who have completed their training and have gained the necessary experience are thus qualified for internal promotions, higher ranks and may register for further academic education abroad.

In addition, each sub-section contains mech., El., Electronic workers who are primarily trained and employed as semi-skilled maintainers and operators.

3.4 Initial Training and Education

3.4.1 Officers

A considerable number of engineer and technical officers are graduates, of various higher education programs. A significant percentage joined as ratings and general workers. Officers either read for their degree at a national university or polytechnics, or enter the Saudi Coast Guard after gaining their degree at a foreign university.

The pattern of training for entry to the Saudi Coast Guard will vary according to their qualifications at entry. They are classified according to the number of years in formal education (Primary, Secondary, Vocational, Technical or University). They all will complete the same elements of military general training, degree and application training.

Only Sea Operations personnel undergo sea training covering professional subjects such as basic navigational science, navigation seamanship and management. This is followed by a term at sea in a training vessel, experiencing the practical aspects of life in a patrol boat, high speed craft or other craft.

The military training is a common phase for officers of all specializations. A period of training in operations and weaponry. During this period, they spend also time attached to each specialist department, gaining experience of the responsibilities of each department and their interaction with each other. They also begin to develop their skills as a manager and a leader.

The technical competence at the Saudi Coast Guard Institute is not an academic degree in engineering. The course which is systems based, includes electrical and mechanical subjects, presented in an integrated way to give a unified view of engineering. Mathematics, design, engineering drawing materials technology, and computer studies are also included. These core studies are supported by a range of industrial and defence studies. At the end of the course, the technical officer is qualified for employment.

On completion of the degree course, Coast Guard Institute graduates are joined by graduates from national and foreign universities and polytechnics for their application training where they extend their knowledge of engineering principles to the direct study of the Coast Guard's particular systems and equipment in their specialist areas. Application training will be carried out either at the Institute or at the provider's place, the Coast Guard Workshops or in an appropriate specialist premise. Marine engineering specialists also spend a period at sea in a training vessel (T/S Tabouk), gaining experience in the operation of the ship's machinery systems.

Once the application training is completed, all graduate engineer officers and technicians will be qualified for higher responsibilities. They then take up appointment as engineer and technical officer, normally in a Workshop, Planning Department or vessel operations.

On completion of the practical training (OJT), engineering, as well as technical officers are drafted to a workshop planning unit to consolidate their knowledge through experience.

Specialized workers are employed on all aspects of maintenance, repair, performance testing on systems and equipment for which his section is responsible. Engineering and Technical officers are required to train on main propulsion and auxiliary machinery. During this phase of his training, specialized workers are given the opportunity to exercise and develop his management skills, through work planning and control of junior mechanic ratings. On completion of this final phase of training, the specialized worker is qualified as a foreman and leader of technical teams.

Specialized workers and ratings not qualified to read for a degree may be selected for promotion to technical officer on the special duties list. After a short course at the Coast Guard Institute, they go to educational institutions, specially in those countries with whom the Saudi State has educational agreements where they undertake technical courses which qualifies them for Technical Officers. This is followed by application training at Workshops, the Saudi Coast Guard Institute or managerial tasks.

3.4.2 Technicians

By these category is meant all personnel such as mechanics, welders, etc. graduated at vocational schools. After a period of common technical training and general military training, these specialized workers are selected into their sub-specializations and go to the appropriate engineering courses at the Saudi Coast Guard Institute. There the apprentice will continue his technical education, leading to the award of Technical Officer. The apprenticeship will also include periods under training at remote Coast Guard stations, and mobile units during which time the apprentice consolidates his training in the practical workshop environment.

3.4.2.1 Mechanics

After a period of general training covering ship maintenance and repair and military skills, the engineering mechanic commences his technical training at the appropriate specialist unit in the Coast Guard Institute. On completion, he is selected for further training on specialised systems, or goes to sea in patrol boats or mobile units. Engineering mechanics with the necessary technical aptitude and academic ability may also be selected for foreman training.

3.5 Professional Development

3.5.1 Officers

In his first appointment after the academic degree and application training, the engineer officer is expected to be capable of carrying out technical and managerial duties. The examination by a senior engineer officer of the relevant specialisation assesses the new officer's stage of professional and character development, as well as his knowledge of personnel and technical administration. On completion of his first appointment, he is considered by the employers to have completed his training.

The technological demands of engineering and technicians are varied, over two thirds of an engineer officer's career will be spent ashore, working in workshops, ship-repair yards, mobile units, Coast Guard operation bases, dealing with suppliers, in planning and development, undergoing training or training others at the Coast Guard Institute, all with the common aim of meeting the operational needs of the Saudi Coast Guard organization. Engineer officers are also appointed to the Coast Guard Headquarters, the Ministry of the Interior and operational staffs where they will be involved in policy making, strategic planning and equipment procurement. Time-in-service and personal abilities determine advancement.

3.5.2 Technicians

On completion of his apprenticeship the technician is available for a wide range of jobs appropriate to his rate and specialisation. His first job is usually in workshops where he becomes a section head planning and managing the work of other technicians, at the same time employing his own specialist skills and knowledge.

At the end of his training the technician is considered to be fully qualified. Thereafter, his employment will reflect his previous experience, level of ability and personal preference.

3.5.2.1 Mechanics

Mechanics follow much the same career patterns as all technicians but over a smaller range of activities and with less emphasis on management and administration. Advancement is also determined by time-of-service and personal abilities.

3.6 Continuing Education And Training

3.6.1 Officers

A limited number of graduate engineer officers read for a second degree at different foreign universities and polytechnics. Of these a small number opt for postgraduate courses at a masters level at the World Maritime University. Postgraduate training is part of the Saudi Coast Guard's commitment to the highest standards of education and training for the professional engineers.

3.6.2. Technicians and Ratings

Individual operational and maintenance units ashore and on patrol boats as well as new technological equipment required the establishment of training organisations to assist candidates in preparing themselves for examination and to ensure that they gain the necessary breadth of experience to qualify them for higher rates. Once the training phase is over, advancement for technicians and ratings is by examination and/or selection. Examinations are usually carried out by the Department of Personnel and Training.

Courses for ratings and technicians are designed to cover the most common equipment and systems currently in service in the Coast Guard. Personnel appointed to ships containing equipment with which they are unfamiliar will receive pre-joining training, ranging from one to six months at the supplier's sites or abroad at specialised institutions.

Whilst all technicians of the same specialisation are trained to a common standard, reflecting the needs of the majority of jobs, keeping updated requires additional specialist knowledge or skills in new technologies and processes.

3.7 Future Training

The trend towards more sophisticated technology and reduced manning levels in patrol boats and marine vessels in general is to have an impact on the employment of engineer officers, ratings and technicians which must be reflected in their training. Training is acknowledged to be an integral and vital part of the support required by new equipment or vessel classes.

Future training of technical personnel in operation, maintenance and repair as well as planning is seen by the author as the main challenge for the Saudi Coast Guard at this stage of development and in the years ahead. It is only with the latest technology available for training of technical personnel that the challenge could be met. In an age of computers and simulators it is not strange that the best modern training technologies come from the exact same applications technologies now being used on ships and in the maritime sector.

CHAPTER 4

THE ESTABLISHMENT OF A TRAINING PROGRAM PLANNING CONSIDERATIONS

4.1 General

The Saudi Coast Guard remains convinced of the importance of training. Efficient operations, appropriate performance of vessels, men and equipment are essential in the Coast Guard's operations. It also recognises that job satisfaction can only come if the individual is confident in his competence, based on proper levels of professional training. Job satisfaction is a major factor in retaining the man and thereby achieving a return on the Saudi Coast Guard's investment.

Training is important in maintaining correct standards and practices, and thus levels of safety. Although training is designed to meet the needs of the Saudi Coast Guard, it is recognised that the Saudi Coast Guard's technical officers and technicians must train continuously in order to achieve high nationally recognised standards. The Coast Guard is a highly technological unit of the government of Saudi Arabia. It operates and maintains sophisticated equipment in the most demanding of environments, often far removed from deep technical support.

Training to this level, although necessary, is costly and the Coast Guard must continually search for the most cost-effective ways of matching training to the needs of employment. However, as manpower levels in ships are reduced, it is inevitable that an individual's training will become more important as his role expands, and consequently the training investment per technician must inevitably rise.

The training of technicians is in itself a challenge. Today's technology is developing at a pace unprecedented in history. Not long ago, technology seemed to grow at an evolutionary pace, i.e. the first step determined the second and this the third one and so on. Today, technology jumps from one step to another entirely new.

In this challenging environment planners must face these new developments with imagination. Adaptation is now the trend among technicians, when it comes to the upkeep of the existing technology. Technicians are undoubtedly confronted with an ever increasing array of new machines and technology to master and maintain. The risk of not upgrading knowledge as well as skills as technology advances is limited transferability of technicians having increasingly obsolete skills. For that a systematic method of keeping training abreast with advances in machinery and technology is needed in the Saudi Coast Guard. Training systems need to be continuously modified and updated.

One of the characteristics of the new technologies is its specific demands. They require:

1. A planning effort.
2. A change in the training procedures, the curricula, training methodologies and examination and certification systems.
3. A change in the human or manpower resources as this may relate to the capability of students to cope with the changing technologies.
4. A change in trainers approach to impart the required information effectively.

Human resources and availability of qualified manpower is considered to be one of the most important factors in any institution, military or not.

The present dissertation has its framework in the need to face these changes in a planned and organized way within the Saudi Coast Guard. For these there is no better place than the technical school. It is in these institutions where attitudes as well as skills are taught and minds moulded. As an extension of the above the entire Saudi nation needs this approach, as everything in it needs maintenance more sooner than later.

4.2 Manpower Planning. Definition

The chapter begins with the consideration of the manpower planning or Human resource planning. Although the terms are interchangeable, the general definition points to a single interpretation, that is

"a process for determining and assessing that the (institution, industry) will have an adequate number of qualified persons available at the proper terms, performing jobs which meet the need of the enterprise ...". 1/

4.2.1 Scope of Manpower Planning

The process of manpower planning must be a dynamic one, not static, and involves many interrelated activities. Plans must be modified and updated as conditions require. This process involves:

1. Forecasting future manpower requirements.
   In terms of mathematical projections or general trends in the developments of an institution or an industry.
2. Inventory of the present manpower resources.
3. Anticipating manpower problems by projecting present resources into the future and comparing them with the forecast of requirements to determine their adequacy both quantitatively and qualitatively.
4. Planning the necessary programmes of recruitment, selection, promotion, training, motivation and compensation so that the needs of the institution can be met. 2/

The importance of manpower planning, in terms of the supply and demand of human resources, including quantity and quality required at a given time or specific period can therefore be a critical factor in the establishment and sustaining of a training system. This becomes more important in countries like Saudi Arabia. Its rapid development demands a qualified workforce to sustain the pace of development and the formation of skilful technicians to upkeep the new technology that is already in place as a result of past development.

Although this manpower planning approach may not necessarily be an easy task in practice, planners should give special consideration to its application. This would be advisable bearing in mind:

1. New boats, new machinery means new technology.
2. Coast Guard officers being trained under different systems in different countries.
3. The investment in vessels, infrastructure, equipment and training.
4. The recruitment and retainment of candidates with adequate background and potential for recruitment.
5. The recruitment and retainment of properly trained instructors.
6. The possible benefits and trade offs of new trends in training, including using simulators and computers.
7. The integration of technical training in the normal education system.

4.3 Manpower Planning and Technical Training

There are some elements of planning that can assist in the establishment of a technical training school. These elements may operate either in isolation or in combinations depending on the circumstances. In addition these elements should not be examined merely as concepts for assisting in arriving at absolute numbers of personnel to be trained, but also for the final decision on the most adequate system to implement. Among these elements are:

1. The objectives of the national educational system.

2. The policy of the Saudi Coast Guard training system.
3. The Coast Guard infrastructure required to support the system.
4. The procedures in place to effectively attain the objectives.
5. The human resources required by the Coast Guard's training system.

4.4 Rationale for a Technical Training System.

The value of any manpower planning process aim at establishing a technical training program could be influenced by the rationale behind the need for such a program. In the case of the Saudi Coast Guard's real or perceived rationale may include:

3.4.1. The Coast Guard's need for the highest performance standards.

3.4.2. For national security reasons the Coast Guard can not afford to have machinery, equipment or ships idle because of lack of knowledge on the part of technicians.

4.4.3. The efficient maintenance of the existing infrastructure and fleet.

Even while bearing in mind the elements and rationale, mentioned above, the experience in existing technical institutions in several countries should be taken into account. The latter is necessary because Saudi Arabia is a net user of technology.

There are consequently many factors and elements to consider in the application of the concept of manpower planning approach for the establishment of a technical training system. In addition, the Armed Forces (Royal Navy, Royal Air Force, Civil Defence and other specialized groups) should take part in this approach since. Each one of them would bring its own impact and influence on the final decision, operation and maintaining of the system. Among the elements are:

a) Survey of the entire Coast Guard.

This exercise should include:

1) Ship, number of ships, characteristics, ages, equipment and machinery, ownership, manning levels.

2) Ship operations

3) Development and expansion, projections and plans: the development plans of the Saudi Coast Guard.

b) Manpower Supply

This is necessary to establish the existing availability of the human resources and the extent to which the current needs are being satisfied in relation to services required and demanded. The categories of manpower under scrutiny here would include all those already operating in the Saudi Coast Guard, trainees, trainers, shore based and seagoing personnel, examiners and planners.

c) Manpower Demand

The relation between supply and deployment of appropriately qualified and certified human resource to satisfy the existing and projected demand of the Saudi Coast Guard is a crucial area. As the Coast Guard expands, new vessels and equipment enter into service, more highly qualified personnel will be needed. The manpower attrition factor has to be taken into account. Any diagnostic on the situation of the human resources of the Saudi Coast Guard should include the development of recommendations regarding the appropriate training program to achieve the objectives.

d) Existing Education System

The establishment of a new training program, based in the modern technology of simulators should take into consideration the existing training system and how the Coast Guard Institute can integrate or complement the present educational tools with the new technology to ensure the production of the most needed qualified personnel.

e) Existing Institutional Framework

Manpower studies should determine the contribution that the Coast Guard Institute and other institute of the Armed Forces can make to the technical training program in so far as they can assist in achieving the objectives. It is likely that support can be available in terms of instructors and equipment among other areas.

A manpower plan can assist in informing the Coast Guard on some of the more pertinent decisions which should be taken in the establishment of a technical training program for maintenance technicians. Assessing some of these are:

i) To what extent can the program fulfil all the Coast Guard's requirements in terms of trained technicians.

ii) The role which the existing normal education system at the Coast Guard Institute can play in the technical training program.

iii) The need for other institutions in providing assistance in establishing the program including the need for utilization of external consultants and advisers.

REFERENCES

1/ Wilson B. (1981) The Personnel Manager. Management Skills. Edited by W.T. Singleton M.T.P. Press, International Medical Publishers.

2/ Smith, A. R. (1983). Manpower Forecasting Estimating Demand and Supply of Managers. Management Development and Training Handbook, 2nd Edition by Bernard Taylor and Gordon Lippet, McGraw Hill Books, U.K.

3/ Waters D. W. (1987) Maritime Education and Training. Policy Objectives and Practical Considerations. World Maritime University.

4/ UNCTAD, Secretariat TB/B/C 4/301, August 1986. Major Issues in world Shipping . Merchant Fleet Development- Structure of World Shipping.

5/ The International Maritime Lectures Association. Fifth International Conference on Maritime Education and Training. 19-22 September, 1988 Sydney, Nova Scotia, Canada.

CHAPTER 5

THE COAST GUARD MARITIME INSTITUTE

Chapter 2 of this dissertation established the need for a continuous educational and training program for officers, ratings and technicians within the Saudi Coast Guard organization. The present chapter examines the training possibilities of the Coast Guard Institute as a national centre for training in new technologies, skills development, and enhancement of performance. Further development of the Coast Guard Institute into a modem school for technical as well as nautical courses is desirable. This will ensure higher standards in performance and efficiency of operations. Modem teaching methods can help achieve this goal. The employment of simulated technical processes and procedures in the formation of nautical and engineering cadets and in development new skills in experienced personnel using simulation technology is seen here as a great step in the right direction.

The establishment of the Coast Guard Maritime Institute in Jeddah in 1973 was the direct result of the organization's needs for expansion. The Institute was to help creating the marine cadre required to operate and maintain marine vessels and equipment.

5.1 Objectives of the Institute

The main objective of the Institute was to train officers in operational procedures and law enforcement as well as the crew and other personnel from different Coast Guard units., so that after completion of the course they could join the patrolling units.

In 1981, the objectives of the Institute were broadened and to a certain degree modified to offer adult education for preparatory school and high school diplomas. Emphasis was placed on the teaching of the English as the language for reading manuals and instructions.

Today the Coast Guard Institute has the following objectives:

5.1.1 To be the national centre for the training of nautical and engineering cadets and technicians of diverse backgrounds in different nautical and technical skills required by the different departments and workshops of the Coast Guard.

5.1.2 To develop the skills of crews to increase performance and the level of efficiency of vessels and equipment.

5.1.3 To provide training as requested by the different units and the maintenance and repair teams.

5.2 Requisites of Acceptance 1/

To join the Institute, the candidate have to fulfil the following requirements:

1. Be a citizen of the Kingdom of Saudi Arabia.
2. Be between 16 and 24 years of age.
3. Get approval of parents for those under 18 years of age.
4. Single.
5. Not less than 168 cm in height and weigh 50-80 kg.
6. Never been convicted in any crime.
7. Pass the prescribed medical examinations.
8. Pass the acceptance tests required by the Institute.

5.3 Specializations Offered by the Institute 1/

As the main premise for the formation of Saudi Coast Guard personnel it has been necessary to include a great variety of courses (short and academic). Table 5.1

shows the main specilization courses offer by the Institute. The list is incomplete, since most of the courses are designed and implemented at units' request. The main criteria for the selection of the courses shown has been how long have they been taught at the institute (core courses) and the potential they exhibit to be the subject of simulation.

Table 5.1 Core Courses at the Coast Guard Maritime Institute.

Nautical Courses	Engineering Courses	Practical Courses
Nautical Science	Mechanical engineering	Secretarial Skills
Communications	Engines Technician	Rescue Operations
Radar Operations	Electricity	Hull maintenance
Deck Technician	Electronics	
	Technical Services.	
	Welding	

Many of the courses require a good theoretical background, but most importantly a solid practical base to develop skills and improve performance not to mention the development of know-how for the decision making processes.

5.4 Training Plan 1/

The general training plan of the Institute is designed to serve the main goals for providing essential nautical and technical personnel to the different units of the Coast Guard at a national level. The program consists of the following:

1) Refresh courses as requested by the units
   a. Technical courses in all aspects of engineering;
   b. Courses in maritime safety;
   c. Courses in operational command;
   d. Courses in law enforcement.
2) Introductory courses for new cadets, common to all disciplines.

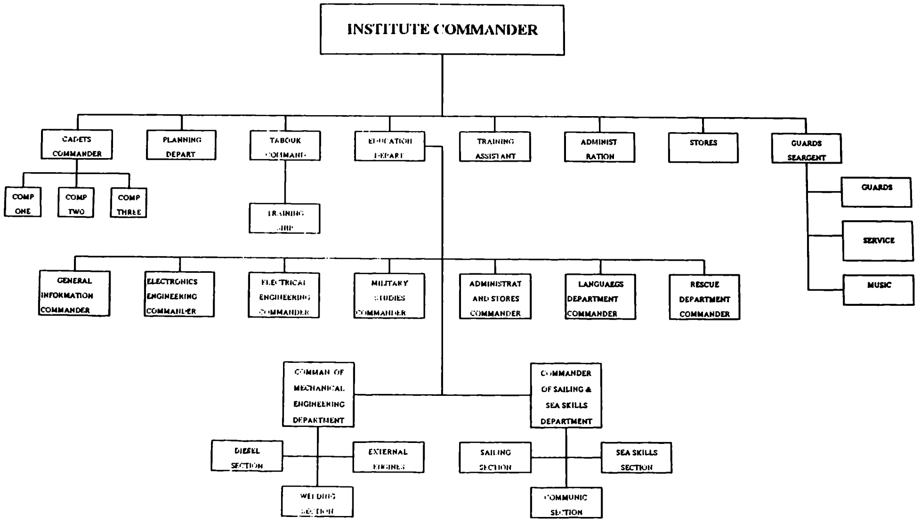


Fig. 5.1 Organizational Chart of the Coast Guard Institute

3) Advanced courses in nautical and engineering subjects.

4) Short courses in practical training as requested by the units.

5) Elementary and high school general courses.

5.5 Main Courses at the Institute

Most applicants to the Institute are secondary or vocational graduates coming from the Saudi general educational programme. The Saudi Coast Guard also employs men with very limited schooling. The policy of the Coast Guard is to train and educate all enlisted personnel, therefore there are general courses in elementary and secondary education for those in need of the diploma to advance in their carriers. The main core of courses at the Institute are offered according to the applicants years of schooling. Most applicants to technical courses are selected according to the English language proficiency. Table 5.2 summarizes the distribution of courses. For the purpose of this dissertation those with high school certificates and an adequate proficiency in the English language are candidates for simulator training.

Table 5.2 Distribution of Courses According to Years of Schooling

High School Requirement	Elementary School Requirement
Electronic Tech.	Engines Maint.
Electricity Tech.	Sailing
Mechanics Tech.	Deck man
Communications	Rescue
Systems tech.	Welding
Workshop Tech.	
Special Courses	
Secretarial Skills	
Store Keeper	

Source: Coast Guard Marine Institute, Jeddha.

5.6 Practice at sea

The Institute has its own training ship, the T/S Tabouk with dedicated specialized marine personnel and instructors. This ship is an old German training ship, expensive to maintain and to operate. Because of age and maintenance problems, students have not been able to fully use the facility that this ship is supposed to offer for training at sea. Here the use of a simulator can fill partially the gap and take out some of the pressure from the Tabouk.

5.7 Program of Study for Maintenance Technicians

Fig. 5.2 shows the path that maintenance technicians and operators follow in the training process. First the cadet has to be a high school graduate and fulfil all the requirements in order to be accepted as the Institute. This is mainly because of the English language requirement.

During the first and second year students take courses in such areas as mathematics, physics, chemistry, science, English, etc. These courses are designed to provide the student with a theoretical background on which to base the specialization courses. The contents of the main technical courses are listed below.

5.7.1 Electronics Course

5.7.1.1 Pre-requisites

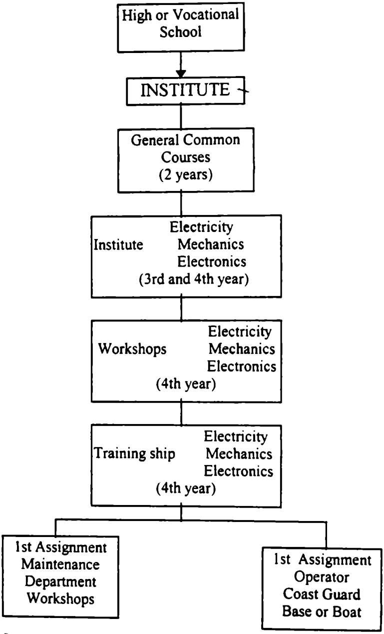
The cadet should have at least a high school certificate and be proficient in English. Table 5.3 shows the general plan of the course.

5.7.1.2 The electronics course is comprise of:

1. Fire fighting and safety in marine vessels.
2. The use, preparation, application of electronic circuits, and use of instruments.
3. Introduction to Computers.
4. Electronic devices.

6. Electronic components,. troubleshooting and spare parts control.

Fig. 5.2 Program of Study for Coast Guard Cadets at the Institute



Source: Own elaboration based on Saudi Coast Guard Institute documents

5.7.1.3 Post-graduation Placement

After graduation the cadet is either transferred to the Maintenance Department where he works in a workshop or on site, or to a unit where he works as an operator on ships or on land.

5.7.2 Course in Electricity

5.7.2.1 Prerequisites

The cadet should have at least a high school certificate and be proficient in English to be admitted to this course. Table 5.4 shows the general plan of the course.

5.7.2.2 The electricity course is comprise of:

1. Instructions in fire fighting and safety in marine vessels.
2. Reading, understanding and making electrical sketches
3. Introduction to Power Supply Distribution Nets.
4. Instructions on the theory and operation of electrical equipment and the types of material used.
5. Diagnostic and location of faulty electrical components.

5.7.2.3 Post graduation Placement

After graduation the cadet is either transferred to the Maintenance Department where he works in a workshop or on site, or to a unit where he works as an operator of engines or machines on ships or on land.

5.7.3 Mechanical Courses for Mechanics

5.7.3.1. Prerequisites

The cadet should have at least a high school certificate to be admitted to this course. Table 5.5 shows the general plan of the course.

5.7.3.2 The Mechanics course is comprise of:

1. Fire Fighting and Safety in marine vessels.
2. Instructions in reading and understanding engineering drawings and in making mechanical sketches.
4. Introduction to air conditioning, etc.

KINGDOM OF SAUDI ARABIA
COAST GUARD
MARITIME INSTITUTE
IN JIDDAH

Planning Department

SCHEDULE FOR
MARINE ELECTRONICS TECHNICIAN COURSE
AT THE COAST GUARD MARITIMR INSTITUTE
IN JIDDAH

		WEEKS
THEORY		101
WORKSHOF		10
ON SHIP		7
TOTAL		118

			PERIODS	FIRST			SECOND			THIRD			FOURTH			FIFTH			SIXTH			SEVENTH			TOTAL		
			WEEKS																						8		
			DATE from																								
			to																								
N	TEACHER	SUBJECT	HOURS	weekly	total	voluntary	weekly	total	voluntary	weekly	total	voluntary	weekly	total	voluntary	weekly	total	voluntary	weekly	total	voluntary	weekly	total	voluntary	Theory	Practical	Total
	GENERAL SUBJECTS																										
1		SPORTS																							0	432	432
2		TROOPS																							96	432	528
3		MILITARY																							126	88	214
4		ENGLISH LANGUAGE																							262	218	480
	SPECIALIZATION SUBJECTS																								.		
5		ELECTRONIC COMPONENTS																							262	155	417
6		SAILING INSTRUMENTS																							96	86	182
7		RADIO INSTRUMENTS																							96	86	182
8		RADAR & MEASUR.																							58	86	144
9		COMP.&COMUN.																							60	88	148
10		PRACT. TRAIN																							0	493	493
	TOTAL PERIOD IN WEEKS																								1056	2164	3220

Table 5.3 Marine Electronics Technician Course

KINGDOM OF SAUDI ARABIA
COAST GUARD
MARITIME INSTITUTE
IN JIDDAH

Planning Department

SCHEDULE FOR
MARINE ELECTRCAL TECHNICIAN COURSE
AT THE COAST GUARD MARITIMR INSTITUTE
IN JIDDAH

	WEEKS
THEORY	53
WORKSHOF	6
ON SHIP	8
TOTAL	67

			PERIODS	FIRST			SECOND			THIRD			FOURTH			FIFTH			SIXTH			SEVENTH			TOTAL		
			WEEKS																								
			DATE from to																								
			HOUR	weekly	total	voluntary	weekly	total	voluntary	weekly	total	voluntary	weekly	total	voluntary	weekly	total	voluntary	weekly	total	voluntary	weekly	total	voluntary	Theory	Practical	Total
N	TEACHER	SUBJECT																									
	GENERAL SUBJECTS																										
1		SPORTS																							0	104	104
2		TROOPS																							96	324	420
3		MILITARY																							96	88	184
4		ENGLISH LANGUAGE																							60	56	116
5		GENERAL TECH. SUBJECTS																							150	64	214
	SPECIALIZATION SUBJECTS																										
6		ELECTICAL ENGINEERING BASICS																							65	25	90
7		ELECT. PROP. OF MATERIALS																							28	2	30
8		ELECT. INSTRUMENTS																							74	40	114
9		OPERATING&MAINTAINANCE																							86	56	142
10		PRACT. TRAIN																							0	406	406
11		INDUSTRIAL SECURITY																									
	TOTAL PERIOD																								655	1165	1820

Table 5.4 Marine Electrical Technician Course

KINGDOM OF SAUDI ARABIA
COAST GUARD
MARITIME INSTITUTE
IN JIDDAH

Planning Department

SCHEDULE FOR
MARINE MECHANICAL TECHNICIAN COURSE
AT THE COAST GUARD MARITIMR INSTITUTE
IN JIDDAH

	WEEKS
THEORY	53
WORKSHOF	6
ON SHIP	8
TOTAL	67

N	TEACHER	SUBJECT	PERIODS	FIRST			SECOND			THIRD			FOURTH			FIFTH			SIXTH			SEVENTH			TOTAL		
			WEEKS																								
			DATE from																								
			to																								
			HOURS	weekly	total	voluntary	weekly	total	voluntary	weekly	total	voluntary	weekly	total	voluntary	weekly	total	voluntary	weekly	total	voluntary	weekly	total	voluntary	Theory	Practical	Total
	GENERAL SUBJECTS																										
1		SPORTS																							0	104	104
2		TROOPS																							96	324	420
3		MILITARY																							96	88	184
4		ENGLISH LANGUAGE																							60	56	116
5		GENERAL TECH. SUBJECTS																							96	144	240
	SPECIALIZATION SUBJECTS																								.		
6		INDUSTRIAL DRAWING																							28	96	124
7		TECHNOLOGY OF METALS																							28	86	114
8		MARINE ENGINEERING																							74	96	170
9		SHIP EQUIPMENT																							60	56	116
10		AIR CONDITIONING																							60	56	116
11		DIESEL ENGINES																							60	56	116
	TOTAL PERIOD																								658	1162	1820

Table 5.5 Marine Mechanical Technician Course

REFERENCES

1/ The Saudi Coast Guard Marine Institute (1994). Presentation of the Institute, (in Arabic).

CHAPTER 6

SIMULATOR SYSTEMS
A MODERN TRAINING DEVICE

6.1 Introduction

One of the main objectives of this dissertation is to study the incorporation of simulation systems to the practical training of students of the Coast Guard Institute at all levels, engineering as well as nautical. Refreshing courses for enlisted personnel and the development of skills in new technological processes should be seen as the main immediate goals. It is evident that with the application of simulation systems to most of the technical and nautical courses offered at the Institute, training time can be significantly shortened, through the transfer of technology that take many years to develop otherwise. This constitutes a great benefit to the Coast Guard's safety and overall performance and to the country in general, due to the savings it implies.

As shown in previous chapters, graduates of the Coast Guard Institute approach their first assignment with a great deal of theoretical knowledge but few have the opportunity to apply the knowledge to the development of skills. For the majority of newly certified (junior) officers training is the responsibility of more senior officers. For the apprentice marine pilot, for example, training is conducted by the working pilot. As a consequence it takes a long period of time to have a fully qualified pilot not to said a fully qualified officer, deck or engine. An additional risk is evident. As training of new technology for in-service officers and ratings is minimal, the junior officer has the risk of commencing his assignment with the "good old technique" and also the "old unsafe practices" and habits.

Furthermore, the process of qualification of a Saudi Coast Guard officer, engineering or nautical, is mainly through experience gained during in-service training conducted throughout the Coast Guard, as part of officers training. This training varies in discipline and technique depending upon the instructional ability of senior officers, the ship characteristics, job assignments and the area of the country where the training is carried out. Its is in this underlying philosophy for training of officers that practical training is performed in most regions of the Coast Guard.

As an armed branch of the Saudi armed forces the advancement through the officer ranks is controlled by time in grade and examinations administered by the Saudi Coast Guard. The examinations are theoretical in nature and require little practical demonstration of skills or proficiency. A license in itself does not ensure technical or engineering competency. Renewal is based upon the officer's recent service and a physical examination.

A gap between the learned theory and the development of practical skills is evident in the formation of engineering as well as nautical personnel. In the opinion of the author a simulation system for marine engineering applications can help to accelerate the training of officers in new technologies in the Saudi Coast Guard.

The present chapter presents a background to the use of simulation equipment as a training device. Here engineering and nautical simulators are presented in their general form to illustrate the possible uses of the technology in the formation of personnel.

As noted before, simulation equipment has been accepted by the educational world as been an effective and powerful training tool. This is certainly the case for military and civil aviation, the nuclear industry and other highly complex industries. In maritime training the implementation of simulator systems is expanding at a very rapid pace.

6.2 Maritime Simulation

Simulation is heavily relied upon in several industries as a cost effective means for the acquisition and improvement of skill. Both the airline industry and the nuclear power generation industry rely heavily on the use of simulation. The operating situation in the maritime field, however, is not repetitive, in the sense that the pilot and reactor operator perform complex sequential tasks, usually procedural in nature, requiring a considerable amount of practice and skill. Simulation has been proven as the most cost effective alternative for procedural skill acquisition and improvement. A large proportion of the engineering officer's tasks are not procedural. These operations appear to be more akin to decision-making, know how and skilled performance. In modern simulators the most important aspects is in fact the training in taking safe decisions, through an adequate knowledge of operations.

The state-of-the-art in maritime simulation technology is already well advanced. The most obvious area of limitation, and that which typically represents the highest cost area, is the visual scene display. Several methods of visual display present a rather fuzzy visual scene, at substantial cost savings. Other methods (computer generated imagery) create the complete visual scene, at a higher cost. The visual scene, in regard to computer generated imagery, has been already well developed. Higher resolution and quasi-normal movements had open the gate to the next generation of simulators: *"the Virtual reality (VR) techniques to provide environmental realism in terms of both operation and maintenance activities."* 1/

The predominant limitation of simulator today is the adequacy to which complex environmental interactions can be simulated. The problem is being addressed by the designers of the new generation of VR simulators. Still one problem is to be resolved and that is the validation at-sea.

Since the simulator is not the real-world, it is likely to always have limitations in the fidelity to which it represents the real world. The important consideration is not whether limitations exist, but rather the extent to which the limitations adversely affect the achievement of specific functional objectives in training.

6.3 Types of Simulators

In general it can be said that any dynamic process or complex operational equipment is suitable to stand model for a simulator system. Skills training concept training and understanding of interactively of systems can be achieved by proper use of qualitative simulator systems. 2/

Some of the types of simulators in use in the maritime and related industries are listed here. The list is an incomplete one because new simulated processes occur regularly: The list includes the following:

Table 6.1 Simulators in the Maritime Field

1. Propulsion plant simulator:
   - replica of engine control room
   - alarm and control panels as in engine room
   - actual engine usually replaced by mimic consoles
   - added noise to create lifelike operational influences
   - can be coupled to bridge simulator,
2. Steam generation plant simulator:
   - stand alone or part of engine room
   - specific functions of steam equipment,
3. Navigation equipment simulator:
   - Stand alone or coupled to radar navigation
   - Modern electronic navigation instruments
   - Operating procedures and accuracy.
4. Communication equipment simulator:
   - Radio communication systems linked to bridge or standalone
   - Full configuration fulfil GMD55 training requirements
5. Radar simulator:
   - Radar observer techniques can be trained
   - Navigating without outside view,

6. Radar navigation simulator:
   - On basis of radar simulator
   - Navigating functions
   - One or more bridges
7. Shiphandling simulator:
   - All components of above mentioned plus visuals
   - Various types of internal and external effects
   - Full navigational instruments,
8. Full mission shiphandling simulator:
   - As above but with full visuals
   - Sophisticated mathematical models
   - Mounted on platform for special effects
   - Interconnecting with other types of simulators
9. Fisheries simulator:
   - Handling of fishing gear and ships equipment
   - Effectiveness of fishing operations
10. Inland waterway ship simulator:
   - Specific elements of river navigation
   - With or without visuals
11. Dynamic positioning simulation:
   - Complicated dynamic positioning operations
   - Due to large number variables, rather intense operating procedures
   - Specific types of Data Processing equipment
12. Liquid cargo handling simulator:
   - Originally oil tanker simulation
   - Dynamic process of filling and emptying tanks
   - Cargo distribution and stability stress characteristics
   - Specially complicated operational vessels as gas, chemicals, oil products.
13. Ballast control simulator:
   - Specially developed for ballast critical craft as oil rigs, offshore construction ships, semi-submersible vessels etc.
   - Tilting platform essential because of influence incorrect operations
14. Dredging ship simulator:
   - Dredging master station simulated with all instruments
   - Dredging operations and results are simulated and shown

Source: S.J. Cross, ref. 2

These simulators, and many others, provide the trainee the opportunity for realistic operations under a variety of operating conditions, designs, and environments.

6.4 Advantages in the Use of Simulators

Training, whatever the means employed, represents one aspect of the solution to the need for improved safety. The cost of different training approaches (on-the-job training, classroom-only training, and simulator-based training, etc.), is well compensated when it comes to security and efficiency of operations.

The objective of introducing more practical, applications type training is aim at:

a. Reducing cost

b. Reducing the emphasis on theoretical knowledge versus skills training

c. Increase systems knowledge with respect to operation

d. Increase emphasis on normal, abnormal, and emergency operating procedures

The advantages derived from simulator-based training are centred around three important aspects:

1. Improved skills.
2. Improve safety, and
3. Cost effectiveness in acquiring that skill on the simulator.

Simulation is also been incorporated into training and certification programs, in most traditionally maritime countries. With the entry into effect of the new STCW Convention, it is expected that this process would be greatly increased to other maritime areas, and countries.

Incorporating simulation technology into the existing training and educational programs at the Saudi Coast Guard Institute for students and in-service personnel the following would achieve:

1. The periodic proficiency checks to maintain a license, for all.
2. In periodic, recurrent training required to validate licenses.
3. At sea, in shipboard training exercises, manoeuvring and even collision avoidance.
4. Combining written and performance examinations to demonstrate handling

proficiency and competence.

5. It will help to shape the curriculum of the Saudi Coast Guard Institute to ensure that up-to-date instruction is available in such things as shiphandling and manoeuvring, navigation and collision avoidance, via simulator.
6. It will help in the formal training required for officer to advance in grade. For example, this could take the form of simulator, navigation and/or collision avoidance training. Safety matters, etc.

A note of precaution is given by Waters and Muirhed

It *"revolves around the capabilities of the simulation medium itself which may range from a humble PC based system up to a full mission simulator. Whilst simulator technical specifications may vary widely, the important principle to be observed by course designers and instructors is that the simulator must have the capability of providing an acceptable operating environment for the chosen objectives and skills to be acquired and tasks to be accomplished."* 3/

Effective simulator based training is reliant upon several factors 4/

a) The development of specific training objectives
b) The selection of tasks relevant to the training purpose and operational skills needed onboard.
c) The effective use of exercise pre-briefing, control, monitoring and de-briefing techniques by the instructor
d) The provision of a suitable simulator operating environment for the selected objectives and training tasks
e) The quality of the instructors/assessors

6.5 Simulators Subsystems

The major simulator sub-systems are listed below:

Nautical Simulators

a. Visual Image Display
b. Visual Image Generation
c. Radar/Collision Avoidance

Engineering Simulators

a. The Electronic Switch Board(PSSB).
b. The control room position

d. Bridge Equipment Config.
e. Audio
f. External Factors
g. Own Ship Motion Base
h. Control Mode
i. Facility Arrangement
j. Ship Dynamics
k. Own Ship Malfunctions

(Man Console)
c. Large touch screens for the engine room actions.

These subsystems provide realistic models of ships including ship configuration and ship hydrodynamics as impacted by local conditions. The advantage of most of these subsystems is that the initial investment required can be as limited or extensive as user resources permit. Likewise, the software base can be expanded within the capability of the associated hardware, within any specified time period.

The touch screens for engine room actions replace hardware which is incorporated in other simulators subsystems. These permit advanced training in malfunctions. Casualties have been grouped by function to include steering, propulsion, electric power, radar, and ship control indicators. The interaction of simultaneous casualties of various ship systems, utilized on a co-ordinated basis, can provide not only basic ship system training, but also flexible degree of stress to permit trainee performance measurement.

Training assistance technology, although not a subsystem in the same sense as the other subsystems, constitutes a distinct function in that it allows the hardware components which compromise the other subsystems to be utilized fully. Training assistance technology is divided into data recording, data reduction, observation/monitoring, performance measurement, performance, diagnostic feedback/ demonstration, problem control, and a long term storage library.
Whole-task training on a simulator would be necessary to integrate the learned skills into a cohesive approach. Two other issues which are relevant to the specification of the training program are:

a) Training effectiveness

Training effectiveness refers to a change in the performance of the trainee when comparing pre- and post training exercises in the training situation. This is the first stage of validity which must be assessed by a training program.

b) Transfer of training.

Transfer of training, on the other hand, refers to "performance validity" which demonstrates an improvement in on-the-job performance as a function of the training program.

To meet this requirement, a modular training program structure is suggested in Chapter 8. The modules may be treated as independent and self-contained units of learning, as if each module constituted a mini-course. An engineering officer or student would undergo training in only those modules pertaining to his weak skills.

This structure will allow the necessary flexibility in

- the design and modification of training processes,
- the tailoring of training to the individual needs, and
- the offering and scheduling of training modules.

Each module will contain a detailed set of topic-level learning objectives, developed to achieved the respective training.

6.6 Diagnostics

The engineer officer's skills could be diagnostically evaluated prior to enter training to determine his strengths and weaknesses. The diagnostic would be used to indicate in which subject areas the officer or student should receive training, if any.

The administration of the diagnostic analysis scenario would result in a profile for each engineer officer across the modules, indicating the level of proficiency in each.

The application of training to overcome the skill weaknesses would depend on many factors. This structure would allow a large degree of individual and institutional flexibility in the tailoring and scheduling of training.

1. Modules offer for training
2. Modules schedules
3. The trainee would undergo training only in areas of weakness, scheduled in parts, when he has available time.

6.7 Performance Measurement

G. Zade of the WMU gives the following explanation of the purposes of training:

"The purpose of training is to enable acquisition of appropriate skills that will allow the individual to adequately perform specified tasks. How do we know that this has been achieved? The validation of a training program relates to the measurement of outcomes of training to ascertain whether the behavioural objectives specified in the program have been met. Validity is determined by the performance of trainees on criteria established as part of the training program. Whilst performance validity becomes increasingly complex, a clear understanding by the trainer of the trainee's role in the workplace is necessary in developing instructional objectives and tasks. If the correlation between real world and simulated world is high then the performance outcomes will be much more reliable and acceptable. This is important in considering the use of a simulator to measure competence of trainees, i.e. an ability to perform a particular function in a safe and effective manner. The steps to be taken to establish training validity have been outlined by Muirhead and Zade." 6

"The results are brought together by the trainer assessor to develop an overall measurement of training outcomes from which he seeks a positive response to the question 'Has the trainee demonstrated that he can perform the given tasks safely and effectively?'. Where training proves to be ineffective it may be that stated objectives are inappropriate or that there are inadequacies in the instruction process or similar)' that the candidate has failed. The same principles apply whether we are training on simulators, on a PC based system, or evaluating hands-on capability onboard ship.

When it comes to evaluating individual competence then performance criteria must be set on an objective and not subjective basis. Some qualitative comparison against real world operations is necessary in setting the parameters if confidence in the transfer of such skills to the workplace is to be achieved. Performance outcomes include:

- *Were the operational outcomes of an acceptable standard?*
- *Did action outcomes meet the designed training objectives?*
- *Did interactions with other trainees meet designed behavioural objectives?*
- *Has the trainee demonstrated that he can perform the given tasks safely and effectively?*

"In the final analysis however, the trainer assessor must consider whether the chosen measures of performance are reliable and relevant to the training tasks, and if the results are iterative in nature." (ref 6)

In summary, positive measurement of skill acquisition can be made on simulators provided that the criteria for effective simulator training is met, that the instructor is adequately trained and is provided with effective recording and monitoring equipment, and that clear performance criteria comparable to real world operations are established." (ref 6)

The performance measure would, for example, provide information pertaining to the officer's expertise and/or areas of deficiency. The diagnostic evaluation and tailoring training to specific needs is based on the availability of valid performance measurement. Performance measures are also necessary for effective training to provide information feedback to the trainee regarding his behaviour. Furthermore, the performance measure serve to establish validity and to determine the amount of training an individual needs meet specific standards. The standards to be met are also established on the basis of a representative sample of performance scores obtained over the population of individuals who describe the characteristics that make up the trainee population.

REFERENCES

1/ A. Al-Ali et all (1995). Specifications of COTSIM. The machinery space simulator at Kuwait. Quebec, Canada, Proceedings of the Second International Conference on Engine Room Simulators.

2/ S.J. Cross (1995). Introduction to Simulator Instructor Training. General Simulator Instructor Course. Norcontrol.

3/ D. Waters and P.Muirhead. Simulators, Pcs or Seatime? WMU, Malmö, Sweden.

4/ D. Waters and P.Muirhead. Simulators, Pcs or Seatime? WMU, Malmö, Sweden.

5/ CAORF (1978). Role of simulators in the Marine training and licensing process. Volume II.

6/ D. Waters and P. Muirhead. Simulators, Pcs or Seatime?

CHAPTER 7

TRAINING SYSTEMS IN SELECTED COUNTRIES

7.1 Modern Times Require Modern Approaches to an all Problem

The International Labour Organization describes the purpose of MET as
"to prepare seafarers to carry out their duties efficiently in order to insure the highest possible standards of operating efficiency and safety onboard ships." 1/

The main purpose of the present chapter is to present the way training is done in other countries. The logical approach to analyse or evaluate a particular system is to look into other's systems that have proven to be viable and learn from their experience, by trying to find the main characteristics and see if some of them could be applied to our system.

There are differences in the kinds of education and training systems existing in the world. These are a reflection of the country's maritime interest and educational systems, as well as the policies follow by the shipping industry. Nevertheless, all these system are directed towards the same objective, i.e. to fulfil the demand of skilled personnel for the maritime industry and for national defence, as well. It is not strange to find many common points to all the systems.

In most countries, with recognized maritime interest, vocational training for seafaring is not enough. The technological advances in the maritime field require a sound academic knowledge, modern technological concepts and a flexible way of thinking, together with the development of skills and know-how trough practical training.

7.2 Marine Officer Training in General

As G. Zade pointed out the development of marine officers training has followed the development in shipping and in safety and pollution prevention requirements. Syllabi of marine officers today contain subjects which deal with the construction of ships, their equipment, their movement, the handling and transport of cargoes and, following the advent of motor-driven vessels, their propulsion. These technical subjects are supported by general education requirements for the entry into maritime academies and, in the academies, by science subjects as mathematics and physics and, for meeting communication requirements, by maritime English. 2/

Survival of the fittest may have been an appropriate description of seafaring at a time when minimum requirements were neither prescribed for the construction, equipment and operation of ships nor for the qualification of their officers and ratings. Measures to increase safety were often, too often, stimulated by accidents which occurred as a result of existing deficiencies. 2/

Today the International Convention on the Safety of Life at Sea (SOLAS) and in often more detailed and stringent national regulations laid down the main minimum requirements for the construction of safety of ships and the minimum outfit.

International regulations for the prevention of collisions at sea, traffic separation schemes and other regulations and recommendations govern and advise on, respectively, the movement of an increased number of ships. Modern navigation systems and equipment allow the precise monitoring of the motion of ships aboard and from ashore.

The International Convention for the Prevention of Maritime Pollution (MARPOL) reflects the attention that is given to this sector of ship operations. Not only the parties involved in an accident suffer from it today but, if dangerous cargoes are involved in an accident often those living in the environment where the action occurred, are affected as well.

7.3 The STCW Convention

Present training of marine officers and ratings is compulsory. It takes years to obtain the required knowledge and about equally long or even longer to gain the necessary shipboard experience for certificates of competency. Minimum requirements are specified by the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) which the training of marine officers in Western European countries normally exceeds by range of subjects and by the depth in which they are covered.

The STCW Convention is limited to requirements which can be met by teaching technical subjects. Although maritime training in most countries gives also attention to science subjects by which technical subjects are supported, syllabi for master mariners used to concentrate solely on the training of seafarers and did normally not comprise technical or any other subjects outside this area.

7.4 Changes in Maritime Technology and Training

Considerable changes in the contents of syllabi have taken place during the last few decades. Pressures from competition have given the survival of the fittest, that was referred to at the beginning of this paper in a safety sense, an economic bias. Supported by the increased use of modern technology, the training of marine officer, and ratings continues to undergo an adaptation to specific requirements.

The training of marine personnel, from its beginning followed training schemes and dealt with technical subjects which were not existing in the training of any other profession. Such specialization of training and separation from the "rest" of the working population created an aura of independence and isolation around seafarers. This independence and isolation of seafarers is no more. It has been replaced by "integration". Although seafarers continue to be physically separated from the shore they are integrated into a scheme of close supervision and control from the head office, or headquarters.

Engine automation has led to watchfree engine rooms. Engine control from the bridge has become possible, i.e. the concentration of all steering and control elements in one location. Processing and condensing as well as suitable presentation of data have made one-man bridges possible.

Modern communication technology allows onshore personnel to stay in permanent contact with ships. Progress in ship construction technology has also facilitated the building of highly specialized ships the operation of which requires special officers and ratings' qualification and skills. Advanced shipboard navigation systems, automation, advanced shore-base systems, vessel traffic services, precise navigation, collision avoidance facilitated by automated radar plotting aids (ARPA), radio steering, etc. are no longer foreign words to the seafarers lexicon.

Training has to become more technical in content and has to be based on a better general education in science. This dissertation sees the integration of the nautical and the engineering training as the Y-model, where "in the stem of the Y represents the common science and the technical subjects and the two branches the nautical and engineering specializations." The work of the ship officer could be limited to the operation of the ship, and to a limited and probably even further decreasing extent to maintenance or preventive maintenance of ship equipment.

The labour turnover from shore to ship, most frequent in merchant ships than in naval fleets, and the natural attrition of personnel, requires the constant training of new officers and ratings. Moreover, the need for and the introduction of refreshing and upgrading courses for holders of certificates and enlisted personnel has required the use of existing resources and improve their knowledge in the subjects of such training.

Many countries have already taken steps in changing methodology and in adopting new systems to face the demands of the industry. 3/

7.5 Training in Selected Countries

A few countries curently at the forefront in redesigning their systems, are Australia, Japan, Germany and France. These countries have had considerable success in developing the new systems.

The study of the training systems of various countries with well-trained personnel should in fact reveal certain elements of common ground. From those common features, it is hoped by the author that, a foundation for a new Saudi system may be laid or the existing Coast Guard system may be modified. The most common elements, among others, include:

- Introduction of a fully integrated dual purpose scheme
- Emphasis in technical subjects
- Use of simulation systems to compensate for training at sea.

The countries I have selected for study are Germany, Japan, England, and France. While England has not undertaking any recent changes to its training system, each of these countries has long standing experience with integrated systems for officers and ratings.

7.5.1 Germany. Dual Purpose Training

The reform of the system dated back to 1978 with the replacement of the bosun and the engine room foreman. This was the first step for the development of a dual purpose training scheme for ratings in Germany. The program was latter extended to the ship's mechanic course introduced in 1983. This latter course had the objective of creating a multi-purpose crew. These ratings are known as 'ship mechanics'.

Since 1986, the German system has changed from the conventional monovalent type to the dual purpose type. Successful secondary school graduates can join the 3-year ship mechanic training program. During each of the three years, each student has a block of 10 weeks of study followed by examinations. Between the blocks the student must serve at sea to acquire sea-experience. At the end of three years, the student takes an examination from the Maritime Administration (Ministry of Transport). The successful candidate is awarded the licence of 'Ship Mechanic'. After a further 4 years of sea service, the rating will be eligible to attend a 9-month advance course. The rating is then examined by the Maritime Safety Administration and entitled to receive the Ship's Trade Master Certificate. A rating has also the chance to follow the officer career path. To do this he must enrol in a polytechnic for further study.

There are some similarities between the German system and the Saudi system, at least the one which applies to the Coast Guard, as explained in Chapter 3 of this dissertation. Differences arise in the sea-training part of the program. As stated before, the newly graduated officer or rating of the Saudi Coast Guard has little chance to practice at sea for developing the necessary skills. As I have suggested in this dissertation, the gap can be bridged with the introduction of simulation systems, both in nautical and engineering subjects.

7.5.2 Japan

With the introduction of a programme with the objective of operating sophisticated Japanese vessels with small crews, education and training began to change in huge jumps in Japan in 1977. The existing crew were given the title of Dual Purpose Crew (DPC), who would be identified on the basis of their common skills as well as their specialized skills as either deck or engine crew. The fixed manning system with a reduced crew for modernized vessel was introduced in 1986.

Training in Japan follows two major streams. The dual purpose crew system has been in place for quite some time now and Japan appears to be heading towards a complete DPC. Both regular and special courses are meant for the dual purpose (DPC) cadets. The regular course is open to the junior high school level students. Senior high school students can join any seamen's training school for one year.

One month of sea training is compulsory in both courses. On completion of the required sea service, students from both courses have the opportunity to become 3rd/4th grade maritime officers on passing the appropriate examinations conducted by the Maritime Administration. The upgrading of existing ratings is done through an updating system at a marine and technical college.

As seen in the previous paragraphs, there are some features of the Japanese system that are transferable to the Saudi system in which high school students from schools outside the maritime system are trained in technical matters. The Saudi Coast Guard system could be benefited from this idea besides the requirement that students show an adequate proficiency in the English language.

7.5.3 The United Kingdom

In the United Kingdom candidates are chosen by individual shipping companies and sent to the National Sea Training College at Gravesend for pre-sea training. A week course with a minimum of classroom work is designed to prepare the trainee rating for a career at sea as either a deck or general purpose rating. An engine rating receives similar training for a duration of thirteen weeks leading to a career at sea as a motorman. With the aid of extra studies in certain subjects, a correspondence course at sea and further college modules, this scheme leads to certification as a watchkeeping officer or an engineer.

Under the present system, trainees are admitted to the Academy after nine years of schooling. The candidates are carefully chosen and put through courses of fourteen weeks duration. On completion of the deck/engine courses, trainees are sent to shipping companies for employment.

The UK system has some interest for the purpose of this dissertation. A simulator is an expensive piece of equipment. Its maintenance and constant updating is a heavy burden to any school or institute. By providing a service, similar to the UK system the Coast Guard Institute should be able to optimize the utilization of the simulators (nautical and engine room).

7.5.4 France

The education and training of bivalent (Dual-purpose) officers courses was introduced in France in 1967. Successful graduates of the program can work as master or chief engineer on board a ship. This is a program for the corresponding 12 years general education European senior high school graduate. Studies are organized according to levels of certificates: The first level, for unlimited grt tonnage, and second level, for ships with less than 7500 grt or 7500 kW, are directed to the dual purpose system, while the third certificate is restricted to coastal ships and retaining the concept of monovalent or single purpose officers.

A good description of the system and a 20 years assessment of the French system can be read in Zade (1988) *A fresh look at education and training of ship officers in France.* 4/ It is not my purpose to evaluate the French system but rather to learn from it, and try to apply some its best characteristics to the Saudi Coast Guard.

The very nature of the job performed by Saudi Coast Guard officers calls for a dual purpose system of training. Saudi coasts are long and the job is not far from being exempted from dangers, mainly due to social and political instability in middle east politics. A deck officer should be prepared to react as swiftly as possible in case of malfunction of engines at sea and/or inability of the engineering crew to perform their duties. The contrary also holds for engineering crew.

7.6 The Dual-Purpose (DECK/ENGINE) System

This system is for the training of officers, either junior or updating of more senior officers. It is already in place with many years of experience in several developed maritime countries. As seen France is a good example. Japan, USA, and Germany have also succeeded in implementing such training schemes.

Dual-training is the direct result of a need of the industry in general to optimize ship operation through better exploitation of vessels and technology, through rationalizing the manning scale.

It is the opinion of the author that this type of system can well serve the Saudi Coast Guard.

REFERENCES

1/ ILO (--) The Analysis of National Training Programmes by the Joint Maritime Commission.

2/ Gunther Zade (1993) The Training of merchant Marine officers what challenges have been and have to be met with special emphasis on Western Europe. Le Havre, France Conference "1993, an opportunity for the French Merchant Navy Officer"

3/ M. Quader (1993). WMU Msc dissertation.

4/ Zade (1988) A fresh look at education and training of ship officers in France. WMU, Malmö, Sweden.

CHAPTER 8

INTRODUCING AN ENGINE ROOM SIMULATOR FOR PRACTICAL TRAINING AT THE COAST GUARD INSTITUTE

8.1 General

The job of an engineer officer and technical ratings onboard a vessel is to operate the propulsion machinery in a safe and efficient way, and to be able to service and repair propulsion plant equipment within a reasonable period of time.

It is therefore essential for engineer officers to have a good understanding of the propulsion systems, their interactions, components and controls. The engineer should be able to quickly recognise and diagnose unexpected plant malfunctions and respond appropriately in order to safeguard the plant, the crew and the ship. 1/

To acquire this level of skills and to be able to perform both tasks adequately through the traditional teaching methods requires good technical background, training and lengthy experience on ships.

Besides the technical side, the growing demand for the safe and efficient operation of modern vessels indicates the need for additional operational training for newly qualified engineers and the need for an increased knowledge on new technologies, processes, materials, methods, etc. to in-service engineers in order to keep training abreast with advances in machinery and technology. 1/ For new and inexperienced engineers the process usually takes between eight to ten years. For the second group of officers.the programs are still to be designed. However, the modern technology of simulation can, to a certain extent, shorten the training period as well as the sea time required.

The present chapter deals with possible ways to meet these demands in order to:

2/ - First, to ensure the number of engineer officers required at the present stage of development of the Saudi Coast Guard.

- Ensure that engineer officers and ratings have the necessary skills and level of efficiency required, and
- Ensure that they get the practice and the experience (hands-on) on technical processes that otherwise would require a very long time to acquire and develop.

It is the opinion of the author that all students will gain in knowledge and time by using simulator training. The Coast Guard will also benefited by shortening the training time required for this most needed personnel.

The basic idea is to introduce the use of engine room simulators to achieve the following goals:

1. To integrate at all levels of education in the Coast Guard Institute a modern interacting teaching and training aid.
2. To enable the students to actually prove their proficiency in a number of technical and operational fields where teaching and examination otherwise have been of a very theoretical in character.
3. The training of in-service engineers and ratings.
4. Operation and procedure training courses for junior engineers.
5. Engine-room management courses for crew teams.

The simulator should be able to provide initial and advanced practical training to students as well as further training for junior and senior engineers. Such training may be from normal procedures for starting up the plant, detection and correction of faults, to energy efficient and safe operation of the propulsion plant.

8.2 Training Objectives of the Engine Room Simulator 3/

According to van der Marel, Harms and Teekema (1995) the following should be the objectives of training exercises on an engine room simulator. These objectives are designed for large engine rooms in merchant ships, but methodologically they can be also applied to patrol boats.

1. Acquiring routine in control of engine room plant sea operations
2. Acquiring routine in control of engine room plant manoeuvring operations.
3. Acquiring routine procedures for preparing engine room plant for manoeuvring and in procedures during manoeuvring.
4. Acquiring routine in checking proper operation of engine room plant in port.
5. Acquiring over-all routine in actions and procedures pertaining to engine room processes, management, equipment such as:
   a) starting up from dead ship condition,
   b) routine operation of cargo pumps or deck winches in port,
   c) operation of electric plants such as starting and stopping generators and auxiliary diesel engine or turbines,
   d) plant condition ,monitoring,
6. Acquiring ability to respond to static operational conditions, such as:
   a) detecting and remedying common, single-fault failures,
   b) remedying a single fault blackout,
   c) in case of bridge manoeuvring recognizing and responding to relevant symptoms.
7. Acquiring routine in remedial actions and alarm procedures such as:
   a) action taken in unmanned engine room when single-fault failure is reported from the bridge,
   b) action taken in unmanned engine room when the alarm systems gives a single-fault failure via cabin alarm.
8. Acquiring and improving ability to respond to dynamic operational conditions, such as:

a) responding to quickly emerging alarm situations,

b) responding to multiple-fault alarm situations,

c) timely detection and analysis of faults,

9. Acquiring and extending knowledge of action to be taken in:
   a) emergency stops and emergency procedures,
   b) maintaining plant in proper condition,
   c) proper fine tuning of processes in main and auxiliary systems,
   d) designing a heat balance and speedy calculation of pertinent process data,
   e) control of the main variable process data on the heat balance.
10. Evaluation of operations and errors made.
11. Optimisation of the whole plant and of separate units, among other things with respect to:
    a) fuel consumption,
    b) engine room management,
    c) maintenance strategies,
12. Knowledge of external factors affecting ship's economics and safety.
13. Exercising emergency manoeuvres and actions followed by evaluation of effects.
14. Optimisation of astern running i.e. achieving the shortest stopping distance with a given plant.

8.3 Training Scenarios

The following summarizes what the Author sees as the main advantage of simulation. A whole set of different situations and circumstances could be fed to the simulator components. The student has to provide the appropriate answer to the circumstance. At the same time his behaviour is being moulded immediately, through trial and error. Such scenarios might look like the following:

1. Preparing engine room plant for departure, manoeuvring and sea operations.
2. Carrying standard jobs.

3. Preparing engine room plant for switch-over form sea operations to port operations.
4. Starting oil fired boiler and standing harbour watches.
5. Bunkering procedures.
6. Standing sea watches.
7. Remedying a black-out at sea.
8. Remedying a fault in cabin alarm situation.
9. Purging engine room bilges.
10. Carrying emergency stop.
11. Synchronising diesel generator and fine timing heat generating systems.
12. Starting and stopping shaft generator and turbo generator.
13. Correcting boiler failure.
14. Correcting thermal overload of main engine.
15. Executing performance report.
16. Removing oil residue.
17. Calculating indicated power.

The training scenarios should be focus on:

1. Preparing engine plant for departure
2. Manual parallel switching of auxiliary diesel driven generator.
3. Removing oil residue.
4. Purging engine room bilges.
5. Standing watches at sea.
6. Calculating power of main engine.

8.4 Organizational Scheme

The scheme chosen for the organization of practical courses follows the Y-model. The stem of the Y represents the common science and technical courses, and the two branches the nautical and engineering specializations.

Students (nautical and engineering, officers and ratings) will have a single point of entry. After the first 2 years of common subjects they will choose a specialization. During the third year of specialized subjects they will be ready to practice using simulation of their own specialized processes. During the fourth year, the dual program will be implemented by which the engineering students will practice nautical science and the nautical students will learn engineering subjects related to practice onboard.

8.5 Training Program for Cadets and Junior Engineers

A complete inventory of types of engines and the corresponding programs to run in the simulator(s) is a requisite of the program. The Saudi Coast Guard has a diverse fleet. Patrol boats manufactured in different countries contribute to this diversity. Ideally the program should include all engine types in order to develop the appropriate skills according to the specific type of engine. Methodologically, the most representative and pedagogical of the engines should be chosen.

An engine room simulator course oriented to the level of cadets or newly certified junior engineers should look like the following: 1/

Course objective:

1. To provide an opportunity for engineering students to gain experience in operating propulsion plant in a safe and efficient manner, under control conditions in the simulator.
2) To improve the professional skills of junior marine officers through a more organised practical training.
3) To provide senior engineer officers with wide ranging methods of managing abnormal operational situations and improve their efficiency in operating the propulsion plant.

This program is based on STCW education requirements. 4/ This is a 27 work hours program and it has the following objectives:

1. To teach how the engine parameters change with different loads and different speeds.
2. To teach how the engine parameters change under different operating conditions.
3. To teach how the engine parameters change when a simple fault occurs.
4. To teach how the typical fault symptoms change when other faults occur.
5. To test the diagnostic and maintenance knowledge level.

Part 1. Introduction: simulation basics, operating instructions, engine parameters inspection, first steps.

Part 2. Engine start, stop and load change.

The engine parameters when stopped.

The engine parameters when running.

The engine parameters under different speed and load.

Part 3. Different operation conditions simulation

Pressure and temperature.

Lubricating oil

Cooling water

Part 4. Single simulation

Air filter increase in air path resistance, air blower, decrease in air flow efficiency, gas turbine, increase in gas path resistance, gas leak through piston rigs or valves, fuel efficiency quantity decrease, injection advance angle change, decrease in cooling efficiency, friction coefficient increase, engine speed, engine load.

Part 5. Multiple simulation

Air filter fault with all other simulation,

Air blower fault with all other simulation.

Gas turbine with all other simulation

Air cooler fault with all other simulation

Gas leak through piston rigs or valves with all other simulation
Fuel efficiency quantity decrease with all other simulation
Injection advance angle change with all other simulation
Decrease in cooling efficiency with all other simulation
Friction coefficient increase with all other simulation
Engine speed, with all other simulation
Engine load with all other simulation

Part 6. Live run exercises, if possible.

8.6 Type of Courses for In-Service Engineers 4/

8.6.1 Basic Operational Training course

The basic engineer training in the Saudi Coast Guard Institute is characterized by being a general theoretical training, in regards to the operation and maintenance of a wide range of technical processes. A current operations routines do not form a central element of the training.

Thus newly qualified engineers have only limited knowledge and conception of the duties and responsibility they will face shortly after finishing their study and they have no experience with the importance of following standard procedures. As mentioned in Chapter 2 the time for the certified engineer to become proficient in technical matter is long. The institution assists them in continuing education, but lacks the development of skills, the one which it is expected from the simulator.

Course objective	To develop safe operational routines.
Course contents	Basic operational training, basic principles of keeping a watch, the use of standard procedures. The STCW regulations and resolutions will form the basis of the course together with the specific department's regulations and instructions. Planning and

communicating and priorities will have a great importance.

Participants: Marine engineers with limited practical experience.

Duration.

8.7 Engine Room Resource Management Course

Course objective To give the participant increase knowledge of the technical processes connected with the operation of the total engine room installation and to develop their understanding of the human correlation with reference to optimum use of the technical and human resources.

Contents: Matters concerning reaction and response time to difficult problems. Crew operations when abnormal situations develop, tracing and correcting system errors/malfunctions, bringing the engine room back to normal operations.

Participants: Marine engineers with a minimum of two years experience.

Duration: One week recommended.

8.8 Team Management Course for Engineers 5/

Area	Subject
1. Model of diesel propulsion plant.	1.1 Introduction to marine engineers team management. Course objective: 1.2 Technical characteristics of simulators and power plant models. Construction features of engines, machinery, steam generation plant and auxiliary systems. 1.3 Alarm, automatic control and monitoring systems of power plant.
2. Preparation of the auxiliary engines and systems for running in mooring conditions	2.1 Exercise planning 2.2 Preparation of the diesel alternators for running, starting, warming up and connection to busbars. 2.3 Putting into operation compressed air systems and oil fire boiler.

3. Main engine preparation and warming through procedures	3.1 Bunkering and start of the separators. 3.2 Start and operation of the main engine auxiliary systems.
4. Manoeuvring into harbour	4.1 Exercises planning 4.2 Manoeuvring in control room and bridge remote control modes. 4.3 Discussion of team management for the safe operation.
5. Manoeuvring to open sea	5.1 Warming of the main engine. 5.2 Exhaust boiler running and turbogenerator start and connecting to busbars. 5.3 Shaft-alternator start and connecting to busbars.
6. Diagnosis of main engine	6.1 Cylinders power card and fuel oil diagrams 6.2 Cylinders and fuel equipment faults location. 6.3 Discussion of various events and action/ responses.
7. Control of the engine and auxiliaries	7.1 Exercise planning. 7.2 Estimation of control loop systems quality. 7.3 Adjustment of the controllers and the Woodward governors.
8. Trouble shooting procedures	8.1 Location for faults of the machinery and auxiliary systems. 8.2 Discussion of various events and action/ responses.
9. Safe operation of the propulsion plant on complex and emergency conditions	9.1 Operation of the propulsion plant in safe and conscious manners for the following situations: wind, tropic conditions, blackout, dead cylinder, etc. 9.2 Team building, planning, error chain, on-board training, developing good team competency. 9.3 UMS situations and emergencies 9.4 Final evaluation

Source: V. Lanchukovsky et al (1995) The Requirements for the Engine Room Simulators Certification as International Standard. Odessa State Maritime Academy.

REFERENCES

1/ A. Al-Ali et al. (1995) Specification of COTSIM- The Machinery Space Simulator at Kuwait. Quebec, Canada, Proceedings of ERS 95.

2/ Svend Erik Lem. (1995) The Danish Simulator Project. Quebec, Canada, Proceedings of ERS 95. Second International conference on Engine Room Simulators, Institut Maritime du Quebec. Teekema et all. (1995) Full-integration simulation using both engine room

3/ Maarten-Jan van der Marel, Maarten Harms, Rene and bridge_simulators, design and experiences. Netherlands, Wageningen MSCN and Terchelling MSTC, Quebec, Canada, Proceedings of ERS 95. Second International conference on Engine Room Simulators, Institut Maritime du Quebec, edited by Institut Maritime du Québec. 1995.

4/ Stefan Kluj. The Role and Mission of a PC-Based Diesel Engine Simulator. Gdynia, Poland, Merchant Marine Academy. Edited by Institute Maritime du Québec. 1995.

5/ Svend Erik Lem. The Danish Simulator Project. In Second International conference on Engine Room Simulators (1995), Institut Maritime du Quebec.

6/ V. Lanchukovsky et al The Requirements for the engine Room Simulators Certification as International Standard. Odessa State Maritime Academy. In Second International conference on Engine Room Simulators (1995), Institut Maritime du Quebec.

CHAPTER 9

SUMMARY AND CONCLUSION

As seen through out this dissertation, the Saudi Coast Guard places great importance to the training of all its personnel. Calls for efficient operations, appropriate performance and adequate service to vessels, and equipment are common in all quarters of the Saudi Coast Guard. This institution of the government of Saudi Arabia has a high technological development. It operates and maintains sophisticated equipment in the most demanding of environments, often far removed from technical supports. Training, specially technical in nature plays a vital role in operations and general performance of men and equipment.

Those institution that regard training as vital as the Saudi Coast Guard does should have a well defined training programme. The Coast Guard training system followed by the technical personnel has to be updated. In this dissertation, I have tried to describe, to the best of my abilities, this system. The criteria used was to select those occupations related to technical tasks. In this way a description is given of the path that officers, ratings, technicians and other workers follow through their entire carrier in the Coast Guard. The opportunities exist for the training of the work force. To better complement the theoretical teachings, practical devices are recommended herein.

The Coast Guard organization has twelve departments, including marine operations, engineering, aviation, telecommunications, logistics, budget and finance. Training is as complex as the organization per-se. It is obvious that the Coast Guard requires continuous training. A further complication arises when one take into consideration the national structure of the Saudi Coast Guard. Operationally it is divided into regions, districts and units, each of them with its own peculiarities, but also with common procedures that need to be periodically updated to achieve uniformity of operations. This structure constitutes also the Coast Guard's alerting system for cases of accidents, emergencies at sea and for the enforcement of laws.

The quality and amount of training necessary to fulfil these responsibilities and functions is a complex one. The security of the coastlines and the early warning system require a strong training organization within the Coast Guard. The degree of compliance with the responsibilities depends entirely on the efficiency of operations.

Many areas require constant training. Marine search and rescue operations, surveillance of borders areas, law enforcement, in constant change, refreshing courses, inspections to vessels in the territorial sea, maritime law, etc. Although very important these areas are outside the scope of the present dissertation.

General considerations on planning of a training system are considered in some detail. I think planning is a vital aspect of any organization that has to show good results. It should be recognised that job satisfaction can only come if the individual is confident in his competence, which is based on proper levels of professional training and skills acquisition. Job satisfaction is a major factor in workers' moral. Training is of the utmost importance in maintaining correct standards and practices, and thus levels of safety.

To train its personnel, the Coast Guard administers the Marine Institute in Jeddha. This institution is dedicated to train Coast Guard personnel in different nautical and engineering disciplines.

Training at this level, although necessary, is costly and the Coast Guard must continually search for the most cost-effective ways of matching training to the needs of employment. However, as manpower levels in ships are reduced, it is inevitable that re-training for displaced individual will grow and consequently the training investment per technician will rise.

I have repeatedly stated in this dissertation that graduates of the Coast Guard Institute approach their first assignment with a great deal of theoretical knowledge but few have the opportunity to practice to develop vital skills. There are certain training objectives that can be properly reached by means of life-like, real-size, hands-on equipment and experience. This is what simulation systems offer.

The potential advantages derived from simulator-based training can bridge the gap between theory and practice by improving skills, safety, and cost effectiveness in acquiring the skill on the simulator.

The introduction of practical training in a simulator should be aim at:

a. Reducing the emphasis on theoretical knowledge versus skills training
b Increase systems knowledge with respect to operation
c. Increase emphasis on normal, abnormal, and emergency operating procedures

Simulation is also been incorporated into training and certification programs in most traditionally maritime countries. With the entry into effect of the new STCW Convention, it is expected that this process would be greatly increased to other maritime areas, and countries.

In particular, engine room simulators are today accepted as necessary training tools in education of engineers. Training time seems to be the greatest advantage of simulators. It can compressed months of experience at sea or engine rooms into a few sessions in the simulator, in a risk free environment. Conditional statements can help to narrow the range where errors are inevitable. (IF (functions)),- DO (operation)-THEN (result)). Simulator training is best for training situations where an error of judgement can endanger life, property and the environment.

Incorporating simulation technology into the existing training and educational programs at the Saudi Coast Guard Institute for students and in-service personnel would help to achieve the following:

1. Periodic proficiency checks to maintain existing licenses.
2. Recurrent training required to validate licenses.
3. At sea, training exercises, manoeuvring and even collision avoidance.
4. Combining written and performance examinations to demonstrate handling proficiency and competence.
5. It will help to shape the curriculum of the Saudi Coast Guard Institute to ensure that up-to-date instruction is available in such things as shiphandling and manoeuvring, navigation and collision avoidance, via simulator.
6. It will help in the formal training required for officer to advance in grade. For example, this could take the form of simulator, navigation and/or collision avoidance training. Safety matters, etc.

Since the simulator is not the real-world, it is likely to always have limitations in the fidelity to which it represents the real world. The important consideration is not whether limitations exist, but rather the extent to which the limitations adversely affect the achievement of specific functional objectives via training.
Waters and Muirhead have a note of precaution. "... the important principle to be observed by course designers and instructors is that the simulator must have the capability of providing an acceptable operating environment for the chosen objectives and skills to be acquired and tasks to be accomplished."

Simulator training in order to be effective several factors must be taken into account: The development of specific training objectives, the selection of tasks relevant to the training purpose and operational skills needed, the effective use of exercise pre-briefing, control, monitoring and de-briefing techniques by the instructor, the provision of a suitable simulator operating environment for the selected objectives and training tasks, and the quality of the instructors/assessors

A potential applicability of both whole and part-task simulators/trainers for the achievement of the set of identified objectives for marine studies include:

a. Radar/navigation simulator - for skills pertaining to collision avoidance, rules of-the road, and navigation
b. Other electronic systems
c. Shiphandling characteristics - fundamental ship manoeuvring
d. Docking, mooring, anchoring.

Two issues which are extremely relevant to the specification of the training program are identified as the application of training to overcome the skill weaknesses, which should be flexible, tailor to the needs of the trainee, modular and an appropriate scheduling and performance measurement

The purpose of training is always to enable acquisition of appropriate skills that will allow the individual to adequately perform specified tasks. The validation of a training program relates to the measurement of outcomes of training to ascertain whether the behavioural objectives specified in the program have been met. Validity is determined by the performance of trainees on criteria established as part of the training program. Whilst performance validity becomes increasingly complex, a clear understanding by the trainer of the trainee's role in the workplace is necessary in developing instructional objectives and tasks. If the correlation between real world and simulated world is high then the performance outcomes will be much more reliable and acceptable. This is important in considering the use of a simulator to measure competence of trainees, i.e. an ability to perform a particular function in a safe and effective manner.

The development of officers training has also followed the development in shipping and in safety and pollution prevention requirements. Construction of ships, their equipment, their movement, the handling and transport of cargoes and, their propulsion are common technical subjects supported by general education requirements.

Present training of officers is compulsory, takes years to obtain the required knowledge and about equally long or even longer to gain the necessary shipboard experience for certificates of competency.

The job of an engineer officer onboard a vessel is to operate the propulsion machinery in a safe and efficient way. Another important task of an engineer officer is to be able to service and repair propulsion plant equipment within a reasonable period of time.

It is therefore essential for engineer officers to have a good understanding of the propulsion systems, their interactions, components and controls. The engineer should be able to quickly recognise and diagnose unexpected plant malfunctions and respond appropriately in order to safeguard the plant, the crew and the ship.

To acquire this level of skills and to be able to perform both tasks adequately through the traditional teaching methods requires good technical background, training and lengthy experience on ships.

Although the simulation technology has advanced a great deal in the last few years, the maintenance simulator, as such does not exist yet. The new generation of simulators, using VR (virtual reality technology) is supposed to do that. It is not until the development of the VR maintenance simulator that the repair man could be able to feel that he is inside the engine, and be able to make a diagnostic of the failure and take or advice the appropriate measures.

Besides the technical side, the growing demand for the safe and efficient operation of modern vessels indicates the need for additional operational training for newly qualified engineers and the need for an increased knowledge on new technologies, processes, materials, methods, etc. to in-service engineers in order to keep training abreast with advances in machinery and technology. For new and inexperienced engineers the process usually takes several years. For the second group of officers the programs are still to be designed. However, the same modern technology can, to a certain extent, shortened the training period as well as the sea time required.

It is the opinion of the author that through the use of accelerated training on a complete simulator both groups of officers would gain in knowledge and the Coast Guard could shorten the training time of this most needed personnel and achieve the following:

1. To integrate a modern interacting teaching and training aid.
2. To enable the students to test their proficiency in a number of technical and operational fields.
3. The training of in-service engineers.
4. Operations and procedures training courses for junior engineers.
5. Engine-room management courses for crew teams.

Courses should be designed in operational training, course of engine room resource management, team management for engineers, aim at acquiring skills in control of engine room plant operations, the control of engine room and plant manoeuvring operations, in actions and procedures pertaining to engine room processes, management, and equipment, ability to respond to static operational conditions, remedial actions and alarm procedures, improve ability to respond to dynamic operational conditions, extend knowledge of action in emergency stops and emergency procedures, maintaining plant in proper condition, proper fine tuning of processes in main and auxiliary systems, evaluation of operational errors, optimisation of plants and units, in fuel consumption, engine room management, maintenance strategies, exercising emergency manoeuvres and actions followed by evaluation of effects. Courses should be directed to Cadets and junior engineers, as well as in-service engineers.

Finally it is suggested that the issues surrounding the demonstration of proficiency for certificates of competence be thoroughly investigated. These might include: the feasibility of testing on a simulator; validation and effectiveness of simulator-based testing; training program-based skill demonstration leading to license. These are very broad areas. They cover a wide variety of skills. The design of a cost effective simulator, together with the training program, necessitates the definition of a precisely defined set of objectives to be achieved via training on the simulator. The development of a good simulator training programs depends mostly on the program objectives, schedules, the training conditions, and the development of supporting material.

BIBLIOGRAPHY

1. A. Al-Ali et all (1995). Specifications of COTSIM. The machinery space simulator at Kuwait. Quebec, Canada, Proceedings of the Second International Conference on Engine Room Simulators.
2. Cross, S. J. (1995). Introduction to Simulator Instructor Training. General Simulator Instructor Course. Norcontrol.
3. CAORF (1978). <u>Role of simulators in the marine training and licensing process</u>. Volume II.
4. IMO Review of the STCW Convention, Consultants reports to the STCW Sub.committee, Report No's 1,2,3 1993-1994, IMO London.
5. International Maritime Lectures Association. Fifth International Conference on Maritime Education and Training. 19-22 September, 1988 Sydney, Nova Scotia Canada.
6. International Marine Simulation Forum, Working group on Simulator Classification- draft report, 19th August 1994.
7. Maarten-Jan van der Marel, Maarten Harms, Rene Teekema et all. (1995) Full-integration simulation using both engine room and bridge_simulators, design and experiences. Netherlands, Wageningen MSCN and Terchelling MSTC, Quebec, Canada, Proceedings of ERS 95. Second International conference on Engine Room Simulators, Institut Maritime du Quebec, edited by Institut Maritime du Québec. 1995.
8. Muirhead P. M., and Zade G., "Assessing standards of competence including the use of simulators", WMU/NI Conference, Malmö, Sweden, 15-16th March 1994.
9. Muirhead P.M. "Qualifications and experience of instructors and assessors. The Use of simulators", WMU Revision of the STCW 1978, 15 March 1995.
10. Saudi Coast Guard work documents. In Arabic.
11. Saudi Coast Guard. The Organization in Brief. Promotional literature for high school graduates in Saudi Arabia.

12. Saudi Coast Guard Marine Institute (1994). Presentation of the Institute, (in Arabic, translated by the Author).

13. Smith, A. R. (1983). Manpower Forecasting Estimating Demand and Supply of Managers. Management Development and Training Handbook, 2nd Edition by Bernard Taylor and Gordon Lippet, McGraw Hill Books, U.K.

14. Stefan Kluj. The Role and Mission of a PC-Based Diesel Engine Simulator. Gdynia, Poland, Merchant Marine Academy. Edited by Institute Maritime du Québec. 1995.

15. Svend Erik Lem. (1995) The Danish Simulator Project. Quebec, Canada, Proceedings of ERS 95. Second International conference on Engine Room Simulators, Institut Maritime du Quebec.

16. UNCTAD, Secretariat TB/B/C 4/301, August 1986. Major Issues in world Shipping . Merchant Fleet Development- Structure of World Shipping.

17. V. Lanchukovsky et al The Requirements for the engine Room Simulators Certification as International Standard. Odessa State Maritime Academy. In Second International conference on Engine Room Simulators (1995), Institut Maritime du Quebec.

18. Wilson B. (1981) The Personnel Manager. Management Skills. Edited by W.T. Singleton M.T.P. Press, International Medical Publishers.

19. Waters D. and Muirhead P.M.. Simulators, Pcs or Seatime? WMU, Malmö, Sweden.

20. Waters D. (1987) Maritime Education and Training. Policy Objectives and Practical Considerations. World Maritime University.

21. Weddle A. J. "The use and development of a prototype diesel plant simulator", Australian Maritime College, in Muirhead P. WMU Simulation systems and training methodology, March 1995.

22. Zade G. (1993) The Training of Merchant Marine officers what challenges have been and have to be met with special emphasis on Western Europe. Le Havre, France Conference "1993, an opportunity for the French Merchant Navy Officer".