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The upgrade of the Marine Engineering Faculty at the Pakistan Marine Academy

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WORLD MARITIME UNIVERSITY
MALMÖ, SWEDEN

THE UPGRADE OF THE MARINE ENGINEERING FACULTY AT THE PAKISTAN MARINE ACADEMY

BY

MOHAMMED ILYAS

Pakistan

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)

1996

DECLARATION

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

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

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Dedicated to my late father whose soul may rest in eternal peace

ABSTRACT

Title of Dissertation: The Upgrade of the Marine Engineering Faculty at the Pakistan Marine Academy to BE (Mar. Eng.) degree level.

Degree: **M. Sc.**

This dissertation is a study of the present development of MET system in Pakistan, its current status, factors influencing changes for the education of Merchant Mariners, new technology on board ships of the current era and different training systems which reflects these changes on board high tech ships.

A brief look is taken at and reviewing the existing organisational structure, evolving the Quality Standard System Model to comply with the STCW Convention 95.

Modern Technology, Economic and Social Pressures brought the need to look carefully at the upgrade of the MET systems in Pakistan to a BE (Mar. Eng.) degree level, thereby the scope of the future Marine Engineers can be diversified not only to take up the shore based jobs in the Maritime Industries in Pakistan, but also in the international job market. The comprehensive BE degree curriculum has been developed in line with the prevailing curriculum of the reputed international Academies and Technical Universities.

Finally conclusion and recommendations have been made towards better education and training; which will enable the shipping industry in general and MET System in particular to cope with the challenges offered by the momentous changes in technology.

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LIST OF ABBREVIATION

ARPA	Automatic Radar Plotting Aid
Bsc.	Bachelor of science
B.E.	Bachelor of Engineering
COC	Certificate Of Competency
C/E	Chief Engineer
DGPS	Director General Ports & Shipping
DPC	Dual Purpose Crew
ENM	Ecole National de la marine
GRT	Gross registered Ton
HOD	Head of Department
HND	Higher National Diploma
IMLA	International Maritime Lecturer association
IMO	International Maritime Organisation
INMARSET	International Maritime Satellite
KW	Kilo Watt
KPT	Karachi Port Trust
KS&EW	Karachi Shipyard and Engineering Works
LNG	Liquefied Natural Gas
MET	Maritime Education and Training
MEO	Marine Engineer Officer
M-0	Man- Zero
MARAD	Maritime Administration
OOW	Officer of the Watch
OBO	Oil-Bulk-Oil
OMBO	One man Bridge Operation

OND	Ordinary National Diploma
OOW	Officer Of the Watch
PMA	Pakistan Marine academy
PNSC	Pakistan National Shipping Corporation
QA	Quality Assurance
QSC	Quality Standard Committee
QSS	Quality Standard System
STC	Seamen Training Centre
STCW	Standard of Training, Certification and Watch keeping
SUNY	State University of New York
UK	United Kingdom
UMS	Unmanned Machinery Space
ULCC	Ultra Large Crude oil Carrier
USA	United States of America
USCG	United States Coast Guard
VLCC	Very Large Crude Carrier
WMU	World Maritime University

1. INTRODUCTION

1.1 TERMS OF REFERENCE

The aim of this study is to identify and define the basic terms of reference which are essential to upgrade the marine engineering faculty of the Pakistan Marine Academy (PMA). The purpose of this study includes:

- To appraise the relevance of the present Marine Engineering Course offered by the Pakistan Marine Academy .
- To assess the nature of future needs of Maritime Engineering Education in Pakistan.
- To diversify the scope of Marine Engineering Education in Pakistan by upgrading to a B.E. (Mar. Eng.) Degree programme.
- To justify the accreditation of PMA with the Ndir Shaw Edulji (NED) University of Engineering Technology Karachi.
- To provide the Regional Maritime Nations with a centre of excellence for Maritime Education.
- To examine International Quality standards with a view to their application at PMA

1.2 SCOPE

A national maritime education and training policy contributes to and forms a part of rational shipping policy which in turn enhance national economic development. This is particularly important in the case of Pakistan in its present historic drive for free market economy and rapid socio-economic development. The success of the programme depends largely on the development of science and technology, as well as on the people who process it. **"EDUCATION IS THE KEY".**

Safety, cost, reliability and protection of the environment are the factors which call for the highest standard of training. Hence, upgrading of the faculty and staff are the need of the hour. Therefore, it is very necessary to device a training and education system for seafarers as well as management personnel for the optimum performance and suitability to meet all national and international standards prevailing in the maritime industry. In other words it is essential that training systems be institutionalised with a built in system of continuing R&D in order to foresee changes and to prepare to meet the challenges. Keeping pace is not good enough even for survival, never mind progress and growth. The author discusses these issues in this paper and tries to reach an optimal solution.

1.3 METHODOLOGY

The fundamental tool used in completing this paper is library research. However many of the ideas utilised in this paper are also the result of two years spent in the nurturing environment of the World Maritime University (WMU).

The basic concepts which were transmitted by the lecturers, professors and visiting professors were used as guidelines in the process of developing this study. The author's ten years teaching experience is also a contributing factor in the development of this paper.

Written materials obtained in the form of hand outs at the World Maritime University and during field trips have also been helpful. Furthermore, comments, suggestions from MET faculty, classmates and colleagues have proved to be a useful factor in the completion of this paper.

2. MARITIME BACK GROUND OF PAKISTAN

2.1 INTRODUCTION

The Islamic Republic of Pakistan is situated north of the tropic cancer and is bordered on the north by China, on the west by India, on the east by Iran and Afghanistan. The South of Pakistan opens to the Arabian Sea with 870 km of coastline and 200 miles of exclusive economic zone.

Among the neighbouring countries, Afghanistan is landlocked and most of their sea trade goes through Pakistani ports. Pakistan has fairly good road links with Iran, India and China. Since the demise of the USSR, Pakistani ports can also act as hub to newly liberated Central Asians states for the carriage of goods to these countries. Fig 2.1 shows Pakistan with its neighbouring countries.

2.2 PORTS & SHIPPING OF PAKISTAN

2.2.1 Ports

Currently there are two major sea ports in the country, Karachi port and Port Qasim. Karachi port handles nearly 95% of cargo, dry & liquid. Port Qasim, the first multipurpose industrial port, was built to provide alternative port facilities and handles raw material imports for Pakistan Steel Mills.

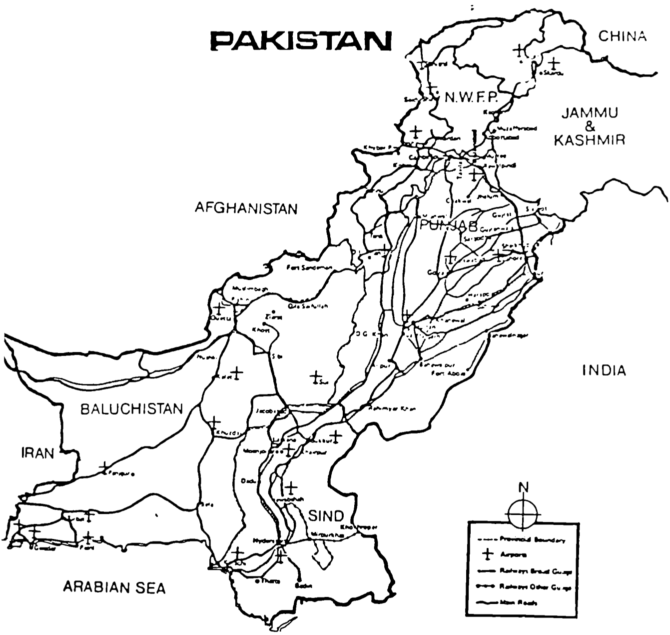


Fig. 2.1 Map of Pakistan

Source: Atlas of Pakistan (1994)

The second mini port cum fishing harbour at Gwader, built at a cost of Rs. 1.750 millions, was inaugurated on 15 March,1993. The first mini port at Pasni, already completed at a cost of Rs. 560 million, is working quite well and is proofing sea trade and the export of fish and shrimps to foreign and home markets. Besides the opening of the mini ports, the foundation stone has also been laid of a deep sea port at Gwader to be built at a cost of Rs. 1682 millions. It will take about 3 years to complete and would accommodate vessels of 10,0000 DWT providing a first class service as an international sea port for trade and traffic for Central Asian States, Afghanistan, Pakistan and the rest of the world.

2.2.2 Shipping

The PNSC started with a fleet of 42 ships in 1979. Except for the 14 ships acquired during the fifth plan period, no ship has been added to the fleet. With the gradual depletion of the older ships, the fleet has now been reduced to 22 .The following tables illustrates the National Fleet and their age distribution.

Table: 2.1 PNSC Fleet as on Ist. January 1994

Source : Summary to the Prime Minister of Pakistan

YEAR	No. OF SHIPS	DEAD WEIGHTS (Tons)
1979	42	522,622
1982	50	709212
1987	29	449,983
1994	19	313143

Table 2.2 Age Distribution of PNSC Fleet as on 1st. January 1994

Source: Summary to the Prime Minister of Pakistan

TYPE	NUMBER OF SHIPS	NUMBER OF SHIPS
A) GENERAL CARGO SHIPS 10 TO 15 YEARS OLD. ABOUT 20 YEARS OLD MORE THEN 20 YEARS OLD	 01 06	18
B)PASSENGER SHIP MORETHEN 20 YEARS OLD		01
TOTAL	19	19

2.2.3 Commercial Performance

During 1992-1993, PNSC lifted 3.63 million tons of cargo which is about 10% of the total national trade. The cargo lifted by the various sectors was:

DRY BULK	**2.26 M. TONS.**
ASIA LINE	**0.82 M. TONS**
EUROPE LINES	**0.44 M. TONS**
USA LINE	**0.11 M. TONS**
TOTAL	**3.63 M. TONS**

In addition PNSC transported Haj and Umra passengers between Karachi and Jeddah. The following table stipulates the sea borne trade of Pakistan during the year 1992-93.

Table 2.3 Share Of Pakistan Fleet in Total Trade 1992-93

Source: Summary To the Prime Minister Of Pakistan

TRADE (M.TONS)	OWN VESSELS	CHARTED VESSELS	FOREIGN VESSELS	TOTAL TRADE
IMPORTS	2.37	2.14	20.18	24.69
PERCENT	9.6	8.7	81.70	100.00
EXPORTS	0.65	0.32	4.51	5.48
PERCENT	11.9	5.8	82.3	100.0
TOTAL	3.02	2.46	24.69	30.17
PERCENT	10.0	8.2	81.8	100.0

2.3 STAGES OF DEVELOPMENT- PMA

The Mercantile Marine Academy was first set up at Chittagong, East Pakistan in 1962. On the creation of Bangladesh, it was re-established temporarily in Haji camp at Karachi in November 1971 and renamed Pakistan Marine Academy. The Academy was finally shifted to its existing premises at Mauripur road, Karachi in June 1978. The PMA is a subordinate organisation of the Ministry of Communications Ports & Shipping wing.

The purpose built campus has an area of 550000 sq.m and located in the north west of Karachi harbour. It comprises an administration cum instruction block, officers club, cadet residential block, workshops, simulator room, jetty, swimming tank, parade grounds, medical centre, mosque, bank, post office, seamen training centre and a residential colony for staff and officers of the academy.

The Pakistan Marine Academy (PMA) is an affiliate institution of the University of Karachi for the award of BSc degree in Maritime Studies to its graduates since 1986. It is also recognised as a branch of World Maritime University, Malmö, Sweden for the conduct of IMO specialised short courses since 1990.

2.4 MISSION OF PMA

- To provide a sound academic background and teach the fundamentals of theoretical and engineering education essential for a successful career at sea.

- To meet the training requirements of IMO in accordance with the STCW Convention-1978 (Revised)

- To develop leadership, honour, character, pride of profession, loyalty and devotion to duty in the service of the country.

2.5 DURATION OF COURSE

The two- year course at the PMA is conducted on the pattern of semester systems. The course of studies is divided into four terms which allow eight weeks of summer vacations during Dec./ Jan. every year.

2.6 ELIGIBILITY FOR ADMISSION

Candidates of not more then 20 years of age and holding a higher school certificate or equivalent are admitted on a regional/provincial quota-cum merit basis in the month of January every year and pass out on the successful completion of the course the following year in the month of December.

Foreign students holding equivalent qualifications are also eligible for admission with the approval of the Government of Pakistan.

2.7 TRAINING FACILITIES

Modern and scientific techniques are being adopted to train the young seafarers to compete with the fast growing world of automation and computerisation. Audio visual aids, video films, a library stocked with nearly 10,000 text/ reference books, well equipped laboratories and workshop, models of machinery and other gadgetry fitted onboard vessels are available for imparting effective training. A language laboratory with the latest facilities help the trainees to improve their command of the English language which is so important to assimilate and comprehend the academic and professional subjects. A most modern computer laboratory has recently been set up both with a view to familiarising the cadets with computer technology and the learning of nautical and engineering subjects.

2.8 COURSES

The academy as a premier maritime training and educational institution in the country, offers a comprehensive range of courses for personnel from the maritime industry. The main areas of training and education presently undertaken by the academy includes:

- Pre-sea training
- Post-sea training
- Modular courses

2.8.1 Pre-Sea Training

50 students/ cadets are inducted every year both in engineering and nautical streams to under go a 2 years academic course leading to the BSc. Degree in maritime studies. This course is designed to develop the knowledge and skills at levels to meet the international standards.

2.8.2 Post Sea Training

In 1986 JICA (Japan International Co-operation Agency) provided advance maritime training equipment to the academy which has enabled it to conduct Post-Sea training courses. The following equipment has been received.

- Radar/ARPA Simulator
- Ship manoeuvring simulator
- Celestial Navigation equipment
- Models of ships

- Loading calculator
- Gyro and Magnetic compass
- Cargo handling Derricks
- Engine plant Simulator
- Cut away models of machinery
- Testing and Measuring instruments
- Fluid Testing Analyser
- Pneumatic Circuit Trainer

Post sea courses are designed for seafarers with seagoing experience. They aim to provide training and education for the acquisition of sound knowledge, skills and attitude for the various grades of competency.

2.8.3 Modular Courses

These intensive courses are of a specialised nature the duration varying from 4 days to 3 weeks. The successful completion of the stipulated modular courses is a pre-requisite for the issuance of Certificate of competency by the Maritime Administration. The courses presently offered are given below.

A. NAUTICAL COURSES

1. Navigation control courses (NCC)	02 weeks
2. Electronic Navigation system course(ENS)	06 weeks
3. Automatic Radar plotting aids(ARPA)	01 week

4. Oil Tanker Familiarisation	04 days
5. Advance tanker safety course	12 days
6. Revalidation of master certificate course	06 weeks
7. Preparatory course for class III & IV	24 weeks
8. Preparatory course for class II & I	24 weeks

B. ENGINEERING COURSES

1. Engine plant simulator (Basic)	01 week
2. Engine plant simulator (Advance)	01 week
3. Engine driver courses	04 weeks
4. Boiler Safety course	02 weeks
5. Ref. & Air cond. Course	04 weeks
6. Preparatory course for class III & IV	24 weeks
7. Preparatory courses for class II & I	24 weeks

C. MODULAR COURSES

1. Basic Fire fighting Course	05 days
2. Approved Fire fighting Course	09 days
3. Personal Survival Techniques Course	04 days
4. First Aid course	05 days
5. Ships Captain's Medical Guide	02 weeks

6. Proficiency in survival craft course 03 weeks

7. Efficient Deck hand course 04 weeks

2.9 RELATED MARITIME ORGANISATIONS

There are several organisations and centres which are related to maritime training in Pakistan. Their relationships are shown in Fig. 2.2

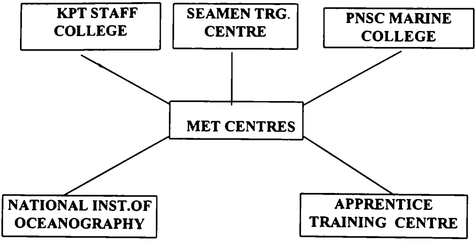


Fig. 2.2 Related Maritime Centres

Source: PMA (1996)

2.9.1 Seaman Training Centre

The Seamen training centre is housed within the boundary wall of the PMA but is a separate administrative unit. It is basically a training institute for ratings. It also conducts mandatory courses for officers to meet the STCW Convention 1978 (revised), and is a subordinate organisation of the Ministry of Communications Ports and Shipping Wing.

2.9.2 PNSC Marine College

PNSC marine college is a unit of the shipping corporation and conducts preparatory courses for the certificate of competency examination. It also conducts mandatory courses on certain life saving appliances.

2.9.3 Karachi Port Trust (KPT) Staff College

KPT staff college arranges the courses of a diversified nature according to the needs of their employees. Apart from a very small number of administrative staff who are permanently employed, the entire faculty is composed of visiting professors from local and foreign institutes.

2.9.4 Apprentices Training Centres

There are three major maritime workshops which are recognised by the maritime administration of Pakistan. They are:

1. Karachi Port Trust Workshops

2. Karachi shipyard & engineering workshops

3. Pakistan National Shipping Corporation workshops

These workshops are only authorised to impart practical training to the successful engineering cadets of the PMA

2.10 ORGANISATION

The organisational chart of PMA is shown in Fig. 2.3 The chief executive of PMA i.e. Commandant of the academy, is an active Commodore on secondment from the Pakistan Navy. The chain of command is a horizontal strata so that it takes the form of a pyramid.

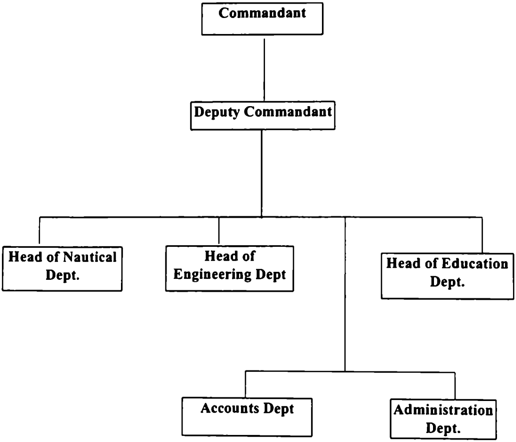


Fig. 2.3 Organisational Chart of PMA

Source: PMA (1996)

An important over all linking function in this management structure is performed by the Deputy Commandant. There is an outline job description as a written term of reference for duties and responsibilities of work. Administrative and functional powers are delegated to the commandant of PMA by the Secretary, Ministry of Communications via Director General Ports & Shipping.

The annual budget of the academy is Rs.6 Millions. The total permanent staff of the academy is over 100 including 22 instructor officers.

2.11 EVALUATION OF ORGANISATION

The concept evaluation is usually used to imply a value judgement. Taking into account the description made of the organisational framework, the following considerations can be highlighted .

A) The development of the Pakistan Maritime Education system in the last decade has been considerable due largely to the support and policy offered and adopted by the Federal Govt. Notwithstanding the progress made to date must be continued, developed and upgraded further, to achieve the global objects of the IMO & STCW Convention-78 (revised).

B) It is essential to provide quality education which in turn demands highly qualified and specialised instructors.

C) Different factors such as reviewing of curriculum, Implementation of new courses, and new requirements set by IMO have to be taken into account when striving for versatile and competent personnel in the maritime industry.

D) It is also essential that new training and education programs are fully integrated with the national education system so that they can achieve wider acceptance in the maritime industries and at the same time are supported by all the people in the organisation.

3. Factors Influencing Changes for the Education of Merchant Mariners

3.1 INTRODUCTION

Most developing countries inherited their maritime systems from one or other of the major advanced nations, generally because of colonial/historical reasons. Although these bilateral arrangements have undoubtedly accelerated the establishment of maritime infrastructures in the developing countries, their appropriateness to local conditions is open to question.

One of the common criticisms levelled at maritime education and training establishments in developing countries like Pakistan is that their curricula have not kept abreast of the significant technological changes experienced by the shipping industry in recent years. There is no doubt that an element of conservatism exists in the educational establishments, but there are also other factors such as education / training dichotomy, and the long **lead time** involved, all of which emphasise the importance of identifying the basic objectives before making substantial alterations to existing systems of training. These technical changes are explained by History of Ship modernisation (1994) in Japan , Hermochue (1995), Ishida (1996) etc.

In this chapter **FIVE** major impacts on the shipping industry and MET are discussed.

3.2 CHALLENGE OF MODERNISATION

The modernisation of ships rapidly initiated in the 1960s with the first planned reduction of crew members, and the automation and modernisation of merchant ships were promoted while placing emphasis on machinery installation to compensate for the reduction in ship engineer officers. An air conditioned engine control room was provided in the engine room, where monitoring and alarm systems and equipment were installed enabling automatic and remote control of the main engine and various other machinery installations and equipment from the control position on the bridge. In this way working environments for engineer officers was greatly improved.

For the automation of machinery installations, an automatic combustion control system, automatic feed water control system for boilers, governor engines etc. representing a partial automatic control system had already been employed. However, the conditions set down later in the programme for modernising merchant ships were to build ships capable of being operated by fewer crew members while securing the equivalent or higher levels of safety as those on ships of conventional design. The introduction of new technology entailed reduction in the crew complement, where degree of ship and machinery automation was determined in an overall assessment of shipowner economy against the demerits arising from the higher initial costs, including such intangible factors as the reliability of plants and ease of maintenance. In this way, the automation of ships in 1960 was promoted at a sound pace with the move towards a higher level of automation. Ishida(1996) points to the stages of automation control in fig. 3.1

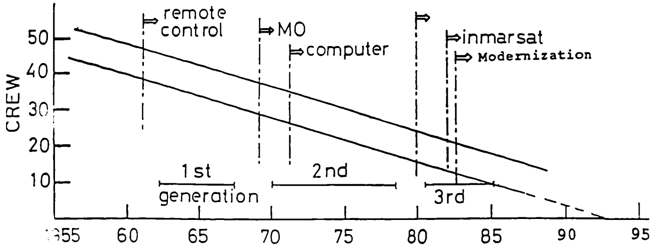


Fig. 3.1 Schematic Diagram of Ship Modernisation

Source: Lecture Notes (Ishida, 1996)

3.2.1 Birth of MO / UMS Ships

The modernisation of ships was aggressively promoted in the major maritime nations and in 1965, a ship requiring no engine room watch officers at night was introduced. These ships were notated as MO by class NK and as UMS by Lloyd's Register. The yearly transition of newly constructed MO / UMS ships to the total number of ships newly constructed is shown in Figs. 3.2 & 3.3 respectively. These proportions are not represented in the proportions of the world but we can guess the tendency of automation on board; the proportion of the automation ship being around 30%.

Japan's first MO ship, " Japan Mangolia, " had a control room for the central monitoring of the engine located on the upper platform of the engine room in 1968. The main engine was capable of being operated from a control room by means of a mechanical link system and from the bridge by means of an electro- hydraulic remote control device.

It is a significant feature of this ship that the bridge was equipped with a monitoring board identical to that in the control room, which permitted redundant monitoring of the engine. Furthermore a monitoring camera was located in the engine room so that a crew member could monitor the engine easily on a TV screen on the bridge.

The monitoring system on this ship used a data logger (input 96 points) and at any time, the channel number and measured value of any point could be displayed on the digital indicator by pushing a button on the bridge or control room. As fire precautions, the ship had a pneumatic fire detecting system in the engine room. This detector was activated when an allowable rates of temperature was exceeded.

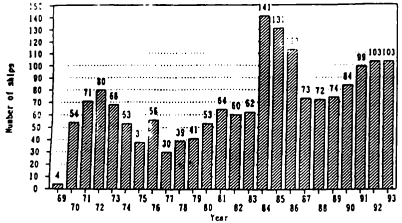


Fig. 3.2 Yearly transition of newly constructed automation ships
Source: (Kiuoshita, 1994)

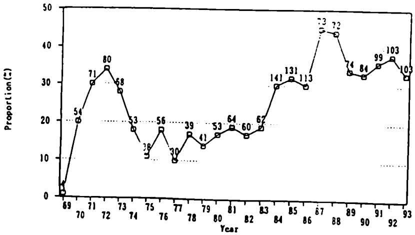


Fig. 3.3 Yearly prop. of auto. ships to the no. of ships new construction
Source: (Kiuoshita, 1994)

3.2.2 Computerisation

After the birth of MO / UMS ships, computers and sensors greatly progressed, and the range of ships was widened from the machinery section to the deck section and to the navigation section. The engine control room, as the heart of automation, then finally shifted to the bridge at the top together with the navigation facilities.

The promotion of ship automation was closely related to the advances in computer technology and its growing applications, and automation progressed side by side with computer development. Initially, a large scale computer was utilised to control as much equipment as possible for a single large scale computer. A typical example of this was the VLCC Seiko Maru built in 1970 and the VLCC Mitsumineasass Maru built in 1971. These ships were centralised computer control ships with a single large scale computer for fully automating not only the machinery section but also cargo handling (start / stop) control of pump, opening and closing of valves, monitoring oil and water levels and the navigation section.

3.2.3 1973 oil crisis

The 1973 oil crisis had a profound impact on all the world's industries, and shipping was no exception. Ship machinery and equipment had consumed large quantities of oil, which had been available at a low cost previously. It therefore became necessary to reduce oil consumption by as much as possible after the oil crisis. Energy conservation was pursued for all equipment and many control devices for energy saving were installed on ships. Moreover, increase in the size and speed of the ships, and the diversification of ships, was promoted. In order to keep down the cost of fuel oil it was necessary to build bigger tankers. The race for the very large crude oil carriers(VLCC) and the ultra large crude oil carriers (ULCC) was on.

One of the characteristics of oil tankers is that they make one way of the voyage loaded and the other in ballast. So to overcome this uneconomical way of transportation the multipurpose vessel, i.e. the oil/bulk/ore (OBO) was developed. Such ships carry oil in one way and various bulk cargoes in the other.

General cargo ships have seen a change in size but for more of the slow cargo handling on and off. The ship spends half or more of its time in port and only half at sea. In addition, the rise in labour costs and the unit value of goods resulted in the introduction of the concept of Unitization, which gave considerable pace to the shipping world, especially for the world's cargo handling.

The result of this was and is containerisation; with the result that the container ship and the RO-RO ship were developed. Since the advent of these types of ships, the turn around times have been reduced by new cargo handling techniques. This means that the crew spend most of their time on board ship.

3.2.4 Propulsion machinery

In spite of the fact that steam engines generate little vibration, the steam turbine ships are being phased out because of high fuel consumption compared to diesel engines. However, the steam turbine ships are suited for Liquefied Natural Gas (LNG) tankers where the boil-off gas can be burnt as fuel for the boilers.

A large family of licenses worldwide constructed oil engines to their own ideas; MAN and KRUPP in Germany, SULZER in Switzerland, BUREMEISTER & WAIN in Denmark, Mitsubishi in Japan, CARLES in Belgium, NOBLE in Sweden, WORKPOOR in Holland and MIRLESS WATSON in UK.

The power output of the diesel engine was pushed up by the turbocharger and by increasing cylinder / bore size. Therefore the majority of engine builders adopted the single acting two stroke with a loop scavenge air system.

On ships such as RO-RO vessels and small container ships, there is a tendency to standardise the medium speed engine at approximately 400 - 500 r.p.m. Such engines are fitted with a gear box which lowers the revolutions per minute in order to improve the efficiency of the propeller.

Currently, design refinement and prototype testing is immensely expensive but has resulted in specific fuel consumption by 25% during the last two decades, from around 155 g / hp in the 1970s to about 115 g / hp in the 1990s.

Reduction of fuel oil consumption has had two benefits for the engine builders. The first is that it has driven out the steam turbine and the second is that all the small license families who were not able to afford such programmes have fallen out of the market. So far the manufacturers are MAN-B&W, SULZER, MITSUBISHI, PIELSTICK, MAK & WARTSILA, etc.

3.2.5 Ports development & facilities

Ports used to be simple landing places on river banks, where shallow draught vessels could come alongside. The movement of cargo on and off the vessels was only manual. As the demand for goods increased, more and larger ships with the need to more space to receive them were required. So the simple landing place developed into a port.

In the 20th century, road transport has filled the space between the lines of the railway to give surfaces for the larger lorries which reach the quayside and have the ability to deliver the goods right to the customer door.

The building of larger and specialised ships such as Ro-Ro and container ships imposed some problems:

- The necessity to dredge the port, to build new berths or even new ports.
- The handling facilities for this new specialised ship- container gantries, grabs for bulk ore, suction pumps for grains.
- The requirements for more space and parking areas.
- The need to create maritime services- pilots, tugs, maintenance of facilities.

These are mainly the general developmental aspects of ports but from the above said it can be concluded that ports are rather followers than leaders of maritime development.

3.3 EFFECT OF CONCEPTUAL CHANGES IN EDUCATION & TRAINING

Maritime Education & Training in the past has chiefly been concerned with safety at sea. Today developed nations like the USA, France and Japan have linked maritime education and training to their mechanical / naval Architecture system. Maritime qualifications have been nationally recognised in these countries and courses leading to the award of degree in Maritime Studies, Nautical Sciences, Marine Engineering and Naval Architecture etc. are being offered to mariners with diversified options of career.

These developments are the results of the conceptual changes in education which were greatly influenced by the social economical and technological changes that took place in the last two decades discussed in previous sections.

Juan Kelly in his article "Time For Change" published in "Sea Trade Review" February 1993 reported that :

> ***"Changing ship board role are also leading to re- examination of the skills required by seafarers and the means by which they are defined and assessed. Training experts are placing increasing emphasis on the concept of operational competence or the ability of seafarers to perform their jobs at sea"***

Efforts are in hand in Pakistan to up grade the MET system to a B.E.(Mar. Eng.) degree level so as to bring the recognition at the National Educational level and also in line with the national maritime interest.

3.4 Scope of Post Graduate education

The primary objectives of any industry is to run a profitable business, at the same time safely transfer cargo, protect the crew and the environment. Thus the common goal is "Safety" . The variable is the "method" used to attain that objective, which is the Education and Training of maritime personnel. Such education and training should reflect the technical innovations taking place in today's ships.

It is a well established fact that technical education cannot be looked upon as a one-time effort and only practical experience will never create expert knowledge, skills and management qualities in the various spheres of maritime technology.

Post graduate studies & research are some of the most important aspects of any organised, structured, training facility. Today maritime technology is progressing rapidly all over the world. Thus, it is of paramount importance that marine engineers have adequate scope of post graduation and research so that the fruits of achievements acquired in some other parts of the world may be utilised for our national needs. A sincere and hectic effort is needed for this to happen in Pakistan.

4 . COMPARATIVE STUDY OF MET SYSTEMS IN DEVELOPED COUNTRIES

4.1 INTRODUCTION

This chapter deals with the maritime education patterns currently adopted in some developed countries. The objective is to highlight how these countries have moulded their maritime education programmes to suit their specific requirements in the context of the changing circumstances created by technological innovation, social outlook, economic needs and, most importantly, safety requirements; and how best Pakistan can derive the benefits of these system by tailoring its own needs and matching them with international standards.

4.2 BASIC PROGRAMMES OF TRAINING

All well established maritime administrations recognise and approve one or both types of training programmes for marine engineers (both officers & crew) which might be described as HAWSE PIPE education program and FRONT END education programme.

In the former type a candidate with suitable experience ashore is engaged as a member (engineer officer or rating) and learns the specifics of his job by doing it under guidance and supervision. Such learning by direct experience is often supported by classroom instruction which includes some education in theoretical subjects.

In the latter type of training , a trainee follows a planned scheme of training, covering all aspects of his expected duties carried out under controlled conditions, mostly ashore in MET institutions.

In considering the suitability of any form of training, the first consideration is the question of what the trainee is being trained to do. This leads to the concept of job description. When such a job description has been prepared, the suitability of an existing training scheme can be assessed. Most developed countries have kept maritime training in the general stream of education and laid considerable emphasis on FRONT END education programmes to cope with the technological advances of recent decades. The following section examines the MET systems of some selected developed countries.

4.3 MET SYSTEM OF JAPAN

Both the **HAWSE PIPE** and the **FRONT END** training programs are in use in Japan. Ishida (1996). The scale of maritime education in Japan is commensurate with the size of the shipping industry. There are two Mercantile Marine Universities at Kobe and Tokyo, five mercantile Marine Technical Colleges, all under the Ministry of Education; and one Marine Technical College. The Institute of Sea Training and ten Schools of Sea Training under the Ministry of Transport. In addition, the fishing industry and the Japanese Maritime Safety Agency have their own training and educational establishments.

The institute for sea training provides all deep sea training on board its four large ocean going training ships (two diesel & two turbine) and two ocean going sailing ships. Periods of prescribed sailing on these ships are shown in Fig. 4.1. In addition each maritime education establishment has its own small training vessel.

The marine technical college under the Ministry of Transport has several specialised functions as mentioned below:

a) To provide training facilities to enable seamen to obtain certificate of competency as marine officers.

b) To provide refresher and validation courses for existing officers to enable them to upgrade their training skills.

c) To provide correspondence courses for seagoing mariners.

d) To provide training for existing officers and ratings to enable them to obtain the dual purpose qualifications necessary to work as watch keepers and dual purpose crew on highly modernised ships in Japan.

4.3.1 Integration of Deck and Engine Department

This is being implemented in stages in a very cautious and methodical manner. Training to achieve this started in 1980 at the maritime technical college. After a suitable period of training , the DPC concept was implemented in its entirety in which manning levels were gradually reduced to 15 and the new job classification of **watch officers** came into existence. In April 1983, the DPC system was incorporated into Japanese manning regulations; and thus the Government has indicated the principal requirements for future training.

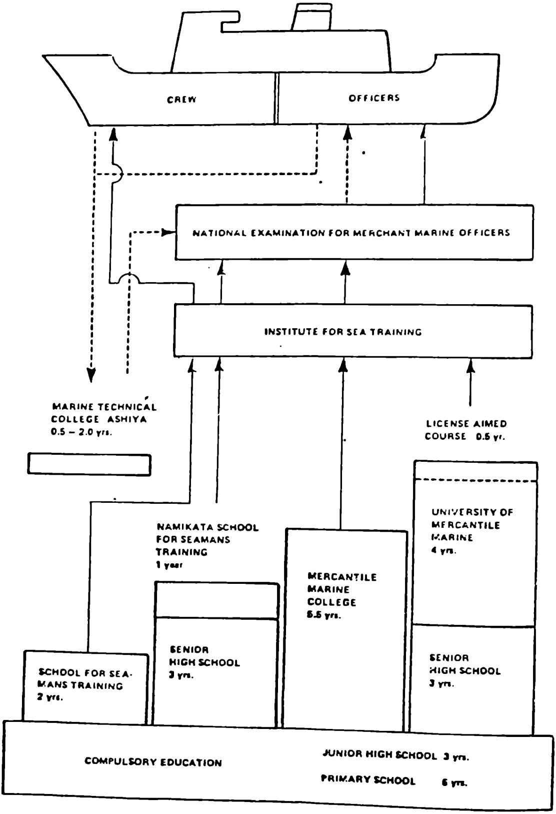


Fig 4.1 Maritime Training in Japan

Source: Ishida(1996)

4.3.2 Marine universities versus marine colleges & schools

The entry qualification for marine universities is nine years of schooling (primary & secondary) plus three years of high school totalling 12 years. The marine technical college takes students after secondary education, i.e. after nine years of schooling. The seaman training school admits students from seafarers with junior high school level. The number of years of study at the universities is 3·5 years plus 1 year on board training vessels totalling 4·5 years. For the technical college the total period is 5·5 years including 1 year on board training vessel. The seamen training school undertakes basic training courses of about 6 weeks duration.

The emphasis at the universities is on research and ample scope is provided for research work on engineering and nautical sciences including marine application of nuclear energy, economics, history and law. Only university degree is taken e.g. B.Sc. and no seagoing certificate is issued, but the graduates are eligible to appear in the National Examination for the highest seagoing certificates.

Technical marine colleges have placed little emphasis on scientific research work, the stress being on ship operating skills. After graduation the students are eligible to sit for national examinations for the highest seagoing certificates.

Thus immediately after graduation, students from mercantile marine universities or technical colleges attain the theoretical knowledge stipulated for the post of chief engineer/ master marines. The certificate is kept pending until practical experience is acquired by the incumbent. The period of experience is about 7-10 years for chief engineers and masters, 5 years for second engineers and chief mates. The graduates are appointed as third engineer or second mate on board, immediately after passing the theoretical examinations.

4.3.3 Entry qualifications

Entry to any type of institution is by means of a written examination. For the universities, entry is by means of the common university entrance examination. Students from technical colleges can change over to a university after a period of 3 years i.e. after an equivalent level of high school education. Entrance to seamen schools is also by means of a written examination.

4.3.4 Modernisation of the seafarer system in Japan

The programme of modernisation of the seafarers system was launched in 1977 with an objective to research a new seafarer system which corresponds to the technical innovation of ships e.g. operating ships with a smaller number of Japanese crew.

By promoting the introduction of the **"Watch Officers" (W/O)** system and deck - engine dual purpose system. Japan had to carry out drastic reforms in seafarers education. Consequently, the size of the Japanese crew has been gradually reduced to 18 men in stage A, in 1986 (Fig 4. 2) and to 16 men in stage B in 1988, and further to 14 men in stage C in 1990. From 1989 onward stage D, which aimed at a 13 man crew, was started and at the same time. "The pioneer ship" experiment, which explores the feasibility of an 11 member crew with selected ship types and sailing routes, was put into effect. These experiments were successful in achieving favourable results.

On the basis of these accomplishments, the two experiments, were unified in July 1991 and stage P was started to establish a system with an 11 men crew (Fig 4.2). Since this experiment was completed smoothly as scheduled, modern ships with an 11 man crew were put into service starting in May 1993.

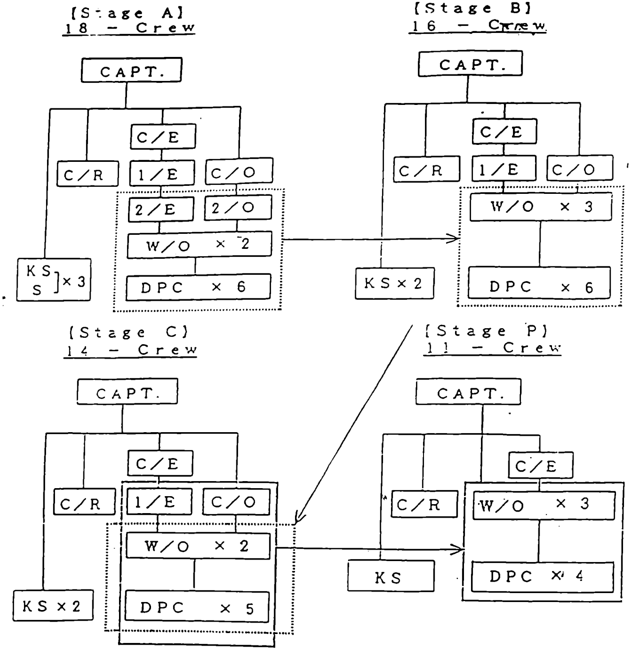


Fig. 4.2 Manning System in Japan

Source: IMO Circular STW/25/INF-7, (30 Nov. 1993)

4.4 MARITIME EDUCATION IN THE USA

4.4.1 Education system in the USA

Another country where both **HAWSE PIPE & FRONT ENDED** education programmes are in use is the USA. The HAWSE PIPE education programme is carried out through the following institutions.

1) Maritime schools managed by unions providing specialised courses and coaching students for the upgrading of licenses.

2) Academic programmes below Bachelor degree level but with a broad based foundation organised by city colleges.

3) Preparatory schools as private undertakings , coaching students exclusively for US coast guard examinations.

The FRONT ENDED programme is undertaken by both the federal government through the Merchant Marine Academy and the State Governments through the State Maritime academies. At present there are six academies in the USA.

Michigan Institution offers a four-year undergraduate programme leading to a nationally recognised Bachelor of Science degree; a coast guard license to sail as officer in the American merchant fleet as third mate or third assistant engineer or both, and commission as ensign in the US Naval Reserve. The four-year programme includes two half year periods at sea aboard training vessels or US flag merchant ships. In the academies, the four basic curricula offered are: Marine Transportation, Marine Engineering Systems and Dual License. State Academy of Michigan, which is especially meant for Great Lakes and river licenses, offers a three-years programme with an Associate of an Arts Degree.

The Federal Maritime Commission bears the entire financial expenditure of the Federal Maritime Academy at Kings Point. All the cadets selected here are paid during a 4- year training period and their expenses are covered.

About 270 graduates each year from Kings Point Academy and about 500 more, excluding Michigan, from state academies depending upon the national requirements. These graduates have wide options either to sail on their licenses or to take up suitable jobs under various organisations. Those graduates who do not sail usually find employment in many respectable positions within and outside the marine industry. They become career Navy or Coast Guard officers, Marine Engineers, NavalArchitecture,ShippingCompanyExecutives,AdmiraltyLawyers,Oceanographers Marine Underwriter, Oil and Mineral Company Executive etc.

The state university of NewYork, like other state universities, provides the following courses for engineers :

- Degree in Mechanical Engineering
- Degree in Marine Engineering
- Degree in Naval Architecture
- Degree in Electrical Engineering
- Degree in Nuclear Sciences & Engineering
- Degree in Ocean Engineering

Out of the four-year course duration, the first two years course curriculum is common to all engineering concentrations and from the third year onward, cadets take specialised courses relevant to the degree provided. The cadets with nautical options, while preparing for third mate licenses, can concurrently study for a degree in any of the following subjects.

- Bachelor of Engineering (Electrical)
- Bachelor of Science (Computer)
- Bachelor of Science (Marine Transport)

All the courses are of four years duration. The bachelor of engineering for navigation officers is especially designed taking into account the sophisticated electronic equipment being used on modern ships.

In the USA there is another programme of training for deck and engineer officers known as the Dual purpose License Programme. The Programme gives a common core of studies and training to both deck and engineering up to third mate/third assist. Eng. level. The block diagram of education and training scheme is shown in fig. 4.3

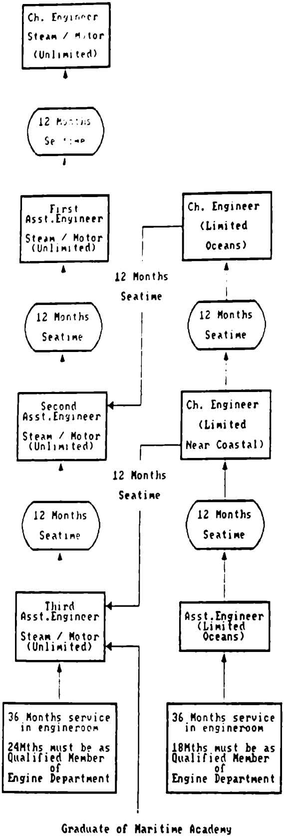


Fig. 4.3 Eng. License Structure, USA

Source: Federal Register Vol.52, No. 2004

4.5 MET SYSTEM OF THE UNITED KINGDOM

The training of the engineer officers in the UK can be divided into three categories. These are:

- Traditional Training
- Cadet Training
- Further Training

4.5.1 Traditional Training

For many years there has been a legal requirement for chief and second engineer on ocean going ships registered in the UK to be duly certificated and the UK administration has since 1863 held examinations leading to the award of such certificates.

The traditional scheme which was basically a "**HAWSE PIPE**" education programme for a period of four years in shipyard or marine workshops. After this, on completion of 18 months of sea service as uncertificated officers on their employer's ships, they were qualified to appear in the second class engineers certificate of competency examinations. They usually attended a private or public maritime college for about six months to prepare themselves for the examination.

A further qualifying sea service of 18 months, while holding a second class certificate, entitled them to appear in the first class examination, though they usually attended a private or public maritime college for a further six months before taking the examinations. The traditional training scheme continued uninterrupted until the early 1950's but was superseded by the cadet training scheme, which is in effect the "**FRONTENDED**" education programme, due to the following reasons:

- A trainee coming out through the traditional programme was not given broader studies of the fundamental aspects of science or engineering.
- Increased diversity and sophistication of ships and machinery called for more comprehensive, systematically planned and carefully controlled training programmes based upon a broader theoretical base which would not only take care of safety but also of management aspects in day-to-day ship operations.
- Necessity to organise an education programme for engineer officers so that they get a nationally recognised qualification which will give them a social standing and ample opportunity to get a shore job any time during their careers.

4.5.2 Cadet Training Scheme

The cadet training scheme is provided at three levels depending upon the qualifications of the entry, these are:

a) OND scheme (Ordinary National Diploma)

b) HND scheme (Higher National Diploma)

c) Degree Scheme

All the three schemes involves almost same degree of practical training but they differ from each other very much in theoretical contents and standards. The schemes are flexible enough so that candidates with a diploma after studying for a certain period can take a bachelor degree. All the courses are for a period of four years. In general the ordinary national diploma covers the theoretical requirement of the UK Safety Administration competency examination. The theoretical contents of the degree scheme is the same in standards and breadth as that of an engineering degree in the UK. These courses also differ in other respects but, in general, the cadets, on leaving school and gaining employment with shipping companies as trainees, spend two years at sea on board the ships of their employers and finally one year at a maritime college.

4.5.3 Entry requirements

These vary as explained below according to the scheme chosen by the candidates.

OND scheme:

Candidates who have passed at least four subjects at 'O' level which include mathematics and a scientific subject or a general certificate including mathematics, erecting machinery and technical drawing.

HND Scheme:

Candidates who have passed five subjects of which mathematics and physics must have been studied at 'A' level.

Degree Scheme:

Candidates must have 'A' level with mathematics and physics. Candidates with HND can follow a further one year curriculum to get a Bachelor degree.

Each of the courses include regular monitoring of cadet progress, continual assessment of achievement and formal examinations which have been approved by the UK Safety Administration, but the examinations are conducted by the colleges.

4.5.4 Exemptions

Although these cadets are required to appear for their certificate of competency examinations, they are exempted from the theoretical subjects of the second class and first class engineer examinations depending upon the scheme followed.

4.5.5 Further Training

The following courses are mandatory and are required of an engineer officer.

- Approved Fire Fighting Course
- First Aid at Sea
- Personal Survival at Sea
- Special Courses for Oil Tankers
- Special Courses for Chemical Tankers and Liquefied Gas Carriers

The last two courses are meant for officers serving on oil tankers, and chemical or liquefied gas carriers.

4.6 MET SYSTEM IN FRANCE

The Inspector General for Maritime Education & Training in Paris is in charge of the administration, development and supervision of MET in France. Its members control the implementation of MET in the national maritime academies and ensure that equal standards are kept. They decide on the annual intake of students and the entrance conditions. They are in charge of the written and oral examinations for academic diplomas and certificates of competency.

4.6.1 Maritime Academies

There are four national maritime academies in France. They are located at LeHavre, Nantes, Marseilles and Saint Malo. The Le Havre school is the academy with the largest number of students and Saint Malo is the smallest. The academies in LeHavre and Marseilles operate a radar navigation simulator and Nantes operates an engine room simulator.

4.6.2 The Dual purpose Course

The education and training of **Bivalent (Dual Purpose)** officers was introduced in France in 1967. The officers trained through this system can either sail as master or as chief engineer. The study programme is well organised and is directed towards the operation of modern shipping technology.

4.6.3 Entry requirements

The entry requirements for the candidates are:

- Must be holder of Baccalaureate C or D in science (12 years of general education)
- Must pass the entrance examination.

4.6.4 Level of certificates

There are three levels of certificates for maritime officers:

- The first level certificate (unlimited)
- The second level of certificate (for ships less than 7500 grt. or 7500 KW)
- The third level certificates (for coastal ships)

The first and second level officers are now trained in the dual purpose system and the third level in single purpose.

4.6.5 Dual purpose first level certificate

It takes 12 years from entering the programme at the age of 18 - 20 years to obtain the highest certificate at an age of 30 or more . A total of 4 years must be served on board. Four months of this sea service is for cadet sea time at an academy, and the remaining 4 years and 8 months must be effective sea time. Since seamen in France acquire 18 days leave for one month of ship board service, this effective sea time will be completed in only about 8 years. The studies and shipboard service flow diagram is shown in fig. 4.4

4.6.6 Second level Certificate

The dual purpose programme for this level started in France in 1986. This certificate allows the holder to command ships of less than 7500 grt. and to be an in charge of the engine watch on ships of less than 7500 KW.

This programme differs in two main aspects from the first level programme. Firstly the students can enter the programme after 10 years of general education i.e. 2 years less than required for first level. Secondly the students are only required to study at a national maritime academy for 3 years i.e. 1 year less. The entire programme can be completed in 11 years.

4.6.7 Third level certificate

The training for the certification of master and engine operators on coastal ships at the third level is mono-valent. No particular level of general education is required but the candidates must have sufficient French and Mathematics. This programme is for the experienced seafarers, nautical or engine, who wish to operate coastal vessels, but who have not obtained the general education required for first and second level certificates.

4.7 Teaching syllabi and examinations

Students for the first level certificate of competency have to attend an average of 31 lectures a week, each lecture lasting 60 minutes. The duration of the course is 4 years. There are 30 study weeks. The examinations consist of a practical, a written test and an oral part. The practical examinations are held by the academies. The written and oral examinations are conducted by the Inspectorate General in Paris. The written examinations are held nation-wide on the same day at the same time for the same subjects. The oral examinations are held continuously in each academy.

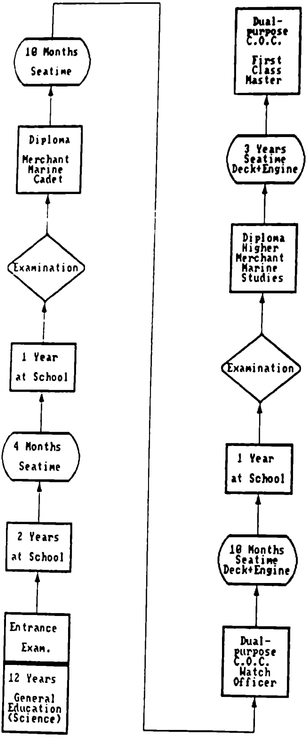


Fig. 4.4 MET in France (Dual purpose Officers)

Source: Lecture Notes G. (Zade 1996)

4.8 MET System of Pakistan

4.8.1 Introduction

The present MET System of Pakistan is more than 30 years old. However, in the year 1986, the PMA was accredited with Karachi University for the award of BSc degree in Maritime Studies.

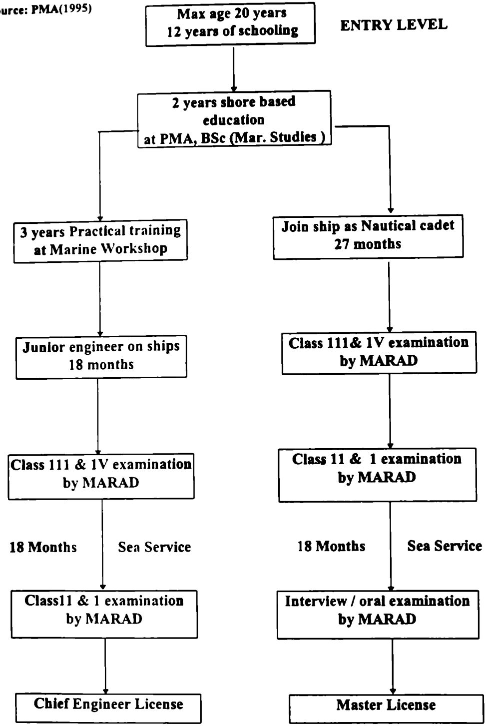
The entry level of the Academy is the same as that of any engineering university in Pakistan i.e. 10 years of schooling plus 2 years of college education, with Physics, Chemistry and Mathematics as elective subjects.

The total education and training is spread over 5 years. Two years are spent at the Academy's residential campus to complete the B.Sc. Degree programme according to the prescribed syllabi as approved by both the Maritime Administration and the Karachi University Affiliation Committee. The remaining three years are for the practical training .The engineering cadets join the approved Maritime Work shops ; while the nautical cadets join ships as cadet officers. There is no administrative control of PMA over the cadets during the period of practical training in the work shops.

On completion of 5 years of education and training the engineering cadets join the ship as junior engineers (trainee) and are in line for the regular ladder of certificate of competency examinations as per rules established by the National Maritime Administration. The career flow chart is shown in Fig. 4.5

Fig. 4. 5 MET-Pakistan System

Source: PMA(1995)



5. QUALITY ASSURANCE IN MET- PAKISTAN

5.1 INTRODUCTION

The contents described here are into quality standard requirements of Maritime and Training for the seafarer as chief engineer or watch keeper in ships trading world-wide. Revision of the STCW convention 1978 has seen definite changes to the greater account of new manning, training and certification arrangements. The same has to be built into the Pakistan MET system being one of the signatories of the Convention. The purpose of this study is to consider the overall structure and identify critical quality assurance factors needed to be taken into account to meet the requirements of the revised Convention.

In past centuries Master Craftsmen passed on their skills to thier apprentices as they worked together for many years. The apprentices learned with practice and eventually became skilled. A master craftsman was able to judge the competence of his apprentice. In today's complex world, there are many factors involved in the competence of seafarers. The main factors are listed below:

- The ability and level of general education of the entrants.
- The content and delivery of general education & training programmes are conducted by appropriately qualified persons/ staff.
- The quality of practical training normally conducted at workshops, laboratories, simulators and at sea.

5.2 QSS MODEL- PMA

The PMA has an enormous task to comply with the STCW convention 95. Here is a proposed Quality Standard System (QSS) Model as shown in Fig. 5.1, with suggestive actions for the revision and inclusion in some areas concerning administration, structure, control functions and documentation processes.

5.2.1 Mission Statement

The PMA has to review/rewrite Mission Statement broadly covering strategic objectives, specifying the role of the academy in the development of the maritime infrastructure of the industry with a clear policy on quality standards, and on meeting the IMO-STCW Convention-95 standards in all maritime training and education programmes. It should also include the establishment of a culture and value system that encourages excellence in teaching and a feel of proud of the product (Mar. Engineers)

5.2.2 Organisational Structure

Presently neither the existing structure fully warrants the internal quality nor any external audit system. Therefore it is a need of the hour to restructure the whole organisation. This is shown in Fig. 5.1

5.2.2.1 Advisory Board

Maritime Authorities must establish an Advisory Board encompassing a broader representation from the various stake holders with policy setting functions keeping in mind the dynamic environment of the maritime industry & the role to be played by the PMA.

The Board shall have 8 members nominated 2 each from Technical Education Body, MARAD, Shipping Companies and PMA. The Board might meet once a year or, twice a year, but the members should be prepared to liaison with each other on a need basis. The Advisory Board will be responsible for:

- Forming strategic objectives, reviewing of mission, approving of budget
- Strategic decision making, and PMA's achieving objectives.
- Provides Guidance and advise to the commandant in the efficient / effective running of the education and training programmes at PMA

5.2.2.2 Chief Executive

The Commandant of the PMA is a serving Commodore of the Pakistan Navy. Normally he is on secondment for a period of 3 years.
He shall be made responsible to the Director General Ports&Shipping for the effective governance of the PMA; including overall direction, control and co-ordination of its management and development. He is guided by the Advisory Board for achieving strategic objectives and assisted by the Deputy Commandant for the day to day running of the Academy's affairs.

5.2.2.3 Academic Council

The proposed Academic Council will have a general oversight of matters of academic policy and practice at the Academy.

It will comprise the Deputy Commandant Head of Departments, Course Leaders, Academic Registrar and External Examiner. The chairperson may be elected by the Council members.

The Council will be the chief source of academic advice to the Commandant and will have a general responsibility for maintaining and setting academic standards, checking and balancing of Quality Assurance, Standards of examination, procedures and methods of documentation in compliance with the STCW Convention-95.

The Academic Council shall be assisted by a Course Committee, Examination Board, Quality Standard Committee and the Academic Registrar. It will monitor the mechanism of study and conduct a regular schedule of committee and board meetings. It will also receive feedback from students, external examiner, shipping companies and other employers.

5.2.2.4 Course Leaders

The course leader shall be selected by the HODs. Such appointments shall be subjected to the approval of the commandant. Course Leaders shall be responsible to the Academic Council in regards to:

- The smooth administration and management of their courses.
- Ensuring that advice on examination dates and other significant Calendar of events are fixed and provided to the academic registrar.
- Ensuring that the assessment schedules and course teaching programmes are provided to the students before the commencement of the course.
- Shall keeping the Commandant informed of course progress and problems which may arise.

5.2.2.5 Course Committee

The Course Committee will be responsible for standards relating to contents, assessment, examination and progression on courses within each faculty, subject to review by the Academic Council. The Course Committee will suggest changes/ recommendations to the Academic Council on matters affecting its course.
Membership includes all academic staff teaching on the courses and will meet twice a year.

5.2.2.6 Examination Board

The Examination Board shall have a closer sight of matters relating to:

- Examination standards
- Approval of papers
- Documentation of results
- Rules of examination
- Appointment of External Examiners

The board comprises the Commandant, Deputy Commandant and a Senior Instructor. The board will work in accordance with the functions & powers set out in the statutes and rules.

5.2.2.7 Quality Standard Committee

The QSC will comprise the Deputy Commandant, HODs, MARAD and a nominee of a Shipping Company. It shall examine/ review the:

- Entry Standards and admission policy
- Student performance
- Course contents and delivery methodology
- Assessment and examination procedures
- Close liaison with the industry
- Shipboard training programmes

The assessment can be done twice a year and adjustments can be made to improve the QS wherever applicable.

5.2.2.8 Academic Registrar

The Academic Registrar shall be nominated by the Commandant and will perform the following function under the guidance of the Deputy Commandant.

- Admission
- Record keeping
- Calendar of events
- Prospectus

5.2.2.9 External Quality Audit

All the training and education activities at PMA shall be continuously monitored at an interval of 5 years by the External Quality Audit so as to achieve the quality standards in accordance with the STCW Convention- 95.

The organisation responsible for the external quality audit shall be a recognised Academic Accreditation Body, or Government Agency. An expert committee whose members are representatives of different maritime institutions and other organisations may be established as an alternative way.
The external audit team must consist of appropriately qualified persons who are not involved in the training & examination activities at the institution being audited.

The Commandant in consultation with Director General Ports & Shipping will request / appoint the external audit committee for the purpose of auditing, stating clearly the terms of reference. The PMA shall provide the following information to the external audit team:

- The mechanism and structure used by PMA to monitor, assure, promote and enhance their academic quality and standards in the light of their stated objectives.
- Procedures & documents which reflects good practice in maintaining and enhancing quality and which have followed effectively.
- Back ground information on the aims and objectives
- The management structure through which matters of quality assurance are addressed
- Prospectus
- Examples of QA mechanism in operation
- Academic plans, calendar of events
- Policies & procedures adopted

5.2.2.10 Support Services

The Accounts Section, Administration Department & Regimental Training has been merged into a Support Services Group. Their functions will remain the same for some time.

5.2.2.11 Internal review mechanism

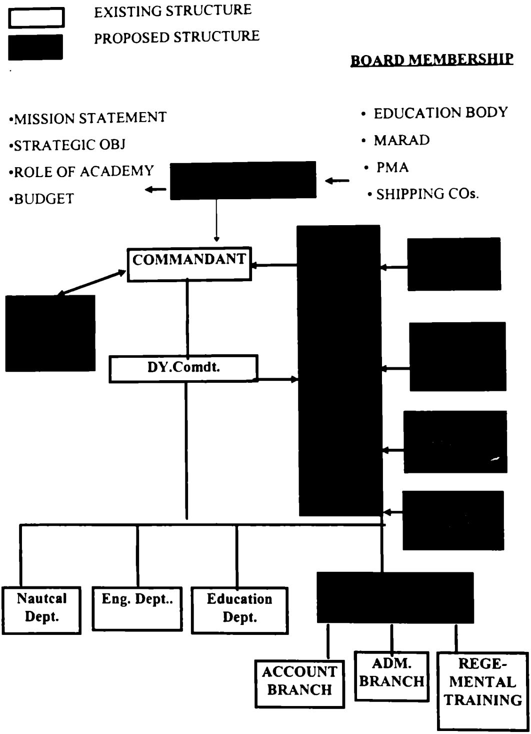
The Academic Council using the resources of various committees, is to review the:

- Course contents
- Assessment and examination procedures
- Documentation
- Schemes, methods and effectiveness of course Delivery
- Student performance
- Admission Policy

and make adjustment to improve quality standards where ever applicable.

Fig 5.1 Proposed QSS Model - PMA

Source: Class notes, Muirhead (1996)



6. Curriculum development

6.1 INTRODUCTION

PMA was established primarily to provide education and training of seafarers for the shipping industry in accordance with the STCW- Convention 1978. This role is being amply fulfilled through the provision of certificates, Bachelor Degree in Maritime Studies BSc. (Mar. Studies) as well as certificate of competency preparation courses. The existing training & education scenario has already been explained in Chapter 2.

6.2 NEED FOR UP GRADATION

With the gradual depletion of the National Fleet due to ageing, there is an increasing demand for technical personnel to take up shore based position in engineering disciplines or look towards the foreign job market.

Increased national and international competition in the job market warrants upgrading of the educational programme at the Academy. This is the basic reason for undertaking this project of the MET System to a Bachelor of Marine Engineering degree level.

Graduates from this programme will especially be well prepared for services as merchant mariners in the wide spectrum of PMA missions and objectives. This programme will also provide a solid educational basis for professional engineering practice, both on board ships and in maritime industries and also permits the graduates a latitude for post graduate study in Naval Architecture, Mechanical Engineering and other related fields of studies. The programme emphasises the development of the students ability to understand the engineering principles and apply innovatively their understanding to the solution of real world engineering problems.

6.3 ACCREDITATION PROCESS

The major will be accredited by the NED University of Engineering & Technology. Accreditation of the Institution will ensure that it meets or exceeds the criteria for assessment of institutional quality applied through a peer group review process. An accredited institution is one which has made available the necessary resources to achieve its stated objectives through appropriate educational programmes, is substantially doing so and gives a reasonable evidence that it will continue to do so in the foreseeable future. Institutional integrity is also addressed through accreditation and brings national and international recognition to the programme.

6.4 ADMISSION REQUIREMENTS

The four-year degree course is open to prospective seafarers (marine engineers). The entry requirements will be based on an open merit system as prevailing in the charter of the PMA. All students being admitted must hold the Higher Secondary School Certificate or 'A' level in Pre-engineering and must be certified by a doctor to be in good health. At the successful completion of the programme at PMA, the graduates will be conferred with a Bachelor Degree in Marine Engineering.

The curriculum will be constantly reviewed to ascertain that it meets the needs of the maritime industry. Therefore the pattern and content of the courses developed in this Chapter may be revised further at any time.

The total duration of the programme will be four years divided into eight semesters of nearly same duration.

6.5 PROGRAMME OBJECTIVES

1. To provide by precept and examples an environment which encourage a high sense of honour, loyalty and devotion towards professionalism.

2 .To provide a sound undergraduate education in Maritime Engineering such that the graduates of the programme will be able to keep pace with the Technological changes of the future.

6.6 PROGRAMME GOALS

Students who successfully complete the programme should :

- Be able to practice in a broad spectrum of Marine Engineering application through out their career.
- Be prepared adequately to follow the steps for licensing as Chief / Professional Engineers.
- Have a sound preparation for entry into graduate programme in Marine Engineering and other related fields.
- Have a sensitivity to social and environmental problems and interplay between society, the environment and the projects they might encounter as engineers.

- Be sufficiently versatile to continually adapt to changing technology.
- Be able to assume their immediate duties as Junior Officers/ Engineer Officers in training as leaders within the field of engineering.

6.7 PRESENT FRAMEWORK FOR BSc. (MAR. STUDIES) DEGREE COURSE

The present degree course of BSc.(Mar. Studies) stretches over a period of 2 years, divided into four terms allowing two months of vacation during the summer and 15 days in the winter.

For affiliation with Karachi University, the PMA has to upgrade the curriculum in all fields including workshops and laboratories. Consequently, in 1986 the PMA was affiliated to the University of Karachi to award of BSc. Degree in Maritime studies to its graduates. The curriculum is divided into three blocks as shown in the table below:

Table 6.1 Present framework of BSc. Degree Course

Source: PMA Prospectus (1995)

Academic/ Humanities	General Engineering	Marine Eng. / License
English	Applied Mechanic	Heat Engines
Pakistan Studies	Machine Drawing	General Eng. Knowledge
Islamic Studies	Electrical Technology	I.C Engines
Humanities & Social Sc.	Instrumentation& Cont. sys.	Naval Architecture
Mathematics	Work shop Theory	Ships Construction
Physics	Work Shop Practice	

6.8 PROPOSED FRAME WORK FOR BE (MAR. ENG.) DEGREE COURSE

Structure of the course is broadly divided into four blocks viz.a.viz Humanities, Basic Sciences, General Engineering and License blocks. This is done in order to meet the National Education system requirements, Accreditation Criteria of the NED University and to meet the Maritime Administration requirements for certification and examinations of seafarers. Four structural blocks are shown in Tables 6.2 (a)-(d)

Table 6.2 (a), Humanities Block

Course category	Subjects	year 1		year 2		year 3		year 4	
		S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8
Humanit -ies Block	Regimental Trig	•	•	•	•	•	•	•	•
	Islamic Studies	•	•	•	•				
	Pakistan Studies	•	•	•	•				
	English	•	•	•	•				

Table 6.2(b) Basic Sciences Block

Course category	Subjects	year 1		year 2		year 3		year 4	
		S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8
Basic Science Block	Physics	•	•						
	Chemistry	•	•						
	Principal of Mgt	•	•						
	Org. Behaviour			•	•				
	Human Res. Mgt.					•	•		
	Mar. Eng. Mgt.					•	•	•	•
	Mathematics	•	•	•	•	•	•	•	•
	Intr.to Computor	•	•	•	•				

Table 6.2(c) General Eng. Block

Course category	Subjects	year 1		year 2		year 3		year 4	
		S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8
General Eng. Block	Eng. Mechanics	•	•						
	Eng. Graphics	•	•						
	Principal of N.A			•	•				
	WorkshopTh.&Pra.	•	•	•	•				
	Electrical Tech.			•	•				
	Electronics					•	•		
	Strengthof Material			•	•	•	•		
	Fluid Mechanics			•	•	•	•		
	Theoryof Machines			•	•	•	•		
	Thermodynamics			•	•	•	•		
	Metallurgy					•	•		
	Machine Drawing			•	•				
	Marine Economics			•	•				
	Automation			•	•				
	Electrical Machines					•	•		
	Machine Design					•	•		
	Heat Transfer					•	•		
	Industrial Eng							•	•
	Lubrication							•	•
	Design & Make Project							•	•

Table 6.2 (d) License Block

Course category	Subjects	year 1		year 2		year 3		year 4	
		S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8
License Block	MarineEng. System					•	•	•	•
	Marine Affairs							•	•
	Law of the Sea					•	•		
	Mar.Env. Issues					•	•		
	Instrumentation					•	•	•	•
	Ship Structure							•	•
	Marine Automation					•	•	•	•
	Basic Fire Fighting							•	
	Adv. Fire Fight.								•
	General.Eng.Know					•	•	•	•

Tables 6.2 (a) -(d): Minimum Subjects Requirement of B.E.(Mar.Eng) Degree

Source : PMA (1994)

6.9 TEACHING TIME ANALYSIS

The duration of the odd semesters (i.e.1st, 3rd, 5th, and 7th) is 21 weeks (19 weeks of teaching & 2 weeks of examinations). The duration of the even semesters is 22 weeks (20 weeks of teaching & 2 weeks of examinations).

The Academy runs 6 days a week. Six classes of 55 minutes each are conducted per day.

Table 6.3 Four Years Programme of Training

Source: PMA (1994)

SEMESTERS I-III-V-VIII | **SEMESTERS II-IV-VIII**

19 weeks class room inst/ Pract.	**2 weeks examin'n**	**6 weeks summer vacations**	**20 weeks class room inst/ Pract**	**2 weeks exam'n**	**1 week Passing Out Parad.**	**2 weeks winter vacat'n**

52weeks

a. Class room Instructions/ Practical	**156 weeks**
b. Examinations	**16 weeks**
c. Passing out Parade	**4 weeks**
d. Summer Vacations	**24 weeks**
e. Winter vacations	**8 weeks**
	208 weeks

6.10 BLOCKWISE TIME DISTRIBUTION

Comparative time distribution (%) has been calculated for the B.E.(Mar. Eng.) degree course as proposed and compared with the prevailing B.Sc. (Mar. Studies) course. There has been a marked increase in the time allocations but the same has been offset by the increase in the number of subjects in all the block except the humanities block which is the requirement of the National Educational Authorities.

Table 6.4 Comparative Time distribution

Source: PMA (1994)

BLOCK	B.Sc. (Mar. Studies)	B.E. (Mar. Eng.)
HUMANITIES	18 %	8 %
BASIC SCIENCES	36 %	40 %
GENERAL ENG.	32 %	34 %
LICENSE/ MAR. ENG.	14 %	18 %
TOTAL	100 %	100 %

6.11 PROJECT SCHEDULING

It is intended to complete the project with in 90 days, assuming that the same will be implemented at a later date. CPM Technique has been used for the purpose of scheduling. The activity list, arrow diagram and bar charts developed are shown in Table 6.5, Fig.6.1,and Fig. 6.2 respectively.

From the table 6.5, it can be seen that the activities are numbered and described, with each having its duration in days and also the preceding and succeeding activities outlined.

According to Fig. 6.1, activity 1 is commencement of project and its duration is 1 day. It is not preceded by any activity but succeeded by activities 2 and simultaneously. Activity 2 has a duration of 10 days and activity 3 has a duration of 15 days. The earliest and latest time for activity 2 from the start of the project will be 1+10 which gives us 11 days with a float of 0.

Where as the earliest and the latest time for the activity 3 is 26 and 31 days with a float of 6 days. Activity 3 is succeeded by activity 7, 8 & 9 having the duration of 5,10 and 2 days.

This is the way project has been scheduled. Activity 13 has a duration of 3 days with a duration of 3 days with earliest and latest occurrence of 89 days with a 0 float. The Critical Path is represented by double arrows.
This concludes that the project should be executed in a maximum of 89 days.

Table 6.5 Activity List

Source: Lecture Notes, Professor Butman (1996)

Activity (I.D)	Activity Description	Activity Duration	Preceding Activity	Succeding Activity
1	Commence Project	1	-	2 , 3
2	AssessFuture needs in Marine Eng	10	1	3
3	Appraise Existing Programme	15	2	7, 8 & 9
4	IdentifyCore Courses of Curricula	2	1	5
5	Analyse Block	1	4	6, 12
6	Redistribute Hours	20	5 , 3	7, 8
7	Enhance General Eng. Block	5	3 , 6	12
8	Enhance Marine Eng. Block	10	3 , 6	12
9	Justify accreditation programme	2	3	11
10	Faculty Up gradation	30	12	11
11	Create a regional Centre	10	9 , 10	13
12	Quality assessment	10	7 , 8	9 , 10
13	Final assessment and completion of project	3	11	–

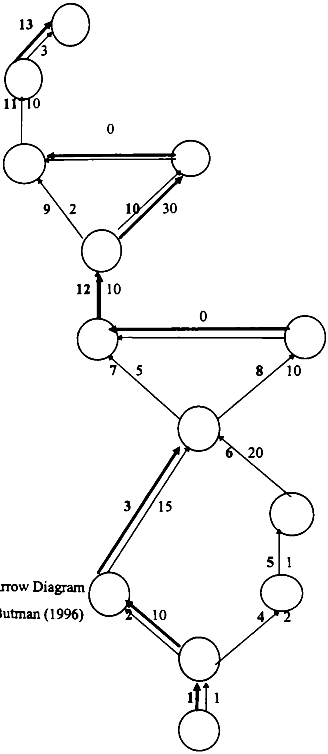


fig. 6.1 Arrow Diagram

Source: Butman (1996)

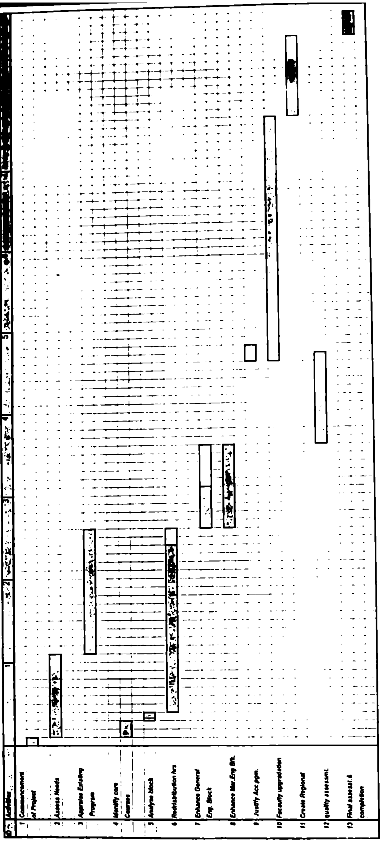


Fig 6.2 Bar Chart

Source: Butman (1996)

7. CONCLUSION AND RECOMMENDATIONS

7.1 CONCLUSION

The Impact of new technology and equipment, modern effective communications, economic and social pressures will result in further change in MET systems in Pakistan.

Pakistan shipping is mainly International. Because of this we will not be able to effectively save our maritime sector from the impressive international trend of technological advances in automation, communication and shipboard operations. Obviously the MET system in Pakistan should accommodate these challenges by providing the manpower of the international standards compatible with the job profiles of European, American and Japanese ships. These standards will also attract the foreign ship owners, thereby increasing the foreign exchange earnings of the nation.

It is concluded that a Board of Maritime Education and Training be established as soon as possible and the proposed degree programme be considered to replace the existing one.

It is further concluded that a team of highly qualified, experienced, dedicated and highly motivated faculty is of paramount importance for the success of the programme. All efforts should be initiated to assemble such a team at PMA.

7.2 RECOMMENDATIONS

The Board of Maritime Education and Training be formulated, so as to implement the B.E. degree programme not only to meet the maritime requirements but also to cater for the whole industry.

Continuous R&D should be undertaken to further the scope of demand based on technical education in Pakistan.

A system of continuous industrial input to the academic system of PMA should be established through participation of maritime industry personnel in the academic activities of the PMA.

All MET Pre-Sea and Post-Sea training activities should be centralised in one place to avoid duplication of resources inputs/ investments.

All Certificates of Competency examinations should be organised and held at PMA in collaboration with MARAD.

PMA should seek accreditation to its academic programmes i.e. B.E. (Mar. Eng.). This can be undertaken immediately by a team representing some of the qualified faculty members and the MARAD. The author is of the opinion that the PMA besides NED University of Karachi should also be accredited by an international accreditation organisation like the Hong Kong Council for academic accreditation. This will fulfil the aspiration of all IMO member countries, prevent criticism of training standards and have the likelihood of a more widespread student population from the developing countries.

The present number of residential staff is small and is not appropriately qualified to undertake the General Engineering subjects of a degree programme. Ideally the academic staff numbers should be expanded. The prospect of doing so is closely related to the student numbers (fee Income) and to other institutional sustainability issues. Sustainability is, however, partly dependent on new and expanded activities at PMA initiated by present and future staff.

In order to increase the versatility of PMA, a careful analysis of the academic staffing profile should be undertaken. It should be based, among other considerations, on academic and professional backgrounds and areas, research experience and age. Age considerations are both to secure institutional continuity and to increase the likelihood of a blending of scientific approaches, teaching methodologies and academic professional back grounds.

The present academic programme should be adjusted in the light of the STCW Convention 95.

The PMA should provide short refresher courses in collaboration with the IMO/WMU in the pertinent areas and to extend its regional seminar activities.

Short regional seminars should be used as another medium for exchange of information and of networking between graduates of the region.

The use of visiting professors should be considered, in particular the planning of their inputs in co-ordination with the residential staff.

The MARAD should encourage the PMA to use modern technology & teaching methodologies. Although Radar and ARPA Simulators are mandatory in Pakistan, there is a need to use various other simulators for improving in skill-based training.

BIBLIOGRAPHY

Abrahamson, B J (1993). ***"Assessing Educational Quality."*** IMLA News letter May 1993, pages 43-45.

Catalogue of Courses(1995), Australian Maritime College Hand Book

Bashir, A. Unnar (1995). ***The Upgrade of MET for Pakistan Marine Academy*** MSc. Dissertation. The World Maritime University, Malmö, Sweden.

Birch, J.F.(1984). ***Conference on Education and Training for Seafarers***: What policy for the 1990's. London: Marine Management Holdings.

Bachelor of Engineering Programmes, Prospectus of the NED university of Technology, Karachi, Pakistan (1995)

Catalogue of Courses (1996), US Coast Guard Academy, New London

Course Curricula Summary (1992). US Merchant Marine Academy, Kings Point, N.Y.

Curriculum for Bachelor Degree Course, (1996). Mehran University of Engineering Technology Jamshoro, Pakistan.

Gamal Mukhtar (1991). ***Proposed Strategic Planning for the development of WMU Educational Programmes.***

IMO, STCW-Convention 1995. IMO, London

Ishida, K (1996). ***Lecture Notes for Met System (Japan).*** World Maritime University, Malmö, Sweden.

Juan Kelly, (1992). ***"Time for Change"*** Sea Trade, February 1992, pages 97&99

Kinosita, T (1994). ***"History of Ship Automation in Japan".*** Lecture Notes, World Maritime University, Malmö, Sweden.

Kennerly, A (1990). ***"Impact of advancing technology".*** Seaways, November 1990, page 20.

L.A. Holder (1994), ***"Better Standards, Training, and Certifications, IMO's response to human error".*** International conference on World Maritime Day held in Karachi, Pakistan.

Muirhead, P (1996). ***Lecture Notes, MET System (Australia)***

Pakistan Marine Academy Prospectus, (1994). Pakistan Marine Academy, Karachi, Pakistan.

Per L. Johanson, (1993). ***ISO-9000, Meeting the new International Standards*** Macgraw Hill- Inc.

Print, M (1988). ***Curriculum Development and Design.*** Allen and Unwin

Quality in Course Manual (1995). South Hampton Institute Hampshire, UK

Rafique Akhter, (1994). ***Pakistan Year Book***: 21st. Edition, Karachi-Lahore
Marine engineering Review (1994). June, 1994, page 31

Redouane H. (1995) ***Dual Purpose Training Past, Present and Future: Integration between Human Resources and Marine Technology.*** M.Sc. Dissertation. The World Maritime University, Malmö, Sweden.

Rowentee, D (1982). ***Education Technology in Curriculum Development.*** London: Pergmon Press

M. J. Sayeed,(1994). ***"Maritime Training Pattern, The future"*** International Conference on World Maritime Day held in Karachi, Pakistan.

Swanson, M. A. (1996). ***Hand out for MET System (USA):*** The World Maritime University. Malmö, Sweden

Under Graduates Prospectus (1996). University of Engineering & Technology Lahore, Pakistan

Waters, D A M (1993). ***"Maritime education And Training - Where is it heading"?*** Lecture Notes. World Maritime University, Malmö, Sweden.

Zade, G (1986). ***"Shipbourd manning and appropriate maritime education and training*** **in 1990's".** Lecture Notes. World Maritime University, Malmö, Sweden.

Zade, G (1993). ***"Standards required by parties involved in MET"*** To the proceeding of the Seventh IMLA Conference on MET.

Zade, G (1989), ***An opportunity for the French merchant navy officers at Ecole de la Marine Marchande, Le Havre, France.***