An investigation of the practical maritime training for marine engineering cadets in the Malaysian MET [maritime education and training] system

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AN INVESTIGATION OF THE PRACTICAL MARITIME TRAINING FOR THE MARINE ENGINEERING CADETS IN THE MALAYSIA MET SYSTEM

By

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Malaysia

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DECLARATION

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

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

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ABSTRACT

Title of Dissertation: - **An Investigation Of The Practical Maritime Training For The Marine Engineering Cadets In The Malaysia MET System.**

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The dissertation is a study of the Maritime Education and Training system practised in my country Malaysia with particular attention to the practical training of the marine engineering cadets.

Existing policy and programs in the present Maritime Institutions, together with the existing problems and shortcomings are being investigated and discussed. A survey of some comparable international marine engineering institutions of more developed countries such as The United Sates, Japan, Australia and India is being studied and compared. The extent to which maritime education and training being adopted to Malaysia Institutions for the changes is the main focus of this paper.

Additionally the impact of change from the International Convention such as STCW95, SOLAS and the Quality Standard System is discussed and the recommendations made to improve the present situations as far as possible.

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LIST OF ABBREVIATIONS

ALAM	Akademi Laut Malaysia (Maritime Academy of Malaysia).
AMC	Australian Maritime College.
AMSA	Australian Maritime Safety Authourity
BSFC	Brake Specific Fuel Consumption.
CBT	Computer Based Training.
COC	Certificate of Competency.
DMET	Directorate of Marine Engineering Training.
ERS	Engine Room Simulator.
FG	Foreign Going.
IKM	Institute Kemahiran Mara.
IMO	International Maritime Organisation.
IST	Institute for Sea Training.(Japan)
JICA	Japanese International Co-operation Agency.
LAN	Local Area Network.
LNG	Liquified Natural Gas.
MARPOL	International Convention for the Prevention of Polution from Ships.
MEO	Marine Engineer Officer.
MERI	Marine Engineering and Research Institute. (India)
MET	Maritime Education and Training.
MISC	Malaysian International Shipping Corporation.
PNSL	Pernas Shipping Line.
PSM	Pacific Ship Management.

PUO	Politeknik Ungku Omar (Ungku Omar Polytechnic).
S/B	Stroke/Bore Ratio
SOLAS	International Convention on the Safety of Life at Sea.
SPM	Sijil Peperiksaan Malaysia (Malaysian Certificate of Education).
SPMV	Sijil Peperiksaan Malaysia Vocational.
STCW78	International Convention on Standard of Training, Certification and Watchkeeping for Seafarers, 1978.
STCW95	International Convention on Standard of Training, Certification and Watchkeeping for Seafarers, 1978, as amended in 1995.
SUNY	State University of New York.
TET	Total Education and Training.
UNDP	United Nation Development Programme.
USA	United States of America
USCG	United States Coast Guard
USMMA	United States Merchant Marine Academy.
UTM	Universiti Teknologi Malaysia
VIT	Variable Injection Timing.
WMU	World Maritime University.(Sweden)

CHAPTER 1

INTRODUCTION

1.1 Background Of Study

The maritime industry nowadays has grown so fast and it moves towards a new millennium and has recognised the importance of qualified seafarers to achieve higher safety standards on board ships. This technology advance has greatly influenced the ways in which ships being designed, operated, manned and managed. Crew nowadays are to be highly skilled and educated to ensure the safe and efficient operation with maritime safety and polution prevention as the objectives.

The International Maritime Organisation (IMO) has realised this trend and has revised the STCW78 in 1995. More stringent regulations are then introduced in the new STCW95 Amendment to give greater emphasis on the quality of seafarers in ship's operation. New training methods need to be explored, identified and implemented to ensure efficient training of future marine engineers. These methods may include ways to increase the competence of the students, increase the number of students intakes, effectively look into the weakness of students in the performances and including competency based training in all maritime training institutes, and also with the use of engine room simulators (ERS) in training seafarers.

1.2 Purpose Of The Study And Methodology: -

The main aim of this study is to investigate the maritime education and training for marine engineering officers in Malaysia particularly in Politeknik Ungku Omar (PUO) about the current trends and future needs. It is also the intention of this study to initiate the process to increase the quantity and quality of marine engineers employed in Malaysian shipping industries.

The main objectives include the following:-

1. To investigate the maritime education and training for marine engineering officers in Malaysia particularly in Politeknik Ungku Omar (PUO) about the current trends and future needs.

2. To initiate the process to increase the quantity and quality of marine engineers employed in Malaysian shipping industries.

3. To study the impact of change upon the training due to present International Conventions such as STCW95

4. To suggest the better ways of the implementation of Quality Standard System into the practical maritime training in PUO .

5. To investigate, analyse the present Marine Engineering Education and Training In Malaysia for its shortcomings, compared with that of major developed countries like USA, Japan; Australia etc.,

6. To make proposals and recommendations to improve the present situations for more effective training of the marine engineering cadets.

7. Observing the impact of modern technology on today's ship and the need for acquiring new equipment for the maritime education and training in the institution.

8. To recommend that the candidates received and acquired more practical knowledge, training at the institution.

1.3 Importance of Malaysia as a Maritime Nation

The early history of Malaysia has documented the activities of sea-faring Malaysians which they used to roam the South China Sea, the Pacific and the Indian Oceans. The basis of the successive Malay empires had been their maritime powers - the ascendancy and decline of such power coincided with their rise and downfall.

More recently the geopolitics of Malaysia was further transformed. With its formation in 1963, Malaysia has been transformed into a maritime nation. By all definitions Malaysia is now a maritime nation. The sea has become a new real estate with the discovery of oil and natural gas. To be precise Malaysia is heavily dependent on the sea for resources, communication, commerce, and security. A few statistics should reinforce our concern as well as commitments to the sea.

The Exclusive Zone of Malaysia is about 160,000 square miles. The coastlines are about 1,900miles long. Besides oil and natural gas, the offshore areas have tin deposits and fish and other marine resources in great abundance. Fishing and its fast growing-related industries now support more than 122,000 people, constituting 2.3 percent the national labour force.

Since 1971, Malaysia's most priced offshore bounty has been petroleum - responsible for about 23 percent of the export earnings in 1984. In 1985, petroleum revenue accounted for about 6.3 billion ringgit or almost one third of the total federal government revenue. In 1984-1985, Petronas was also the single largest taxpayer for the government.

It has been reliably estimated that out of 414,000 square kilometers of Malaysia's continental shelf possessing hydro potential, only 74,000 square kilometers have been explored for hydro carbon traces. Current reserves of petroleum are about 3.1 billion barrels.

Malaysia also has a substantial reserve of natural gas - estimated at 43 trillion cubic feet of associated gas. Malaysia's reserve of natural gas in energy equivalent terms is about three times its oil reserves.

It is interesting to note that at present most hydro carbon resources are offshore and some of the active fields are as far as 180 miles from the coastline. Is is established fact that most of the Malaysian exports go through Singapore and the two ports in the Strait of Malacca - Penang and Port Klang. A small proportion of exports is processed through Pasir Gudang (Johore) and Kuantan (Pahang) on the east coast. The Strait of Malacca is of strategic significance to Malaysia not only because it forms a vital sea lane of communication but because it also contain resources of immense economic value to Malaysia. Beside fish, the Strait of Malacca is believed to be rich in tin deposits and there are also traces of petroleum.

CHAPTER 2

SHIPPING INDUSTRY AND MARITIME INSTITUTIONS (IN MALAYSIA)

2.1 Shipping Industry

MISC, the National Shipping Line of Malaysia, was incorporated as a public company on 6 November 1968 with the responsibility of providing efficient shipping services to the country's export and import trade. This was to complement Malaysia's role as a leading producer and exporter of raw materials. Malaysia's steady growth as well as development as an industrialised nation through the years has led MISC to diversify its services to include all modes of sea transportation.

Today, with a modern and diversified fleet of 80 vessels as of 10 November 1998, each named after a Malaysian flower with the exception of the LNG vessels, MISC continues to serve the nation as its flagship seagoing carrier, with a combined tonnage of more than 2.97 million deadweight tonnes. These vessels are deployed in the Liner, Tanker, Bulk, LNG and Petroleum trades.

MISC, through its wholly owned subsidiary, MISC Enterprises Holdings Sdn. Bhd. (MEH), has also diversified into a wide range of shipping and non-shipping related activities such as shipbuilding and repair, container haulage, warehousing, trucking, container and prime mover container depot and shipstores as well as travel and port management.

MISC's Corporate has the following objectives: -

1. To operate shipping services that will generate a fair return on the capital employed

2. To achieve and maintain a balanced composition of vessels and their operation in order to meet the country's needs as well as the needs of other shippers for ocean transportation and to ensure a stable level of profit against fluctuations in freight market;

3. To meet the objectives of the Malaysian Government with respect to;
   3.1 Growth in the size of Malaysian flag vessels;
   3.2 Level of participation in Malaysian national, regional and coastal shipping services by Malaysian flag vessels;
   3.3 Shipping commitments in bilateral and other trade agreements
   3.4 Minimising vulnerability of the national economy from being over-dependent on non-Malaysian shipping lines;

4. To train and develop Malaysians in technical, professional and commercial aspects of shipping for efficient management of the Corporation;

5. To achieve and maintain high technical and professional standards in respect of ship design and operation, safety practices and environmental protection

6. To conduct all activities with a high standard of business ethics and in full conformity with all legal requirements.

Those people, who are interested in becoming a marine engineer cadet, can join MISC's sponsorship programme. The minimum qualification is a Grade Two in SPM (equivalent Cambridge SC Certificate) or in an equivalent examination with Credits in Mathematics and Science.

To qualify as a marine engineer officer, one will have to undertake a four-year Diploma in Marine Engineering, comprising 2 years (academic semester) at the Ungku Omar Polytechnic in Ipoh or Akademi Laut Malaysia (ALAM) in Melaka, Malaysia; 6 months in the shipyard; and one year (practical training) at sea.

Upon completion of his second year of training at the Ungku Omar Polytechnic, or ALAM, he will join a merchant ship for a year at sea. During this time, he will be given on-the-job training on ship operation where he learn to operate ship machinery in the engine room.

After a year at sea, he will return to the Ungku Omar Polytechnic for the final year. Upon completion of his training, he will be awarded a Diploma in Marine Engineering. This will prepare him for his Fourth Class Motor or Steam Marine Engineering oral examination with the Marine Department, where, upon passing, he will be awarded the Fourth Class Motor or Steam marine Engineer Certification of Competency.

For a Fourth Class Certificate he must undergo modular courses in first aid, fire fighting, marine engineer watch-keeping and proficiency in survival craft. He is now a qualified Marine Engineer Officer and will start his career on board a merchant ship.

During your 18-month sea service, he will be promoted to either Fourth or Third Marine Engineer Officer based on his performance on the job. Having completed your 18-month sea service, he will attend a four month preparatory course at ALAM and sit for the Second Class Motor or Steam Marine Engineer Certificate of Competency. Then he will go back again to sea for another 18 months on board more merchant ships. This will prepare him for his First Class Motor or Steam Marine Engineer Certificate of Competency. He will have to attend a four-month preparatory course at ALAM and pass the examination. With this Certificate, hi ambition to be a Chief Engineer will be achieved.

PNSL Ship Management Sdn Bhd (PNSL SM) is another fast growing shipping company in Malaysia and it is an associate company of Anglo-Eastern Ship Management Ltd., Hong Kong. PNSL SM provides Technical and Operational management for the Group's varied shipping interests, managing a mixed 34-vessel fleet comprising LNC, LPC, PCC, Oil Tanker and Drybulk Tonnage. In line with its continuing expansion, PNSL SM wishes to recruit Engineer Superintendents and Technical Assistants. Applications are invited from candidates with the relevant experience.

2.2 MET Institutions in Malaysia

2.2.1 Politeknik Ungku Omar

Ungku Omar Polytechnic is the first polytechnic in the technical and vocational education system in Malaysia. Polytechnic was founded in the year 1969 by the Malaysia Education Ministry with the help of The United Nation Development Programme (UNDP) had allocate RM 24.5 million to support the financial. UNESCO is responsible on polytechnic construction that is 22.6 hectare situated at Jalan Dairy, Ipoh. This polytechnic was named after the late Dato' Professor Ungku Omar Ahmad to appreciate his merit and contribution for the country and nation especially in the medicine world.

The aim of Polytechnic is to train the passed secondary school student to become skilled technician in any technical field, executive officer and half professional for public sector and privates sector. In addition they should be also highly moral and responsible whereas our country's vision requires.

Ungku Omar Polytechnic has 5 academic departments including :

- Civil Engineering Department
- Electrical Engineering Department
- Mechanical Engineering Department
- Marine Engineering Department
- Commerce Department

All of the departments above are offering many courses at Diploma and Certificate level.

2.2.1.1 History of PUO

Education Ministry established Ungku Omar Polytechnic in 1969 with help by UNESCO. Sponsor from United Nation Development Programme (UNDP) with amount RM 24.5 million. UNESCO was responsible to plan and assemble the polytechnic building on a 22.6 ha base at Jalan Dairy, Ipoh, Perak, Malaysia.

From beginning, this polytechnic is place in Dairy Training Centre Building (DTC), Ipoh. Lecture for 300 students for 4 departments including Civil Engineering Department, Electrical Engineering Department, Mechanical Engineering Department and Commerce Department, which is running in 2nd JUNE 1969. Local lecturers are about 28 person and with help by 14 volunteer from Canada, State of America, German and Japan.

In 1972, Marine Engineering Department was established with help from JICA (Japanese International Corporation Agency). Including this department, this polytechnic was became a unique polytechnic. In 1973 only, this polytechnic has the own campus, which is located now. The campus was officially by the late Tun Abdul Razak bin Hussain, our second Prime Minister.

In the early stage , PUO only owned one management building , two building for lecture class , and two block of workshop for the civil and mechanical engineering. For the following year , five blocks of hostels are built to occupy 600 students. During 1975, the Marine Engineering had its own building fully facilitated and by 1980, Civil Engineering also had its own building which is located opposite the Management building. The year after , a new library was built to support the increment of students in polytechnic. In 1982, two block of building was built in Electrical and Commerce Department. With the completion of these two blocks of building , all the Departments in the polytechnic had its own building. Then , by 1987 every department had their own lecture hall . The increase of the students not only required extra classroom but also a larger and comfortable hall . So, in 1993, the new various-user hall was build. The polytechnic was developing not only from the physical size but also the increment of the intake.

2.2.1.2 Administration

PUO is headed by the Principal and with assistance by the deputy principal. PUO is being divided into several Departments as shown in the organisation chart. There are several units such as Maths & Science Units and Library Units to support the PUO management.

A Head Department leads every Department. The Head Department is responsible for their department's management. A specific Unit assists the Head Department.

2.2.1.3 Programmes

The polytechnics offers full-time certificate and diploma courses. The course duration is two years (four semesters) for the certificate programmes and three years (six semesters) for the diploma programmes, except Diploma in Marine Engineering Course which is four years (eight semesters). Certificate holders with excellent results will be offered to further the Integrated Diploma course, the course duration is one year (3rd year of Diploma course).

2.2.1.4 Industrial Training

Industrial Training is a compulsory component in all the polytechnic courses. All students have to undergo practical training in industries in the third semester (six months) for the certificate courses and in the forth semester for the diploma courses. The students of Diploma in Marine Engineering Course have to undergo six months of practical training at dockyards in the third semester and on board ship training in the sixth and seventh semesters (one-year). Currently more than four hundred companies are actively involved in the industrial training programme.

2.2.1.5 Student Evaluation

The evaluation of students consists of continuous assessment and final examination. The continuous assessment covers the students' assignments, projects, practical works and tests. The students must have at least 85% attendance to sit for the final examination.

2.2.1.6 Student Admission

The admission of new students is conducted twice in a year for the January Semester and July Semester. The advertisements for student admission normally appear in local newspapers in around the months of March and September. The application form can be obtained from all the polytechnics under the Ministry of Education Malaysia.

The entry requirements are such that the candidates must be Malaysian Citizens and possess SPM/SPMV Certificate or equivalent with a pass in Malay together with the following qualifications obtained in one examination sitting.

<u>For Certificate Course</u>: -

Pass SPM/SPMV Grade 1, 2 or 3.

PASS in Mathematics/Additional Mathematics; and

CREDIT in one of the following subjects:

Physics, Chemistry, Biology, General Science, Additional General Science, Geography and related technical/vocational or commercial subjects.

OR

Pass SPM/SPMV Grade 1, 2 or 3.

PASS in Mathematics/Additional Mathematics; and

PASS in one of the following subjects:

Physics, Chemistry, Biology, General Science, Additional General Science, Geography and related technical/vocational or commercial subjects.

For Diploma Courses: -

Pass SPM/SPMV Grade 1 or 2

PASS in English

CREDIT in Mathematics/Additional Mathematics; and

Two CREDITS from the following subjects:

Physics, Chemistry, Biology, General Science, Additional General Science, Geography and related technical/vocational or commercial subjects.

2.2.1.7 Scholarships and Fees

The tuition fee per semester is RM 200. Students are also required to pay subscriptions for the Student Representative Council, the Polytechnic Ungku Omar Co-operative, insurance and others. Various government agencies, state governments and private companies offer scholarships and loans. Students can apply for the scholarships and loans through the polytechnic.

2.2.1.8 Accommodation And Other Facilities

The polytechnic is a residential educational institution and will provide accommodation for students. Outstation polytechnic students can apply for a place in the 300 meters away hostel owned by Ungku Omar Polytechnic itself. All outstation freshies are given a place in the hostel for the first semester and they have to get accommodation outside after their semester is over due to great demand of applications. But students can easily find accommodation for themselves in the nearby residential area within easy reach of the campus. Besides that the cost of living and accommodation around this area are suitable for students of all races and stages of life. Housing areas that are popular with students are Taman Cempaka, Pekan Razaki, Ampang Bharu, Gunung Rapat and Rapat Setia etc.

Student can buy reasonably priced meals, snacks or refreshments in two separate canteens, which are housed, in the separate blocks of building. The main canteen also known as the cafeteria provides a wide choice of meals especially Halal food with all the traditional hot and spicy food to satisfy a variety of appetites and dietary requirements. The canteen is open from 7.00 am to 6.00 pm from Mondays to Fridays and serves breakfast, lunch and dinner. This canteen is situated in the between the library and the PUO hall. The second and smaller is located in the Electrical Department offers a variety of refreshments and snacks. It is open from 7.00 am to 5.00 pm on weekdays.

The polytechnic provides a variety of facilities and programmes for sports and recreational activities on campus. Inter-Department and Inter-Courses as well as a Family Day are organised regularly by the Department Sports and Student Board Committee and also by the various student societies. Friendly matches and competitive tournaments with outside educational institutions and sports organisations are also arranged for the polytechnic teams. At present the polytechnic has 3 sports field marked out for soccer, rugby and also hockey and a basketball court. Students also use the field for jogging and other purposes. In addition there are 1 volleyball court, 8 badminton courts and a tennis court. There are 2 badminton courts in the PUO hall and the other six is in the new Jubli Perak Hall newly erected in 1995 the pictures are as below.

2.2.1.9 Computer Laboratories

The Computer Laboratories of the polytechnic provides computer facilities for teaching computing courses. There are presently 4 computer laboratories. This computer laboratories service all the computing related subjects such as computer programming like Turbo Pascal, C^{++} programming and also Auto CAD. It also caters for students the knowledge of the basic of word-processing, spreadsheet and database. Thus, enabling the diploma and certificate students to undergo computer training. The Computer facilities are available for use by the students and staff from 8.00 am to 5.00 pm on weekdays and also 8.00 am to 4.00pm on Saturdays during term time. Lab assistants are available in all laboratories to assist students to use the computer hardware and software. At present there are 30 personal computers (486 DX-33) which supports Novell LAN and Unix system all linked to Dot Matrix printers. The lab provide a number of operating systems, programming languages and a wide range of application software for the students and staff to use. The polytechnic continues to upgrade the facilities from time to time.

2.2.1.10 Library

The primary objective of the institution library is to serve the learning and teaching needs of the institution. Its resources and services are made available to all students and staff as well as the alumni. The library is a double floor building equipped with all the technical and general related books and references. The reading hall is situated in the first floor and has a seating capacity of 210. Besides that its has one conference room, one meeting room and a control room. And the library operates from 9.00 am to 5.30 pm from Monday to Friday and on Saturday is operates from 9.00 am to 1.00 pm. Its opens whole year round except public holidays and polytechnic holidays. The library has at present approximately 80,000 volumes of books pertinent to the courses offered at the institution and subjects of general interest. The Reference Section houses a variety of publications such as encyclopedia, dictionaries, handbooks, atlases, universities' prospectuses, a selective collection of British Standards, ASTM Standards and SIRIM Standards.

2.2.2 Akademi Laut Malaysia (Maritime Academy Malaysia)

2.2.2.1 General

The Maritime Academy of Malaysia or more commonly known by its national language, ALAM, is Malaysia's premier maritime education and training institution. It is located near the countryside, overlooking the busy Straits of Melaka; the Academy has a 24-hectare campus. The Academy lies south of the capital city of Kuala Lumpur and north of Singapore City.

The Academy is unique in that it provides a comprehensive one stop educational and training centre whereby all courses leading to professional maritime qualifications, together with the safety and management programmes are provided under one roof. The objective of the Academy is to provide the highest quality of courses, which not only meet but also exceed the national and international requirements.

The Academy promotes academic qualifications and teams of visiting lecturers and professionals from the industry both locally as well as from abroad complement the work. This enables ALAM to offer an even wider range of specialised courses to satisfy the needs of the dynamic maritime industry.

The Academy has strong links with universities and training institutions in Canada, Australia, Europe, United States, South America and Asia. These global linkages and strategic alliances have propelled the Academy further to be an international player and a major contributor to the maritime education and training world. It is now a branch university of the World Maritime University, Malmo, Sweden.

2.2.2.2 Diploma in Marine Engineering

This is the pre-sea programme and act as a first step towards a career at sea. The objective at this introductory level is to provide students with sufficient theoretical knowledge and the requisite practical skills necessary for safe shipboard operations at the first entry level. Courses conducted are based on the Total Education and Training (TET) concept where emphasis is not only on knowledge and skills but also on attitudinal development and values enhancement through a balanced and integrated curriculum. TET aims to cultivate and promote a strong sense of responsibility, determination, endurance and team spirit to ensure safe and efficient shipping.

The Marine Engineering Course provides the cadet officers with such academic knowledge and requisite practical skills to serve as marine engineer officers on merchant ships. It instils discipline and conditions the cadet officers, mentally and physically, to the rigours of a ship's environment so as to ensure a more convenient adjustment to life at sea. It also provides the cadet officers with a strong academic background to pursue professional careers in maritime related industries.

The entry qualifications for the Diploma Course are: -

- Age between 17 to 21 years old.
- Possess SPM/British O-Level Certificate (Grade 1) with a strong credit in Mathematics,
- Physics and English Language.
- Normal colour vision.
- Physically and medically fit.

Upon completion of the course, the cadet officers will be awarded a Diploma in Marine Engineering. They will also be eligible to sit the examination for the Class 4 Marine Engineering Certificate of Competency.

2.2.2.3 Preparatory Course for 2nd Class Marine Engineer Part B (Motor/Steam)

This course provides the candidates with such knowledge necessary to prepare him for the 2nd Class Part B (Motor/Steam) Certificate of Competency Examination. The candidates must have completed one of the approved course of the training as an engineer cadet (equivalent to holding a Diploma in Marine Engineering); or completed 4 years of engineering craft training which may include full time education between the ages of 16 and 17 years (training before the age of 16 not accepted) and shall include 1 year off-the-job training in the use of tools and techniques of general engineering craft practice at an industrial centre approved by the Department; or satisfactorily completed an approved full time course of study in Mechanical or Marine Engineering for a period of not less than 3 years at a Polytechnic or University together with 18 months of engineering training relevant to the duties of sea-going officer shall be deemed to have completed the initial training.

Candidates shall, in addition to the above requirements, complete a minimum of 18 months qualifying sea service in ships of not less than 750kw propulsion power of which 9 months shall be spent in watchkeeping on the main propelling machinery of a motorship. The remaining period may be spent on the main propelling machinery of a steamship or a motorship, or on suitable auxiliaries or on day work.

Prior to the issuance of the Marine Engineering 2nd Class Part B (Motor/Steam) Certificate of Competency by the Marine Department, candidates will be required to possess the following supplementary certificates:

- Basic Fire Fighting at Sea.
- Basic First Aid at Sea.
- Proficiency in Survival Craft
- Shipboard Management

2.2.2.4 Preparatory Course for 1st Class Part B Marine Engineer (Motor/Steam)

To provide the candidates with such knowledge necessary to prepare him for the 1st Class Part B (Motor or Steam) Certificate of Competency Examination. The qualified candidates must hold a valid 2nd Class Marine Engineering Certificate of Competency and completed the qualifying sea service of 18 months in ship of not less than 3000kw propulsion power whilst holding a 2nd Class Marine Engineering Certificate of Competency.

Prior to the issuance of the Marine Engineering 1st Class Part B (Motor/Steam) Certificate of Competency by the Marine Department, candidates will be required to possess the following supplementary certificates:

- Basic Fire Fighting at Sea.
- Basic First Aid at Sea.
- Proficiency in Survival Craft
- Shipboard Management

2.2.2.5 Intensive Module for 2nd/1st Class Marine Engineer Part B

This 4 weeks intensive programme, exclusively focusing on Naval Architecture and Electrotechnology, aimed to provide better appreciation and performance at the Marine Engineering 1st/2nd Class Part B (Motor) Certificate of Competency examinations. Successful completion of the course together with the Internal Assessment will lead to exemption from these subjects by the Marine Department. The entry qualification refers to the 2nd Class Marine Engineer Part B or 1st Class Marine Engineer Part B.

2.2.2.6 4th Class Marine Engineer

This course prepare the candidates for the Marine Engineer Officers Class 4 Orals examination for certification as an Engineer Officer in charge of a watch, satisfying the requirements of STCW78 regulation III/4.The candidates must possess a Diploma in Marine Engineering from ALAM, Polytechnic Ungku Omar or any other approved institutions, and completed the qualifying sea service of 6 months. Upon completion of the course, candidates are required to attend the MEO Class 4 Orals examination at the Marine Department and upon passing, candidates will be issued the MEO Class 4 Certificate of Competency by the Marine Department.

2.2.2.7 Training Vessel

The Academy's training vessel, M.V. Akademi 1 is a single-decker vessel fully equipped with actual sea-going equipment. Used by all training sections, it exposes the trainees to all the principle shipboard systems, deck and engine room machinery. It provides excellent opportunity to the deck trainees to undergo training in seamanship, cargo operations, ship construction, safety operations and also communication training. The marine engineering trainees benefit from the actual shipboard systems by way of exercises in plant preparation, overhauling, systems familiarisation, trouble shooting and diagnostics. The vessel is also utilised for the modular/safety courses in areas such as survival training, fire prevention and control and any other safety of personnel courses.

2.2.2.8 Resource Centre, Computer and Language Laboratories

A well stocked resource centre, which subscribe to all major international journals and magazines. The resource centre has a total collection of several thousand volumes of books and publications. The centre is also equipped with audio-visual facility, which include videotapes, slide and film projectors related to maritime matter.

The computer laboratory contains desktop computers networked together. Training in various software packages is given to assist students in their daily duties onboard ships. Students are then able to utilise this application in their course work. The laboratory is also used to run special courses on customised software used in the maritime field.

The language laboratory is provided to improve students' command of English and thus enhance their career prospects. The laboratory is equipped with up to date equipment to help the students to have a more personal interaction with the tutor. As a result, a better teaching and learning process will take place thus enable the students to have a better command of English Language as required in the maritime field.

2.2.3 Universiti Technologi Malaysia (UTM)

UTM is situated about 200 miles due south of ALAM. The Marine Engineering Course is set up within the Faculty of Mechanical Engineering to meet the demands of the shore based maritime industry. A degree level program of 5 years and a diploma program of 3 years duration are added. Graduates of these course are usually employed in the oil and offshore segment, shipbuilding and ship repair industries. The students intake is about 15 for the degree and 35 for the diploma program per year. Although very few graduates will finally go to sea, their input to the shore maritime industries cannot be underestimated.

The course in Marine Engineering comprises the following subjects:

- Marine Power Plant
- Hydrodynamics
- Ship Building and Coastal Structures
- Naval Architecture
- Marine Engineering
- Transportation
- Ship Management

2.2.4 Institute Kemahiran Mara (IKM)

IKM offers a proficiency certificate course in Marine Mechanics. After graduation, the trainees mostly are serving on board government crafts and private coastal vessels and marine craft repair facilities. A very small number of trainees may join the merchant shipping companies.

CHAPTER 3
Existing Marine Engineering Training in Malaysia

3.1 Existing Policy and Program (Marine Engineering Department)

Marine Engineering Department becomes one of the Ungku Omar Polytechnic departments in 1972 with assistance from JICA (Japanese International Co-operation Agency) under Colombo Project. With this department, PUO became first of the institution that provide formal Marine Engineering Course. At first, this department is being organised by 5 Japan's expertise and few mechanical department's lecturer. This course is being introduced upon the country's development sake. The achievement of this country's development partly depends on the water transportation. As for this, the marine course is introduced to produce young skilled labour, which will increase the country's economy growth.

The main objective of this course is to produce enough marine and also mechanical based engineers to be equipped with high moral, educated, experienced and capable.

The course will spend four years or eight semesters to graduate. In this four years, students will covers with the knowledge and technology in operation and maintenance of sea- going vessels, marine power plants, associated equipment, as well as ship construction and naval architecture.

The course offered is Diploma in Marine Engineering. The course will spend four years or eight semesters to graduate. In this four years, students will covers with the knowledge and technology in operation and maintenance of sea- going vessels, marine power plants, associated equipment, as well as ship construction and naval architecture.

Industrial training is a compulsory component in Marine engineering course. Difference with another department, the students of Diploma in Marine engineering Course have to undergo six months of practical training at dockyards in the third semester and on board ship training in the sixth and seventh semesters (One year). During the Semester 3, the students are sent to various shipyards or dockyards in Malaysia such as Naval based Dockyard in Lumut, Malaysia Shipyard and Engineering Sdn. Bhd. in Johore, Fisheries Departments in Port Kelang, etc. During the Semester 5, they are sent to their respective sponsored shipping companies for their cadetship training, such as MISC, PNSL, PSM shipping lines etc.

3.1.1 Facilities in the Marine Engineering Department

- General Computer Laboratory
- Boiler Water Treatment Laboratory
- Fuel Testing Laboratory
- Electronic and Control Laboratory
- 2-cycle Diesel Engine workshop
- 4-cycle Diesel Engine Workshop
- Steam Turbine Workshop
- Steam Boiler workshop
- Refrigeration Workshop
- Hydraulic Workshop

- Steering Gear Workshop
- Purifier and Oily Water separator Workshop
- Winches workshop
- Electrical Motor Workshop

3.1.2 Diploma in Marine Engineering

The course covers the operation and maintenance of sea-going vessels, marine power plants, associated equipment, as well as ship construction and naval architecture. This 4-year course incorporates a 12-month on-board ship training. The Malaysian Marine Department exempts students who successfully complete this course from Part A of the 2nd class Certificate of Competency examination conducted.

The Marine Engineering Department of PUO also set up preparatory course for the fourth class Certificate of Competency for its own graduate students to get them prepared for the sitting of the Oral Examination in the Marine Department in Port Klang to be qualified to sail as a marine engineer at the operational level in the merchant fleet.

The career profile is as shown in the figure 3.1 for the graduates of marine engineering diploma course of PUO and figure 3.2 shows the career profile the graduates of marine engineering diploma course of ALAM.

Class 1 Engineer C.O.C.
Examination
3 Months Upgrading Course in ALAM

↑

18 Months as Engineer Officer On Board F.G. Ships

↑

Class 2 Engineer C.O.C.
Examination
3 Months Upgrading Course in ALAM

↑

18 Months as Engineer Officer On Board F.G. Ships

↑

Class 4 Engineer C.O.C.	
Examination	
Diploma	
Sem.8	Study at PUO
Sem.7	Study at PUO
Sem.6	6 Months Sea Training as Cadets
Sem.5	6 Months Sea Training as Cadets
Sem.4	Study at PUO
Sem.3	6 Months Shipyard Training
Sem.2	Study at PUO
Sem.1	Study at PUO

Figure 3.1 Marine Engineering Career Profile in PUO

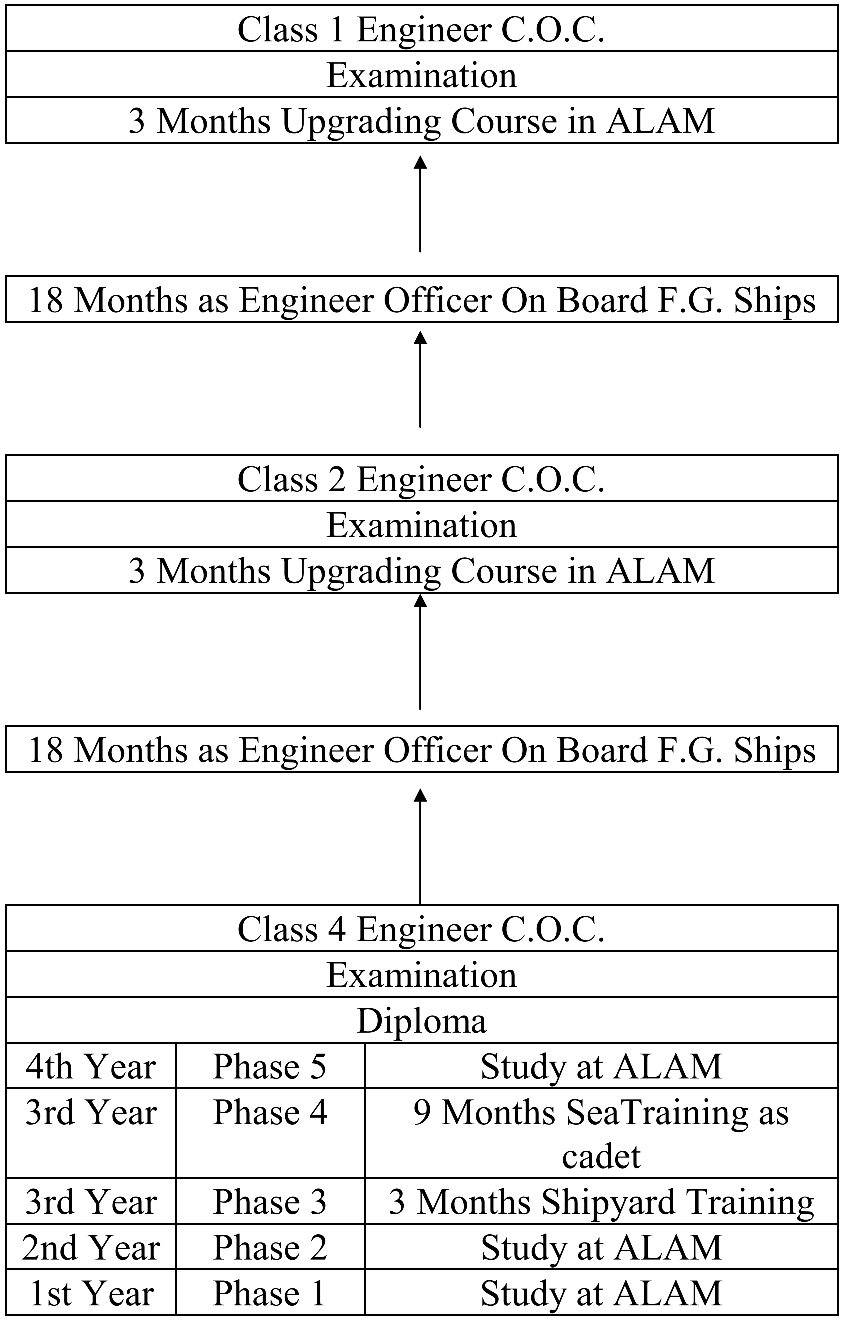


Figure 3.2 Career profile for ALAM graduates (marine engineering)

3.2 Some Identified Problems And Shortcomings

3.2.1 Experience and Qualification of Staffs

Including the departmental head of the Marine Engineering Department, there are a total of 16 academic staffs with their qualifications as shown below: -

- MSc (Mechanical Engineering) --------------- 1 person
- MSc (Marine Engineering) -------------------2 persons
- MSc (Maritime Education & Training) ------1 person
- BSc (Mechanical Engineering) --------------- 2 persons
- BSc (Electrical Engineering) ------------------ 1 person
- BSc (Naval Architecture) --------------------- 1 person
- 2nd Class COC with Marine Eng. Diploma --3 persons
- 4th Class COC with Marine Eng. Diploma -- 2 persons
- Diploma in Marine Engineering --------------- 1 person
- Diploma in Electrical Engineering -------------1 person
- Diploma in Technical Education ---------------1 person

In addition to the above teaching academic staffs, there are also 4 supporting staffs as follows: -

- Technician -------------------------------------- 1 person
- Engine Driver ------------------------------------ 1 person
- General Assistant -------------------------------- 2 persons

The Table 1 shows qualifications and experience for academic staffs in Politeknik Ungku Omar (Marine Engineering).

Table 1: Qualifications and Experience for Academic staff In Politeknik Ungku Omar (Marine Engineering)

Value	COC Levels	SE (Sea time)	AQ Levels	TE
5	1st class COC	5 years	PhD	5 years
4	2nd class COC	4 years	MSc	4 years
3	4th class COC	3 years	BSc	3 years
2	1st class ED	2 years	Diploma	2 years
1	2nd class ED	1 year	Certificate	1 year
0	Nil	0	Nil	0

Source: Marine Engineering Department, PUO.

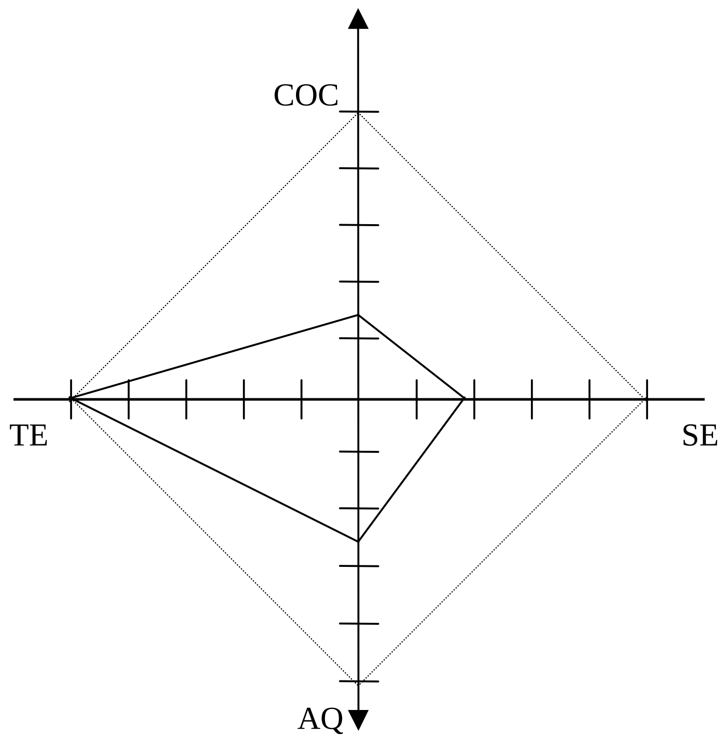
An analysis is done by breaking up the qualities of all teaching staff into 4 categories tabulated in the table above with the meaning of the abbreviations as follows: -

- COC = Certificate of Competency
- AQ = Academic Qualification
- SE = Sea Experience, calculated as actual sea time
- TE = Teaching Experience
- ED = Engine Driver Certificate
- PhD = Doctorate Degree
- MSc = Master of Science
- BSc = Bachelor of Science

Based on the calculation of the mean values of each of the four categories, the results are obtained as follows:

- COC approximately 1.3
- SE approximately 1.9
- AQ approximately 2.7
- TE equals 5.0

These four means are clearly plotted in the figure below: -



As can be seen from the above figure, the dotted line polygon is the optimum ideal environment for the maritime education and training system whereby all the four criteria should be well balanced at the maximum values of five (5). Then the blending of the academic qualification and experience will be the best and effective in the Maritime Education and Training.

The present situation shows there is a lack of high COC holders in the teaching profession probably due to unpleasant salary schemes as compared to other profession lines such as sailing careers and manufacturing industries. In the writer's opinion, one of the best way to attract the highest COC holders to join the teaching careers is to give better incentives for the first class COC holders.

Due to the shortage of staff members, it is not feasible to send staff for sea training and the existing staffs also unwilling to join the sea training, which they have to leave the families behind to acquire higher COC. Thus in the future recruiting staff into the department, it should by all means to recruit those having the highest possible COC qualification and wider sea experiences.

As the amended STCW95 stresses the importance of competence skills onboard ships, it become very essential to take in more experienced seafarers to train the students to be more competent in their future times. If the existing staffs were to be given more opportunities to participate seminars, upgrading courses etc., the quality of the students output will sure be better in their future careers and promote the maritime activities for the nation.

3.2.2 Simulation

At present there is still no engine room simulator training program in the Marine Engineering Course in PUO. Efforts is still on the way to purchase one for the benefits of the future seafarers to increase their quality and standard of their seafaring career.

Simulator training is, no doubt, a strong teaching and training tool for marine engineering students especially in training the students in emergency handling of all possible emergencies such as power black out, main engine sudden stop at sea, boiler miss fire, boiler low lever alarm, purifier overflow, steering gear failure etc.

All these kinds of emergencies can be practised by the students safely without causing any kind of risks to the main engine and auxiliary machinery by the use of simulator training. In some countries such as Norway and USA where on board ship training is quite a problem to arrange with the shipping companies, they use the ratio of the simulator time to sea time to replace some part of the onboard ship training of the cadets.

In the author's opinion, the onboard training should not be replaced by the simulator training. It is better if simulator training can be added without reducing the onboard training time. This is due to the fact that on board training is very important to train cadets in the real working environment. They should be trained to rush to the scene in rolling and pitching environment in case of emergency. This may include running up and down the staircases in the engine room even in very rough weather or sea conditions. This is to ensure that they can get to the problem and remedied at the earliest possible to avoid serious damages caused due to the time delay in getting to the scene.

In the author's experience, during the first ship that he joined as cadet engineer, he has a dizzy head due to seasickness and it last for some three weeks or so to get used to the sea sailing atmosphere. Thus it is an important fact that onboard ship training gives the cadets a time to get used to the sailing circumstances before they are graduated and being employed to handle the watchkeeping duties later. Furthermore, homesickness is also another point that the students should be trained to get used to during the onboard training. This also contributes to the fact that they are mentally and psychologically prepared for their future sea carrier after graduation.

All these reasons of seasickness and homesickness are quite vulnerable to cause damages to machinery or even worse may cause loss of life or properties which is considered to be some of the causes of the human errors that is believed to have caused almost 80% of all the maritime casualties or accidents in the world. So the onboard should not be replaced by any other form of training as far as possible and the writer believes if the onboard training is carried out in proper and effective manner, the maritime casualties will be reduced to the minimum in the future.

Without reducing the on-board training, engine room simulator training do help a lot in training the students effectively. Modern and new technology has raised the level of automation and has more sophisticated machinery equipped on board ships. It is capable to produce a dynamic computerised simulator easily that can compress years of experience into few weeks, as quoted by many simulator manufacturers and operators. Though it is better to have the practical training in a real engine room to learn from the real life, but if there were to be any error made, it may result in casualties, which may include loss of life in extreme cases.

Today the engine room simulator is able to simulate a realistic engine room environment, although not identical to real life, but it gives the trainees the first hand experience of the dynamic response of the engine room systems. Furthermore self confidence can be gained through practising several times for various types of operation, inclusive of those operations that cannot be done on the real engine.

Therefore, the conventional type of maritime training that uses classroom studies, workshop training, sea training, that are still common in many developing countries including Malaysia, should be enhanced with engine room simulator training.

Basically, the advantages of engine room simulators are: -

- No risk of life, no equipment damages and is environmental friendly.
- Operational experiences can be obtained within a much shorter period of time.
- Can split into various categories of training by adjusting the degree of difficulties and complexity of the training.
- The same training scenario can be repeated several times till competence of skill is obtained.
- Promote self-confidence and motivation.
- Develop better operational monitoring techniques.

The various main limitations of simulation are: -

- Low trainee to instructor ratio which is about 5:1
- Need to have specially trained instructors
- Too high the initial cost for most developing countries, especially the full-task/mission engine room simulators.
- Cannot demonstrate some technical skill such as dismantling and reassembling of machine components
- No governing bodies or authorities to control its quality and standard
- Cannot fell the real atmosphere of the engine room.

3.2.3 Computer Based Training Programmes

Increasing competition, a global market place, and the shift in the working population - all these developments mean patterns of training are set to change. The application of modern technologies into training maximises the use of training resources. Computer based training (CBT) represents the delivery of training material by use of a computer and can also include the use of interactive audio and interactive video. With CBT, learners have control of their learning, as CBT can be self-paced. It provide self satisfaction due to personal involvement, individual feed back and the capacity to assess one's own progress. Some CBT programmes enable learners to develop their own learning strategies.

CBT is used: -

- To teach trainees to perform complex analytic tasks.

- To provide automated and individual drill in manual and manipulative skills.

- To teach deductive inference and advanced problem solving techniques by conversational interaction and / or simulation.

The advantages of CBT are: -

- People can work through the material at their own speed.

- The programmes are designed to check understanding of the subject matter.

- Many programmes allow for studying those sections that are relevant to the training needs, by mean of a menu facility (all the content items are listed and a selection is made).

- The time devoted to the training is highly flexible and can be agreed by the manager and the individual.

- Training is usually carried out on an individual basis, but people with similar training requirements can pair up. The exchange of views expressed can results in mutual sharing of ideas and issues.

- People are away from their workplace for a minimum amount of time.

- It promotes consistency in training throughout an organisation.

The disadvantages of CBT are: -

- Large investment for purchase or rental and for installation and maintenance.
- Programmes are difficult to design because of their inherent complexity.
- It requires a greater commitment by the manager and individual.
- Since individual works on their own, they may feel a degree of isolation.
- Some people may be anxious about computers for training purposes.

Both qualified computer programmers and programmed instruction programmers are required to develop instruction materials. Therefore the development of a programme production capability locally or contractually, is required.

As the trainee progresses, the speed and difficulty of the programme increase automatically; if the trainee slows down or exceeds a predetermined error rate, the computer adjusts the programme accordingly. In addition, a record of response can be maintained. The computer-based training can provide the ultimate in machine instruction by engaging the trainee in a mutually responsive conversation, communicated through a keyboard.

3.2.3 Modern Technology

3.2.3.1 Modern and new common specific design and operational features of the last generation marine diesel engines.

Development of the diesel engines in the 1970s was characterised by simpler yet more sophisticated design solutions. One of the good example is that of the step by step introduction of *bore cooling.* The liners of the RND low speed engines were also bore cooled and it was later extended to cylinder covers in the RND-M series in 1976, and pistons in the RL series in 1979.

All the combustion chamber components of the RL engines, and now in the new RTA design, are bore cooled. It has proved very successful in allowing component surface temperatures to be able to adjust at the design stages until the desired level. Bore cooling is therefore the best way of controlling the stresses and strains in these critical components by segregating the mechanical and thermal design criteria. Even there is much increase in power output and maximum cylinder pressure, it has significantly reduced the stress level to a low value.

The RND-M series introduced in 1976 provide a 15% increase in power output more than the RND series. It yields about 12.3bar brake mean effective pressure (bmep), giving cylinder output of 1900, 2400 and 3350bhp/cyl from the three bore sizes of 680, 760 and 900 mm respectively. The RND-M crosshead was fitted with thin walled aluminium-tin bearing shells and provided with separate high pressure lubrication (16 bar) to give a better margin against the bearing fatigue strength.

There were much efforts to reduce the fuel consumption following the 1973/74 oil crisis. In 1979, the trend to lower the rotational speeds for higher propulsive efficiency was met by the introduction of the longer stroke RL engines in which the stroke/bore ratios were increased from about 1.67 in the RND-M series to 2.1in the RL series. At the same time, the brake specific fuel consumption (BSFC) is further reduced by fresh optimisation of combustion and scavenging, together with the use of higher efficiency turbochargers.

In 1976, B & W was the first to introduce modern long stroke engine with L-GF stroke-bore ratio of 2.5. and B & W was also the first to put the engine of stroke-bore ratio 3 into service in the year 1982.

Sulzer RL series engines were the first low speed engines to be equipped with variable injection timing (VIT) mechanisms standard. It was continued in the TRA series to keep the combustion pressure virtually constant at its maximum value down to 85% load and then automatically reduces it as a function of the engine load. Even with the use of poorer quality fuels, it also incorporates manual adjustment to compensate for the delayed combustion. The valve controlled fuel injection pump design of the Sulzer engines can readily suits modification for VIT while other engine builders use VIT variants of the traditional jerk pump.

3.2.3.2 The New Generation of Low Speed Engines

Further improvements in overall propulsive efficiency are now possible with the new Sulzer RTA low speed engine series. It offers both lower propeller speeds and much reduced specific fuel consumption to cater for the present and anticipated future needs of shipping. In 1982, the RTA design was launched and has achieved remarkable market success. By the end of January

1984, it had attracted orders for 394 engines with an aggregate output more than 4 million bhp.

The results of the analysis of the various factors indicates the need for lower shaft speeds. The optimum solution for low speed engines is to lengthen the stroke/bore (S/B) ratio, permitting a simple, cost effective direct propeller drive. Increasing the S/B ratio has a disadvantage of an adverse influence on engine initial costs and dimensions.

Table 1 S/B Ratios of Sulzer Engines

	RND-M series	RL series	RTA series
S/B Ratio	1.67	2.10	2.90

Source: Brown, D.T.

It can be seen from the above table that the S/B ratio increase between the RND-M and RL series is 0.43 while the S/B ratio increase between the RL and RTA series is 0.80. The S/B ratio increase is almost doubled showing the marine main diesel engines design today is towards lower shaft speed and to give better specific fuel consumption for economy purposes.

At this much of increased ratio, Sulzer´s traditional loop scavenge system is thermodynamically at a disadvantage, thus a change to the uniflow scavenging with single poppet-type exhaust valves was quite logical. The RTA also operates at a maximum combustion pressure (Pmax) of 125 bar for favourable fuel economy, taking the advantages of the good experience gained with RLB engines at similar high combustion pressure.

B & W was the first to build uniflow 2-stroke slow speed engine in the year 1933 while Sulzer start just lately.

Another common new design feature is the waste heat utilisation. Traditionally all the exhaust gases are led to the turbocharger. Today some of these exhaust gases (about 12 % of the exhaust) are tapped to drive another power turbine and coupling, then through the gear for power take in, extra power is added to the main engines. Thus by efficiency-booster concept, surplus exhaust gas energy can be directly recovered and applying it mechanically to the engine crankshaft through the integral Power Take-Off gear. Consequently the specific fuel consumption can also be reduced. The sketch below shows a typical example of the system: -

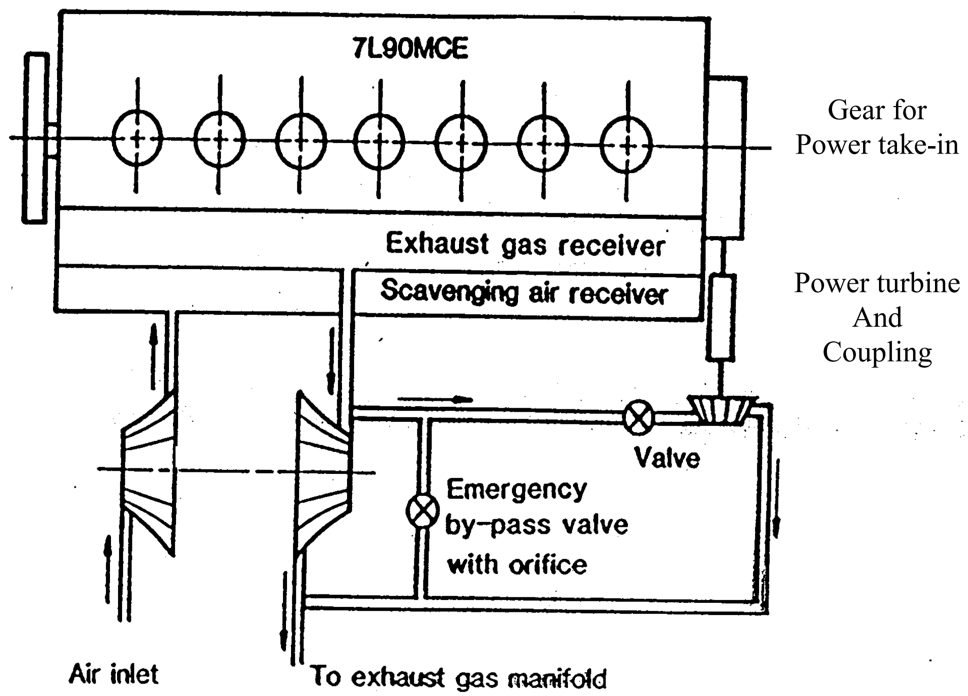


Figure 3.3 Turbine Compound System of a typical marine slow speed engine

The figure below also shows that the Brake Specific Fuel Consumption can be reduced as much as 5 g / bhp hour at about 82 % power which is the optimum condition by Efficient-Booster System.

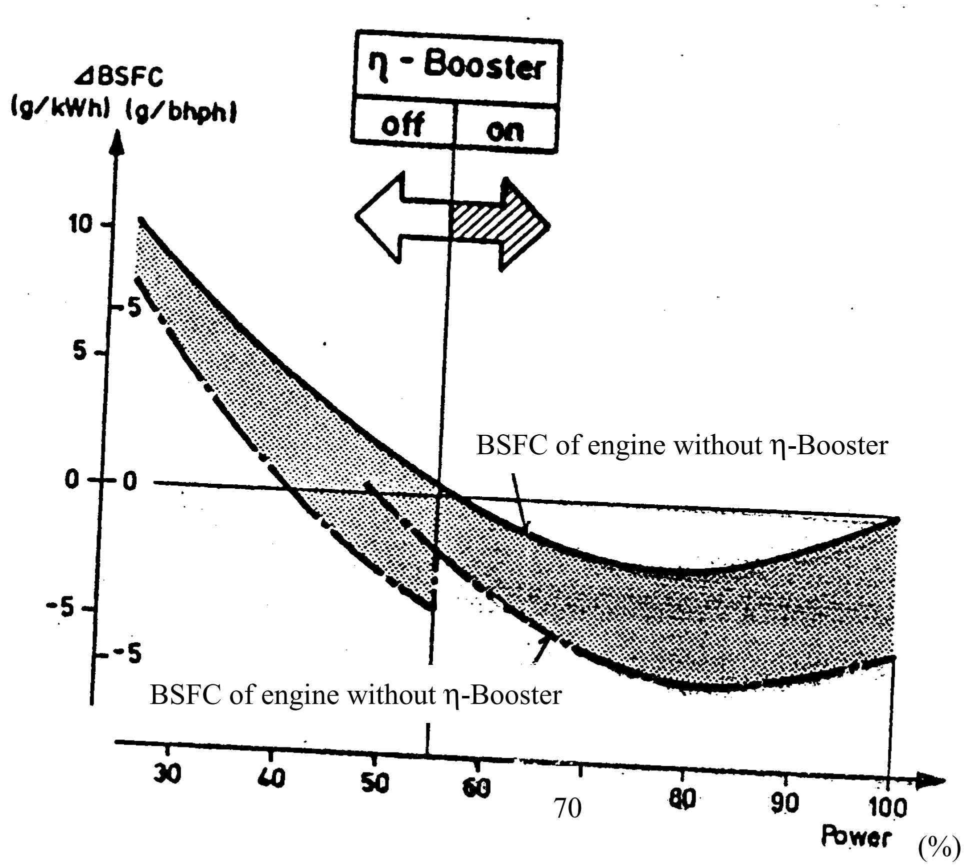


Figure 3.4 Effect of efficiency-booster on the BSFC of a typical marine slow speed engine

3.2.3.3 Last Generation Sulzer Marine Diesel Engine

Table 2 Main Data of Marine Sulzer Diesel Engines

TYPE	CYL.	BORE, mm	STRO., mm	BMEP BAR	OUTPUT/CYL. kW	BSFC g/kWh
RTA96C	6-12L	960	2500	18.2	3845-5490	164
RTA84C	4-12L	840	2400	17.9	2230-4050	159
RTA84	4-10,12L	840	2400	16.6	1930-3500	159
RTA84T	5-9L	840	3150	18.0	2130-3880	156
RTA84M	4-10,12L	840	2900	17.2	2050-3730	156
RTA76	4-10,12L	760	2200	16.6	1580-2870	160
RTA72U	4-8L	720	2500	18.2	1640-2990	158
RTA62U	4-8L	620	2150	18.2	1220-2220	159
RTA58	4-9L	580	1700	16.7	920-1670	163
RTA52U	4-8L	520	1800	18.1	860-1560	160
RTA48	4-9L	480	1400	16.8	600-1090	169
RTA38	4-9L	380	1100	16.7	370-680	171
ZA40S	L & V	400	560	24.1	600-720	178-175
AT25	L & V	250	300	17.9	140-220	193-192
S20	4,6,8,9L	200	300	20.4	115-160	188

Source:- New Sulzer Diesel Ltd

From the above table, it can be seen that the Sulzer RTA series offers a wide range of engine types to fit all ship propulsion requirements. They give power outputs between 2000 and 89640 bhp (1480-65880 kW). The 3 main types of engines available with each typical stroke/bore ratio: -

- RTA-C Types:- about 3.0 stroke/bore e.g. RTA84C, RTA96C
- RTA-U Types:- about 3.5 stroke/bore e.g. RTA52U, RTA62U, RTA72U
- RTA-T Types:- about 4.0 stroke/bore e.g. RTA48T, RTA58T, RTA68T

A fundamental feature of the RTA engine series is the great flexibility for the selection of engine ratings. The wide range of engine speeds allows an exact match to the ships optimum propeller speed. At the same time, the power range available for each cylinder size caters for the desire choice between the lowest BSFC and lowest first cost in which the full derating gives 8 g/bhph (11 g / kWh) reduction in BSFC.

For example, a 40,000 tdw bulk carrier sailing at 14 knots with a maximum possible propeller diameter of 6.75m, a total of 15 different RTA engines are available such as: -

- lowest daily fuel consumption - 6RTA62
- lowest capital costs - 4RTA62
- lowest combined fuel and capital costs - 7RTA52
- most popular engine model - 6RTA58

As a traditional features of Sulzer diesel engines, all components of the combustion chamber are bored cooled. This ensures optimum surface temperatures and prevents high temperature corrosion due to too high temperature on one side and sulphuric acid corrosion due to too low temperatures on the other. At the same time, rigidity and mechanical strength is provided by the cooler material behind the cooling bores.

Basically the RTA design features are:-

- Bore-cooled cylinder:- a special water guide keeps the cooling water off the cylinder jacket (dry jacket).
- Short piston with a bored cooled piston crown
- Bored-cooled cylinder cover with one large central exhaust valve in a valve cage.
- Very efficient bored cooled exhaust valve seat ring.

3.2.3.4 Measures applied to reach todays high high overall ship propulsive efficiency

$$\eta_{soe} = \eta_H \times \eta_{rot} \times \eta_P \times \eta_s \times \eta_g \times \eta_t \times \eta_i \times \eta_m$$

Where:- η_{soe} = Ship propulsive overall efficiency

η_H = Hull efficiency (about 1.1 - 1.3)

η_{rot} = Relative rotative efficiency (about 0.99)

η_P = Propeller efficiency

η_s = Shaft efficiency (about 0.98)

η_g = Gear efficiency (about 0.96-0.98)

η_t = Thermal efficiency

η_i = Indicated efficiency

η_m = Mechanical efficiency

Hull efficiency, η_H is given by:- $\eta_H = \dfrac{1+t}{1+w}$

where t = suction factor and w = wake factor

Quasi Propulsive Efficiency, η_{qpe} is given by: -

$\eta_{qpe} = \eta_H \times \eta_{rot} \times \eta_P$ and it is approximately equal to η_P

due to the fact that η_H and η_P are nearly unity

Engine efficiency, η_{eng} is given by: -

$$\eta_{eng} = \eta_t \times \eta_i \times \eta_m$$

and also because η_s and η_g are nearly unity too

Therefore $\eta_{soe} = \eta_P \times \eta_{eng}$ approximately

As the propeller efficiency, η_P is highly depend on the size of the propeller and the speed. Large diameter propeller and slow propeller speed will yield the highest propeller efficiency, $\eta_{P.}$

Thus modern trend to engine design go towards long stroke and super long stroke engines and larger shaft diameter in order to achieve slower propeller speed and thereby obtaining the higher ship propulsive overall efficiency, $\eta_{soe.}$.

Another factor is that by reducing the number of propeller also increased the propeller efficiency, η_P but there is a minimum number of blades to be used. Todays the biggest propeller diameter has reach a figure of 11.0m and stroke bore ratio has increased to 4.2 in 1998.

3.2.4 Sea Training (Training On Board)

The philosophy of the sea training sandwiched between the academic studies, as practised at the Marine Engineering Course, Politeknik Ungku Omar, is based on the premise that integrating work experience within an academic program enriches the quality of learning. The work experience must be closely related to the student course of study and, as such, has educative value in the curriculum.

The growth and development of students are enhanced through the period of sea training by preparing the students with social, behavioural and attitudinal skills that will help them very much in their respective future careers. The underpinnings of this phase of training are to assist students to learn from and through experience.

To facilitate the implementation of the training phase, the participants, namely the marine engineering cadets from PUO, should accept the following during the process of their training: -

- That Politeknik Ungku Omar remains fully committed to the philosophy that recognise sea training as an important educational approach, and is prepared to provided the necessary resources to achieve the goals set out below.

- That student will abide by the Politeknik guidelines and accept personal responsibility for their educational development with guidance from their course lecturers.

- That the employers providing the sea training will work closely with the Politeknik to assist in structuring the worthwhile learning experiences through the related employment situations. The employers recognise that the work experience forms an important part of the curriculum both for the vocational development of the students and for ensuring course relevancy.

The goals of the sea training are as follows: -

- To provide each student with meaningful learning experiences by blending work experience with formal education.

- To assist the student in understanding that learning is a life long process.

- To promote an environment where students can be adequately prepared to meet the changing demands of work and society upon graduation.

- To develop a strong relationship with employers by making available students who can fulfil their employment requirements. In return, employers provide their expertise and support to the educational process.

3.2.4.1 Organising Training

For the training to be effective, it is necessary that the onboard training to be well organised. The efficiency of an organisation is required at three levels, each with associated roles and responsibilities: -

Trainees:- learning individual skills and teamwork

Shipboard management:- carrying out training and assessment of competence

Shore-based management: - established policy, providing resources and monitoring effectiveness

Motivation is most important, and commitment is required, both for the trainees and the trainers, and also from the senior managers ashore and at sea whose encouragement and support is essential.

3.2.4.2 Role of Seastaff as Trainers

The experience and expertise of senior seastaff are the most important resource available. In their own training and years of service they will have had gained experience sometimes through mistakes.

Senior seastaff should have the responsibility for ensuring the efficiency and safety of the operations and welfare of cadets by: -

- familiarising them with the ship and equipment
- implementing safe procedures for routine operations including the prevention of pollution
- providing the emergency response training
- encouraging career development

3.2.4.3 Objectives Setting

As much information should be obtained on the 'starting point' of the voyage programme in order to avoid any unnecessary duplication or gaps in the training. Qualifications and experience of the people on board should also be considered when setting objectives and priorities for the voyage.

Meeting the legal obligations of the IMO Conventions and Regulations must be given the first priority. The second priority will then be to ensure the efficient operation of the ship, which take into account the needs of each crew and each voyage. Finally but not the least, the third priority is given to the needs of shipboard training as part of the career development of each member of the crew inclusive of the cadets training.

Steps to be followed to make sure that each trainee must know: -

1. What training he or she is expected to undertake
2. What are the facilities available for the individual training
3. What kind of formal training for the voyage and how to prepare for it.
4. What assessment undertaken and the quality and type of evidence likely to be needed.

Each trainee should have the following: -

- A training and assessment plan for the voyage
- A copy of the relevant record book or record sheets.

If possible, it is also useful to supply each trainee the following: -

- A copy of outlining responsibilities and opportunities for learning on board, and
- A copy of the Company's Training Policy Document.

NOTE: STCW95 Section A-I/6 paragraph 2 states 'Persons conducting in-service training or assessment on board shall only do so when such training or assessment will not adversely affect the normal operation of the ship and they can dedicate their time and attention to training and assessment.'

3.2.5 Evaluation of Competence

3.2.5.1 Competence And Necessity of Assessment

To measure the skill and knowledge of the trainees or students, a good and effective mean of assessment system should be used at entry level and also as their training progresses. The system should not be too much time consuming and it should minimise costs by allowing training to start at the correct point and avoid gaps and repetition. As soon as the standard is satisfactorily reached, each trainee should move on to the next stage without delay. Ways in which the quality and effectiveness of training can be validated will be discussed here.

It has been long time that people are thinking of certifying seafarers' competence. Seafaring in the 1800s had become very hazardous work, and the poor safety record led to the public concern and then to the Governments of major seafaring nations introducing formal 'Certificates of competency' for ships' officers. The examinations were, and still are, usually carried out ashore and often concentrate on the knowledge required, rather than the practical skills. Both knowledge and skills are equally important and needed and it is onboard ships that real competence must finally be demonstrated when the trainee qualifies.

The statement 'COMPETENCE' include the assessment of:

- Skills to specified standards
- Relevant knowledge and understanding
- Ability to use skills and to apply knowledge and understanding to the performance of relevant tasks

There are certain circumstances in ships, where 'real life' testing of emergency scenarios may be very costly and hazardous. However, there is real potential for testing 'in the workplace'. The type of skills assessment which can be carried out on board is normally that associated with lower level of competence, particularly repetitive and non-critical tasks which do not endanger the vessel. It is more complex to test the complex skills such as high level decision-making related to the infrequent events (e.g. major engine failures, search and rescue etc.)

In order to have the assessment on board to be valid, particularly it is to be part of the formal national and international certification, it must be properly organised, carried out and recorded. In the past, with larger crews and lower crew costs, the assessment of the practical training was often informal. As the trainee was observed by his seniors carrying out a task many times, in different circumstances, the senior person would report:

'Need more practice' and finally 'Training completed'

Without standards of competence being lowered, the training could be much shorter if an effective ASSESSMENT SYSTEM were to be used.

3.2.5.2 Assessment

The meaning of assessment, in the simplest way, is to evaluate the training that is being performed by the students or trainees. An assessor would see that the candidate demonstrating competent performance in the workplace. It would be usually be necessary to assess pre-requisite and complementary knowledge by methods other than by observation. Appropriate means needed to be selected and material developed.

3.2.5.3 Methods Of Assessment

The following are some common methods used by most institution and training ships to be more effective in the training both shore-based and sea-based.

- Practical examination (demonstration of skills 'on the job')
- Project work (assessment of results and records)
- Oral examination
- Simulation, full
- Simulation, simple including part tasks
- Written examination, closed book type
- Written examination, open book type
- Written, with multi-choice options

There are also other new methods used on board, particularly:

- Video-based, assessment with writen support material
- Computer-based assessment
- Interactive video incorporating assessment
- Audiotapes, photographs, slides etc with written support material

Not all methods are suitable to be used in assessing practical performance onboard and some of the more complex skill areas may require more than one method to be used.

To be ideal, the assessment methods chosen should be capable of being used not only for the new entrants but also for the mature and experienced persons who wish to upgrade or to widen their knowledge and their vocational qualifications.

These methods used should also be efficient in setting the correct standards and performance criteria as well as in terms of availability, time taken and costs.

ASSESSMENT:- An Example

Ship Systems for Steering and Engine Control etc

- Project or oral questions

Briefly, the usual methods of assessment used on board would probably include:-

- Practical demonstration of skill by the candidate under personal supervision of assessors
- Computer-based assessment or interactive video with verifiable individual computer records
- Simulation exercises with computer-based monitoring and/or supervision by assessors
- Writen examinations, with or without audio-visual material

The Assessors should be provided with suitable materials and taught how to use it effectively to be able to carry out this sort of assessments effectively.

3.2.5.4 Validation

As to comply with the STCW95, it is important for assessment of competence to be validated by an independent authority.

Formality of assessment may vary, starting with self-assessment by the trainee to measure his or her own progress. Some of the more formal ways to undertake the assessment are:-

Assessment by senior staff onboard
Assessment by company personnel or agency
Assessment by national or international authorities

Unlike a factory ashore, it is sometimes difficult for independent assessor to visit the workplace in merchant ships, but even then, it should be possible for designated senior staff to carry out some assessments. They should be properly briefed, supported and equipped for that part of their work. Bearing in mind that not all personnel and not all ships or trades may be suitable environments for training and assessment.

CHAPTER 4

Maritime Education And Training In Some Developed Countries

4.1 Maritime Education And Training in U.S.A.

4.1.1 Maritime academies

In the United States, there are seven maritime academies providing Maritime Education And Training for officers such as the following:-

- The United States Merchant Marine Academy (USMMA), King's Point.
- State University of New York Maritime College (SUNY), Fort Sohuyler.
- Maine Marine Academy.
- Michigan Marine Academy.
- Texas Maritime College, University of Galveston
- Massachusetts Marine Academy
- California Marine Academy

All of the above academies except the King's Point Merchant Marine Academy are run by the state governments while the USMMA is run by the national government. These academies are residential and provide course curricula which enables a cadet to achieve a nationally recognised degree as well as a certificate as 3rd mate and 3rd assistant engineer.

4.1.2 Course

Generally the courses offered in these academies has a duration of four years with the aim to train young men and women to be officers serving on board commercial ships as well as serving in some other capacities such as ship designers, maritime lawyers, port engineers, shipping company executives, naval officers, Coast Guard officers, and oceanographers.

Figure 4.1 is the flowchart showing the way in which a new entrant can achieve the highest certificate of competency as Chief Engineer by way of a Marine Engineering Program. It should be noted that there are many other qualifications that are equally accepted. The point of entry is indicated in the flowchart of figure 4.1.

Only entrants with completed high school studies and having good grades in English, Mathematics, Physics or Chemistry are considered qualified to be admitted into the academy. Midshipmen (a term used for both men and women) will spend a total of four years at the academy during which they undertake cadet shipboard training of two 6-months periods (that is a total of one year) on United States flag commercial ships. This is to enable them to acquire professional on the job training and valuable hand-on training.

At the end of the course, they will have to sit for the academy's final examination and also license examination conducted by the United States Coast Guard (USCG). Upon successful passing both examinations, they receive Bachelor of Science Degrees, Certificate of Competency (C.O.C.) AS Third Assistant Engineer for foreign going vessels and additionally they are also naval reserve officers commission. They will then continue to sail for 12 months to be qualified to sit for the next higher C.O.C. as Second Assistant

Engineer; 12 months sailing again to sit for C.O.C. as Second Assistant Engineer and final 12 months sea time to sit for C.O.C. as Chief Engineer.

4.1.3 United States Merchant Marine Academy (USMMA)

As a midshipman, one will be required to complete a series of required courses that comprise the core curriculum. These courses give a nucleus of knowledge in key academic and professional subjects. The major course of study will begin at the end of the second trimester of the fourth class year during which one have to determine the type of merchant marine license one is to receive. All midshipmen have to spend approximately one year at sea regardless of which majors they select.

There are three academic trimesters, which span 11 months in one academic year in the Academy, generally from late July to late June. Credit for courses are given in semester credit hours. The core curriculum has the following components:

- Mathematics
- Science
- English
- History
- Comparative Cultures and Humanistic Traditions
- Naval Science
- Physical Education and Ship's Medicine
- Computer Science
- Internship

4.1.4 Major Programs

Midshipmen select their major course of study from among the six programs below: -

- Marine Transportation - combined nautical science and intermodal transportation management.
- Ship's Officer - Marine Transportation Program enhanced with marine engineering studies.
- Marine Engineering – focus on shipboard engineering operations
- Marine Engineering System – focus on engineering design accredited by Accreditation Board of Engineering and Technology (ABET).
- Dual License – Combined both specialities of marine engineering and marine transportation studies.
- Shipyard and Marine Engineering Management – management of shipyard and other large engineering endeavours.

4.1.5 Marine Engineering Program

This program focuses on the operation and the applied aspects of the marine engineering profession. It allows the midshipmen to choose the elective courses to tailor the program of study to meet their personal professional goals. The following major program courses are to be completed by them to satisfy the curriculum requirements: -

- Engineering Mechanics II
- Heat Transfer
- Diesel Engine Maintenance
- Managerial Process
- Three Engineering Electives

- Three Free Electives

Graduates of the Marine Engineering Program are exceptionally well suited for employment at sea as engineering officers, as well as ashore in the applied phases of the engineering spectrum such as power generation and technical marketing.

4.1.6 Sea Training Year

All midshipmen have to undergo shipboard training in US flag merchant ship during their third and second class years. The first sea period is one trimester long while the second sea period span two trimesters. The first sea period is short, roughly 135 days during which the midshipman is assigned to different types of vessels before returning to the Academy to build on his/her experiences at sea. The second sea period is longer, roughly 265 days during which the midshipman finished his/her sea service requirement and completes an internship with a company or organisation with involvement in the transportation industry. During the second sailing period, a midshipman with a strong interest in a naval career may request a 30-day sailing aboard a US Navy ship. All midshipmen are required to complete a written report on their experience, which is submitted to their designated Academy Training Representative for evaluation and grading.

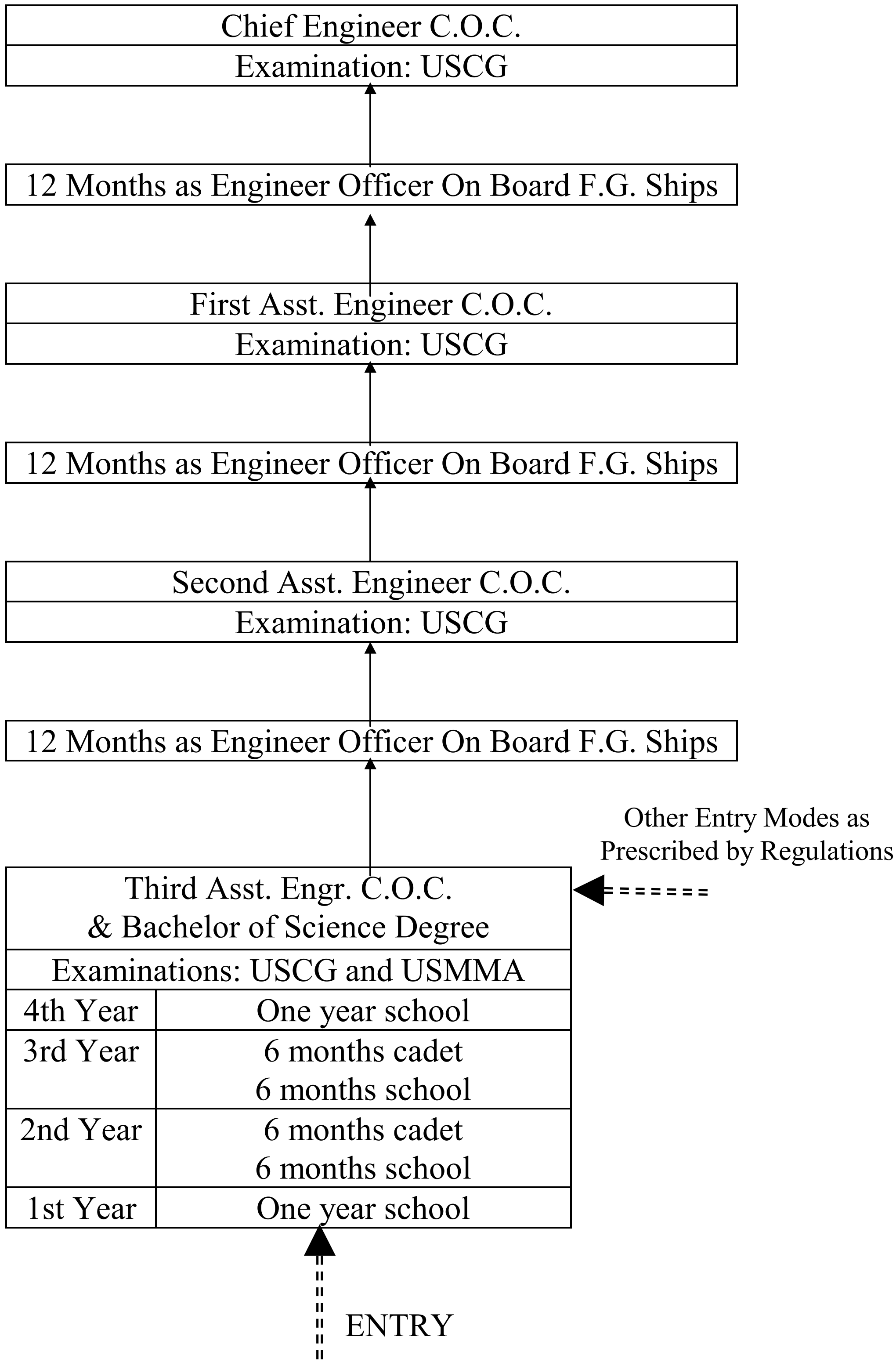


Figure 4.1 The U.S. Marine Engineer Lisence System (USMMA)

4.2 Maritime Education and Training system in Japan

Japan education system basically contains two levels of compulsory education schooling, which consists of six years of elementary school and three years in junior high school. After graduating from junior high school, one may apply for admission into a Mercantile Marine College for Marine Career instead of joining senior high school.

The written entrance examination and health examination are used to judge the admission standard. For those who failed may still apply for admission to rating training school if they are still interested to sea career. On completing few years of qualified sea service and acquired some maritime knowledge, the ratings will have to be admitted to Marine Technical College for further maritime education and they need to clear the officers´ licence examination before proceeding to sea.

Students graduating from senior high school may seek admission to a University of Mercantile Marine in Tokyo or in Kobe to become a deck or engineer officer on board merchant ships. They may also join the rating school first to become ratings and later seek admission to Marine Technical College for their career to be officers in the future.

On board training are compulsory for all students at the Mercantile Marine College, Mercantile Marine University and rating schools before they can be graduated from the respective institutes. The Institute of Sea Training is responsible for carrying out this on board training of which the duration varies for different courses. The National Examination Board has the sole responsibility for conducting licence examinations for deck and engineering officers and issue the respective seafarers' licences to qualified officers working at sea.

Students who received maritime education at the Mercantile Marine Colleges and Mercantile Marine Universities have the advantages that they are exempted from sitting the written examination of third grade level of licence for either engineering or nautical or both, but they still need to pass the oral examination to be qualified to sail as a watchkeeping officer on board a foreign going vessel.

4.2.1 University of Mercantile Marine

The highest educational institutions for officers in the ships are the two Universities of Mercantile Marine located one in Tokyo and the other in Kobe. Both are under the jurisdiction of the Ministry of Education and have a four-year academic system. The students shall take subjects from both academic and specialised divisions to be granted with a bachelor's degree.

Those students who want to get a license of maritime officer are requested to study further for six months at the Sea Training Course after completing the courses in the Department of Marine System Engineering, the Department of Maritime Science. These students have to receive practical training aboard the training ships of the Institute of Sea Training for one year totally; six months during undergraduate and another six months during the Sea Training Course. One-year sea training is indispensable for the application for maritime officer's competency. Those who proceed to the engineering course should win the credits required in the undergraduate engineering course.

4.2.2 Mercantile Marine College

There are five mercantile marine colleges in Japan and each college provide five and a half years engineering course offering both technical and general subjects studies. Unlike universities, these colleges do not do any research but pay more importance on the skill acquisition for shipboard operations.

4.2.3 Marine Technical Colleges

The Marine Technical College acts like re-educational institutes imparting further knowledge and skills to the experienced seafarers for the operation of high technology vessels and provide additional facilities for learning. It is the sole government-run institution to re-educate seamen. The courses it offered are: -

- Preparatory study for the higher maritime officer's competency.
- Refresher and revalidation course for officers
- Correspondence course for seamen
- Dual qualification for existing officers or ratings as watch officers and dual-purpose crew on highly modernised ships.

4.2.4 Institute for Sea Training (IST)

It is under the jurisdiction of the Ministry of Transport with its headquarters located in Yokohama and its branch office in Kobe. Totally it has two large sailing training ships, two turbine training ships and two diesel training ships. It offers one year on board sea training for students from Universities of Mercantile Marine and Mercantile Marine Colleges and six months training for rating schools. The engineering students receive 3 months on a turbine ship, 6 months on a diesel ship and 3 months on a sailing ship. The main purpose of this sea training is to cultivate qualities such as adaptability, the discipline, the sense of responsibility, the determination, the endurance, the spirit of co-operation and the international-mindedness that are indispensable elements for ship's officers in addition to the operational techniques of the vessels.

In parallel with the training, IST conducts various studies and research relating to ship operation. It is also necessary to include an ocean training cruise to foreign countries during training on either turbine or diesel powered ship. For those who want to be a deck officer or marine engineering officer of domestic waters only, 9 months continuous sea training is compulsory and those catering members need compulsory 10 days sea experience.

There are nearly 20 teacher-officers on each training ship, and they live together with the students. The teacher-officers keep navigation watch on bridge or in engine room with the students, eat the same meals with students. In other words, they carry out real life education and training all days and nights.

The most important principle of the training methods is teacher-officer leave the matters to be done to the students as much as possible according to their grades. To operate and to handle of every navigational instrument is entirely free to those students. As for the Engineering Course students, based on the same principle, the same way of teaching is applied in engine room and engine control room.

4.2.5 Conclusion

The most effective way to train good seafarers is to have a one complete year of practical training on board training ships as pre-sea training. During this time, they face different rough sea conditions, learning not only about navigation and engineering, but also the art of discipline and co-ordination.

In the future, even with the most advance and highly sophisticated ship, it is believed that the seafarers must be always stable both in mind and body against the severe working condition at sea. If a seafarer has only school knowledge, he will have a lot of problems on board. Thus he must acquire working knowledge and the qualities which are necessary to be a merchant marine officer.

Characteristics of the on board training scheme are: -

- ❖ Centralised practical training by government instead of private shipping companies.
- ❖ To use ships for training purposes only.
- ❖ Complete and well qualified experienced and skilful teacher-officers and crew.
- ❖ Well prepared curriculum

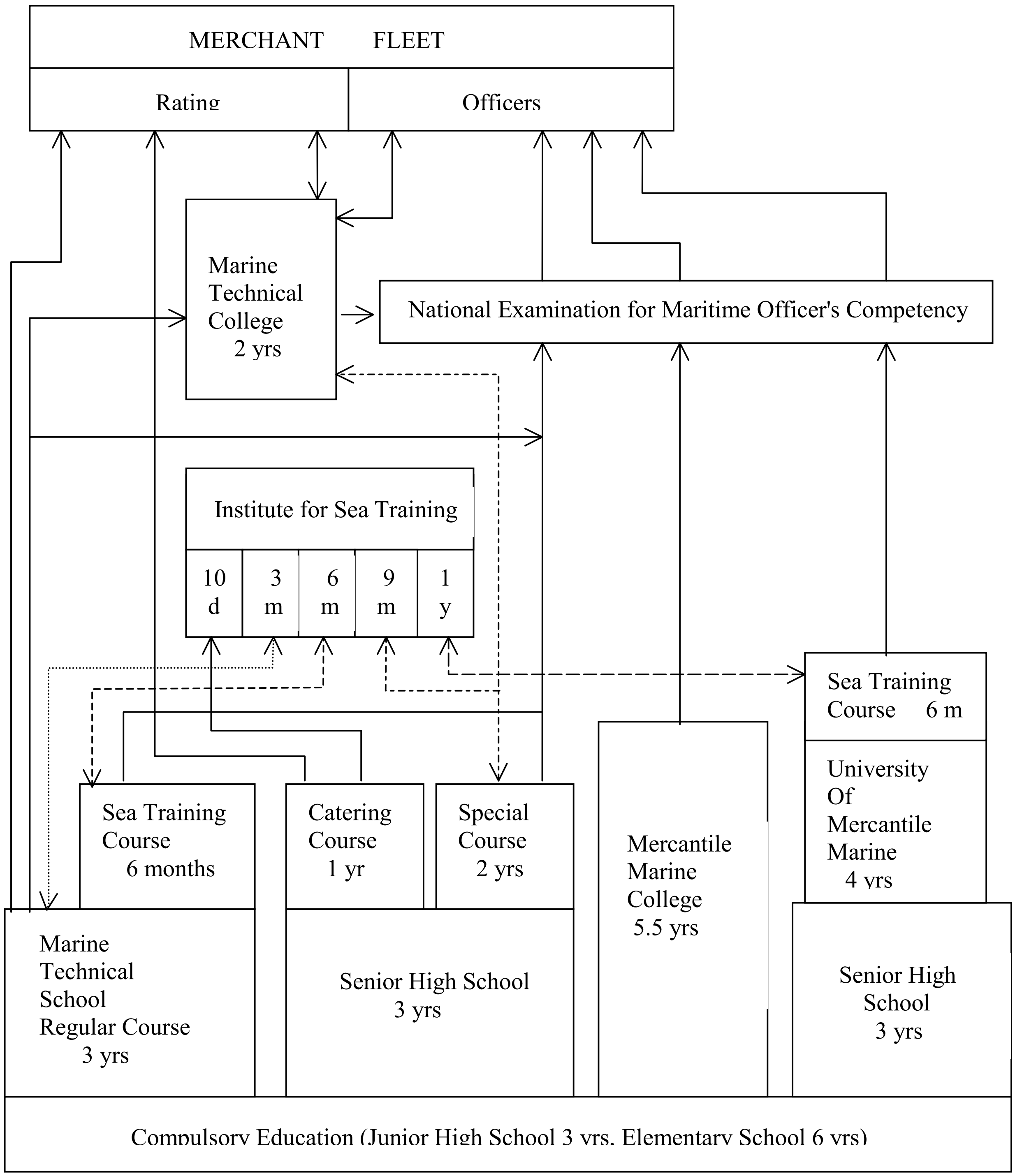


Figure 4.2 Marine Engineering manning in Japan

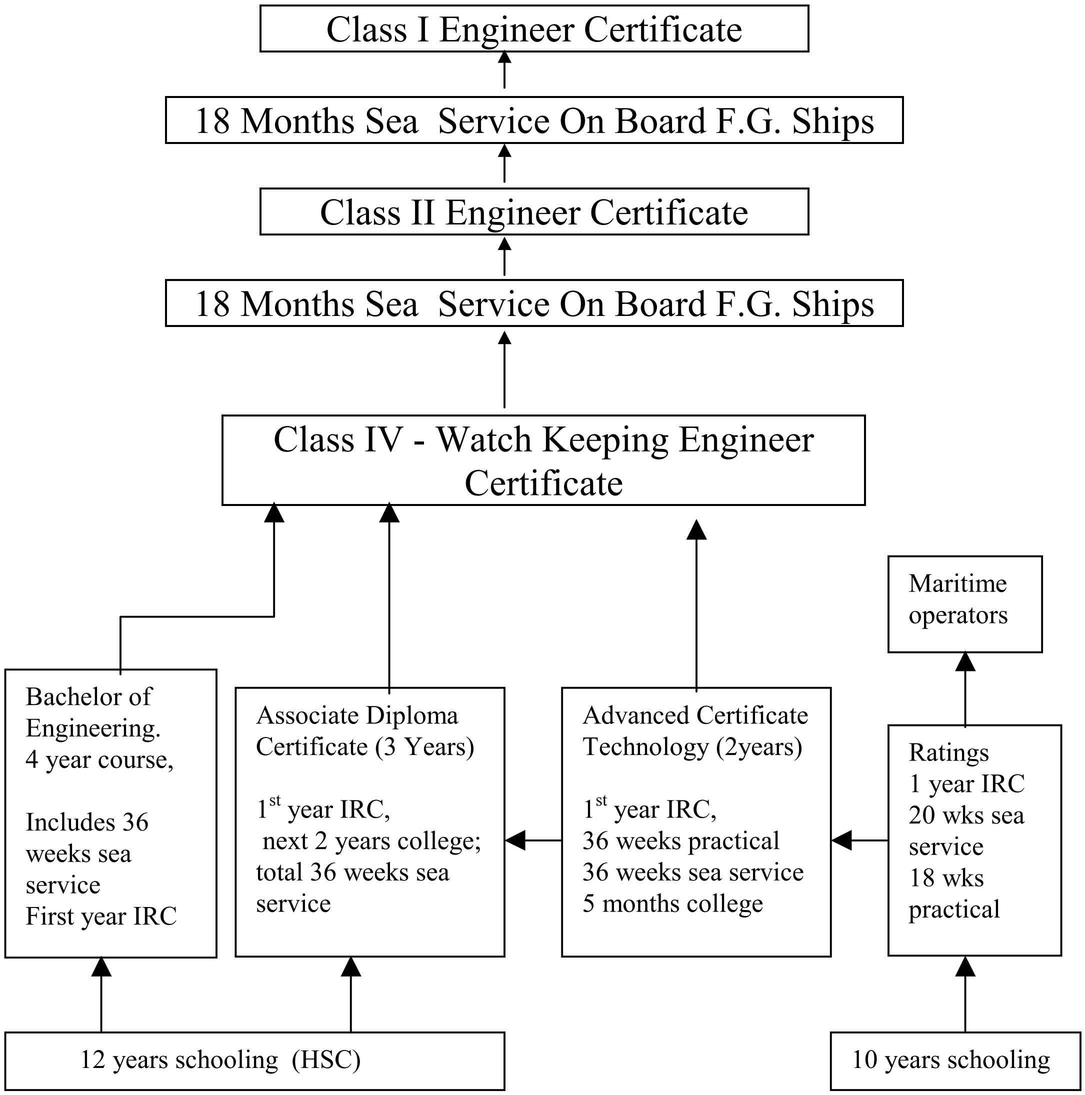


Figure 4.3 The Australia Marine Engineer License System (AMC)

4.4 Maritime Education And Training System In India

The examination and certificate system in India are based on the U.K. Merchant Shipping Act of 1894 and centralised examinations system commenced in May 1929. The rules in conformity with the STCW95 Convention have been implemented from the first of August 1998. In 1949 the Directorate of Marine Engineering Training (DMET) was set up in Calcutta and later a branch of DMET was set up in Mumbai to utilise the marine workshop facilities there. In 1992 the names of both institutions was changed to the present name the Marine Engineering and Research Institute (MERI) situated at Calcutta and Mumbai. The Directorate General of Shipping (DGS) is an executive and regulatory body under the Ministry of Surface Transport and it is responsible for governing the Marine Education and Training in India.

4.4.1 Marine Engineering Courses

There are various education and training systems followed by marine engineers serving in Indian ships: -

- A four year pre-sea course in marine engineering at MERI, Calcutta

- A five year Bachelor of Engineering (B.E.) degree course in mechanical engineering at one of the recognised engineering colleges and also one year of marine orientation course at MERI, Mumbai, port trusts or shipbuilding yards.

- A four-year marine apprenticeship training at one of the recognised marine repair workshops, ports or shipbuilding yards.

4.4.2 Marine Engineering And Research Institute (MERI)

There are two institutes named MERI in India, both owned and run by the Government of India; one at Calcutta and the other one at Mumbai. The MERI Calcutta conducts the four years core course in marine engineering training. It has its own workshops with working real equipment like boiler, steam engine, turbine, diesel engine alternators, electrical distribution boards, electrical machinery material testing laboratory and other facilities for basic skill training. The facilities of the marine workshops engaged in ship repair are also used for additional practical training.

MERI Mumbai trains two batches a year for about 200 candidates who have passed their mechanical engineering and want to enter into the career of seafaring engineering officers. The candidates undergo 6 months of pre-sea training and 9 months of on board training.

4.4.3 Examinations And Certification

For unlimited foreign going motor vessels, marine engineering officers have to sit for the following examination conducted at Mumbai, Calcutta and Madras that held every month except in the month of May: -

- Class IV (Motor)
- Class II part A and part B (Motor)
- Class I part A and part B (Motor)

Marine Engineer Class IV (Motor) examination is for certification of officers in charge of an engineering watch in a manned engine room or as designated duty engineers in a periodically unmanned engine room on a vessel powered by propulsion machinery of 750KW or more. It is only an oral examination and the general requirements are minimum 6 months qualified sea service, 1 month preparatory course at a recognised institute, 3 days simulators training and 1 week advance fire fighting course.

The Marine Engineering Class II (Motor) examination is for certification of second engineer officers on motor ships of 3000KW power or more and it consists of part A and part B. Part A is the minimum qualification for junior engineer for unlimited vessel. Thus all marine engineers must have at least part A before proceeding to sea unless they are exempted from the part A examination.

Similarly the Marine Engineering Class I (Motor) examination is for certification of chief engineer officers on motor ships of 3000KW power or more and it also consists of part A and part B.

4.4.4 Pre-Sea And Post-Sea Training

There are various schemes through which a person can get trained to pursue sea career as a marine engineer officer depending upon the entry qualification. Basically the minimum qualification is Higher Secondary School Certificate (12 years of schooling) with mathematics, physics and chemistry amongst the subjects. After getting the first level of C.O.C., that is, Officer in-charge of Engineering Watch, the further training scheme for higher certification is common. Figure 4.4 shows the career profile from the first level to the highest level of certification in India. The post-sea training of preparatory courses for C.O.C., refresher training courses and short training courses etc are conducted by Government and private institutions except T.S. Chanakya and MERI Calcutta which are for pre-sea training only.

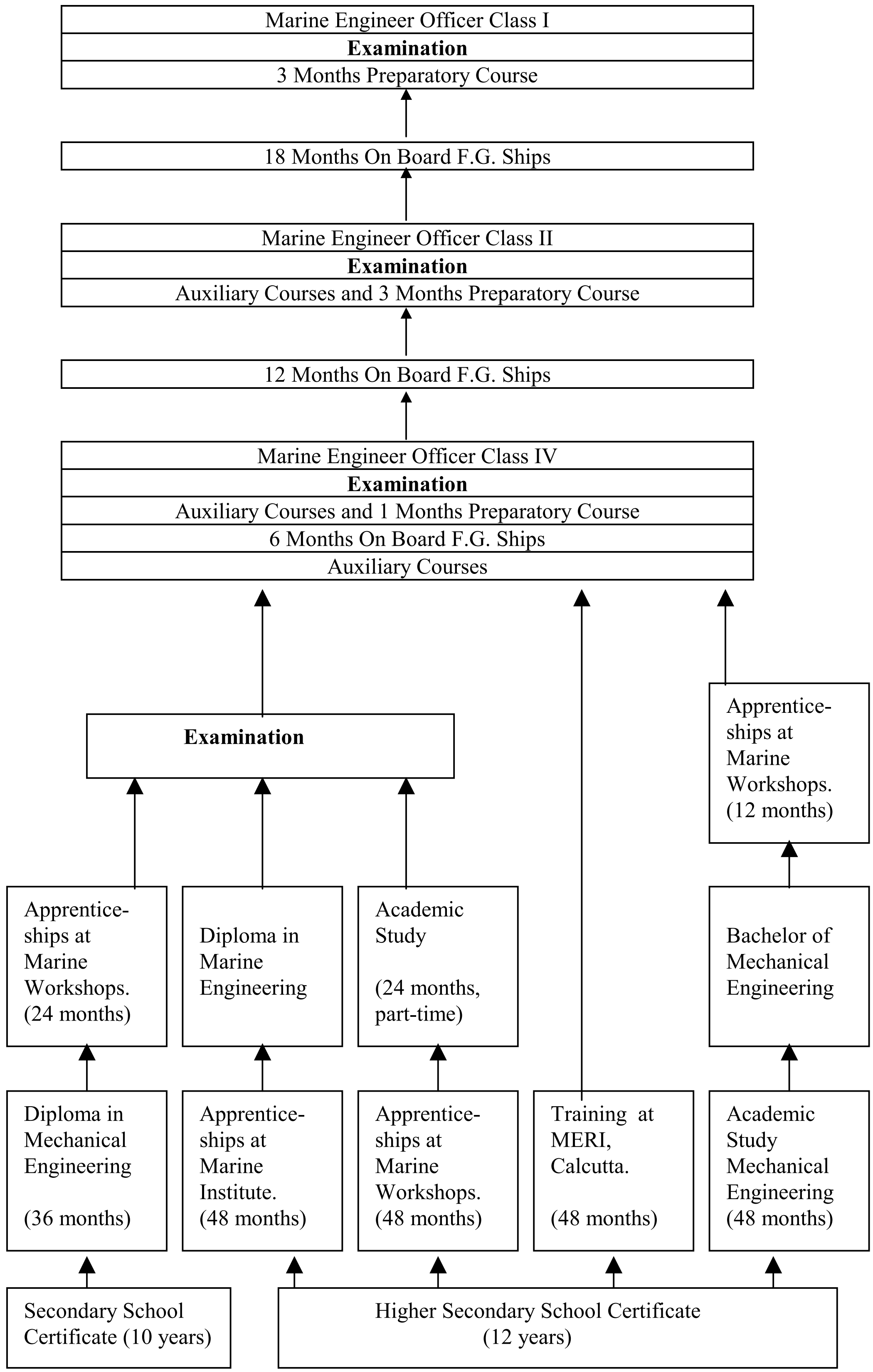


Figure 4.4 The Marine Engineer Career Profile (India)

CHAPTER 5

Impact Of Change Upon The Training In PUO

5.1 STCW95

5.1.1 Overview of the STCW 1978 Convention

Highly trained personnel are required to operate ships to safeguard safety on board in addition to the ships equipped with the highest standard of construction and equipment. IMO had investigated into the matter of maritime accidents and found that '*Human Error* ' had contributed the main cause in most of the cases of maritime accidents even in ships having the best and most modern equipment on board. The main reasons for human error are: -

- Lack of Knowledge
- Inexperience
- Incompetence
- Inadequate training
- Inadequate qualification

From the beginning, it had been for years that Maritime Education and Training was not uniform and standards varied considerably from country to country all over the world. In 1959, IMO had set up rules not only to improve the safety of life but also the standards of seafarers who sail the ships. The minimum standards of training, certification and watchkeeping for officers and ratings are prescribed in the STCW 1978 Convention, which come into force in April 1984. This Convention consists of articles, annexes and resolutions.

The articles contain the legal provisions of the convention, entry into force provisions, amendment procedures, certification, dispensation etc.

The annexes dealt with the regulations of mandatory technical requirements for the personnel sailing in the ships. Basically it is divided into 6 chapters as follows: -

- ❖ Chapter I - General Provisions
- ❖ Chapter II - Master and Deck Department
- ❖ Chapter III - Engine Department
- ❖ Chapter IV - Radio Department
- ❖ Chapter V - Special Requirements for Tankers
- ❖ Chapter VI - Proficiency in Survivor Crafts

There are also 23 resolutions in the convention, which are not mandatory but are recommended to be used partly or wholly by the party or respective government if conditions require them to do so. Basically, Resolutions 1-6 define the principles and operational guidance for engine, deck and radio personnel in charge of the watch at sea and in port. Resolution 7 give recommendations for radio operators about their training, certification, revalidation, safety radio watchkeeping etc. Resolutions 8 and 9 specify training requirements for engine ratings and deck ratings who form part of the navigation watch. Resolutions 10-13 provide the guidelines for special training and qualifications of all personnel sailing in oil tankers, chemical tankers, LPG

Tankers and other ships carrying dangerous goods. Resolution 14 and 15 for training radio officers and radio telephone operators. Resolution 16 deals with additional technical assistance for training and qualification for masters and other responsible personnel sailing on oil, chemical and liquefied gas tankers. The remaining resolutions about the radar simulator training, collision avoidance aids for deck officers, personal survivor techniques, large ship handling for masters and chief mates, technical co-operation among parties.

5.1.2 Review of STCW Convention

A series of maritime accidents and casualties in the eighties had drawn attention to the IMO that the STCW78 is still insufficient to keep 'Safer Ships and Cleaner Oceans' globally. There was still a considerable number of incompetent, ignorant and inexperienced personnel employed on board vessels that plied internationally. Thus it is necessary to review the STCW78 due to its shortcomings as follows: -

- No precise standards of competence stated that relates the abilities needed to perform shipboard functions safely and effectively.
- No guarantee that any party is complied with the STCW requirements as IMO had no role in the enforcement of the Convention.
- It only prescribes the minimum period of sea training without precisely defined skills and competence.
- It failed to accommodate the modern development in training and shipboard organisation, that is, it lacks flexibility to suit the modern industries at that times.
- Officers and crew with multiple skills and higher competency are needed especially in sophisticated and specialised vessels.

5.1.3 STCW95

The 1995 amendments to the STCW Convention are conceived to achieve uniformly world-wide of the minimum level of seafarers' competence. The STCW Convention with its Articles, the Annex of Regulations and the STCW Code (with the mandatory Annex A and the voluntary guidance of Annex B) provides the legal framework that will result in significant changes to the system of seafarer education and training as well as the quality of seafarers' certificates.

New responsibilities to shipping companies and new uniform standards of competence have been implemented. Effective measures have been provided to ensure implementation by governments and companies (IMO White List, Port State Control).

Those became mandatory on February 1, 1997 are: -

- Ship board familiarisation for all personnel on board.
- Familiarisation or instruction in safety for all seafarers.
- Basic safety training or instruction for all seafarers with designated safety and pollution prevention duties.
- Certificate or endorsement for Training of personnel on tankers(Oil, gas, chemical) for Masters, officers and ratings
- Documentation Evidence of Training of personnel on ro-ro passenger ships (some parts of this requirement may be postponed by the flag Administration until 1.8.98) for Masters, officers and other personnel serving on ro-ro ships on international voyages.

- Certificate of proficiency in the use of fast rescue boats for every candidate requiring certification of proficiency in fast rescue boats.
- Certificate or documentary evidence of advanced fire-fighting for those designated to control firefighting when they are not certificated for the deck or engine department (chapter II or III).
- Special certificate or documentary evidence for medical first aid for those designated to provide medical first aid.
- Special certificate or documentary evidence for proficiency to take charge of medical care aboardship for those designated to perform these duties
- Minimum rest periods to ensure fitness for duty and placement of watch schedules for all watchkeeping personnel

5.1.4 Company Responsibilities and Obligations

Each company is responsible to ensure that each seafarer assigned to its ships holds an appropriate certificate and its ships are manned in compliance with the applicable safe manning requirements documentation and data of all seafarers employed in its ships are maintained and readily available seafarers on being assigned to any of its ships are familiarised with their specific duties and all ship specific arrangements, installations, equipment procedures and ship characteristics the ship's complement can effectively co-ordinate their activities in an emergency situation.

In addition, companies will have to be aware that references to expanded English language requirements for seafarers are included in the Convention. Officers are required to have appropriate knowledge of the Flag State's maritime legislation. Governments are advised to prescribe measures for the prevention of drug and alcohol abuse.

5.1.5 Implementation Dates

February 1, 1997

The 1995 amendments to the STCW Convention enter into force.

August 1, 1998

Transitional measures have been implemented for the existing certificates of STCW 78. All new entrants commencing training after this date will be required to do so according to the new standards.

February 1, 2002

The 5 years transitional period ends.

5.2 Implementation of Quality Standard System

With reference to the Maritime Education and Training, quality assurance may be defined as 'fitness for purpose'. By the revised STCW convention, all organisations engaged in the Maritime Education and Training activities should have their quality standard system in place and controlled by the respective national administration. The quality system should be maintained, developed, established, implemented and documented by each of the organisations. The system is about having processes and procedures in place that are actively used and implemented to achieve the main objectives.

Under the Regulation I/8, the requirements for Quality Standard Systems apply to all the STCW education, training, assessment, certification, endorsement and revalidation activities, which include the qualifications and experiences of instructors and assessors in both the governmental and non governmental organisation areas. Part B I/8 of the code provides guidelines about the development of the quality standard and how to establish the internal quality assurance evaluations inclusive of the self study programs.

Generally there are four main elements in the quality standard system such as: -

- Documentation
- Processes and Procedures
- Internal quality review
- External evaluation

In the documentation process, the provisions and the requirements of the quality system must be well defined and documented to become a part of the overall document of the organisation inclusive of the following: -

- The detailed course programme including syllabus, objectives, duration, instructor-student ratio, training facilities etc. which are approved by the maritime administration.
- Organisation policies with its structure and objectives.
- Qualification and experience of the instructors and assessors
- Quality system structure inclusive of the main organisation.

All the activities of education, training, assessment, certification, endorsement and revalidation are required to be implemented in compliance with the processes and procedures as stated in the documentation.

The internal quality review should be well planned, implemented effectively and then properly recorded in accordance with the procedures in the documentation. Competent personnel independent of the area being evaluated should only be allowed to perform the task, then the evaluation team will submit to the management a record of compliance or non compliance. Finally the management will ensure all corrective actions are taken appropriately with reference to the evaluation report.

The independent external evaluation of the whole MET system needs to be conducted at least once in every five years to provide an independent assessment of the effectiveness of the quality standard arrangements at all levels. Advance information about the functions of the organisation should be given well before the inspection. The external evaluators should be well qualified in the MET system to carry out evaluation in accordance with the documented procedures. Their duties is to identify weaknesses and flaws in the system so that the departmental heads can be notified and remedial actions taken; and finding out whether the functions, procedures and processes are being conducted in accordance to the requirements of the revised convention.

Each party should report to the IMO the result of each independent evaluation within six months after the completion of the evaluation. The links and interactions of the quality standard system are shown in the figure 5.1

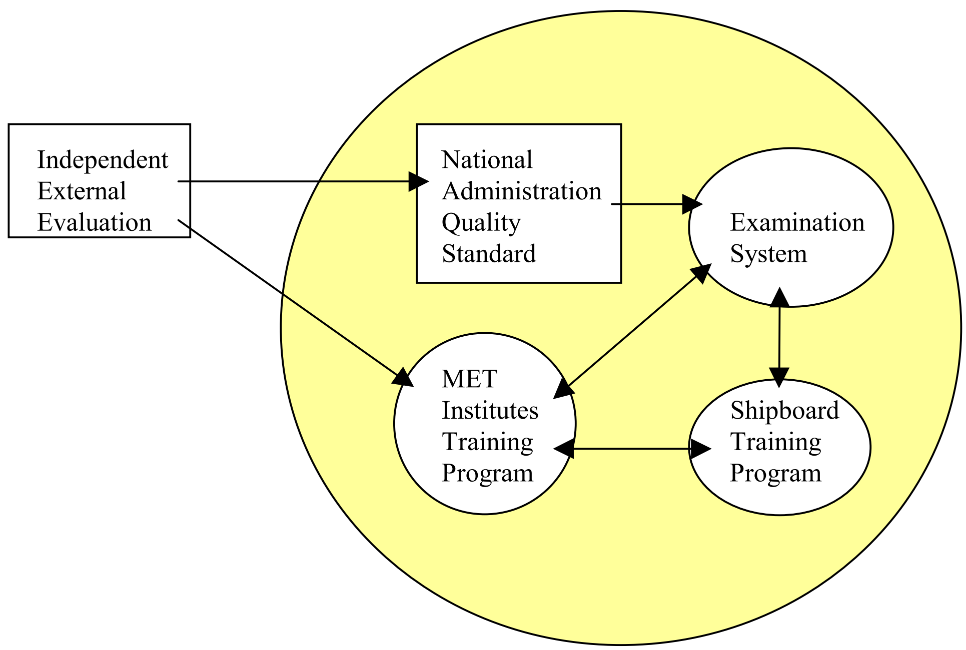


Fig 5.1 Quality Standard System.

Source: Prof. P.Muirhead (1998)

5.3 Teaching New Technology And Methodology

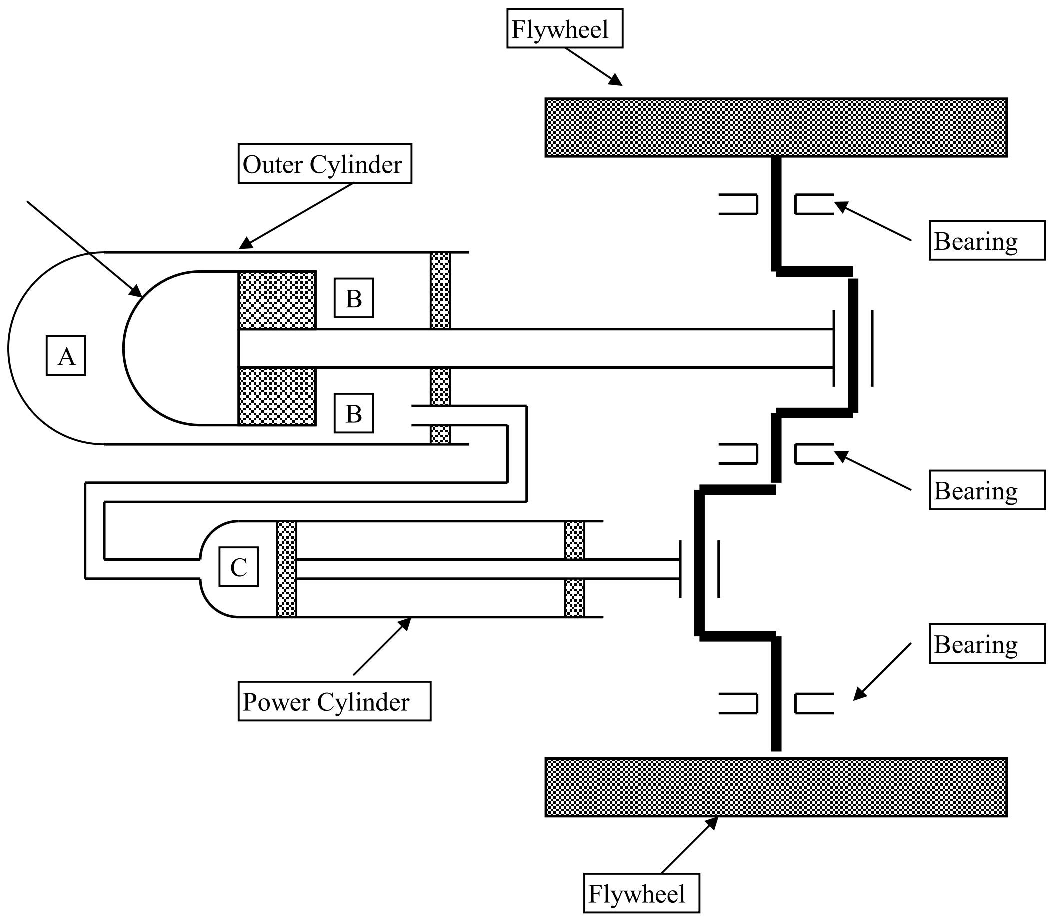
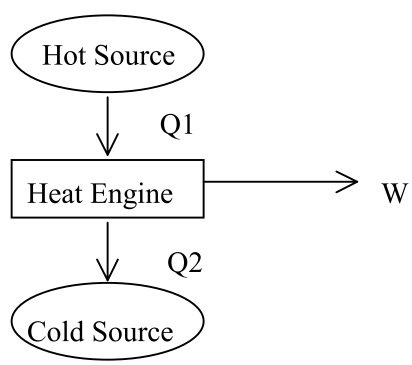


Figure 5.2 Principle of heat engines
Source:- Professor Tsuchiya , Meiji University

This apparatus shown in Fig. 5.1 is designed by Professor Tsuchiya from Meiji University, Japan. It is a good illustration to show the principle of heat engine and thereby can be used as a good teaching aids to let the students see how temperature difference of air can be used to produced mechanical work. The working principle is that the round end of the outer tube is heated by a flame or other source of heat energy so that the air in chamber A is heated up and expanded, the expanded air travelled to the power cylinder and push the piston to the right to turn the crank. At the same time the other crank will move the inner cylinder to the left. Now the chamber B is filled will cold air which contract to suck the piston of the power cylinder to the right. And the camber A again receive heat and expands to repeat the cycle to turn the crank continuously. The purposes of the flywheels are to carry over the momentum over to the next stroke of the reciprocating motion.

It is also a useful illustration for explaining the basics principle of the second law of thermodynamic to the students whereby a cold source is necessary for a heat engine to operate, that means in the equation of the heat engine:-

$$Q1 - Q2 = W$$



The designed project can clearly clarify that the Q2 cant never equal to zero and the Q1 will never equal to work done, W which thereby satisfy the second law of thermodynamic which states that not all the heat energy can be converted to work and some heat energy will sure to be lost to the cold source.

The concept of analogy is also a useful way of a better understanding some abstract terms which cannot be easily understood by the students. Professor Nakazawa from WMU have suggested a few ways which I think is very useful for me to practice when I returned to my home country for better and more effective teaching of marine engineering students. Here I would like to emphasize a few examples of analogy of some abstract thermodynamic terms to the natural world of water.

The differences between heat and temperature may be hard to understand but by comparing to the world of water, the concept and the characteristics of the terms will be easily understood and remembered and later may make it interesting to study deeper into the subject.

The temperature is analogous to the height of water in a tank while the heat is analogous to the amount of water in the tank. The water will only flow when there is different level or height of water from one tank to the other, similarly heat energy will only flow when there is a difference in temperature from one place to the other.

Also the second law of thermodynamic can be explained by water analogy, work can be produced by placing a paddle wheel or turbine to the flow of water from high level to low level. A low level reservoir is necessary for the work output. Similarly the heat engine needs a low temperature reservoir to produce work too and that explains the second law of thermodynamics clearly and effectively to be remembered in the mind for long periods of time without forget it easily.

The heat flow through the tube walls in marine boiler can also be made analogous to the current flowing through the electrical resistances connected in series to a voltage supply. The voltage is analogous to the difference in temperatures between the walls of the gas side and water side.

CHAPTER 6

Conclusion and Recommendation

It is absolutely clear that the MET (Engineering) system in Malaysia has great spaces for development. The two Marine Engineering wings in Politeknik Ungku Omar (PUO) and Akademi Laut Malaysia (ALAM) have grown and developed relatively isolated from one another. The wide geographical and administrative separation between the two complementary engineering wings is seen to be a serious handicap. The excellent workshop and laboratory facilities in PUO are beyond the effective utilisation of ALAM students. There is little centralised co-ordination, planning and organisation as far as marine engineering education and training is concerned.

The areas of specialisation are different with the PUO engaged with the pre-sea marine engineers MET, and the ALAM primarily involved in post sea courses such as second class and first class certificates of competency preparatory courses. However the approximately 70 students intake per year does not justify the existence of 2 independently run, widely separated marine engineering wings. Furthermore the set of students involved are the same group from PUO, who finally arrive to the ALAM for the post-sea higher certificates of competency.

Based on the field trips study of the MET system in more developed countries and the lectures in World Maritime University, most institutions in USA, Japan, Norway, Netherlands, France, Germany and others run simultaneously pre-sea and post-sea courses in marine engineering, marine transportation and navigation. Can the MET (marine engineering) in Malaysia defend its position?

(Source: - United States Merchant Marine Academy. Newyork)

(Source: - Lecture notes of World Maritime University)

6.1 Problems of present MET system

It can be seen from the present MET system described above do have problems of separation and lack of integration of the two engineering wings of PUO and ALAM. The existing engineering set-up in Malaysia needs utmost consideration towards integration or consolidations as practised by, among others, the Netherlands and the United Kingdom. The vital human resources are scarce; teaching equipment under utilised and also the system is under productive. The separation also deprived the engineering MET many advantages and strengths that accrue to a well-managed integrated MET college. This matter is so serious that the effects of this continued separation are discussed. Below are the four major effects caused, namely the effects on development, effects on education and training objectives, effects on the courses and the effects on MET generally

6.1.1 Effects on Development

As far as infrastructure planning and development and utilisation are concerned, geographical separation and administration division makes up increased problems. Due to small intake of students, it is often difficult to justify on economic grounds the acquisition of new and effective teaching equipment. Normally the school budget is allocated according to the number of students in the school concerned. Particularly this is true in PUO where budget allocation for marine engineering department is often too low compared to the expenditure, and the developmental budget is almost minimal during the recent years. This is a serious hindrance to the ability of the marine engineering section to respond to any new technology change or demands.

6.1.2 Effects on Education and Training Objectives

Both PUO and ALAM are manned with small number of staffs and thus are facing similar problems such as staff development, promotion and academic enrichment opportunities. The staff in ALAM has comparatively more shipboard experience and possesses first class certificates of competency and the staff in PUO has more academically based qualifications with less shipboard experience. It is believed that there needs a balance of both academic and professional capabilities for the graduates to perform competently onboard ships.

There are also few opportunities for staff development through study leaves, upgrading courses and others such as seminars, meetings etc. This does mean that there is less motivation and possible degradation of the standard of the courses.

6.1.3 Effects On Courses

Many short courses that are recommended by the STCW 78 convention and the Amended STCW 95 are still under review in Malaysia. With the continued geographical and administrative separation of about 300 km, the engineering wings of both colleges are too feeble to be able to make a possible response for most of the courses. The technology of the world today has changed so rapidly that many marine engineers are in danger of losing touch and become antiquated. Our marine engineers are more unfamiliar with the modern shipboard technology unless measures are taken accordingly to increase confidence in the safe and efficient operation and maintenance of modern ships.

6.1.4 Effects On MET Generally

The continued separation of complementary marine engineering education and training facilities is likely to hinder seriously the response of general MET to meet future needs and demands. The effects on development of short courses as described previously are one of the major problems. The long-term effects may be more serious. Due to the expansion of education opportunities nation wide and world wide, the public have higher expectation of higher education quality. The MET in general will suffer from incapability to offer courses of sufficient standards to attract capable students. The maritime industry is then suffers from less growth relative to other industries. Due to lack of coherent and integrated structure of education and training, the situation of marine engineering sector will be aggravated based on public perception of weaknesses.

6.2 Proposals for Actions

Recognising the weakness of the present set-up, swift action needs to be taken to overcome then. Four recommendations which address these weaknesses are integrating of the MET (engineering) for PUO and ALAM, co-operation and joint conduct of courses and examinations, external co-operation and linkages with industries and the development programmes for staff members.

By integration, the number of institutions of the same field can be reduced to bring about a more qualitative and quantitative strengthening of higher vocational institutions. Another objective is to decrease the cost in education budget due to economic difficulties. Furthermore it allows for a more flexible response to the changes in the demand of higher education. Co-operation and academic linkages are important to prevent underutilisation of the scarce and valuable resources and to encourage staff motivation. Delegation of all written examinations for certificates of competency to the institutions from Marine Department Malaysia can, somehow, also greatly increase the morale of staff and staff enrichment opportunities. The interrelationships between the industries and the institutions and the Maritime Administration are very important to the continued relevance and efficiency of the MET programmes so that any changes in the demands of society will be communicated and adaptation measures could be taken to ensure constant updating of the curriculum of the institutions.

6.3 Improvement of English Speaking Skills

At present, the English language is introduced during the first and second semester with the aim of attaining higher standard of English for students to do research in the library as most of the technical books are written in English. This is also due to the fundamental in English is not strong during their primary and secondary school days during which most of the subjects are taught in the national language, Bahasa Malaysia.

Some major shipping companies such as Malaysian International Shipping Corporation (MISC) had fed back some information about the graduates of the institute that their English standard is still yet to be improved or upgraded. This is to make the future marine engineers more confident in communication with the outside world in international waters. Furthermore there are still a lot of foreign crews employed in Malaysian ships. Thus it is very important for the institution to make sure that the students are well equipped with good and fluent English speaking skills to facilitate their works on board ships.

The author would like to recommend that English should be continued to be taught during semester 4, semester 7 and semester 8 so that they will not be lagged behind and forget what they had studied before. The timetable for semester 7 and semester 8 may be full and no space to put the subject in. Then possibly it is good idea to introduce Saturday morning class for the students to brush up their English speaking skills. And if there were to be work overload to the English lecturers, flexitime may be applied to the teaching staffs that work on Saturdays.

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APPENDIX 1

GENERAL INFORMATION (MET MALAYSIA)

Institute name	ALAM	SMTC	PUO
STCW Ractification	*	*	*
Type of Institute	P	P	G
Language	E	E/M	M/E
No. of Full Time Lecturers	58	8	18
No. of Part Time Lecturers			
Max. No. of Candidates	800	180	80
Availability of Accomodation	*		*
Availability of Meals	*		*
Oversea Candidates	*	*	
Basic Progs.Leading to DO W/K Cert.	*		
Basic Progs.Leading to EO W/K Cert.	*		*
Upgrading Courses Leading to DO Cert.	*		
Upgrading Courses Leading to EO Cert.	*		
Availability of Short Courses	*	*	*
Availability of Ratings Coureses	*		*

P = Private
G = Governmental
E = English Language
M = Malay Language

APPENDIX 2

TRAINING FACILITIES

Institute Name	ALAM	SMTC	PUO
Ship Handling Simulator	*		
Engine Room Simulator			*
Radar Simulator	*		
ARPA Simulator	*		
Tanker Simulator			
Planetarium			
Electronic Navigation Laboratory	*		
Seamanship Laboratory	*		
Meteorological Laboratory	*		*
Refrigeration Laboratory			*
Automatic Control Laboratory			*
Electronic Laboratory			*
Language Laboratory	*		*
Communication Laboratory	*		*
Computer Laboratory	*		*
Physics Laboratory	*		*
Chemistry Laboratory			
Fire-Fighting Training Facilities	*	*	
Survival Training Facilities	*	*	
Marine Polution Prevention Trg. Facilities	*		*
Engineering Workshop	*	*	*
Diesel Power Plant / Workshop	*		*

APPENDIX 3

STUDY PROGRAMMES AND SHORT COURSES

Institute Name	ALAM	SMTC	PUO
DO W/K Cert. Programmes	*		
EO W/K Cert. Programmes	*		*
DO Cert.Upgrading Programmes	*		
EO Cert.Upgrading Programmes	*		
Basic Fire Fighting	*	*	
Advance Fire Fighting	*	*	
Personnel Survival	*	*	
Search and Rescue	*	*	
Proficiency in Survival	*	*	
Radar Obs. and Plotting	*		
Radar Simulator	*		
ARPA Simulator	*		
GMDSS Simulator	*		
Medical Emerg. Basic Training	*		*
Medical Emerg. First Aid	*	*	*
Medical Care	*		
Oil Tanker Familiarisation	*		
Advance Oil Tanker Operation	*		
Chemical Tanker Familiarisation	*		
Advance Chemical Tanker Operation	*		
Liquid Gas Tanker Familiarisation	*		
Advance Liquid Gas Tanker Operation	*		
Basic Stability	*		
Other Courses		*	