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The training of marine engineers : present methods and future directions in developing countries (Africa)

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WORLD MARITIME UNIVERSITY
MALMÖ, SWEDEN

THE TRAINING OF MARINE ENGINEERS
Present methods and future directions in developing countries
(Africa)

By

YASSIN MAGONGO SONGORO
Tanzania, United Republic of

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

MASTER OF SCIENCE
In
MARITIME EDUCATION AND TRAINING
(Engineering)

2000

DECLARATION

I certify that all the materials 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 content of this dissertation reflects my own personal views, and not necessarily endorsed by the University.

.....
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ABSTRACT

Title of dissertation: **Training of Marine Engineers: Present Methods and Future Directions in Developing Countries (Africa)**

Degree: **Master of Science in Maritime Education and Training (Engineering).**

This dissertation is the study on technological developments, its application onboard ships of the future and its impact on the education and training of marine engineers.

The roles of marine engineering practice and maintenance management systems have been briefly examined. The economics of ship operation and the role of technology in the training of marine engineers have been compared.

The growth in automation engineering and its developments in machinery space handling have changed the face of seafarers training in most part of developed world.

Computers, simulators, and the information technology are increasingly replacing the traditional *hands on* and classroom training methodologies for seafarers of the future.

The historical development of some MET systems and the development behind them have been collated and evaluated. Curricula developments have been analysed and compare with the STCW requirements.

Additionally, demands on crew reduction onboard *system ships*, manning requirements, crew costs and its impact on the safety of ships have been analysed.

The concluding chapters have remarked problems faced by some MET in developing countries. Financial constrains have been pointed out as the key element in the updating and developments of curricula that will determine the competency of marine engineers from developing countries. A number of recommendations on the need for the centralisation of education system, establishments of manning agency, institutional and regional co-operation have been proposed.

KEY WORDS: Impact of technology on education and training of marine engineers; Crew costs, manning and safety of ships; STCW and ILO Requirements; Automation, maintenance management and simulator training for marine engineers.

TABLE OF CONTENTS

Declaration	ii
Acknowledgements	iii
Dedication	iv
Abstract	v
Tables of contents	vi
List of Tables	ix
List of Figures	x
List of Abbreviations	xi
1 Introduction.	1
2 Marine Engineer in the Maritime Industry	6
1.1 The Role of Marine Engineers in the Maritime Industry	6
1.2 Training requirements for Marine Engineers:	
Reflection on STCW'95 Code	9
1.3 Ship owner's responsibility in training of Marine Engineers	15
1.4 Human element (factor) in the maritime safety	19
3 The future of Marine Engineers	24
2.1 The International Labour Organisation	30
2.2 Shipboard Maintenance and Cost Effectiveness	31
2.2.1 The Preventive Maintenance Cost	32
2.2.2 Corrective Maintenance Cost	35
2.2.3 Break Down Maintenance Cost	36

2.2.4 Workmanship Quality and the Shipboard Maintenance	38
2.3 Development in Automation and Control at Sea	39
2.3.1 Performance diagnostics in marine engineering systems	41
2.3.2 Marine engineers and the ships of the future	42
4 Modern technology in the training of Marine Engineers	47
3.1 Computer Based Training	48
3.1.2 Proto type and Full mission engine room simulators	51
3.1.3 Comparison: Hands on training and the use of simulators	53
3.1.4 Career development for marine engineers	54
3.2 Cost evaluation for the training of marine engineers	56
5 Marine Engineer’s Training. Comparison of selected countries	58
4.1 The United State Merchant Marine Academy (USMMA)	60
4.2 Kobe University of Mercantile Marine (KUMM)	62
4.3 Dar-Es-Salaam Maritime Institute- (DMI, Tanzania)	66
4.4 Maritime Education and Training in Spain	69
4.5 Maritime Education and Training in Denmark	72
6 5.0 Training of Marine Engineers in Tanzania	75
5.1 The SWOT analysis	77
5.2 Education system in Tanzania: Its impact on Marine Engineers	80
5.3 Engineers Registration Act: Registration of Marine Engineers in Tanzania	81
5.4 The East African Co-operation (EAC): Education for seafarers	82
7 Conclusion	83
6.1 Conclusions	83
6.2 Recommendations	85

References		88
Appendices		
Appendix A	WMU Graduates by country-MET	91
Appendix B	Trend for Engineer Graduates from MET course	92
Appendix C	Attention and ‘Perceptual error’	93
Appendix D	Japanese Experience of Cutting Labour Cost	94
Appendix E	A letter from Maritime and Coast Guard Agency	95
Appendix F	A letter from ‘Marine Mangers LTD’	96
Appendix G	Spanish MET Educational scheme	97

LIST OF TABLES

Table 1	Break down of deficiency items related to crew.	17
Table 2	Crew cost of Different Nationalities	26
Table 3	Cost of Training to Class 3. UK	56
Table 4	Training Cost at USMMA	56

LIST OF FIGURES

Figure 1	System Hierarchy	8
Figure 2	Ship's operating costs	24
Figure 3	Maintenance Policies	32
Figure 4	The Bath Tub	36
Figure 5	Integration of ship's Systems	44
Figure 6	Machinery Space Simulator (CBT)	48
Figure 7	Full Mission 'Graphic' Engine Room Simulator	50
Figure 8	Full Mission 'Real Console' Engine Room Simulator	51
Figure 9	WMU- Graduates in Maritime Education and Training (1983-2000)	58
Figure 10	Maritime Education System in Japan	64
Figure 11	Engineering Course Structure at DMI (Year 2002 Projection)	66
Figure 12	Maritime Education and Training in Spain	70
Figure 13	Maritime Education and Training in Denmark	72

LIST OF ABBREVIATIONS

A	Advanced (Secondary Certificate).
AB	Able Bodied (seamen).
ACTME	Advanced Certificate of Technology (Marine Engineering).
ADME	Advanced Diploma in Marine Engineering.
ADTME	Advanced Diploma of Technology (Marine Engineering).
AMC	Australian Maritime College.
B&W	Bermuster & Wein.
BIMCO	Baltic and International Maritime Council.
BSc	Bachelor of Science (degree).
CBT	Computer Based Training.
CD-ROM	Compact Disc-Read Only Memory.
CMO	Certificate in Marine Operations.
CORLEG	International Convention for Collision Regulations
DK	Danish Kronor.
DMA	Danish Maritime Authority.
DMI	Dar-Es-Salaam Maritime Institute.
DMTU	Dar-Es-Salaam Maritime Training Unit.
DOC	Document of Compliance.
DPC	Dual Purpose Crew.
Dr.	Doctor.
E	Engineer(ing).
EEZ	Exclusive Economical Zone.
EU	European Union.
GMDS	Global Maritime Distress Safety System.
IACS	International Associations for Classification Societies
IBC-Code	International Code for Ships Carrying Dangerous Chemicals in Bulk

ICERS	International Conference on Engine Room Simulators.
ILO	International Labour Organisation.
IMCO	Inter Governmental Consultative Organisation.
IMO	International Maritime Organisation.
IOPP	International Oil Pollution Prevention
ISF	International Shipowners Federation
ISM-Code	International Safety Management Code.
ISO	International Standards Organisation
ITF	International Trade Federation.
KUMM	Kobe University of Mercantile Marine.
MAPEX	Maintenance Performance Enhancement with Expert Knowledge.
MARPOL	International Convention for Prevention of Pollution from Ships.
MEPC	Maritime Environmental Protection Committee.
MET	Maritime Education and Training.
MNOAT	Merchant Navy Officers Association Of Tanzania.
MSC	Maritime Safety Committee.
MV	Motor Vessel
N	Nautical.
NGOs'	Non Governmental Organisations.
NI	National Insurance.
NIT	National Institute of Transport.
NKK	Nippon Kaiji Kyokai
NO	Nitrogen Oxide
NORAD	Norwegian Agency for International Development.
NSD	New Sulzer Diesel
O	Ordinary (Secondary Certificate).
P&I	Protective & Indemnity.

PM	Preventive Maintenance.
PMS	Preventive Maintenance System.
PPT	Propulsion Plant Trainer.
PR	People's Republic (of).
Prof.	Professor.
PSC	Port State Control.
RCM	Reliability Centred Maintenance.
DEREL	Diesel Engine Reliability Database.
S	Super long Stroke
SMC	Safety Management Certificate.
STCW	International Convention for the Standards of Training, Certification and Watchkeeping of Seafareres.
TACOSHILI	Tanzania Coastal Shipping Line.
UK	United Kingdom.
U	United Nations.
US	United States.
USCG	United States Coast Guard.
USD	United States Dollar.
USM	Unattended Machinery Space.
USMMA	United States Merchant Marine Academy.
WMU	World Maritime University.
XII	13 th (Century).
XIV	14 th (Century).
Yrs	Years.

THE TRAINING OF MARINE ENGINEERS PRESENT METHODS AND FUTURE DIRECTIONS IN DEVELOPING COUNTRIES (AFRICA)

Introduction

The operation of merchant ships is becoming more specialised and complex following fast technological developments in this '*science and technology*' arena.

Engineering of today is based more on automation, computerised operations and monitoring in terms of equipment design, performance and maintenance.

Traditionally, monitoring was based on manual 'hands on', where a piece of machinery equipment were to be striped off for inspection and determination of its life time by visual inspection and physical measurements. Compression (piston) rings, for example, were to rely on the engineering experience of the personnel on board and or the manufacturer's instructions before they could be opened up for the necessary actions. Manual operations for equipment on board were an ideal traditional engineering practice. Time and cost was not an important element in shipboard operations because labour was relatively cheaper.

The economic recession taking place at a global level is witnessing a number of developments in ship operation practice. The concept is to reduce running costs; especially manning costs and improves in ship's safety. Ships and machinery handling have become more centralised as a result of innovation in automation and control engineering. To day, piston rings wear can be monitored through computers on board and with the development of technology, maintenance engineers ashore may have access to the engine performance. Through this way, planned maintenance may be arranged without much interference to the ship's operations. Similarly, operations of various equipment onboard can take place from a remote place, quicker than before and with a minimum effort. Maximum utilisation of the manpower onboard can be arranged.

The development in automation engineering and the application of computers onboard has brought a number of changes in terms of maintenance policies to be applied and the necessary manpower to be employed. Changes in the world economy have an influence over management and operation of ships today. The manning requirements shows every indications to be in favour of ship owners who, regard less of size, wants to operate their ships with the smallest possible the number of crew. The author may suggest that the move in the increasing application of computers and automation onboard ships has been influenced by ship owners in trying to cut down ship operating costs, in particular crew costs. What impact this new science and technology has over the future of marine engineers in the shipping industry?

Traditional marine engineers were basically trained to serve on board as watch keeping officers. The developments and changes that are taking place in the shipping industry to day, training should also focus on other maritime related aspects both ashore and afloat. Flexibility in the training and education of marine engineers in developing countries needs to be reviewed in order to give competitive opportunities to other engineering and production industries ashore.

Everett. C. Hunt and Boris. S Butman, of the United State Merchant Marine Academy, addressed the training of marine engineers as, *“Marine engineers to day are required not only in ship’s machinery operations, but also in decision making, ship design and research. They must be able to address qualifications of risk and uncertainty and make optimal use of resources including labour, material, capital and technology, and to apply effectively the techniques of engineering economics and cost analysis. This is because:*

- *Ships today cost more each year in absolute terms due to large size, greater complexity, and improved in high technology.*
- *Ships are becoming less flexible in terms of employment as trade has become more segmented by speciality tonnage.*
- *Economic life cycles of assets/equipment are shorter due to the increasing pace of technological innovation and changing*

requirements.

- *Financial resources, the life blood of capital intensive shipping, have become more difficult and costly to obtain.”*

However, such developments have increased demand for technically trained personnel in the maritime industry in order to qualify for these changes. Marine engineers of the early days in the last century were basically trained on ‘hands on basis’. It was not until the early 60’s where formal training was looked as a vital process for efficient operations of machinery in merchant shipping.

Safety considerations, local and international regulations, have an increased pressure in the education and training of marine engineers who are required to work according to these requirements. The adoption of the 1971 Assembly Resolution A.248 (VII) under the then IMCO (Inter Governmental Consultative Organisation), through the conference held in London (14th June to 7TH July 1978) was the beginning of the appreciation on the importance of the formal training for the world seafarers. The objectives were to come up with uniform standards, and bring qualified personnel to a uniform level for the safety of operations and for the prevention of pollution of marine environment from ships.

The standards of Training, Certification and Watch keeping, STCW78, came into effect globally and entered into force on 28th April 1984. These guide lines, which were to be applied to all member States upon ratification and being merged into their national laws (implementation), set up a new mile stone for the appropriate training of marine engineers as indicated in Chapter III, Reg. III/1 through Reg.III/6 of the Convention.

Following the economic struggle of the world and the drastic changes of technology over the last half a century, training of marine engineers and their employment opportunities in the maritime industry, present a point of concern to the author of this dissertation.

A substantial part of this work will base on the author's past professional experience as a marine engineer (from developing county in Africa, Tanzania to be specific), and as a lecturer in a maritime institute. Particular empathises will be directed towards the role and training of marine engineers, present methods and future directions as will be analysed through chapter I. Technological developments, ship owner's responsibilities, maintenance management and the requirements from the International Labour Organisation (ILO), will be discussed in chapter II, looking closely to the future of marine engineers.

The application of modern technology in the training of marine engineers, Computer Based Training (CBT), simulator training, use of distant learning and their effects over the traditional 'hands on', will be discussed in chapter III. Chapter IV will analyse training methods, curriculum development and entry requirements from selected maritime institute, colleges and or universities from developed countries and make comparison with similar institutions in developing countries in Africa. The author, on the experience gained from field studies visited to maritime institutions, maritime administrations and maritime industries, ship building and ship research institutions as well as some few land based production industries, has realised that there is a potential need for readjustment of curriculum for METs' in developing countries. The new curriculum should absorb not only the STCW requirements, but also improve academic qualities and qualifications for marine engineers in order to provide flexibility in employment opportunities and give them the real competency to face the challenges of the future.

Chapter V will be specifically discussing the training of marine engineers in Tanzania. Strengths and weaknesses of Dar-Es-Salaam Maritime Institute will be analysed, threats and opportunities will be pointed out and finally concluding remarks will be given in chapter VI along with recommendations in the institutional and regional co-operation for the training of marine engineers in East Africa.

It is therefore hoped that the contents of this work may highlight the problems in the educational structures for the training of seafarers from developing countries so that any identified weakness could be changed into opportunities. Curriculum development in MET institutions from Africa need to be restructured to move in pace with technological and economic changes which are taking place at a global level. The training of marine engineers should focus into other maritime related sectors. However, the idea of institutional and regional co-operation towards training and educational enhancement, on cost effectiveness and the appropriate utilisation of human resources, should be looked by maritime administrations at all levels. The source of success toward achieving the international standards as set up in the STCW'95-Code, should aim at institutional and regional co-operation.

Regional co-operation in matters regarding maritime affairs, such as Port State Control, International Safety Management (ISM), Search and Rescue and many others, will always stand as a motto of the International Maritime Organisation, the IMO. Education towards enhancement and making those IMO's objectives meaningful, should be a mirror toward co-operation at all levels.

CHAPTER I

Marine engineers in the Maritime Industry.

1.1 The Role of Marine Engineers

No ship is any better than her marine engineers on board and on shore. The safety and the efficient operation of any ship, despite the advancement of technology, rest entirely on the hands of marine engineers. Safety and pollution prevention from ships has been, and will continue to be the main objectives of the IMO. Ship's safety of operation lies on the reliability and maintenance management of equipment on board, various cargo handling gears and that of communication facilities.

Traditionally, marine engineers were needed on board only for operational purposes and as such the economic conceptions in total operating cost and design criteria (in reducing this vital part of the total ship cost), was left to shore based and ship yard personnel. The regulatory regime set up in different IMO's Conventions over the last thirty years now, were all aiming in improving the safety of ships and the prevention of pollution of marine environments. The improvisation of laws, recommendations and protocols into national legislation system, were not (and still a practice for some countries today) effective because there were ignorance to the severe impact on safety and economical consideration to their society and the international community. Why bother, for example, ratification and implementation of SOLAS74 or MARPOL73 and its Protocol of 1978, while the country has no ships qualifying in to these IMO regulations!

The reactive mentality still binding those with authority to make decisions might be centred to serious catastrophes the world will never forget. The sinking of the giant TITANIC (12th April 1912), capsizing of the Herald of Free Enterprises, Scandinavian Star and perhaps that of MV Bukoba (Lake Victoria 1996), the grounding of the Exxon Valdez and many other maritime accidents, has been associated by human factor and lack of competence in maritime safety affairs.

The consequences of these un forgettable catastrophes have influenced the IMO to come up with strong and comprehensive regulations in a move to prevent its repetitions. The STCW'95 is centred towards improvements in the management of ships operations in bringing the safety standards to the highest level. Today, many countries have ratified most of IMO's Conventions, but to some, implementation is still questionable.

The suffering caused on one hand laid on the engineering technology of the day, human factor and other an avoidable saccumstances. Marine engineers, in co-operation with engineering professional, has a great role to ply, in ship design, research, ship building and the development of various maintenance management in the promotion of safety and the prevention of maritime casualties. Ships must operate efficiently, safely, reliably and environmental friendly in order to achieve the objectives of '*Safer Shipping and Cleaner Oceans*'.

The concept of economical operation, safety and prevention of pollution of marine environment from ships is one of the major concerns of marine engineers all over the world. The progressive development of different operational and maintenance phenomenon, from traditional manual to automation engineering was put in practise. Today, computerised systems on board are becoming popular. The maritime society, ship owners, ship managers or operators and all others interested in maritime transport have witnessed the advantages of these technological innovations. Fast turn round, minimum running cost, and fast return of initial investments, gave ship owners opportunities to remain competitive in maritime transport. More important is that of safer shipping and cleaner oceans.

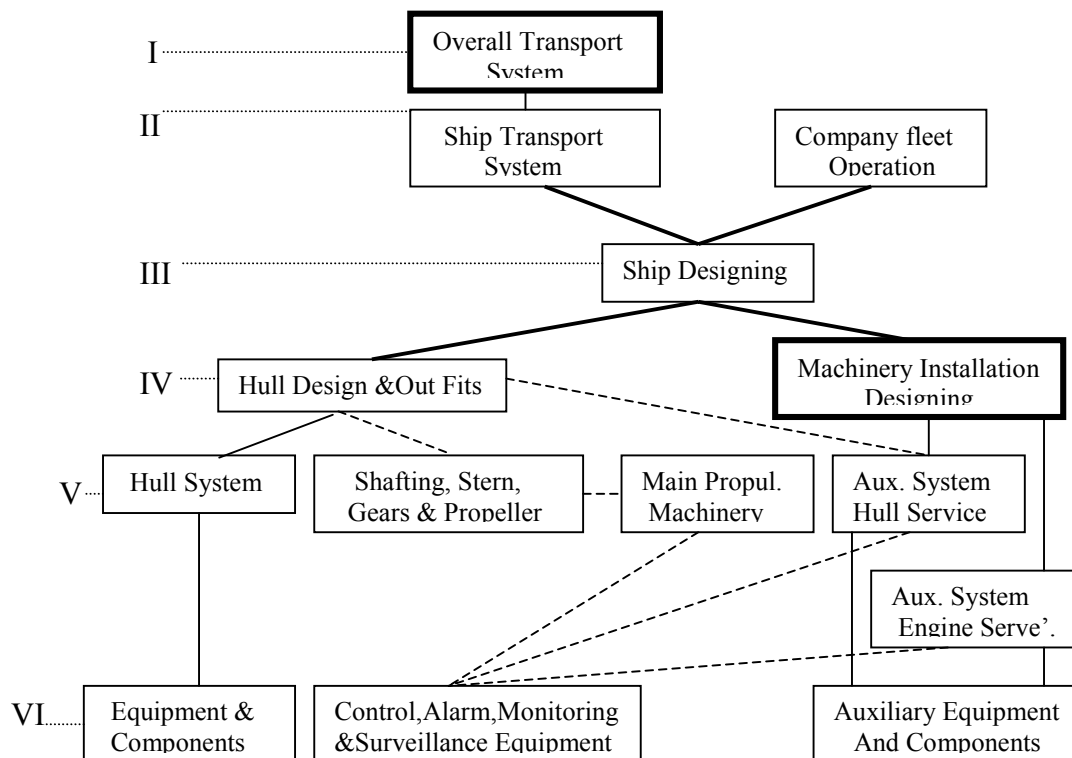
As an example toward contributing to this phenomenon, marine engineers have voluntarily established different associations. The Institute of Naval Architectures and Marine Engineers of the United States, the Institute of Marine Engineers of United Kingdome, and perhaps, the Merchant Navy Officers Association of Tanzania, to mention just a few. These institutes forms a gathering of marine engineers from all over places, sharing the experience and more important, are major advisory bodies in marine engineering activities with respect to safety issues.

To give an aiders on some of the roles of marine engineers to day, consider a ship as a system and as a mode of reliable transport in the global economy.

The proceedings of a conference (7-8th June 1971) of the Institute of Marine Engineers, on the ‘Factors in the selection of marine machinery and plant with particular reference to reliability, maintenance and cost’, mentioned that; “A system may be defined as an array of interacting components which co-operate purposefully in order to accomplish a defined objective.”

The following organisation chart may give a clear definition of the system and the way components interact to accomplish a desired objective.

Fig. 1. System Hierarchy.



Source: Proceeding of a Conference 7/8 June 1971. Institute of Marine Engineers, London, United Kingdom.

Referring to figure 1 above, a ship is a complex system comprising individual components as indicated. The complete system should comprise all components,

which interact with one another in a rhythmic manner to accomplish the desired function. At level III, it is sufficient generally to say that, the design of both ships' hull including outfit, machinery installation including main propulsion, auxiliaries, control, and alarm and monitoring are the vital elements for a sea worthy ship. Marine engineering practice should strive to ensure that, the design, as the backbone of the whole entire system complies with the need and the safety standards. A failure of one component means a collapse of the whole system. The conference further highlighted that; "A central feature of the system design process is optimisation, i.e. the design of a system in such a way that it achieves the objective most efficiently." Public concern over maritime activities and their impacts on human health, living organisms and the Green house effect, are the challenges putting marine engineer at their core. Therefore there is a need to develop comprehensive research to meet the requirements of today's world regulatory regime.

1.2 Training requirements for Marine Engineers and the revised STCW'95 Code.

When we talk of '*sea worthiness*', a common man might suggest that, it is the construction of a ship to the highest standards. Perhaps under the ISO quality standards or that set by the International Maritime Organisation (IMO), and if he may be lucky, he may think of that of Classification Societies. Today the worthiness of the ship will mean more than this.

The 1974, International Safety of Life at Sea, here referred to as SOLAS74, in its chapters 1, II/1, II/2, III...through chapter VII, laid down a number of regulations ranging from the construction, subdivision and stability, *machinery and electrical installations* to the carriage of dangerous good. Important area in this regulatory instrument is clearly indicated through chapter IX, ***Management for the safe operation of ships***. Management in terms of safety construction of ships (as per Classification Society and IMO standards), but a complete seaworthy ship must have

competent personnel on board. It is this competency of management ashore and crew onboard that will determine the quality and the degree of safety in the maritime transport sector. Empathising the subject, the International Safety Management Code (ISM-Code) was adopted by the IMO through Assembly resolution A741 (18) on 17th November 1993 and entered into force on 1st July 1998. The requirements through this Code has been made mandatory for passenger ships, high speed passenger crafts, all types of tanker, bulk carriers and all types of high speed cargo crafts above 500 gt. The Code will be made mandatory for all other ships by 1st July 2002.

The Code basically deals with people on whom compliance to the safety standards depend upon and gives a substantial contributions in trying to solve the major problems the shipping industry has had for years in dealing with safety and marine pollution prevention.

Like wise, the International Convention on the Prevention of Pollution from Ships, refereed to as MARPOL73/78, Annex I through VI, has defined different measures to be taken, through various regulations contained in it to ensure ships operate safely and environmental friendly. A new Annex, (Annex VI), under this convention was adopted by the Conference through the protocol of 1997 which set out Regulations for the '***Prevention of Air Pollution***' from ships. A technical Code on the control of emission of Nitrogen Oxides (NO_x) from marine diesel engines was also developed. The importance of these IMO Conventions and the Regulations set up within them reflected the need of having competent, trained seafarer to serve onboard merchant shipping.

In the eighteenth century many of the European countries had codes of law which had to be complied with the masters, mates and chief engineers of their merchant ships. Navigation schools were established and the training incorporated academic as well as nautical and engineering subjects. One may still find navigation school in Europe established over 200 years ago. In the UK the industrial revolution and the associated pressure to export manufactured goods, resulted in sub standard ships and the incompetent crew. Political and public concern forced the introduction of marine

safety legislation, including statutory certificates of competency (but no provision for training) in the middle of the last century.

At the global level, the International Labour Organisation (ILO), the '*officers*' competency certificates Convention (No53) of 1936 required masters, chief engineers and officer in charge of a watch to be certified by competent authority, but on the other hand did not establish an international standards of competency.

This came with the STCW'78 following major international conventions on Load Lines (69), avoidance of collision regulation CORLEG (72), safety of life at sea (SOLAS74) and the prevention of pollution from ships (MARPOL 73/78). Now virtually all national merchant shipping legislation is based on international conventions with majority from developed countries exceed these limits.

A joint committee on Training was established in 1964 by the governing bodies of ILO and IMO's Maritime Safety Committee. A **Document for Guidance 1964** on the education and training of masters, chief engineers and seamen on the use and operation of instruments, machinery and equipment's contributing to safety at sea was prepared.

In 1971 the IMO Council requested the MSC to give urgent consideration to the matter which resulted in the establishment of the Sub-Committee on Standards of Training, Certification and Watch keeping for seafarer which was finally adopted through Assembly resolution A248 (VII) of 15th October 1971. The Convention entered into force on 28th April 1984. This was a new mile stone for the global standards on the training of seafarer.

Training of marine engineers was specifically defined by the STCW78 in chapter III, Regulation 1 through VI. It set out minimum mandatory requirements for all persons wishing to work in the engine room at different capacities. It also set out minimum requirements for all engineers in relation to the main propulsion machinery. To support maritime institutions in establishing appropriate training curriculum, on what was important for the safety operation of merchant ships' machinery, IMO made a number of model courses in establishing uniform global standards. However, with the good intention of IMO the Convention did not set capacities of maritime institutions in terms of facilities to be employed, quality and qualifications of

lecturers, assessments and certification procedures was finally interpreted to the 'satisfaction of the Administration.' Changes in the world economy, open registry policy, lack of human resources and commitment from Maritime Administration, especially in developing countries created differences in interpretations, which undermine the effectiveness of the STCW78 Convention.

Strict regulations and crew cost in some developed countries, saw the 'open registry' as a valuable opportunity to continue develop their (ship owners) economies and therefore exploited the weaknesses of the STCW. The global standards, which were the concept of STCW78, could not be achieved.

The weaknesses of the STCW78, the global economy, technological developments and crewing demand from ship owner's standpoint, shipping disasters and pollution incidents in the late 80s' and early 90s', gathered ideas from member states, on the consideration of a comprehensive review of the STCW. The MSC therefore, established a Sub Committee to work on a draft proposal in 1992. Finally a new code (STCW'95 Code) to the Standards of Training, Certification and Watch keeping for seafarers was realised in 1995 and came into force in 1st February 1978. The Code replaced the original annex to the convention but the original article was left intact.

The aim of the amendment which resulted into the STCW Code were:

- To establish a well balanced set of *verification* and *control* mechanism which will ensure that parties take all appropriate measures to give full and complete effect to the convention requirements.

This is indicated in the general provisions contained in the Annex, chapter 1, Regulations; 1/2 on the control of certificates, 1/4 Port State control, 1/5 investigating reported incompetence, 1/10 recognition of certificate between parties and 1/11 on revalidation of certificates. More important to this code is the approval of training and assessments including the qualifications of trainers and assessors (reg. 1/6). Parties to the convention are also required to provide detailed information on training and certification to IMO (REG 1/7). The application of quality standards to training and certification will enable the MSC to identify parties that are unable to give full

and complete effect to the convention and therefore introduce accountability between them.

→ To clarify the skills and competency requirements.

Part A of the STCW Code have recast the fundamental knowledge requirements of the STCW78 in tabular form, competency function, methods and criteria for demonstration, and evaluating competency have been high lighted.

→ To transfer all the technical matters to the associated code which would facilitate up dating or amending the existing one, as indicated in part A and guidance on their application in part B of the code.

This may facilitate uniform interpretation on the training and competency requirements of the code.

Training of marine engineers (part A, chapter III of the code), for chief/second engineer officers and rating forming part of engine room crew, the author of this dissertation have a point to comment. The concern is on the mandatory requirements (part A chapter III) and the recommended guidance regarding provisions of the of the STCW Convention and its annex (Part B Chapter III). The following are observations to comment:

(a) Engine room simulator(s)

With a drastic change and the development of technology on control and monitoring in engineering watch today, the use of computers takes its position and will play a great role on board modern ships. **Safety commences on the drawing board.** The state of the art must start now, as the future engineering would need a chief engineer behind the computer to operate the machinery. Computer based training should be included in the mandatory requirements of part A of the code. The competency anticipated should not create a vacuum between engineers from developing and developed countries other wise the whole concept of global standards will not be realised. Full mission engine room simulators may be a substantial tool in the transfer of knowledge without fear of undue break down of machinery components. The

problem of *sea service* for many young engineers from developing countries has been identified as a stumbling block for their carrier progress. The resulting out come will be a severe shortage of competent seafarer, which is already existing in some part of the world. Full mission engine room simulators may be well applied to give a feeling of the real life on board and hence complement the large part on the interface in the effect of practical and the theoretical requirements. It may also keep the maritime institutions flexible to accommodate and be in readiness to comply with changes and amendment such as STCW Agenda 31. The agenda discussed among others, the validation of model training courses content (item 3- use of computer based assessments was recommended). This is an example of the changes that are due to take effect in the near future. Quality of seafarers from developing countries will for sure depend on the capacity of their maritime institution.

(b) Use of communication facilities. (Res. 697(17)).

At a managerial level a chief/second engineer officer should be in a position to use bridge equipment for communication purposes. Equipment such as GMDSS or Radial Telephony should be familiarised to at least two most senior engineer officers such that they may be able to use them under distress condition. Revelling to this point is a story with the title; *A SHARK CAUGHT BY CREW BITES BACK*. It says; “*A Shark almost finished off all but one of the crew of the cargo ship Mint Quick. Not because it ate them, but because they ate it. Severe food poisoning struck down 10 of the 11 crew after they consume a shark they had caught earlier in the voyage says a report in the Numast Telegraph. That left the vessel steaming along off the Virgin Islands at 12 knots with only one inexperience crewmember on the bridge.*

A rescue party sent off after distress call was picket up had difficulty getting on board because the vessel was going too fast and no ladder had been deployed. But eventually managed to do so and gave immediate treatment to the stricken crewmembers. According to medical experts, the men would have died within another hour.”

This statement should refer to Table A-III/2, column 1&2 about (a) The use of internal communication systems and (b) Operation of all internal communication systems onboard. It was not pointed out the use of other communication facilities in particular during distress conditions like one of the shark story. One may assume that the knowledge is included, should the dual-purpose is applied in the training process, but experience has shown that its effectiveness have low probability. The experience may prove that, the attitude of marine engineers at managerial level is not more than the concentration on their engineering practices. If they are involved in the safety management onboard, the participation will be on all others except distress communications.

The traditional reactive attitude applied to amend Conventions should switch over to a proactive before it is too late. IMO should not turn a deaf ear into this problem as its consequences may result into surprises!

(c) Refrigeration and Air conditioning

Table A-III/2, column 1, of the Code should emphasise about the subject above. Ship owners may bear with the author of this dissertation that, with the increasing demand in reefers and refrigeration containers in maritime transport, competency in refrigeration and air conditioning engineering is gaining more importance. It could be one of the ways, like in the dual-purpose practice, of reducing unnecessary number of engine room crew. On the other hand the knowledge may increase flexibility to marine engineers and provide more employment opportunity as far as to shore based industries.

1.3 Ship owner's responsibility in training of marine engineers.

Ever since the establishments of the enforcement mechanism, to ensure compliance with relevant IMO Conventions and codes, the Port State Control, ship owners are totally preoccupied with the ISM Code. That is basically their main worry and that STCW does not seem quite important issue to them. This is because the ISM-Code,

after all, is a necessary combination of the procedures operating on their ships, in their management structure, on the certificates to be issued to their ships and company DOC and SMC. The STCW frankly, does not seem to be some thing that is of too far much direct concern to them.

Should they happen to pick up and open the STCW'95-Code, they will quickly at the section dealing with company responsibility and, in many cases they would say; Well, we are dealing with this under the ISM-Code any way, the rest of it is for some one else to worry about.

Ships' registration by Classification Society, is a statutory requirement before being accepted by Flag Administration. That is the ship shall have a valid certificate from a recognised classification society before issued with mandatory certificates from the Administration. These certificates include Passenger ship safety, cargo ship safety construction, cargo ship safety radio, load line and more others that are relevant for granting permission and endorsed by the Administration, to operate as within the specification it was constructed for.

Flag Administration has the responsibility to survey and ascertain compliance with relevant mandatory requirements to a ship before she may be issued with the appropriate certificates mentioned above. Some Administrations may (have) delegated some or all of the survey responsibilities to class societies for which ships' certificates may be issued on their behalf.

There is obvious a common link between class societies, Flag Administrations and ship owners on issues concerning safety of ships and all that is in her, in addition to prevention of pollution of marine environment.

Due to some differences in standards among classification societies, some ship owners took to advantage and preferred to work with societies with least requirements. This way a number of substandard ships were found in the maritime industry with the consequences of accidents and incidents which resulted into losses of lives, properties and the pollution of the marine environment.

The establishment of the International Associations for Classification Societies (IACS) set up standards to be followed by her members in effort to eliminate substandard ships in the maritime world. This is another regulatory regime which, on

top of the PSC, ship owners must comply in order to remain into a competitive maritime trade.

To ensure global standards on maritime safety and pollution prevention, IMO developed an International Safety Management Code (the ISM under SOLAS chapter IX) which was adopted through Assembly Resolution A596 (15) in 1987. It all concerned about shipboard and shore based management to ensure safety operations of ro-ro passenger ferries. Two years later (1989), guide lines on management for safe operation of ships and for pollution prevention was adopted (Assembly Resolution A647 (16)). Subsequent amendments took place through Assembly Resolutions; A680 (17) in 1991, A741 (18) in 1993 and finally Assembly Resolution A788 (19) was adopted by IMO on recognising the need for uniform implementation of the ISM-Code. It requires Administrations to enter into agreements in respect of issuance of certificates by other Administrations. The ISM-Code has been made mandatory and entered into force on 1st July 1998.

Regulation 6 of the ISM-Code has been mandated to carry out verification and control of all the mandatory requirements though Port State Control, on safety issues and pollution control, and today, manning and crew certification as required by STCW become mandatory (STCW95-Reg. 1/14).

To give an idea, most of the Maritime Administrations and or Classification Societies, through various Memorandum of Understanding on Port State Control are more committed on ships safety issues. Table 1 below shows breakdown of deficiency items according to the statistics of the number of ship reported in 1998. This information as compiled by Class NKK of Japan is an example of how ships were un safe before coming into force of the ISM-Code. The survey carried out also cares for the quality and minimum manning for crew serving onboard. The number of deficiency in respect to crew manning and certification may bring concern to ship owners who will now be gradually involved in the training of seafarers and comply with ISM and STCW requirements

Breakdown of deficiency items related to crew.

Table 1.

Deficiency Items	No of Deficiencies
Certificate of Competency	30
Number/Composition (Safe Manning)	7
Medical Certificates	5
Sub-Total	42

Source: Annual Report on Port State Control 1998, NIPPON KAIJI KYOKAI Tokyo, Japan.

Chapter III, Part A of the STCW95 Code elaborates mandatory requirements on Standards regarding the engine department. In the training process for a marine engineer in charge of a watch in manned engine room, or designated duty engineer on a periodically un manned engine room, the onboard training has been emphasised. The knowledge, understanding and proficiency together with the methods for demonstrating competency have been indicated in column 2 &3 respectively.

Many maritime institutions in developing countries do not possess training vessel(s) in order to accomplish practical training process. Neither do they have engine room simulators that could be used to bring the interface on theoretical and practical training. In appreciating that developing countries will continue to be the great suppliers of seafarers in the world, a potential contribution from ship owners here becomes eminent. To provide birth onboard their vessels for training purposes not only will enable a candidate to cope with his/her training requirements but also will enable ship owners to comply with the requirements of the ISM-Code. The link between various regulatory bodies, i.e. the ISM-Code, STCW95-Code and the Port State Control dedicates the responsibility to both parties. That is to say training of marine engineers is the concern of Maritime Administrations, ship owners and shipping companies as well as the maritime institutions.

With the ISM-Code and the STCW so nicely harmonised, it is necessary to document training related to STCW in the safety management system. There are two documents

having the same goal. The STCW requirements regarding this aspect could be integrated and documented into the procedures and requirements of the safety management system. When the company has implemented and is operating a formal training system within its ISM, it would hardly be practical to maintain voluntary company training outside the scope of the ISM. The STCW Convention now shifts a major part of the responsibility for competency building related to professional certificates over to the shipping companies, as more and more of the training of marine engineers are to be done in-service. It follows therefore that, Maritime Administrations in developing countries should dedicate their responsibilities in the training process ever been before. The consideration in shipping manning costs, requirements of the STCW-Code and the ISM-Code should establish a balance for the appropriate safe manning of the ships of the future.

1.4 Human element (factor) in the maritime safety.

Over the last few years, the term human factor or human error was realised as the root cause of many accidents and incidents that have occurred in the maritime industry. The studies on different accidents that have been reported, revealed that human factor contributes to over 80% of the cause of accidents worldwide.

Human element (factor) is a complex phenomenon in terms of safety and prevention of pollution of marine environment. The author of this dissertation will not go into details of it but intends to indicate the interaction between training and education and the human element in the maritime industry.

A machine malfunctioning may be described in terms of its behaviour, and explained what caused it. This is the fundamental of maintenance management and should it be carried out in an appropriate manner, with the knowledge and skills and the commitment from the management, certainly what is called failure of the equipment would not have happened over the life time of a machine.

The concept of human factor can be maintained and rectified in some way, but we should realise that;

- It is all about people,
- It is about people in their working and living environments,
- It is about their relationship with machines and equipment, with procedures and the environment about them,
- And it also about their relationship with other people.

Dr. Per Byrdorf of the Institute of Aviation Psychology of Denmark, in his presentation at the 3rd International Conference on Engine Room Simulators, held at Svendborg Denmark (26th to 30th May 1997) explained that; “After many years with focus upon technical faults and pilot errors, commercial air line companies and air force had to come to realise the importance of focussing upon *human element*, because it was found that three out of four air craft accidents were due to what was called human failure of one kind or another. One of the milestones in aviation Human Factors may be seen as the recognition that basic education in Human Factor was needed through out the industry. Therefore the air line industries, back in the seventies, began to focus on training of Human Factors principles and psychological subjects such as information and processing, communication, decision making, human performance and limitations were introduced.

The above comments indicates the concern and the commitments from management to the operation level at all disciplines regarding the human factor and the air lines safety issue.

In the maritime industry the subject of human factor were identified several yeas ago. This came following amendment to most of the mandatory conventions and in some cases codes and guidelines were formulated. The STCW’95 is an example of this recognition. Regulation 1/14-1.2 of the STCW Code elaborates that; “The Administration shall ensure that ships flying its flag are manned in compliance to safe manning requirement”. This is no doubt that working conditions and environment

may create fatigue, which generally impairs performance, misleading in decision making and finally catastrophic disasters.

Dr. Per Byrdorf further giving an example that; “Some disasters at sea are results of old fashioned leadership style. The officers either on the bridge or in the engine room do not dare to give their opinion of the situation because they knew that the captain or the chief engineer would not tolerate interference in their leadership. This kind of social interaction will often lead to incidents and accidents. The captain or the chief could also be over confident and think that he/she is invulnerable, so he/she does what he/pleases. So it was at the Tenerife accident some 25 years ago, where the captain of a Boeing 747 took off without authority from the Air Traffic Controller, and the first officer, having once already told the very much more senior pilot, he did not have the courage to intervene a second time. They hit another Boeing 747 at the run way and more than 500 people were killed.”

It has been a common trend onboard merchant ship, to find a captain or a chief engineer who does not wish to entertain ideas from their immediate junior officers for reasons similar to the one explained above. However, the increasing demand from ship owners, in favor of fewer crew onboard their vessels, and the technological growth for modern ships to day should not be left without being discussed. Why? There are two things to consider. The relationship between a man and his working environment. Firstly, is there any interaction between his ability to command the environment at his working place? The joint session of MSC/MEPC working group on human element and the formal safety assessment realise that, as fatigue increases, the brain of a human being appears to fall asleep involuntarily, against his will, especially, not exclusively, when his/her performance demands involve sustained attention and monotony. Thus the effect of fatigue on performance are based in changes in brain function.

Regulation III/1 of the STCW95-Code deals with fitness for duty, and has set up a minimum mandatory standards thus; “Each Administration shall, for the purpose of preventing fatigue:

- (i) establish and enforce rest period for watch keeping personnel;
- and

- (ii) requires that watch keeping are so arranged that the efficiency of all watch keeping personnel is not impaired by fatigue, and
- (iii) duties are so organised that the first watch on the commencement of a voyage and subsequent relieving watches are sufficiently rested and otherwise fit for duty”.

This implies that with fewer number of crew on modern ships today, there are likely chances to cause fatigue because this phenomenon may be a result of several reasons. Some of them have been identified as overloading, motivation, working environment, over aged personnel, poor management and lack of skill and knowledge.

Secondly are the socials needs and demand has any relation to the nature of duties at sea? The problem of fewer crews onboard may have a psychological impact in particular when the integrity of mixed crew is taken into consideration. Loneliness, different culture and lack of social integration may result into fatigue of its own kind and hence impair ones performance. Fatigue affects the ability to judge various things and may easily interact the good will of an operator resulting into accidents.

The empathise pointed out from SOLAS74 Chapter IX, on the management for safe operation of ships, which came out with the ISM-Code, will have more than one thing to do with regard to human factor. The ISM-Code has pointed out all what the shipping company need to be. The possession of valid DOC (reg. 3 par. 1 &2) and that Administrations shall issue the Safety Management Certificate on verifying that the company and her ships comply with the safety management system. A more concern to the ISM and the Administration is to establish clear definitions on how human factor training could take its position within the safety management system.

The objectives for human factor training programme should be the philosophy for the crew resource management in:

- (a) training of crew to recognise their own limitations.
- (b) working relations among them selves including out side agencies.
- (c) ensuring best use of available resources on decision making on bridge or in the engine room in the light of all available information.

(d) develop safety culture among the crew and shore based personnel.

Successful management system, conscious of safety of personnel, properties and the prevention of pollution of environment, is the management that is considering training at all levels of competency and on human resource management.

CHAPTER II

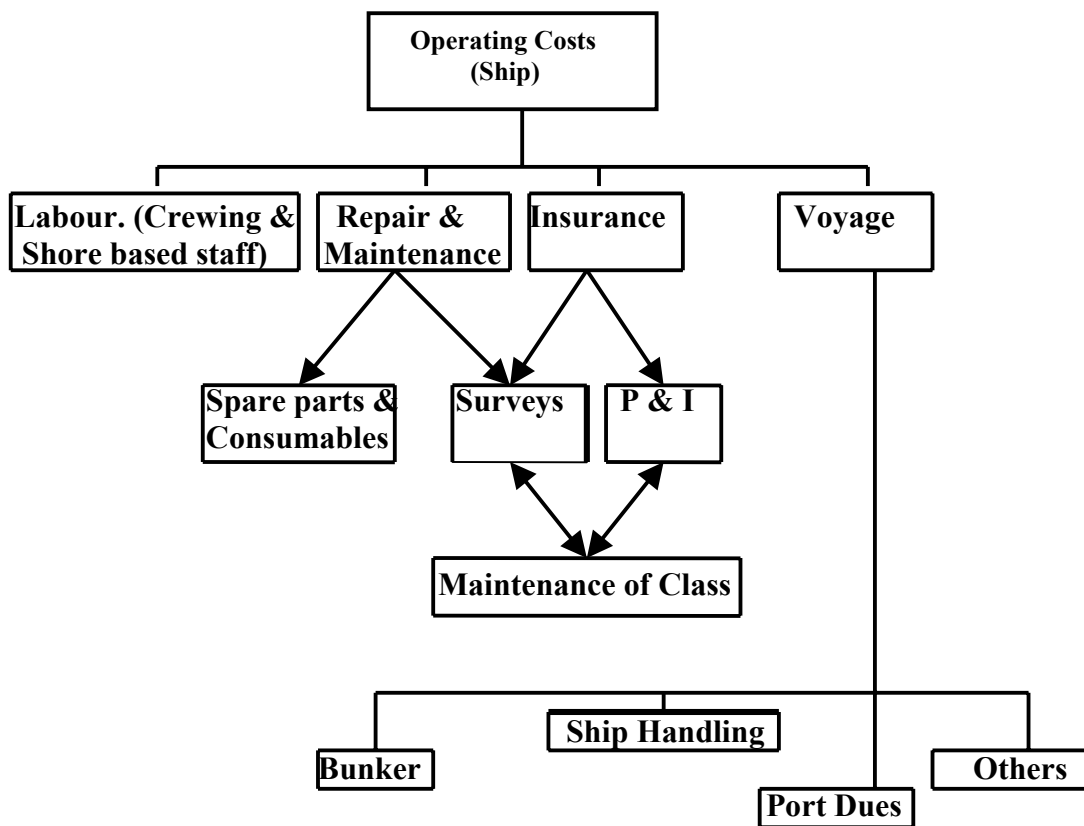
2.0 The future of Marine Engineers.

The world is experiencing drastic changes in engineering technology for the last half a century. Production industries, manufacturing companies and even the service industries have appreciated the innovations in automation engineering. Machines such as robots and computers have been gradually replacing men in various activities. Machines can work longer, and if well programmed, more efficiently and hence could give high production at reasonably lower cost. Energy industries are striving to produce more at low inputs for high profits on the output. Shipping industry is of no exception. In order to remain in a competitive shipping market, every effort has been deployed to reduce the running cost, but as it was mentioned in the introductory note of this dissertation, ships today are more costly in absolute terms and that financial resources are more costly to obtain. The technological innovations in shipping industry have influenced a relative company restructuring. Companies are becoming bigger through merging, joint venture and alliances for the purpose of cutting down cost. There is a centralisation in keeping companies by down sizing number of staff due to technological development through which human being are replaced by machines such as computers.

Engineering practice on board has been highly centralised and modified. A round the clock traditional watch keeping, which required a duty engineer and as many assistants and ratings are gradually being replaced. Firstly by unattended machinery space system (UMS) in some ships. Secondly, further to modern ships, a one-man stand alone bridge watch keeping is becoming a common practice in marine engineering today. The practice is to reduce operating costs in particular crew costs. Economic researchers and ship owners in collaboration with ship builders have revealed that crew costs including wages, insurance, medical care; provisions and repatriation may be as high as the fuel used per year.

A general lay out of ship's operating cost is indicated in figure 2 below. These costs may take different shapes according to the company policy and type of trade. For example containers, bulkier, oil tankers, passenger ferries etc, but in general, covers the major items as indicated.

Fig. 2. Ship's operating costs.



According to Professor (Dr) Ma Shuo, of the World Maritime University, on his lecture on *Maritime Economics*, he pointed out that; “How can ship be in operational condition? First of all the ship should be technically fit and operational. This means that the ship has to be *manned*. A ship is still a complicated machine, which require full team of crew to operate it day and night. This includes a Captain, Chief Engineer

and other officers and seamen. The ship must also be maintained and repaired to be in a good operational condition or to be always sea worthy.

Secondly, as the ship operational involved risk activity and exposed to big accident possibilities, ships count for huge amount of capital investment.

To be financial and commercially operational, the ship needs to be covered by proper insurance. Consequently, shipping operating costs should include all the above mentioned expenditures namely labour cost, repair and maintenance costs and insurance costs.”

This statement is the appreciation to the fact that operating costs mentioned above contribute greatly to the ship total cost today. The oil crisis of the early 70s, requirements from Classification Societies, port dues and manning costs are the major contributory factors to this subject.

To give an aidea of scale about crew costs, refer to table 3 below.

Crew Cost of Different Nationalities
Typical Rank Berth Cost-USD Per Month
(Includes basic wages, leave, overtime and Provident Fund, where appropriate)

Table 2. World wide Trading

	<u>Master.</u>	<u>2nd Officer.</u>	<u>Bosun.</u>	<u>AB</u>				
Country								
Australia	7000	5658	5165	4239	3816	3450	3521	3073
Burma (Myanmar)	—	2900	—	1094	—	562	—	436
Canada	6797	6452	4839	4608	3917	3687	3399	4038
Chile	3840	3762	2394	2333	1228	1196	805	784
PR China	2200	2000	1560	1300	900	750	630	520
Croatia	4000	3520	1800	1650	1280	1000	1000	800
France	10115	9195	5390	4900	4340	3945	3780	3440
Hong Kong	7440	—	3427	—	—	—	—	—
India	3600	3300	2150	1970	1050	1000	1000	970
Indonesia	2979	2594	1403	1220	680	571	482	423
Japan	14100	13900	9300	9200	10300	10200	8900	8800
Latvia	3380	—	1775	—	1100	—	1000	—
Norway	9201	9201	6192	6192	5218	5218	—	—
Pakistan	3651	3515	1912	1841	624	624	503	503
Philippines	2975	2975	1488	1488	1114	1114	929	929
Poland	4000	3200	2100	1960	1265	1205	1068	1013
Portugal	4880	4244	2749	2390	2223	1933	1871	1627
Russia	2650	2520	1700	1620	1250	1200	1060	1020
Singapore	4454	4000	2281	2050	1026	930	962	875
Spain	5800	5600	2800	2700	1930	1868	1417	1394
South Africa	—	5200	—	3450	—	1750	—	1570
Sri Lanka	4400	4000	2600	2360	500	460	430	390
United Kingdom	6700	5800	3750	3400	2900	2550	2550	2150
Vietnam	2200	—	1200	—	800	—	500	—
ITF (World-wide)	6464	6464	3344	3344	2141	2141	1922	1922

Source: Precious Associates Ltd.

South Africa, may well represent African continent under this race of crew costs according to nationality, and in comparison on monthly payments of say an AB, it can be observed that one from Japan earns $\approx 560.5\%$ of his counter part from Africa. The relations indicated here has many implications in terms of cost cutting exercise and the best alternative for ship owners is to go for a foreign flag where labour costs

are cheaper. However, in order to protect the indignity of people from developed countries, a great number of ships are still flying flags of their original nationality.

A policy towards second registry, as already established in some of the European countries, gives more attractive environment for a return of national flagged ships.

The high labour costs of shipboard officers and crew from developed countries could be assumed to be one of the reasons that made ship owners to come with strong requirements on reduced manning level. One of the alternatives has been directed towards the developments in computer and automation engineering for shipboard operations.

Japan is the most advanced country in shipboard engineering technology and as such they have proved that it is possible to have a zero manned ship(s).

This doesn't mean that ship owners will refrain from flying their ships under the open registry, the practice will take too many years to change.

Most shipping companies will experience multination flag in their fleet, mostly from developing countries. Panama, Liberia, Bahamas and Honduras, are the traditional foreign flag nations. The concept of trade liberalisation under reform in many developing countries may expect to bring more foreign ships flying flags from many numbers of African countries in the near future. The African continent has a lot of potential in the supply of the world seafarers should the maritime education and training be re-structured to meet the acceptable international standards.

A study carried out by the author of this dissertation during field trips in Europe and Japan, have revealed that there is a growing trend for they would be marine engineers (and other seamen in general) of loosing interest with the carrier at sea. Attractive working environments on land based industries has become an alternative for seafaring carrier.

Nevertheless, it was established by Prof. (Dr) Ma Shuo that; "Maritime transport is a service sector with a derived demand from trade, or often, foreign trade which it self generated by economic activities of a country or a region. On the other hand shipping does not have its own demand; its demand is derived from trade.

It is quite important for those who work in the maritime transport to know and fully understand that people do not need shipping they need trade. Shipping become interesting just because it is part of trade chain.”

There is no inherent failure in maritime industry, but the environment that provides depressed freight rates, and in some sectors, extensive unemployment of tonnage will be determinant factors for ships manning requirements in the future. How much an average size of crew onboard for economical operation and for the safety consideration? This will incorporate a lot more to design criteria, technical innovation, the demand in trade, but more important, safety in ships operation. We have to accept changes rather than find it imposed upon us by economic necessity. A balance at this point should compromise with safety issues.

Once again, consideration should be made on how to determine a realistic manning level. Comparisons of manning are very difficult, bearing in mind the multitude of ship types and sizes.

Beyond the construction of ship and her engine(s), is the trade to which she is committed and the voyage length. A self-maintenance should gain priority for both economic and safety consideration. There is a considerable difference between a ship on a fixed voyage, with spare facilities at both ends, and a world-wide trading ship. There is a need to determine the maintenance policy and the extent at which, the manning will have to allow for the ship’s upkeep. It may well prove either necessary or cost effective to carry a number of engine crew sufficient to cover all or proportional for up keep and maintenance. Maintenance policies will be discussed at a later stage.

There is also the matter of safety. Owners must ensure that survival tactics leading to lower manning do not produce an impossible position, where ships in service can not be run within the bounds of safety.

2.1 The International Labour Organisation.

The International Labour Organisation, is the United Nations Agency, which deals with the rights of workers of different categories. Seafarers are among the targeted groups. Like any other UN agency, ILO has been establishing Conventions and recommendations to be followed by member states upon ratification. The objective of these various conventions is to establish balance in various elements between employers and employees in their working environment. It is not intended to mention every ILO conventions and elements contained in them, but for the purpose of this dissertation, few conventions relating to seafarer's basic requirements, in particular working environment will be discussed.

While IMO puts more emphasis on human element, seafarers and safety through STCW'95-Code, Regulation VIII/1- '*Fitness for duty*', and Regulation VIII/2- '*Watch keeping arrangement and principles to be observed*'. The ILO have long been, establishing conventions on seafarer with regard to minimum manning level, wages, certification of marine officers etc. The 1926 Article of agreement Convention C22, which came into force on 4th April 1928, has a reflection on crew motivation. It may be looked at as a competency of its own kind. It requires a clear understanding by crew, the rights and obligation for the duty or duties assigned to them and more concerned is the number of crew the ship is going to carry, type of trade and voyage, (Article 6-sect 3(4), (5), (6) and (10)). Experts in maritime transport have identified that:

Competency + motivation = safer shipping.

Some Administrations and ship owners, if not masters of their respective vessels have been taking advantage, by being not in possession of these instruments in their national laws, violate the right of seafarers. This attitude has resulted ship manning to operate at substandard level. Manning of ships for safety and social reasons has been a major concern of ILO. The 1996 Convention C180- '*Seafarers Hours of Work and the Manning of Ships*', (Article 5, sect 1(a) I & ii or 1(b) I & ii), pointed out limit of work and rest hours. Considerations have been directed towards the ability of human being to work effectively and efficiently and the consequences of fatigue on mental

and physical abilities. (See Annex... efficiency/time relation). How far practically these instruments may become effective?

Legal processes in some countries, inflation and down sizing of government departments render ineffectiveness to these conventions. Political considerations have witnessed a great amount of technical assistance from various UN agencies, NGOs' and alike, fail to benefit targeted sectors or groups from the advice and assistance provided because of bureaucratic inertia. The advice not being appreciated by those with authority to take action, or being appreciated only by those without authority to take appropriate action. The barrier will continue to exist with an element of corruption, irresponsible and lack of human resources in some Administrations.

2.2 Ship board Maintenance and Cost Effectiveness.

Much has been discussed about training of marine engineers, their role in the maritime industry with some view on the manning of modern shipboard engine rooms. The subject of safety, manning and competency of marine engineers may well come to a balance with economical consideration in ships operations. Ships of tomorrow may require lesser and lesser crew on board, but how effective the idea is, depends on the maintenance policy in practise. Researchers, maintenance managers and experienced chief engineers with varying degree of success, have proposed varieties of maintenance policies. The effectiveness of any chosen style of maintenance may be based on many factors, but the economy of shipping companies and the safety consciousness will dictate the best policy to be applied.

Traditional maintenance of ship machinery and equipment involved numerous manual inspections performed by ship's crew and or shore side support personnel. Labour was relatively less expensive than the engine parts and so it made sense to open and visually inspect components following its break down or maloperations. The criteria used to accomplish this rested on the experience of the chief engineer(s) and the instruction manuals from component manufacturers. The maintenance was

carried out on the basis of running hours and as a result, and in some cases company policy was overriding decisions from chief engineer(s) on the effective maintenance periods. The reliability of equipment was therefore questionable. Failure of fuel injection equipment for example, or a burnt exhaust valve, or a failure of lubricating oil system at sea may present distress and possible consequences to the safety of ship and the marine environment. Sufficient number of marine engineers was required to manage and restore the situation, but the economical pressure is bringing down this number to the size that might not be capable to cope with the situation.

However, to day's labour, even a sailor is more expensive than engine parts. Therefore it is more economical to shift to the maintenance systems which are more cost effective, to avoid unnecessary down time, and make use of possible fewer crew for the safety of ships.

Maintenance can be briefly defined as any activity carried out on an individual component or a system in order to keep and maintain its reliability and availability. That means, to maximise the probability of a device to perform its purpose adequately under stated conditions for the period of time intended. To understand the cost effectiveness in maintenance policies, their management and the costs involved, following is a brief analysis of the maintenance systems in practice.

2.2.1 The Preventive Maintenance Cost.

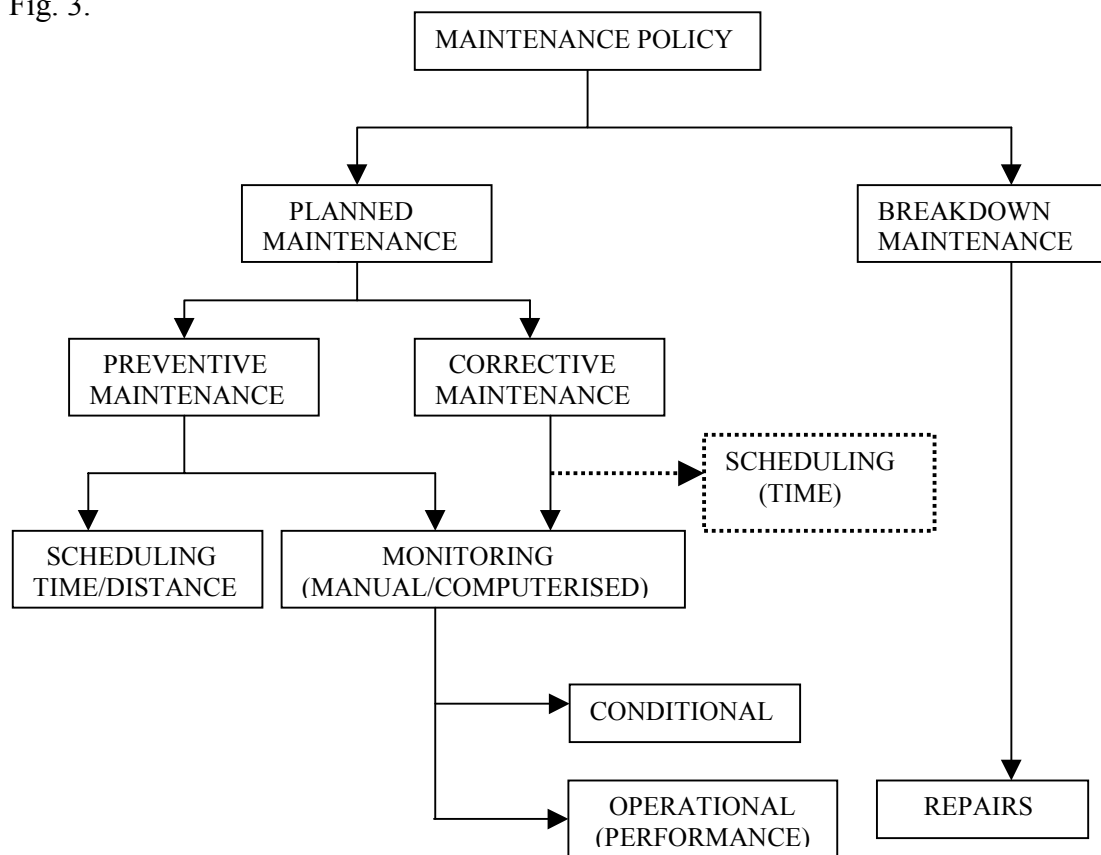
It will be noted that every maintenance system, **planning**, from management to operational and support level should be adequate.

Preventive maintenance (PM) is a planned maintenance task carried out basically to prevent unexpected component failure. In this system, the maintenance is carried out at predetermined intervals (equipment running period or distance, which ever might be applicable), or to other prescribed criteria. The main objective of preventive maintenance is to avoid functional delays, reduce maintenance cost, increase equipment life cycle and improve safety and reliability.

Several practical approaches in determining the criteria in achieving the effective preventive maintenance were brought in practice with various degree of success. Scheduling as already explained, rested on the experience of management and operational personnel with close advice from equipment manufacture(s) and classification requirements. The varying degree of experience, quality of equipment manufacturing, the availability of competent labour and spare parts has an influence on the total down time of the equipment operation. Therefore it adds up to the maintenance, running and operational costs. Based on these facts, operational environment of the equipment and the risks involved at sea, scheduling was modified for more effective maintenance, **monitoring maintenance scheme**.

A schematic maintenance policy is indicated in the following diagram.

Fig. 3.



The basis of its function depends on equipment performance, that is the amount of out put expectation relative to the desired value(s). This is the equipment efficiency. Any sign on the reduction of this value away from the desired margins (lower &

upper) can be used, as a criterion for the planning of the maintenance required. It involves testing and collection of data for the equipment performance and establishing safe operation margins. Different instruments to record and compare the readings with the desired values are available in the market or may be supplied by equipment manufacturers.

The knowledge and experience, supported by data, may suggest timely planning for maintenance of the equipment, far before total failure.

Further development have been carried out on preventive maintenance scheme by the United States Coast Guard (USCG) with plans to shift to condition based system to reduce labour and down time. The data collected from this system are integrated to computer database.

Main diesel engines, for example, must be overhauled periodically to maintain optimum performance level and to guard against engine failure. The determination of when to complete the overhaul is a matter of significant importance to ship owner(s). Concepts such as RCM (Reliability Centred Maintenance) which was further up graded to DEREL (Diesel Engine Reliability Database) have shown to benefit maintenance managers and engineers on board in effort to reduce unneeded labour, down time and cost. Access to electronic, as compared to machinery failure data on paper for particular ship is a big advantage. This means the engineer can make better decision on allocating scarce resources towards the maintenance of the equipment of his ship. The need for spare parts can be better forecasted and timing of repair anticipated more accurately.

Information (for equipment data for break down failure) was collected through a long term research and experience, which determined margins for its safe and reliability performance. Any deviation of equipment performance from these margins may be monitored through computer screen for necessary actions. The repercussions on this development to marine engineers from developing countries will be discussed at a later stage.

2.2.2 Corrective Maintenance Cost.

As its name implies, this style of maintenance today is very expensive. It falls between preventive and break down maintenance schemes. It involves immediate replacement of parts following overhauls and or breakdown of minor nature. The system does not need highly experienced and hard working engineers on board but close support with adequate materials and spare parts are needed.

Furthermore due to industrial competitions today, engine manufacturers have established a close follow up of their products already installed onboard. Besides providing with operation manual, spare parts and service manuals, where a step by step removal and replacement procedure is indicated, maintenance videotapes are supplied to support shipboard engineers with a more pictorial and verbal procedures. It is '**just do it**' as you see from the tape. In addition to manuals and videotapes, the economy in machinery maintenance is considered in terms of pay back time and that is why some ship owners refrain from installing new features until otherwise it is reinforced by the law. However, maintenance support teams are increasingly growing with maintenance experts through information technology. Internet and mobile teams are gradually becoming popular. Is this safe and cost effective? The corrective maintenance policy remains a question of economy rather than safety and cleaner environment.

The system could be worthwhile for some components considering time and cost for repair, and it therefore becomes much cheaper to replace them. Items such as electronic cards for temperature or pressure or any other parameter on engine performance, or oil ring in a servo-starting valve, could be worth replacing than an attempt to carry on repair on them. Conditional or performance monitoring on such equipment is unpredictable due to several factors, and any fluctuations on its working environment could lead to sudden failures. Like wise, cost of some parts and or the risks involved may determine the style of maintenance to be applied. Reconditioning of injection valve onboard for example, is a difficult practice. Although this piece of equipment may have a moderate cost due to its precision machining and the tolerances required, but in comparison to risks involved when it fails at critical

conditions of manoeuvring or at high seas, the price should not compromise with safety. Priority of equipment function in terms of safety, cost involved and time should be judged to find best method or a combination of methods to be employed for effective shipboard maintenance.

Every machine component has a lifetime in its operations and as such the replacement decisions should be considered correct. The limits of wear rates determined from metallurgical properties and test bench analysis from manufacturers, should be considered in whichever maintenance style selected. Although people says '**old is gold**', it is obvious to note here that, even with high quality maintenance in place, efficiency of most equipment deteriorates with time. The concept can be easily understood taking an example of a main engine cylinder liner. Different manufacturers have given different values depending on the materials employed and other parameters. An approximate figure of 0.1mm per thousand hours is acceptable for large engines. Maximum wear before renewal is usually limited to 0.6-0.8% of the original bore diameter, or less when the manufacturer advises. Therefore, the lifetime of such a cylinder can be anticipated by simple calculations, giving sufficient time to order for a replacement.

2.2.3 Break Down Maintenance Cost

The break down maintenance scheme is defined as the '**trouble call system**'. Nothing is done unless someone calls the trouble desk to announce equipment failure. Depending on company policy, a ship owner who plans to buy new ship(s) at every say, 5-7 years, might opt to use this system performing no preventive maintenance nor replacement of parts other than checking ship's documents to avoid Flag Administration and Port State Control. Many ship owners, who place this policy in their companies/ships, might be influenced that new equipment rarely fails. Maintenance managers and researchers have identified two probable critical equipment failures during its lifetime. Probability of equipment failure is high at its virgin age because it require time for running in, settling and adjusting with their

working environment. Consider a new cylinder liner from the previous example, fitted with new piston rings. Experience recommends to operate the machine (engine in this case) with increased lubrication and that the loading of the cylinder liner should be increased gradually for a period of time before subjecting it to the rated full load. This is necessary to give adequate time for running in. That is for small machining textures, of few microns in size, should be slowly and gradually rubbed off by a relative movement of piston rings, or otherwise they may be scooped off, causing abrasion and an obvious case that cylinder liner wear will be at vicinity. Loss of power and possible scavenge fire could render the engine un operational. The costs involved in bringing the engine back to service and restore ship's manoeuvrability, will be extremely high associated with probable total loss and possible damage to marine environment. The Safety of Life at Sea and other regulatory, national and international laws will not entertain such a maintenance policy onboard. Not only for the benefit of ship owners, but also for the obvious reason of safety and prevention of pollution.

Examples of were paten relative to the time is indicated below.

Fig. 4.

It can be seen from the diagram above that the probability wear for any chosen equipment is high when it has first be put in operation. It reduces with careful running in procedure to a value where, the wear rate remains almost constant and for almost its lifetime. As the equipment approach close to the end of its life in service, wear rate values increases sharply and therefore calls for a replacement.

2.2.4 Workmanship Quality and the Shipboard Maintenance.

The manning requirement of ships of the future will require highly skilled engineers both at maintenance management and operational level onboard.

Maintenance management should include not only competence at technical level, but also management of spare parts and the economy of ships and the financial ability of the company. The success of maintenance policy to be adopted requires careful planning with close relation to the company objectives. Proper scheduling based on conditional monitoring, priority, and risk analysis, material management, assessments and record keeping should be in balance with competency and availability of crew both ashore and onboard in order to reduce down time and cost. It was mentioned earlier that, the choice of maintenance policy might dictate the minimum number of engineers to be carried on board and that forming a strong support ashore. If much of the work were to be carried on board, as might be suggested by the author of this dissertation, adequate number of competent and experienced engineer on the running and maintenance of merchant ships would be necessary. To bring such a manpower to the required level would need an accumulation of academic and practical experience for a period of time. In a profession that is heavily dependent on experience, you can anticipate how long it could take to achieve such qualifications.

The STCW'95 is dictating much about the quality and competency of seafarers at operational and management level on board without taking into consideration the changes in maritime trade. Will the present curriculum on training, assessment and examinations, and demonstration of competency, as is in part B of the STCW, match

with the minimum manning requirement (from ship owner's point of view, ILO etc) and the sophisticated machinery space of the future merchant ships?

It is anticipated that ships of tomorrow will be faster and quicker in cargo handling in order to accommodate economic upturns and down turns in a competitive maritime business. Shipboard maintenance is the backbone in providing support to the changes and challenges in maritime trade. It should have a strong workmanship on board and on shore.

It was once before mentioned that the trend, due to social and economical pressures ashore, would leave a wider gap between supply and demand of competent and experienced engineers to serve in the maritime industry. There is a missing generation of those would be marine engineers because people now are exercising free choices, to seek a sea carrier or to diversify into shore employment. The industry should look on how to motivate young men and women to join the carrier because failure to train and recruit marine engineers in the present generation will have a consequence on the maritime industry of the future. Training must be given high priority in any maintenance organisation so as to have a crew who can repair anything in the plant that breaks down.

2.3 Developments in Automation and Control at Sea.

The demand for quality products and the economical upsurge and down surge in the maritime trade, and the need for high efficiency and limitations in human factors has been noted as the motive towards the innovation and improvements of the modern technology we are experiencing today. This sub paragraph is not intended to discuss in details the technical developments, although it is worth mentioning a few. The aim is to analyse the impact of this technology in the maritime industry, in particular ship transportation and the marine engineer's education and training.

Engineering technology could prove that there is virtually no limitation to the degree of sophistication a control system can reach. It can start with manually operated systems in open loop and go all the way to full automatic, close loop computer

controlled. Each step of added complexity costs money and should be justified in terms of added value to the user.

It has already been mentioned that, research on casualty reports have revealed that human factor plays a big role in maritime accidents. Engineers and scientists would suggest a complete replacement of human being by machines and or much of the functions of a system be performed automatically in a controlled manner. The advantage to the user of such a system is an obvious efficiency in operation/production, quality products and probably more safe at a low cost.

Traditional engine room watch keeping required one or more engineer(s) supported with a number of assistants and engine room ratings. The reason was obvious, the control of engine room machinery to accomplish safety operations. The man's five common senses, i.e. touching, hearing, smelling, seeing and tasting were necessary in determining operational parameters such as temperatures or pressures before a corrective action could be executed. Human element and the cost of labour was not a point of concern and as a result errors and or misinterpretation of various parameters was committed and in some cases a serious breakdown was realised. Temperature and pressure gauges were (and still in applications today) mechanically activated to register a certain value. Technology of today is almost entirely replacing human senses in executing and interpreting data more accurately and without delays. No wonders, why we have electronically operated measuring equipment in engineering practice today? The fine readings obtained, very close to desired values are possible to maintain with tolerances very close to zero. Performance will be brought to high efficiency with improvement in safety. Distance operations of engine room machinery (remote operated) have eased the work of marine engineers and an obvious redundancy of engine room crew. Safety consideration and economic pressure from ship operations will continue to set the course for further development in automation and control for the ships of the future. Unattended machinery space system (UMS) for most deep sea going vessels, is an example of these developments. It was mentioned previously that for safety operations of ships of the future, the state of the art should commence from the blackboard drawings. Education and training

of marine engineers from developing countries should focus on the demand for automation and control; computer based operation for ships of the future.

2.3.1 Performance diagnostic in marine engineering systems.

The demand for high efficiency in marine engineering practice needs several factors to be accomplished. The horse power race of the early 60's is now becoming high efficiency contest. Safety and reliability considerations require highly trained and experienced engineers on board not only able to efficiently operate but more important to interpret various operating parameters in terms of safety management. Every engineering management requires maintenance procedure in place.

Today, the adoption of quality assurance system (ISM, ISO etc) is not an option; it is a licence to operate. In the course of adopting such a system, companies have to re-consider their policies and the way they operate in certain fields. One such field is the Preventive Maintenance System (PMS) the company should have for its vessels.

A ship is a complex system and for her to remain seaworthy, a performance diagnostic for her operations should be carefully conducted with co-operation between those working in her and the management ashore. An increase in fuel consumption, for example, may result in changes in ETA's, something that is not economical in terms of operating costs. The poor performance may be a result of marine growth if not a cause of bad weather and or difficulties in propulsion system. The need for docking, for cleaning the under water part of the ship's hull is an obvious solution.

It is nicely elaborated in SOLAS Chapter 1, part B, Regulations 6 to 20, of the need for ship performance in terms of safety and reliability, the '**seaworthiness**'. It requires survey and inspection of each and every individual component contributing to safety of the ship and all that is in her in addition to protecting the marine environment. Certificates are issued as evidence that the ship is fit for the assignment it was designed for.

The conditions on such surveys are basically based on calendar year. They may be either an annual, periodical or special surveys but entirely not on equipment/system performance. It would need committed management and experienced shipboard officers to admit that such surveys should base on equipment/system performance. Visual examinations by surveyors may be proved not adequate to warrant safety of the ships. Human element interface in surveying procedures will continue observing bulk carriers, oil tankers and even passenger ships/ferries go resting at their eternal peace every year, far deep on the sea bed, claiming thousands of lives, lose of properties and pollution of marine environment.

It is not cheap to establish an entire system performance monitoring (of a ship for example) and continually register strength of a longitudinal girder or a frame as the ship rolls, or pitch or heaves in a rough sea. The magnitude of fatigue imposed to such sub systems might be beyond their maximum calculated strength causing them to collapse and paralyse the whole entire system: *catastrophes!* However, the improvement in engineering technology may bring our dreams become true. For example, it is possible today to monitor performance for top piston rings of some engines (SULSER has experimented this in some of their engines), diagnose and or predict and arrange maintenance without un due delays of a ship (down time) or major accidents (blow-past and causes of scavenge fires).

2.3.2 Marine engineers and the ships of the future.

The existing population of marine engineers may decline over time due to variety of reasons:

- People leaving the industry due to lack of motivation and for alternative employment ashore.
- Fast growth (demand from ship owners) of automation and control may require specially trained manpower for ships of the future.

There are stringent regulations from authorities, IMO, EU, and Flag Administrations on fast phasing out or reduced age of existing bulk carriers, tankers and other types of ships for reasons of safety. Traditional ships which used to have an average of 25 (8 to 10 engineers) crew will soon disappear from the market forever, probably be placed in maritime museum for history. Like wise, traditional experience, education and training will have no room in what is regarded as ships of the future. Retirements on medical grounds, ageing and natural mortality (death), will continue to witness a further decline of number of the existing marine engineers.

The history tells where marine engineers used to belong in the maritime industry. The introduction of steam in merchant shipping over the last two decades became a force to be reckoned with, giving the beginning a previously undreamed manoeuvrability to vessels and a degree of independence from the wind. The introduction of compound steam engines swept the sailing ships from the sea. Since then, along with the introduction of iron and steel, ships continue to grow. The changes from coal to oil burning introduced diesel engines able to burn heavy residual oils with output reaching over 40,000 kW and improved thermal efficiency in the range of 60%. Steam ships of low horsepower (50hp) required five men to manoeuvre the engine plus the firemen and trimmers to attend the boiler.

The '*supper horses*' marine engines today have been arranged with a periodically unattended engine room, being manoeuvred by one lever or button on the bridge.

There is a growing demand for energy sources to replace oil in the future. The uncertainty of the present source of energy (oil) and its associated environmental problems will open a new debate to scientist and engineers about the propulsion means for the ships of the future. This will therefore create demand for restructuring of education and training for marine engineers of the future.

The displacement of steam and gas turbines by diesel engines has influenced training patterns and system and there is every reason to believe that the energy demand for the future engine (propulsion) calls for investment in training of (new) marine engineers for the survival of future ships. At present the only use of atomic propulsion plant at sea is in large submarines, Russian icebreakers and large aircraft carriers. One science magazine writes glowingly about *Synroc*, a high performance

ceramic capable of immobilising high level of nuclear waste for thousand of years. Should other similar materials be developed, then we should see an expansion of that mode of propulsion.

Conditional monitoring by computers enable the engineer to monitor vital parts involved in the combustion process, such as:

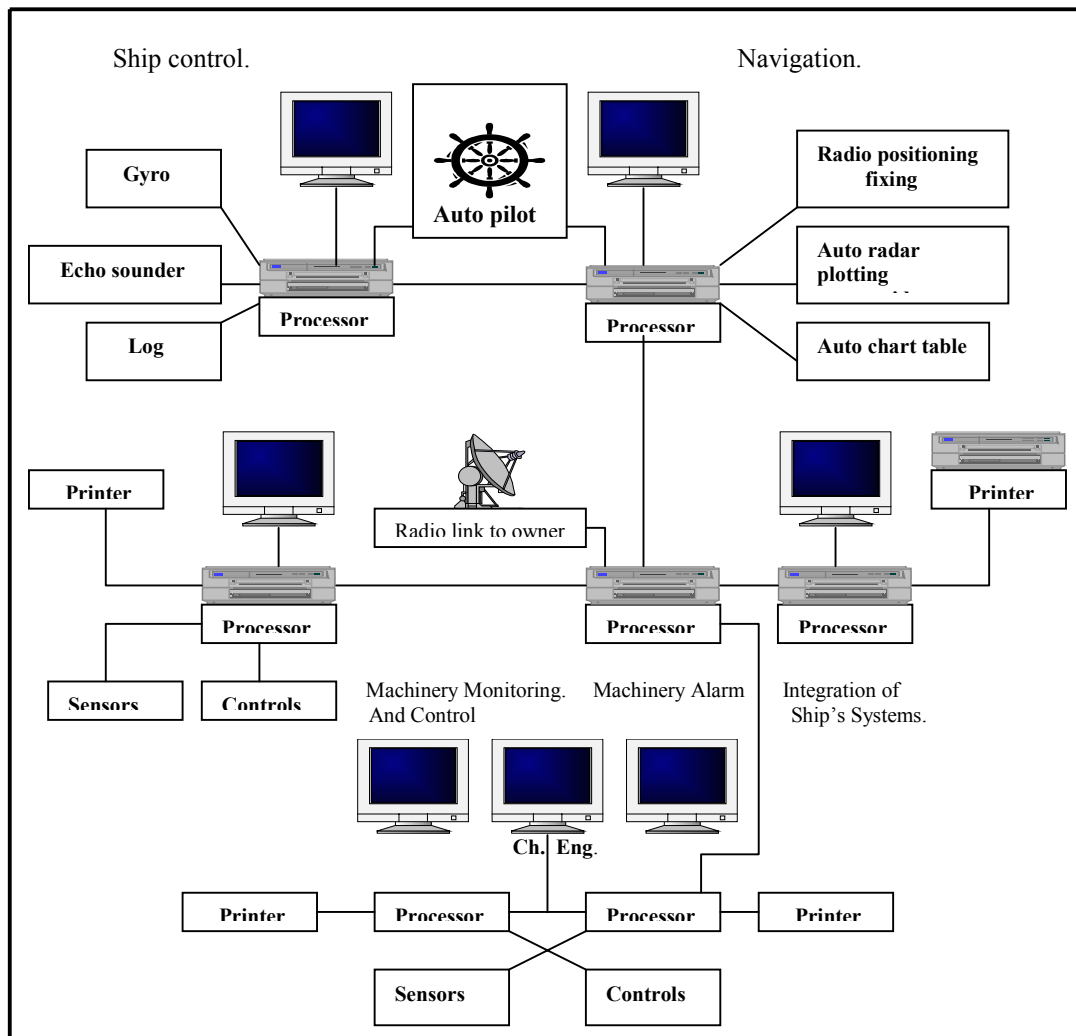
- Injection breaking and peak pressures
- Fuel pump timing in respect to crank angle
- Light spring diagram
- Piston ring condition
- Turbocharger performance in relation to air and gas ends, etc

This development will out model the conventional analogue display to counter monitoring and will extend to other areas of the engine room as further software programmes are developed.

Regarding control engineering, it is expected that automation will extend to all systems on the future ships. At present for example, the USCG is moving towards integrated expert management of various automated systems aboard their ships such as DEREL. MAN B & W has developed other expert systems known as MAPEX and Wärtsilä Diesel is currently experiencing a system called FAKS with considerable success.

As example, an integrated ship's systems may comprise basically the following array:

Fig. 5. Integration of ship's Systems.



Source: Workhorses in Australian waters (Transactions, Institute of Marine Engineer, Vol.97)

The challenge for the future is to obtain all the information that the operator requires at the right time, which will enable him to make the best decisions. With all these technical innovations put in practice and approved by the authorities (IMO, Flag Administrations, ILO, ITF, ISF, etc), there is every hope that standards of safety can be obtained which most of the ships in service today do not provide at any time at sea.

Nevertheless, there might be a considerable risk of misuses, if regulations combine minimum manning requirements with technical standards and training. The question remain, will ships of the future require marine engineers?

We are all invited to watch out that on the one hand man and machine meet the necessary requirements and on the other that the *system ship* meet the need of man.

For we marine engineers it may be wise to think that:

When the last crank and crosshead's been tightened,
And the Third Engineer's laid to rest,
When his tools are all rust an unbrightened,
Divide what you think are the best.

No rods to swing, no gear to string,
No bottom end to tighten,
No glands to pack, no nuts to slack
No over flow to make you worry

No valves to grind, no check's to mind,
No thrust to cause him worries,
No leads too fine, any guides to line,
No chief to make him hurries.

No forced draught, no tail end shaft,
No mid watch to keep,
No cranks bilge pumps or crank that thump,
To him from his sleep, and where is he now?
He is signed for his last voyage!

CHAPTER III

3.0 Modern technology in the training of Marine engineers

It has been mentioned over the previous chapters about the outlook of modern technology, automation and control engineering and its growing applications on board merchant ships.

Researchers in the world-wide demand for and supply of seafarers have pointed out and made predictions on large shortage of officers and surplus of ratings, presently and in the future. With the varying degree of approach, these predictions are becoming a reality. Several reasons have been pointed out but the major one is as follow:

Shipping policies in most traditional maritime nations:

The research carried out by BIMCO/ISF 1995, on Manpower update- Manning Report have revealed that, *“During the 1980s the international shipping industry experienced deep and prolonged recession resulting from **over supply of tonnage**. Shipping companies were forced to examine their operating cost closely, of which manning and training were the only significant variables. One consequence of these tight financial circumstances was a shift towards the use of open register and the creation of second or international registers to facilitate the employment of increased numbers of lower cost seafarers from developing countries.”*

High taxes had driven out most of the ships to open registry system. Major concern was as indicated in Table 2, the high cost of European seafarers. The high levels of competition from other unrelated maritime industries, offering relatively high wages and better conditions of work, could be regarded as de-motivator for new entrants in the maritime profession. Whilst it is true that most of the labour supply comes from developing countries, to most shipping companies quantity, (in terms of crew supply and profit margins) and unfortunately not quality, was the major concern for

employers. An increasing number of accidents, though contributed from other reasons as well, were identified to be to lack of quality seafarers. Seafarer training from developed and less developed countries is not at balance in terms of quality and training facilities at their disposal. Advances in technology will continue to widen the demand of qualified seafarers unless a genuine effort is sought to close the gap.

Realising such an increasing difference in quality of seafarers, the IMO came up with a strong instrument, the STCW'78 that set minimum standards to be followed at a global level by its member states. The use of a grandfather's clause, '*to the satisfaction of the administration*', gave away the quality remedies intended. The success of any quality education depends on many variables. The availability of training facilities and qualified lecturers forms an important part in the designing of curriculum to the need of the society and the industry. The up dating and the re-design of curriculum should move in pace with changes in technological innovations.

How could you expect a trained marine engineer during the age of coal revolution to practice his/her competency at this arena of science and technology? How do we expect the training approach of the 20th century to provide competent marine engineers to operate ships of the 21st century? Automation and control engineering is the need, the want of today's society. Training should focus to fulfil the social desires.

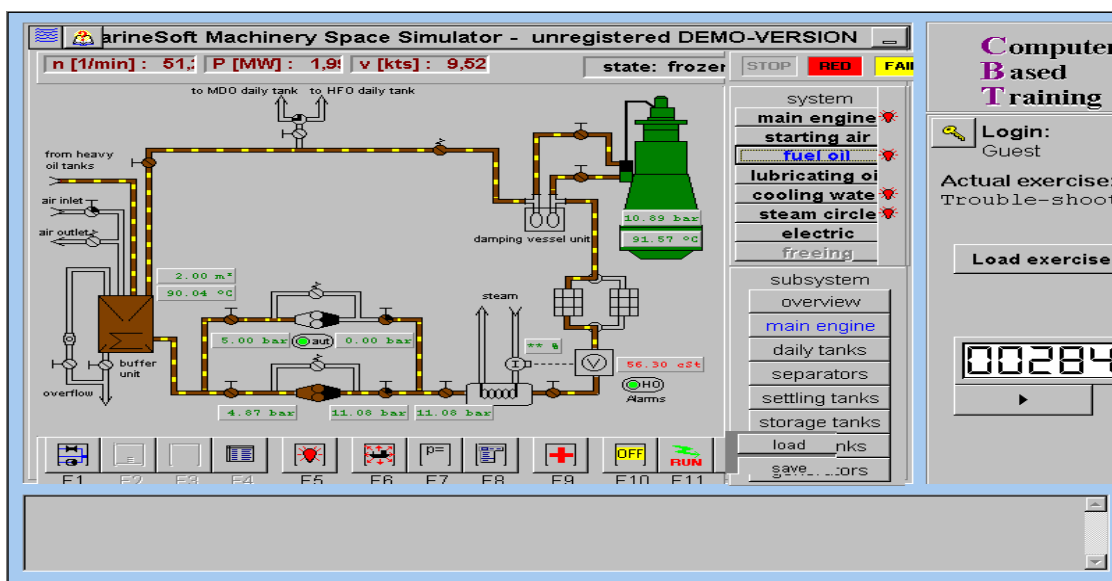
3.1 Computer Based Training (CBT).

The demand for engineering of today, design, performance testing, stress calculations, drawing and production, has been simplified and made more accurate and faster by applying intelligence systems installed in computers. A particular destructive test, for example, which was used to determine variables of mechanical properties of engineering materials, can be successfully carried out without actually destroying that material. Greater saving in cost and time could easily be realised.

Whilst it is true that there is no substitute for the real thing and undoubtedly the best method for training of seafarers is still the actual sea experience, nevertheless simulators may offer unique advantages. Computer usage in training is not simply a case of technological bandwagons; it may offer a genuine opportunity.

Computer based training, what is it about? We should appreciate that the processes of education are complex events, depending on a number of parameters for the transfer of adequate knowledge. Traditional teaching style could have an impact to students on the absorption of the knowledge required. Computer usage may bring simulation of the intended objective faster and may give the user a great degree of insight into the composition of the origin. An example of a CBT is indicated in figure 6 below. Fuel oil system indicating necessary components involves temperatures and pressures, alarm and flow. Movement of yellow dotted lines (graphically) may simulate the operation in the fuel oil system close to real environment in the engine room. Student may have an insight on the system arrangements, understand necessary adjustments and precautionary measures to be taken to correct the operation.

Fig. 6. Machinery Space Simulator.



Source: MarineSoft.

Paffet (1981) have observed the following advantages. *“Simulators are much cheaper than the actual component, cheaper to run and hence saves money and time.”*

Operating condition of any engine room machinery or system, graphically represented can be kept under control. Paffet further added that, *“Simulator above all is safe”*. Students can be taken through exercises, which could be completely inadmissible in the real practice. Effects on the maloperation of the boiler safety valve for example, may be simulated without damage or injury except to the ego of the user. Such an experience could not have been allowed in actual practice and it could even take one's professional life without coming to such boiler disasters. Computer based training can bring flexibility and fast interaction to students within their course of study. Programmes can be developed, up graded and or up dated using software to suit any training environment. Besides, it may be made possible for self-assessment and or be used as a competent assessment tool.

However, it may look expensive to have specialised computers for training purposes. According to Professor J.Splinter of Hogeschool van Amsterdam, specialised computers such as NOR-CONTROL installed with a PPT 2000 MC90 programme for graphic simulation of B&W 7S80MC main engine cost approximately \$120,000 (USD) and an additional of \$ 20,000 (USD) annually as service fee per piece.

Software in the form of CD-ROM, or floppy disks and others, could be available in the market. TRANSAS MARINE, POSEIDON, MARINE SOFT and other specialising agencies, in collaboration with engine manufacturers (MAN-B&W, WÄRTSILA NSD etc) are producing such products for different training module. These products have been certified to meet IMO requirements and they are simple to use with an ordinary desktop or personal office computers, sources from 'MarineSoft' have revealed.

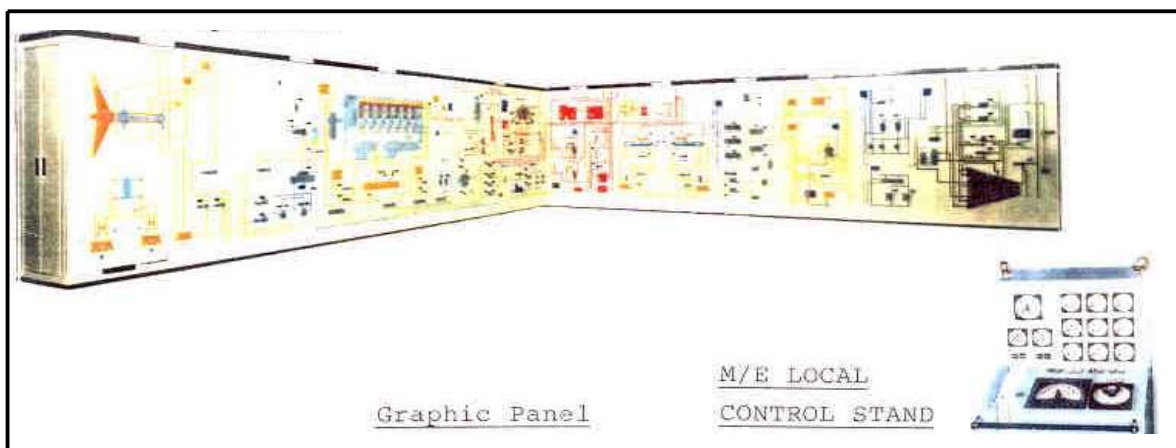
Computer based training could bring adequate interaction among students, create attractive learning environment, possible for team work practice, easy for distance

learning, video conferencing and internet and above all prices are relatively reasonable.

3.1.2 Proto type and Full mission engine room simulators

The proto type simulator is an array of drawings of some typical basic operating system(s) built in with necessary switches, valves and operating gears. A control station similar to a standard engine controls room, with necessary gauges; visual and audible alarms have been incorporated. Some signals of various operating machines are simulated from a recorded real life engine room.

Fig. 7. Full Mission ‘Graphic’ Engine Room Simulator.



Source: Marine Technical College. Japan.

With the arrangement indicated in figure 7, it is possible to simulate necessary procedures for main and auxiliary engine operations including necessary engine room auxiliaries. Watch keeping arrangements/procedures, evaluation of various parameters may be carried out through this simulator and may assist in giving the insight to students in preparing possible maintenance programme. It takes a trainee marine engineer to a real task of engine room activities, prepare him/her to meet a real situation on board.

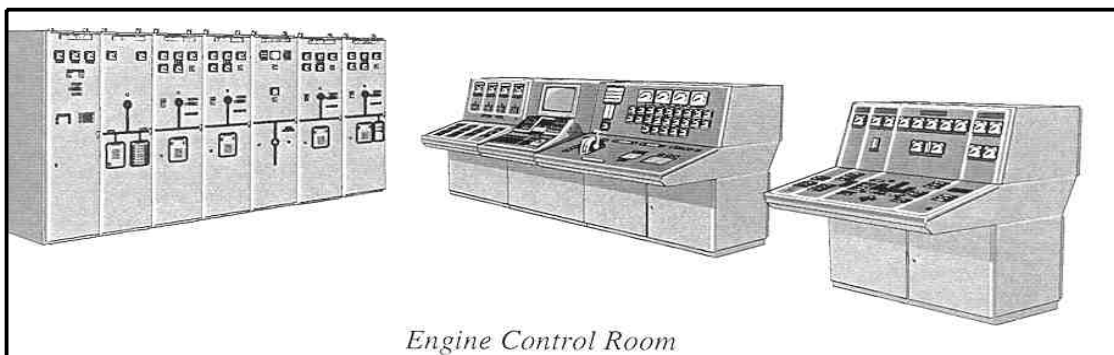
Proto-type engine room simulator is very effective for interfacing knowledge taught at schools with the actual practice onboard. Experience gained from field study in Japan Marine Technical College deserves to have some comment(s).

Principally most of the knowledge required for watch keeping engineers may be simulated but the system is some how rigid. It requires a lot of space and it is not flexible in terms of adopting various alternatives. These alternatives are essential because engine rooms are different for different ships. Besides, according to Professor T.Hikima, the cost of such an installation was approximately 100,000,000Yen in 1987. The current price for the same installation reaches approximately between 200,000,000Yen to 300,000,000 Yen.

The most popular full-mission engine room simulators, comprises of real items similar to that installed onboard. A control console with operating gears, telegraph, monitoring gauges, audio-visual alarm system with a remote change over switch for bridge control is provided. Electrical panel with voltage indicators, frequency and current meters, synchronising device and switches, load indicators and all safety devices are included as part of control work station.

An example of such an arrangement is shown below.

Fig. 8. Full Mission Engine Room Simulator



Source: NOR-CONTROL.

Computer monitoring is included for data processing of various engine-operating parameters such as indicator cards; temperature and pressure can be recorded and printed. Students may be able to observe the trend of these parameters and make analysis about the health of the plant.

With full mission simulators, the operation of both, the main engine and auxiliary machinery may be practised in various stages in handling of the engine room. Manoeuvring conditions like dead ship, anchoring in port, warming up and prepare the engine room ready for sea voyage etc, may be conducted. Moreover, a double creation device incorporated in these simulators makes it possible for students to experience operations under extraordinary conditions. It brings the situation close to reality but the initial, installation and running costs are relatively high.

3.1.3 Comparison: Hands on training and the use of simulators.

The traditional training of marine engineers required, among the theoretical knowledge from classrooms, a laboratory, workshop and sea service. It took an average of between nine to fifteen years to achieve the knowledge and competency level a chief engineer's. Machine shop training including the knowledge of materials, shaping, turning, milling and various welding techniques was necessary to equip a trainee engineer with necessary maintenance and repair skills onboard. Sea service training required, according to the level of competency, a duration of between 18 to 36 months onboard, to learn and demonstrate the skills for competent engineering practice in handling engine-room machinery in various operating conditions. The practice was, according to the observations and opinions of the author, very essential in the training process. However, there are some short falls as indicated bellow.

- ☛ Maritime institution were (are) not readily equipped with training ships.
- ☛ Unwillingness of ship owners to provide berth to trainee engineers for practical training purposes.
- ☛ Some Government policies for training of seafarers in relation to the national education systems are yet to be established.

- ☛ Unwillingness for qualified marine engineers to undertake additional duties as trainer's onboard, etc.

This created lack of opportunities and poor training environment towards the achievements of uniform competency level intended. The situation is even worse in some countries Tanzania is an example. Graduate trainee engineers remain uncertain with their future career opportunities. Simulator training could be very effective for the knowledge and competency requirements to marine engineers. The necessary skills toward maintaining ships of the future may be developed reasonably from a classroom. Training of marine engineers in the future should centre on the use of modern technology.

3.1.4.Career development for marine engineers

Maritime transport is the largest, most dependable and cheaper means for carriage of goods over the sea. The influence of technology in the shipping industry, the economical upsurge and down surge, shipping policies from both maritime and non-maritime nations, have a repercurtions on the carrier development for marine engineers. Ships today are highly automated. Although ships grow in sizes and shipping companies merges and or conferencing, the size of crew required on individual ships continue to reduce.

The reduction in number of crew onboard not only leaves the subject of safety with unanswered questions, but also the employment opportunities that marine engineers used to enjoy with the traditional manning system is no longer exist. We must accept the changes for an alternative substitute. The influence of technology and the manning arrangement of the future ships have a great impact to some MET in developing countries. Changes for curriculum in maritime institutions, revising and or modifying the present curriculum has become necessary in order to comply with the STCW'95-Code.

The development of new curriculum, which should be accredited into the national education system, or other education governing bodies, becomes eminent for the recognition and restoration of the lost reputation for MET graduates. The substitution for the alternatives have been practised in developed countries for many years with great success.

The polyvalent education systems applied to some maritime institutions in these countries have given wider career alternatives for the graduates engineering practitioners. The introduction of multi-skilled education and the dual-purpose training systems was the response to these changes. Professional training centres have been reforming to accommodate technological changes and provide education in response to the new demand in the maritime industry. High quality, professional and academic qualifications will be necessary for marine engineers in the near future. The reform should provide flexibility essentially to marine engineers with means to meet the challenges brought about by technology. To remain in the career as marine engineers serving onboard ships or with an opportunity to practice engineering skills either onshore or offshore industries may need such qualifications.

Dr. Murray Print defined the curriculum design and development as, *“At one level, curriculum is an idea, a construct of society. It is a statement of a society value. What it wants to continue, what it wants to change and what it wants to renew. Of course, even this conception of the society as having an entity, a capacity to make choices, is contentious. In curriculum, our society makes choices in various ways: by encouragement through public instrumentality’s, by expressions of view through parent groups, by statements from employer groups or trade unions and by contentions from special interested groups. The contentions and struggle will continue in that they recognise the challenging relations with which all teachers and students deals”*.

It is the challenge in the society that will require new skills for marine engineers to remain competitive in their careers. The curriculum should prepare marine engineers to face the dilemma of *system ships* of the future.

3.2 Cost evaluation for the raining of marine engineers.

The overall cost involved in the training process for marine engineers varies from country to country. Much of these variations depend on the education systems but the quantification remains to the economical level of an individual country. The duration at the college is a fundamental reference for establishing training cost for many institutions, but other variables such as currency devaluation factor, salaries for lecturers and staff, insurance etc have to be considered.

For government owned institutions, these costs may be subsidised to nearly 80%, reducing the cost sharing burden to parents or shipping companies to within an affordable margin. In the last 15 years or so, the Merchant Navy Training Board of the United Kingdom (UK) made an intensive research to investigate the subject of 'Cost-Effective Training'. The consideration was to reduce the cost of training to the industry and the reduction in the lead-time between training and qualification as a watch-keeping officer. The report produced a representative breakdown of a typical fixed costs of training to class 3 certificate as shown in Table 3 below. According to Capt. Phelan, tuition cost at the colleges was currently subsidised to an extent of 84% by the local Education Authority, who also pays 35% of the accommodation cost.

The training cost at USMMA, for the class of 2002, for the US citizen and foreign students is indicated in Table 4. For a US citizen, the major cost of attending the USMMA is borne by the Federal Government. The training is a 4 years program leading to the Bachelor Degree (BSc) in various engineering and nautical studies. The US Coast Guard, on completion of competency examinations awards watch-keeping certificate to candidates.

The cost for training marine engineer(s) at DMI in Tanzania is relatively low in comparison to that in United Kingdom and United States of America. These costs, excluding transport and accommodation should be borne by student sponsors/parents and it may cost about 4,000 (USD) to complete a three years course. The costs are relatively high to be borne by individuals and it therefore needs a dedicated joint force from governments, ship owners and all interested parties in the maritime transport. Quality at home begins by charity.

Table 3. Cost of Training to Class 3. UK.

Entrant level	Ordinary Secondary level. ('O' Level)		Advanced Secondary level. ('A' Level.)	
Salary (incl. Employer N.I)	11,211	63.80%	9,396	64.70%
Subsistence (at sea/on leave)	2,619	14.90%	2,606	17.90%
Residence at College	1,890	10.70%	980	6.70%
Tuition, Examinations (incl.short courses)	1,027	5.80%	891	6.10%
UK Travel (College/leave)	840	4.80%	660	4.60%
Total fixed cost	17,587	100%	14,533	100%

Source: Capt. C.N Phelan. Seminar 9th Feb.1983. Ship Manning Present and Future.

Table 4. Training Cost at USMMA.

Citizenship	United States	Foreign
Pliable class (Freshmen)	5,057.10	12,000.00
Third class (Sophomore)	959.50	4,800.00
Second class (Junior)	1,282.00	4,800.00
First class (Senior)	1,770.00	8,800.00
Total (4 years)	9,068.60	30,400.00

Source: USMMA (1999). The 2000 Academic Catalogue.

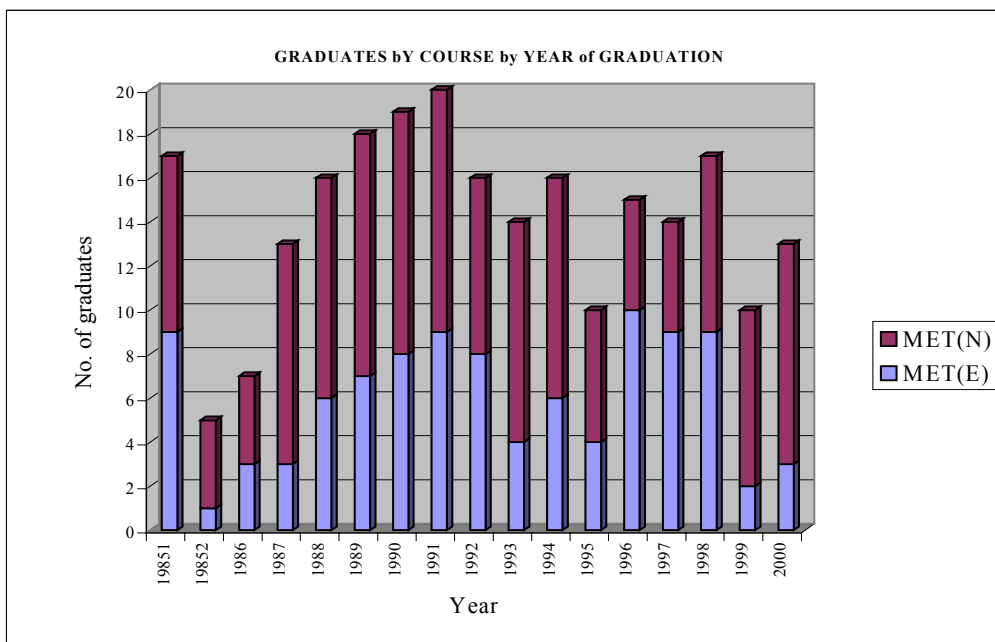
CHAPTER 4

4.0 Marine Engineer's Training. Comparison of some selected countries.

Since the endorsement of the revised STCW'78, the STCW'95-Code, by IMO in 1995, every maritime institute especially from developing countries, is working hard to meet the requirement of so called “**the white list.**” The reason for this is obvious, that is to maintain the carrier opportunity for their graduates at international set and acceptable standards. The STCW'95-Code require, as one of the conditions that, all maritime institutes to prove beyond no reasonable doubt (through their respective maritime Administration) a new method of training and certification has been developed, the ‘functional approach’ which will run according to this Code.

More important, the Code clarifies, among other competency requirements, the need to have **qualified instructors and assessors**, introduce effective reinforcing mechanism in order to give greater flexibility and thus broaden the carrier opportunities for seafarers.

The question of qualified trainers and assessors, upon whom the carrier opportunities for seafarers depend, it is still uncertain to the author of this dissertation. It is uncertain for the reason of comparison on its effectiveness as compare to student-instructor ratio at a global level. Professor Peter Muirhead, MET course Professor at WMU mentioned that, since the establishment of WMU in 1983 there is a total of 227 graduate instructors and assessors, most of whom are from developing countries. This figure was confirmed from the Registrar, Mr Bruce Brown and it includes the 1999 graduates. This is an average of about 14.2 graduates per year. It can be seen from figure (), that the trend for graduate instructors and assessors from WMU is far from reaching the realities to satisfy the requirements of the STCW. This figure can further be proved to be very low when looking on the number of graduates per the country of their domicile. Tanzania, for example, has so far with only 3 MET graduates from WMU, and the number is expecting to rise to 5 by the end of year 2000. See annex (no...).



Unless it can be proved otherwise that an equivalent training (as one offered by WMU) for instructors and trainers is carried out from other institutions or by some other arrangements, these figures are extremely low to meet requirements of section A-1/6, paragraph ii of the STCW-Code. The review of curriculum at WMU, which runs in line with the quality standards of the association of European universities, and the introduction of elective system, could enable improve the number of graduates with sufficient background of pedagogic skills. Graduates may have an added advantage to work as instructors and or assessors in MET systems in their respective countries. This way the instructor student ratio could improve and make possible to meet the STCW'95 requirement of regulation 1/6.

It was mentioned from the previous chapters about the influence of technology in manning arrangements of the ships of the future and the demand in the shipping industry on the application of the intelligence systems onboard.

Notably, these have been the influencing factors that piloted pro-active decisions taken by some MET's and other professional learning institutions in the developed

countries. Curriculum was designed, revised and updated to meet the challenges of the future. Among them is the unpredictable amendment and requirements taking place within the STCW. The decision to reorganise MET system has produced a considerable success in developed countries as compared to the reactive attitude for their counterpart in some developing countries. To understand how MET systems operate, for the achievement of the aims and objectives of the STCW'95-Code, there is a need to look at some selected countries who have had success in this area. Comparison will be made with much empathise centred at curriculum design for carrier development of the graduating students.

4.1 The United States Merchant Marine Academy (USMMA)

The USMMA provide a four years-academic program leading to a Bachelor of Science (BSc) degree and a licence as a merchant marine officer. The USCG issues the certificate of competence, for students who satisfies the STCW requirements and pass the examination set by this organisation. The curriculum for various learning specialisation have been designed to cope with the mission statement of the academy which states:

“ To educate and graduate officers and leaders of honour and integrity who are dedicated to serve the economic and defence interests of the United States in our Armed Forces and Merchant Marine, and who will contribute to an intermodal transportation system that effectively ties American together.”

Curriculum design and development is under constant review and revision within the limits established by the law and Maritime Administration, US Department of transportation Orders. The obligation of such review and revision suggests the consideration with changes brought about by technology and the demand in the American economy. It provides a greater flexibility in the carrier development and opportunities to the graduating students from this Academy.

Graduate students may also be appointed as commissioned officers in reserve components of the US Armed Forces including the Merchant Marine Reserve of the US Navy.

The current curriculum at USMMA comprises seven major programs as indicated below.

- ① **Marine Transportation:** - A program combining nautical science and maritime management business.
- ② **Marine Operations and Technology:** - A marine transportation program enhanced with marine engineering studies.
- ③ **Logistics and Intermodal Transportation:** - A program combining nautical science and logistics and intermodal management.
- ④ **Marine Engineering:** - A focus on shipboard engineering operations.
- ⑤ **Marine Engineering Systems:** - An emphasis on engineering designs.
- ⑥ **Marine Engineering and Shipyard Management:** - A program based on a marine engineering core and emphasising on the management of shipyards and other large engineering endeavours
- ⑦ **Dual Licence:** - A program combining marine engineering and marine transportation studies for licensing in both specialities. Available only to students with substantial prior college course work.

In addition, students undertake a licence program, a comprehensive written examination, administered by the US Coast Guard, for their licences as merchant marine officers. As a requirement for certificate of competence, candidates have to attend at least 320 days of sea service. Most of this (sea service) is carried out onboard MV Kings Point training vessel.

Marine engineering studies have a broad flexibility, which provide graduates with a great carrier opportunities in the maritime industry in general.

More information about USMMA may be available by writing to:

Director of Admissions, US Merchant Marine Academy, Kings Point, New York 1102-1699 USA. E- mail address. – admission@usmma.edu or through Internet web: - [http:// www.usmma.edu](http://www.usmma.edu).

4.2 Kobe University of Mercantile Marine. (KUMM).

The technology advancement and its applications in various sectors towards Japanese economy, is going along with the demand in exploitation and exploration of

the natural resources available from the sea. KUMM is the centre which defines it self from its objectives that:

“...To bring into the world competent technologist for a global transportation system with the key words such as safety, serving energy and environmental protection.”

According to Mr. Kiyoshi Hara, the president of KUMM (at the time the author of this dissertation visited the University), there are four major fields of study both at graduate and under graduate courses comprising mainly of the following major fields:

- ① **Maritime Science.**
- ② **Transportation and information Engineering.**
- ③ **Ocean Mechanical Engineering.**
- ④ **Power Engineering.**

The studies, which are carried out from the department of Marine Science, viewing a ship as a comprehensive system, provide an extensive education with regard to science and technology on ship operations and management. A four years study will lead a candidate to a Bachelor degree with an option of additional two years to a Master degree graduate. Doctorate degree caters for additional three years at the university on relevant professional studies. Marine engineering course under this department offers a comprehensive curriculum, preparing candidates in the two main fields of mechanical engineering and electronic control engineering. The main objective of this course is to educate engineers for both field of land and the sea. Options for the carrier as a seafarer, opportunities to work with ship designs construction and repair, as well as on related maritime research centres have been made available and attractive. More studies under this department contains a curriculum which covers, transportation and information engineering with the emphasis on planning, development and management in the field of transportation systems and logistics using the techniques of information science and system engineering.

The ocean Electro-mechanical Engineering cover studies with regard ocean sciences and Electro-mechanical engineering, main areas of which are oceanography and mechanics including mechanical, electronic and control technologies.

Furthermore, the curriculum for Power System Engineering was designed and implemented where the studies of system technology on power and energy with emphasis on their application and management, the development of mechatronics and

intelligent man-machine systems are being carried out. Such broad curriculum designs, leading students for a higher gain in academic and professionalism, gives a greater career opportunities and development to marine engineers. More important, it provides retention platform of professionals in the maritime industry.

The primary professional training for Japanese seafarers took a new turn over the last thirty years or so. Technology has brought remarkable changes in operation of merchant ships, which provide the impetus for modernisation of maritime education and training in Japan. The idea to remove the conventional division between deck and engine, introduce a program with the objective of operating sophisticated Japanese vessels with a small number of crew. This program requires a complete review of the existing work division between deck and engine operation.

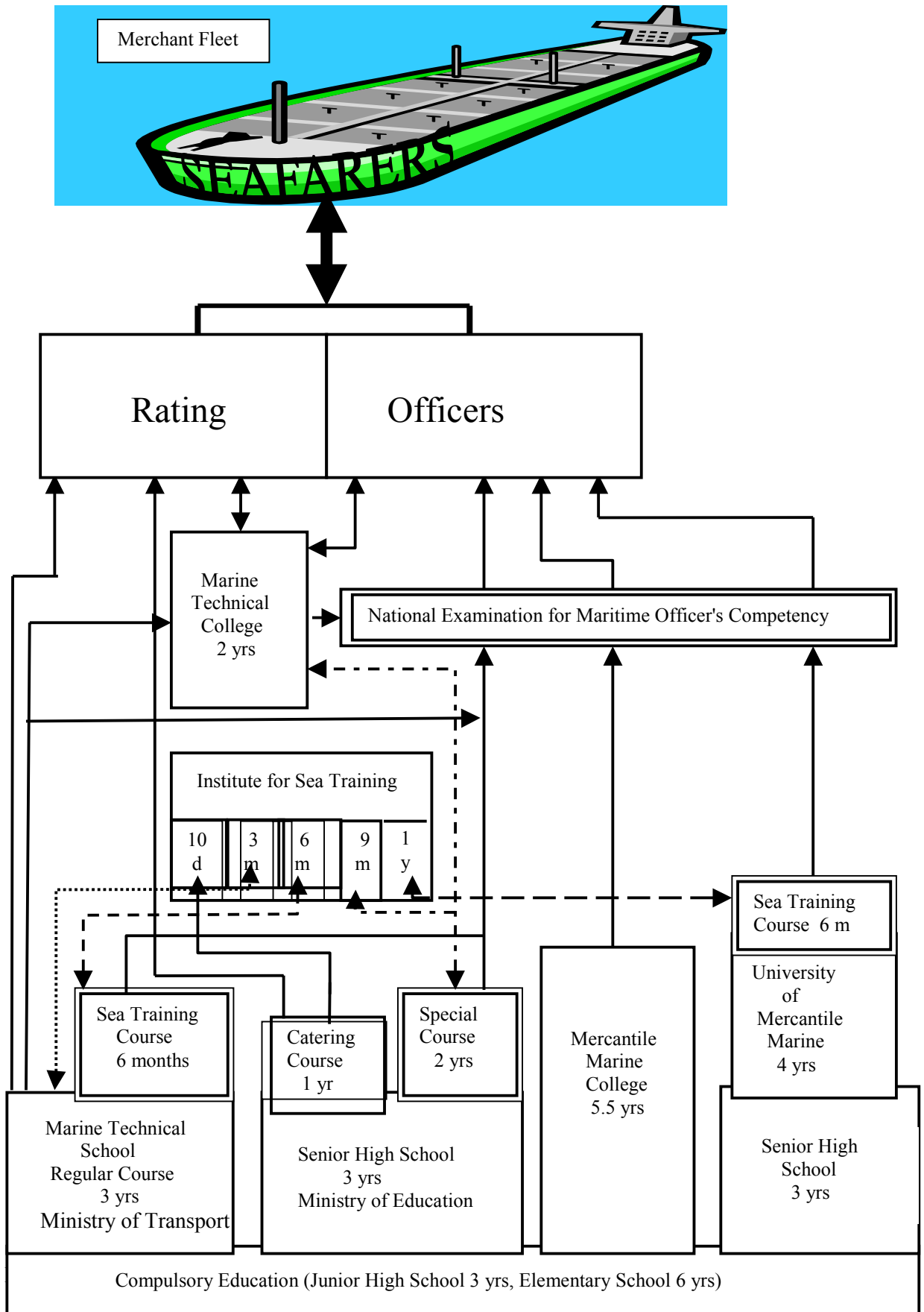
The dual purpose crew (DPC) program was introduced, where crew would be identified on the basis of their common skill as well as specialised skills either engine or deck crew. The fixed manning system with a reduced crew for the Japanese vessel was finally legislated into the revised ministerial ordinances in 1986.

Even though, rating training in Japan follows two major systems, regular and special. There is a marked change towards multi-skilling. The dual-purpose crew system for the Japanese maritime training appears to be heading towards a single point entry. Both regular and special courses are meant for the dual-purpose crew.

The regular course is for junior high school graduates who can join a three years course at any of the eight schools for seafarer training. Senior high school leavers can join a seamen training school for one year. The Institute for sea training have six ships which takes care for students sea service on board sail ships, main diesel and turbine propulsion system. When student complete the required seas services and pass the appropriate examinations conducted by the maritime administration, the award is a 3rd/4th-grade marine officer certificate.

The upgrading of existing rating is done through a reduction system at Marine and Technical College in Kobe with the opportunities to join the KUMM for specialised studies at a higher level, i.e. Masters and PhD-degree. The educational structure for maritime education and training in Japan is as indicated bellow:

Maritime Education System in Japan



4.3 Dar-Es-Salaam Maritime Institute (Tanzania).

Marine engineering training in Tanzania was established by the 1964 Merchant Shipping Act No 47. The main objective was to have personnel with a formal marine engineering training to serve the merchant shipping industry in the country, as well as the then East African National Shipping Line. At this time training of seafarers were largely depended from colleges and institutions abroad. Following the breakdown of the East African Community in 1977, the training of seafarers in the country was to take a new turn. The costs involved to train local seafarers abroad and the increasing demand for qualified personnel to serve the national Coastal Shipping Line (TACOSHILI) and the inland water ways services (in Lake Victoria, Tanganyika and Nyasa) was the motive toward the establishment of DMI. This was made possible by technical and financial support received by the Government of the United Republic of Tanzania from the Norwegian Agency for International Development (NORAD) in mid 70's. Training at the then DMTU, was meant for personnel already employed in these shipping companies. The evolution in ship transportation sector created a further demand in training of seafarers, and as a result curriculum was to be restructured to accommodate these demands. DMI was then established by the Act of Parliament in 1991 with full mandate for seafarers training within and out side the country. Since the country became party to STCW-Convention in April 78, training at DMI is mainly focusing within the requirement established by this international treaty.

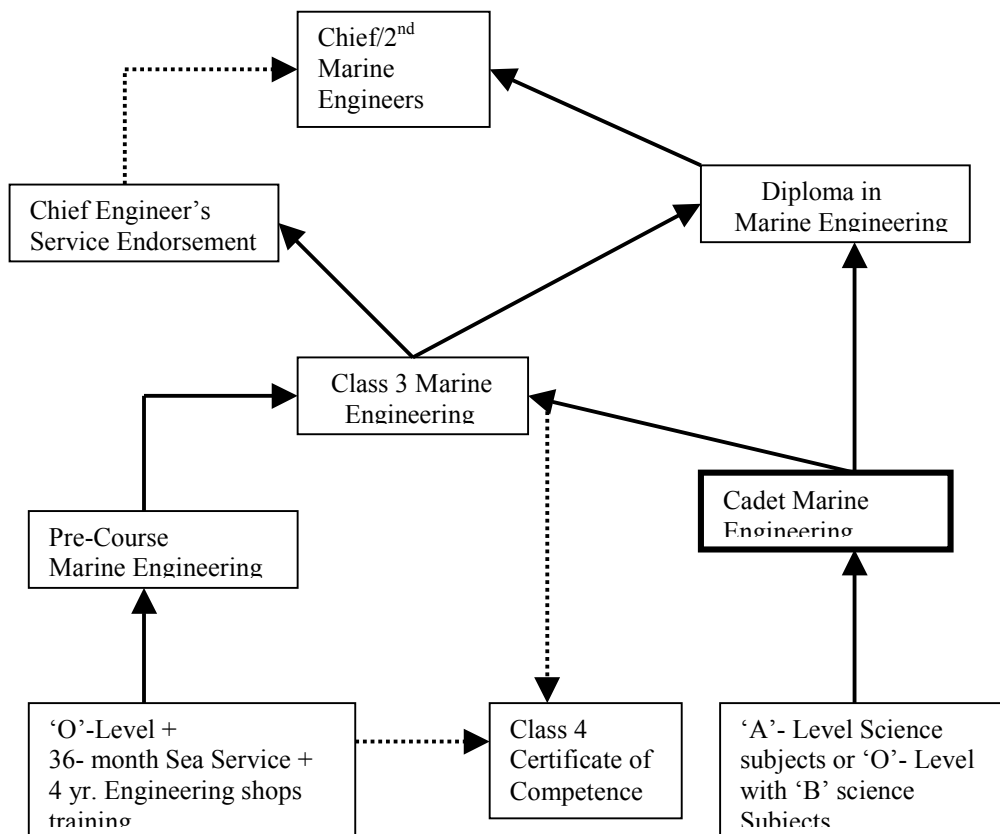
The entry requirement as stated in the Merchant Shipping Act, regulation 78, was very high and it was regarded as an obstacle for more students interested to become marine engineers.

The idea to design and develop curriculum for 'Cadet Marine Engineers' was brought forward by the author of this dissertation (in 1987) in respond to the growing demand from private shipping companies. A study carried out by MNOAT, a non governmental maritime officer's association, based on trade liberalisation has indicated that there is a potential growth in the shipping industry in the country, the East African region and the neighbouring countries of Namibia, Zambia and Malawi. Therefore, it was eminent to have the base for qualified marine engineers, not only to meet the demand and supply of seafarers in the booming ship transportation in this

area, but also to make them readily available to serve the existing shipping companies.

Cadet Marine Engineers' provides the opportunity for career development of young men and women who are interested in becoming professional marine engineers. The curriculum was fitted in the engineering course structure of DMI as indicated below.

Engineering Course Structure at DMI (Year 2002- Projection)



In response to the advancement in technology and the demand from other related maritime industry such as oil companies, shipyard and even land based industries such as railway locomotives, electrical etc, DMI is developing courses to suit these industries as well. Cadet marine engineers may have option to develop their carrier as professional marine engineers or undergo further 2 years studies leading to a Diploma in Marine Engineering. For those candidates who can not afford to pay for further studies they may apply for Class 4 Certificate of Competence Examinations on

successful completion of 24 months sea service as engine room rating. They may then become watch-keeping engineers' onboard ships with power output of up to 750kW. Cadet Marine Engineering is an 18-month theoretical with a combination of workshop practice, industrial and shipboard visit. It is running quite satisfactorily and it forms the foundation for marine engineer officers of merchant ships in the region. The content in the curriculum is of a combined academic, technical and professional character, giving a variety of career developments to the graduating candidates. With the technical background, it is possible to develop the carrier as a professional marine engineer or apply for further studies in engineering specialised institutes. This has not taken effect for reasons that will be explained in the following chapter. However, the curriculum is also attractive to candidates from Zambia, Malawi and Namibia. In the move to strengthen the education system for marine engineer at DMI, the head of Engineering Department, Mr Thomas Mayagilo, who has been recently appointed as DMI Principal (March 2000), initiated new curriculum design. Its development is under way and its implementation will take effect later 2002. This will run concurrently with class 2/1 course for 2nd and chief engineers as indicated in the course layout above.

4.3 Maritime Education and Training in Spain.

Spain is one of the strong maritime nations in the world. The history may be traced way back during the times of Christopher Columbus, an Italian seafarer who (accomplished his mission on behalf and the support from Spanish Kingdom), travelled across the Oceans round the world. The expert in navigation skills made the success into such difficult voyages possible, which enabled him to discover America. There were no nautical schools at that time, but the learning of the sailing was acquired through the accumulation of experience while sailing onboard. Before granted the position as a master to command ships of those days, it is believed that the endorsement by some kind of association(s), which have had the responsibility to verify the capacity of sailors, was necessary.

Later with the development in trade, these associations are believed to have been the initiators of a formal maritime study of the kind we see today in Spain. They (associations) organised and established institutions in the XIII or XIV century in

Spain which was known as “Universidad de Capitanes de Naos, Maestres y Mercaderes” or briefly Masters and Tradesmen University, as could be translated in English. The “Colegio de Pilotos Vizcainos (College Deck officers in Biscay), which probably could have been established in XIV century in Seville was a result of these transformation, where formal education for seamen was conducted and recognised countrywide.

Since that time, the maritime education and training in Spain has continuously been modified and restructured to adapt the training need of the maritime transport development in the country.

According to Captain Fernando Pardo, Associate Professor of WMU, the evolution in the nautical carrier has passed through the following main step:

- Regional, local or private academies without defined course programmes, mainly teaching Astronomy and Navigation.
- Special education system based on three courses and sea period, independent from University and controlled by the Ministry of Transport. No academic background was needed to enter the Nautical Schools, but passing an entry examination was required.
- Officially recognised university level with a school period of 5 years and training at sea. A high school certificate was necessary as entry requirement.
- Education and training fully integrated in the university structure, under the Ministry of Education.

Before 1970, different Ministries (Industry, Transport, Commerce and Education) governed the education system in Spain. Initially, the maritime education and training was under control of the Ministry of Commerce and later transferred to the Ministry of Transport. This brought difficulties for graduates from nautical schools to have an access for employment opportunities to land based and or private companies. Employment with directly linked to maritime transport; marine pollution, ship building etc were normally for university graduates with certificates as Civil and Naval Engineers, Economist and Lawyers.

The plan to integrate all higher education under the university structure, with a new five- year course programme for Nautical Schools or MET was approved in 1977.

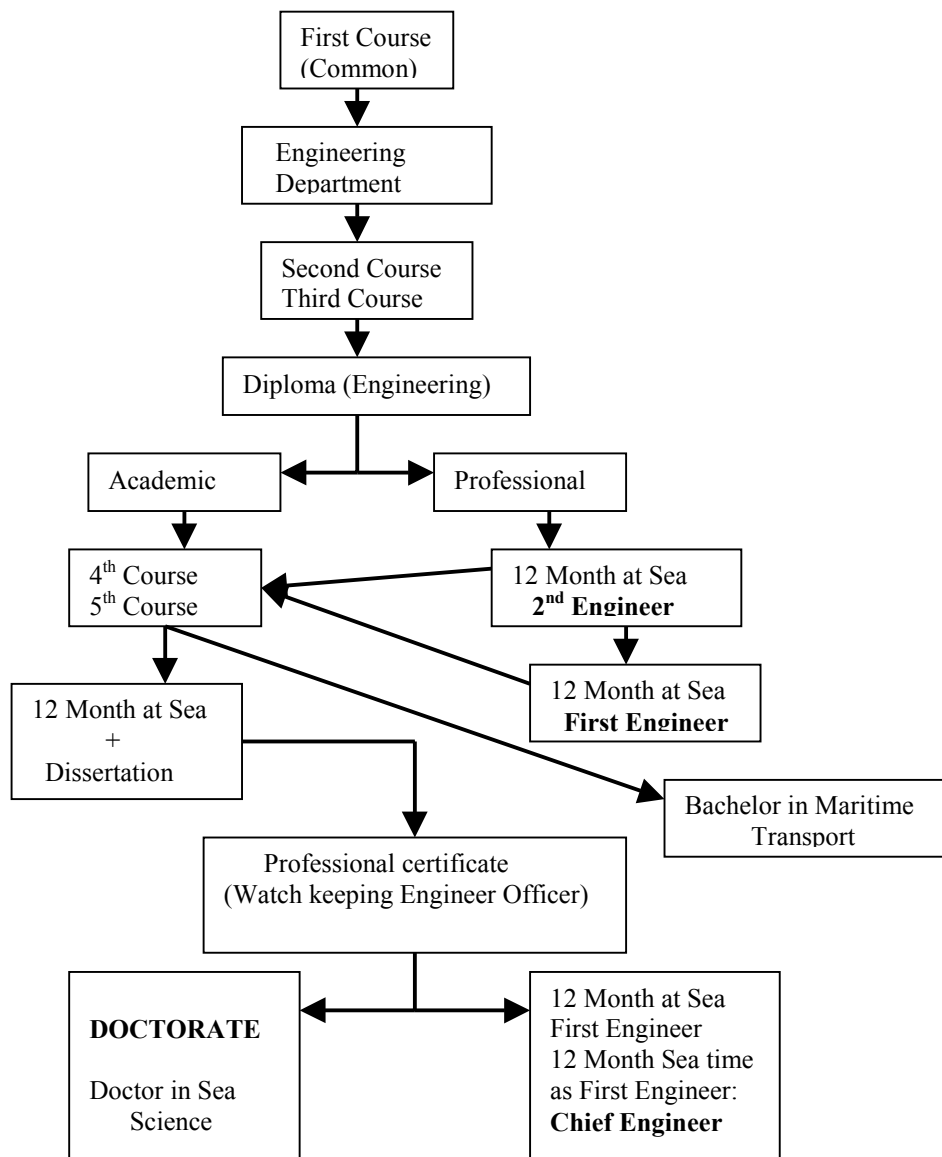
Under this arrangement, the nautical studies in Spain has taken place with objectives focussed not only to provide training for seafarers, but also to offer the opportunity to

the students to have a university level certificate which will allow them to work in other fields of maritime transport. Carrier development in fields such as Maritime and Port Administration, Shipping Companies, Oil Industries, Shipyards and or even other industries such as Power Plants (Marine Engineers) has been made possible for graduates from MET system. At present the Maritime Academies are fully integrated in the university system and are under the management of the Ministry of Education. However, the professional certificates (certificate of competency) are under the control and authority of the Ministry of Transport.

The Engineering structure for MET system in Spain is indicated in the following figure. A complete MET structure in Spain including navigation, including course contents, refer to appendix...

Maritime Education and Training in Spain (Engineering).

Entry academic requirement: Examination (Common for all university studies)



Examinations for certificate of competency at any level, is governed and monitored by the Ministry of Transport. Captain F. Pardo further explained that, there is an Institute for Simulator Training, an independent organ with the responsibility to conduct and provide simulation training on behalf of Universities, Institutes and Colleges in the country. With regard to sea service training, it is the responsibility of the students themselves to establish contact with shipping companies to accomplish the required sea service period. Spanish ship owners are much willing to provide accommodation for sea service to graduate students as part of their contribution toward the training of seafarers.

4.6 Maritime Education and Training in Denmark.

Maritime education in Denmark is under the management and control of the Danish Maritime Authority (DMA) which is a government institution under the Ministry of Industry. Any important issues on maritime education passes through the Maritime Education Council whose members are representatives from ship owners and seafarers association, the Royal Danish Navy and the DMA.

Training institutions in Denmark are under two categories. Private owned institutions are under different maritime organisations with 70% of the running costs subsidised from the government. Students enrolled at these institutes have to pay some little amount as tuition fee. Large numbers of maritime institutes are under direct sponsorship from the government with students enrolled needed not to pay for tuition fee.

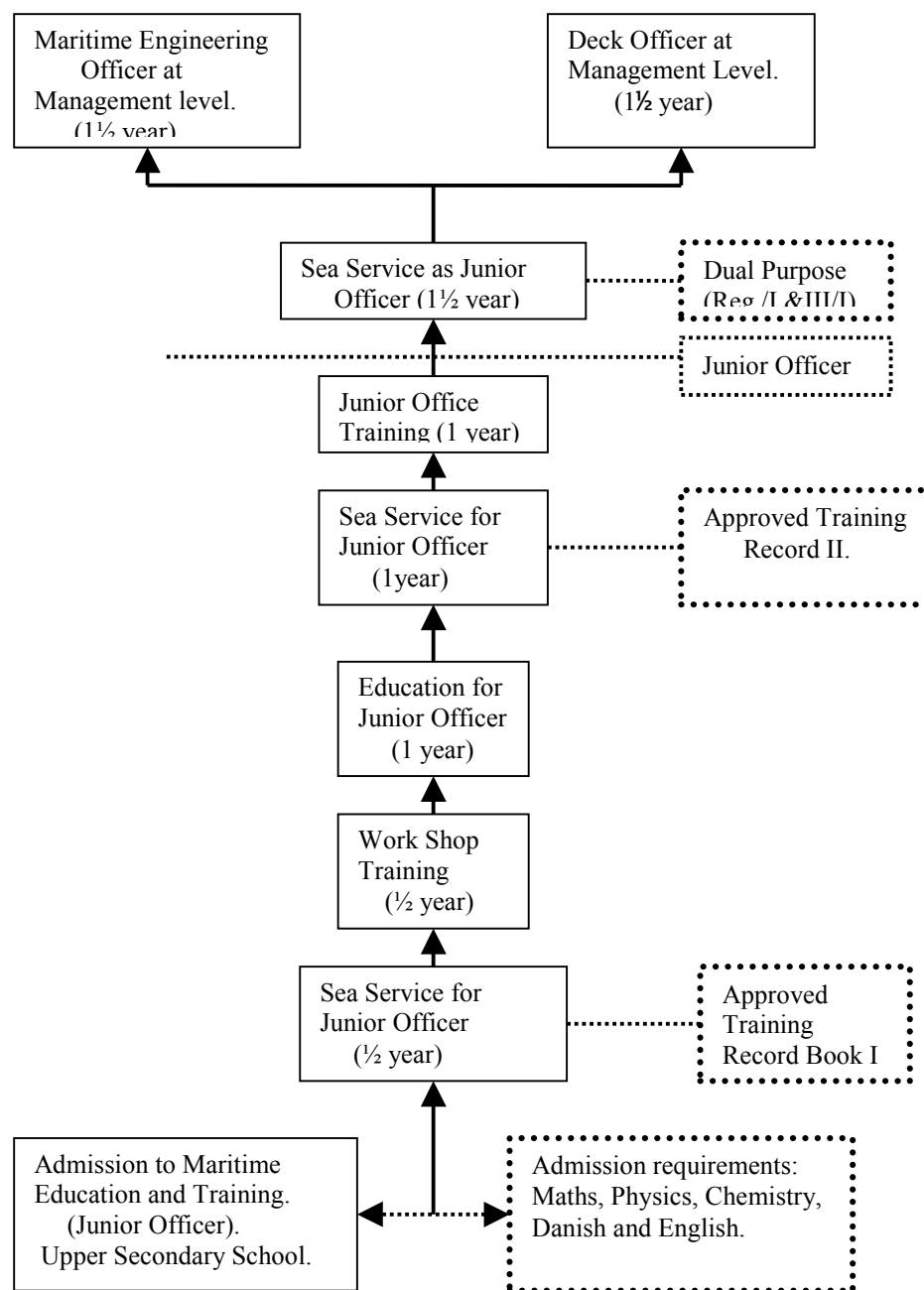
Mr Hemming Hinderborg, DMA's consultant mentioned that the government pays approximately 10,000 USD for every student enrolled in the government institutes and an additional 4,500 DK for accommodations and food is paid to students. He further pointed out that it is a mandatory for every student to have an agreement with any Danish ship owner or company before accepted for enrolment. This is necessary to ensure that every student secure birth for sea service training.

The influence of free trade, lack of interest and the cost of employing Danish seafarers have come as a result for the introduction of new scheme for MET of

officers for Danish merchant shipping. This new scheme, the dual purpose at junior officer level started in July 1997.

The main feature of the scheme is a combined MET program for apprentices employed by Danish ship owners leading to dual purpose qualifications as junior officer (full compliance with STCW Convention reg./I and III/I.) in the deck and engine department.

The general carrier path for maritime training in Denmark is indicated in the following figure.



After a period of sea service as a junior officer, students rejoin the studies at management level either at a nautical college or an engineering college. On graduation, students qualify as senior officers onboard in either deck or engineering.

The carrier at sea for most Danish seafarers has shown a declined trend over the last 5 years or so, according to Mr Hemming. He further added that, the cost of employing Danish seafarers, as the case in most developed countries, have influenced Danish ship owners for an alternative seafarers from abroad, mainly from Asia and Eastern European countries. These new changes and the demand from ship owners gave a wide spread concern that MET system in Denmark should take a new turn in trying to keep abreast with the developments in the industry. In addition to the dual-purpose system, maritime education in Denmark is moving towards integrated system and curriculum that will lead graduates receive higher certificates at university level. It is intended to establish a Bachelor (BSc) and Master (MSc) of science degrees which may extend to a level of a PhD degree in the maritime related specialisation. The aim is to develop and broaden carrier opportunities in the maritime sector both on and off shore, he concluded.

4.5 The Australian Maritime College.

The Australian maritime education has been progressively moving with pace over the last thirty years or so. It started with a traditional maritime education for seafarers training, primarily for the Australian Maritime transport industry in the early 60s’.

The rapid wide spread of technological changes in the shipping industry (in the 1960s’ and early 70s’), the introduction of 200 miles Exclusive Economical Zone (EEZ) and the development of sophisticated special purpose ships, gave rise to the concern that the Australian maritime training and education was failing to keep abreast with the development in the maritime industry. The inadequacies which was observed in the training for shipping and fishing industry, was the motive towards the

rationalisation of the maritime training and the transformation of the AMC to an institutional of higher education.

Today, the AMC offers a wide range of accredited courses from certificates to degrees and postgraduate levels. In addition to providing a substantial number of short special purpose courses, the college is also engaged in a number of research and project activities.

For the purpose of this submission, only some of the curriculum and carrier development in the engineering sector will be mentioned.

Marine engineers in Australia today have a wide range of carrier development covering both academic and professional specialisation. The curriculum incorporates the traditional ‘safety oriented’ certificate of competency requirement within the systematic courses of education and training. It also encompasses commercial and managerial work, not required for the certificate of competency, and lead to recognised educational qualifications.

The introduction of **Certificate course in marine operations (CMO)**¹ provides the basic training required by those who are seeking to become ‘Integrated Ratings or Engineers or Deck Officers.’ Candidates for this course must be graduates at a minimum year 10 in Australian Secondary Schools. Carrier development for successful candidates, holders of CMO, is made possible by pursuing further studies in **Advanced Certificate of Technology [Marine Engineering (ACTME)]**² and the Associate Diploma of Technology [Marine Engineering (ADTME)]. The ACTME is designed for those who wish to gain a certificate of competency as Engineer Watch-keeper, and the ADTME is for those seeking to become Engineer officer’s class 1 or 2. There must be an accumulation of the appropriate experience (industrial or sea service) before enrolment to the ADTME course.

The design of the Diploma course (**Diploma in Marine Engineering**)³ takes account of the changes in the training of ratings (introduced in 1989) which has also affected officers training through common initial training for officers and rating. The present arrangement has included a common first year of ‘provisional integrated rating’ training comprises of the first three modules: the ‘*engineer watch keeper*’ and ‘*engineer class1*’ modules may be followed consecutively subject to the admission requirement.

Under the Faculty of Maritime Transport and Engineering, further studies leading to **Advanced Diploma in Marine Engineering (ADME)** which incorporate the DME (watch keeping) covers the fundamental knowledge requirement for engineer officer professional certificate of competency. It is designed to meet the need for student seeking such professional qualifications as well as providing carrier path for integrated ratings who have completed the CMO.

The **Bachelor of engineering** (a four years study in Naval Architecture) is designed for 'post year12' people. It provides an opportunity to gain professional status in the field of naval architectures. Graduates from this course may have employment opportunities in shipping companies, shipbuilding and ship repair companies, defence organisations etc. Students may also have the opportunity to expand their carrier spectrum by further education leading to a **Master and or a PhD- degree in Maritime Transport and Engineering**, to mention but a few of the varieties of the courses offered by the AMC.

Courses and curriculum at the AMC are under constant revision and review, updated and developed to meet the national and international need of the maritime industry.

For more information about the AMC, please contact, Student Administration, Australian Maritime College, P.O.Box 986, Launceston, Tasmania 7250 Australia.

Or by e-mail; amcinfo@mariner.amc.edu.au or through the Internet web:

[http:// www.amc.edu.au](http://www.amc.edu.au).

CHAPTER V

5.0 Training of Marine Engineers in Tanzania.

Training of Marine Engineers in Tanzania has been briefly explained in chapter 4, section 4.3 and the career development clearly indicated in fig (11).

The objective of this chapter is to analyse the environment surrounding professional engineering practitioners in the country, in particular professional marine engineers. Engineering practitioners serving onboard ships, or in any maritime related engineering practice, and who have undergone internationally recognised formal training from any maritime institution, DMI is of no exception, are entitled to qualifications of ‘Marine Engineer’.

The grades of these entitlements depend on the level and responsibilities both on board and onshore, and the procedures followed in the formal training process.

Based on a combination of onboard, academic (theoretical) and practical training offered at these unique maritime institutions, it may be possible to qualify to the highest professional level that of a ‘Chief Engineer’. The competency gained enables the holder to execute and discharge his/her knowledge on design, manage, maintain and operate ship’s machinery and the affiliated equipment safely, orderly and more important in a cost effective manner.

Statistics may justify that; it could take between 18- 20% of some ones life to arrive at the highest professional level of a ‘Chief Marine Engineer’ (in some places Marine Engineer Class 1). Captain Steen Stender Petersen, Deputy Secretary General, BIMCO, explained that, *“there is little we can do to accelerate the ten years that is usually cited between the recruitment of a young cadet and the achievement of a master’s or chief engineer’s qualification. In a*

profession that is heavily dependent on experience, you just have to wait for the experience to accumulate.” This is very difficult to understand for some one that is not related to the maritime industry, particularly, training for seafarers. The contributions rendered by marine engineers to the national and international community at large is of a magnificent value that can not easily be measured.

However, the environment is not so friendly in some part on this universe and Tanzania is among the many distinguished countries. Marine engineers at different levels in such countries are not appreciated by their contributions in the national and international economy and or trade. People they like trade. Ship transportation sector has been, and will continue to be a favourable means of massive transportation of commodities that links the trade among the people of the world. Because it is the trade, be it of industrial or of agriculture products that determines the economy of individual countries. The import and export of commodities that links the people of different nationalities, forms a large part of local and international trade. Marine engineers have been working tirelessly, managing machinery and equipment to enable ships of different sizes, from smaller to the giant ULCCs’, cross Oceans carrying different commodities.

Why are marine engineers not appreciated in some parts for their contributions in the global economy? The reasons given in this dissertation, section 5.2, will reflect the experience of the author in his home country, but interested readers leave most of other reasons for discussion.

5.1 The SWOT analysis.

There are several points to be discussed in this SWOT analysis, for the education and training of marine engineers in Tanzania, but for the submission of this dissertation, only those of important considerations will be highlighted.

Strength:

The re-establishment of the East African Co-operation (formally known as the East African Community) in 1998 and the co-operation of member states forming SADC region, gives opportunities for investment in the maritime transport and fisheries sector. It is expected that, there will be an increasing number of ships', shore and offshore activities in the region. The exploration of natural gas in southern part of the country, along the coast line of Indian Ocean and the deep sea fishing within the exclusive economic zone, is an indication of the growing demand for sea transportation in the East African region. The training of marine engineers must keep abreast with these new demands.

DMI, an institution where most of marine engineer's education and training in the country depends, is recognised by IMO. The education that leads to marine engineering qualifications are internationally recognised. This recognition gives equal opportunities for employment on any foreign flagged ship. Besides, it was stated in the 1996-2001 DMI's strategic plans that, "*DMI's mandate is clearly set out and is broad enough to facilitate unrestricted developments.*" The development of academic and the establishment of professional class 1&2 marine engineering studies form a great strength for people who are interested in such qualifications. It will be locally available and yet at a reasonable tuition fee.

Weakness:

The main weakness in the training of marine engineers in Tanzania is that, though the training complies fully with the STCW'78 as amended in 1995 (STCW'95-Code), the education process still follows, much of it, on the '*traditional hands on*' training system. Lack of modern training facilities, computers, engine room simulator(s) and training ship(s) makes training at DMI away from keeping abreast with technological changes that are taking place in the shipping industry today.

The innovations in computer technology and its fast growing application onboard *system ships* will require marine engineers to learn how to sit behind computers to execute their duties. The financial constrains, most likely facing many other METs' in the developing countries, has been identified as the root cause of these weaknesses at DMI.

Opportunities:

In the move towards the development of new curriculum (Diploma in Marine Engineering), and the re-establishment of the '*Engineers Registration Act*', marine engineers will be empowered with more rights and broaden their carrier opportunities. The onboard experience may be extended to shore and land based industries. In addition, the establishment of the manning agency will provide a platform for marine engineers and other seafarers in the country to be known beyond Tanzania borders.

Threats:

The status of DMI after year 2002 poses a great threat for the training of seafarers in the country. This is the time limit set by IMO for MET institutions in all member states to have complied with STCW'95-Code. It is an important period expecting to experience uniform education, training and certification level. The validation of certificates for DMI graduates poses a great threat due to uncertainty of the outcome of IMO's white list. DMI has done, through its parent ministry, the Ministry of Transport and Communication, a lot to comply and prove to IMO that it deserves to be in the white list status on or before the given time frame. GMDSS and ARPA simulators have been installed and are effectively utilised. Instructors are on intensive training program to comply with Regulation 1/6 of the STCW-Code. Assessment, examination and training system have been properly organised in the functional approach manner and are

running according to this Code. Should DMI fail to qualify on requirements to bring it on the white list, it may imply the lost opportunities for its graduates.

It was sighted in the *East African*, a weekly newspaper (September 8th to 14th 1999, on the Maritime pages) that, “*ITF had organised sponsorship of fourteen Tanzania seafarers to train in South Africa in October 1999*”. The paper further revealed that, “*TASU (Tanzania Seamen Union), has more than 4000 Union members who have not taken part in the newly STCW’95 courses which is conducted overseas because Tanzania’s only training school, the DMI has been unable to adequately comply with the convention.*”

Cases of some Tanzania seafarers in danger of losing employment due to some irregularities sighted in their mandatory certificates, was pointed out by some Greek ship-owners in 1998. A letter from ‘Marine Managers LTD, (refer to appendix F) is an example of such ‘irregularities’. Should the grounds that lead to such incidences proved to be the inability of DMI failure to comply with STCW’95 requirements, it will pose a great threat to its graduates on the career opportunities they are depending on in their lifetime!

5.2 Education system in Tanzania: Its impact on Marine Engineers.

The education system in Tanzania had a lot to do to move in pace with the need of the fast changing society. The 1967 Arusha Declaration which gave room for free education to every Tanzania citizen and the economical reform that was taking place over the last thirty years or so, had influenced a lot of changes in the education system in the country. The demand for qualified personnel in different professions kept the education system in transitional reform and its management toward ‘educational self-sufficiency’ in all economic sectors.

The management of the education system was under the Ministry of National Education. The demand for qualified professional personnel in all production

and service sectors, have witnessed the establishment of professional learning institutions which were governed by their respective parent ministries. The obvious outcome of such a management is the differences in academic standards. National education enhancement program took place in the late 80s' with the establishment of the Ministry of Science and Technology. The governance of all academic and higher learning institutions was to be brought under this newly formed ministry but professional institutes and colleges were to remain under their respective parent ministries. In addition to the differences, which were sighted before this program, a further division that of recognising certificates from among the colleges and institutes emerged. What implication did such a system have on the education and training of marine engineers? The obvious answer is that marine engineers could not be accepted for admission to other institutes including universities.

The absence of a central national education system is creating rigidity and immunity among the institutions, which tends to control and dominate in the higher education system. Such rigidity does not favour changes in professional career, leave alone bringing them to university status.

5.3 Engineers Registration Act: Recognition of Marine Engineers in Tanzania.

The absence of a common education system in Tanzania was a root cause for professional marine engineers not recognised in the country. The re-establishment of the **1997 Engineers Registration Act** has brought about two governing and regulatory instruments relating to marine engineering practice. Marine engineers are certified and recognised as duly trained and qualified to discharge and execute any engineering practice onboard and or on shore on any marine engineering discipline according to the **1967 Merchant Shipping Act, as amended in 1981.**

Engineers Registration Act, part IV, Regulation 13, has defined the restrictions on private engineering practice of any person not registered with according to this Act. Paragraph (1) of this regulation states that, *“No person other than a registered engineer shall engage in professional engineering work or services.”* Part V of this Act, Regulation 14, paragraph (1) & (2), elaborates restrictions on employment of an engineer as, *“No person shall employ any person who is not a registered engineer”*. It further continues, *“No person shall take up or continue in any employment as a professional engineer unless he is a registered engineer”*.

The Engineers Registration Act did not have any clause, which defines categories for professional engineers, such as marine engineers, aviation engineers, mining and agriculture engineers etc. The interpretation was endangering marine engineers for not being recognised in their traditional professional industry. The dangers of establishing governing instruments without close consultation and research in other professional engineering disciplines, their management and regulations upon whom they are being governed, is an indication of the weaknesses that could emerge in a country where education system is not centralised.

Finally, in September 1999, marine engineers got seal of approval from the Engineers Registration Board. It was mentioned in the *East African* (September 8th to 14th 1999) that, *“Marine Engineers have finally won the recognition of Tanzania’s Engineering Registration Board (ERB), ending months of vicious haggling”*, the paper commented.

5.4 The East African Co-operation (EAC): The education for seafarers.

Co-operation among the member states has been emphasised by IMO for a long time now. The obligation on this matter is to ensure the realisation of IMO objectives in a more effective manner. Safety issues are a major concern in all maritime related aspects. Port State Control, harmonisation of ship inspection and certification, search and rescue activities etc, could be done much more effectively at a regional level.

Co-operation has more than one advantage. Sharing of little resources available in developing countries for the betterment of the services anticipated by the society, the maritime community in the region and at a global level. Education and training is the power behind any success.

Realising the importance of regional co-operation, the East African member states have re-established the '*East African Community*' that came into being with effect from July 2000. Through the East African Co-operation, it was proposed among others, to have a common maritime education and training.

DMI was suggested to be a Regional Maritime Centre. This joint effort may benefit education and training of seafarers in the region as well as those from SADC member states. It may be possible to have a common full mission engine room and bridge simulator(s), training ship(s) etc (Spain have one common maritime simulator training centre) which at present is a major financial constrain for an individual maritime institutes in complying with some STCW requirements. Moving together as one may improve maritime education and training in the region.

CHAPTER VI

6.1. Conclusions.

The objectives of this dissertation have been centred towards the developments in technology and the methods of training employed by some maritime institutions in developing countries. The experience gained by the author of this dissertation through field study visits has indicated that, maritime education and training in developed countries is moving in pace with the technological innovations. The pro-active decisions in the developments of curricula way ahead of the STCW'95 requirements have helped most of the MET institutions to gain stability and in providing flexibility for career opportunities for their graduates.

The establishment of modern training equipment such as computer laboratories, CBT's and full mission simulators have created flexibility in the learning environments which suggests the future need for the training of marine engineers in the application of engineering technology. Automation engineering and the application of computers onboard ships of the future may have an impact on maritime education and training methodology employed in some MET's in developing countries. The financial constrains faced by these countries, Tanzania is an example, may suggest the need for institution co-operation for the improvement of maritime education.

The study has revealed that, the developments in the world economy, social needs and technological innovations may have a long-term impact on maritime education and training. The international regulations such as the STCW should be received with a high priority in national education system.

The standards pointed out in the STCW do not lay limitations in the curriculum developments. The STCW established minimum standards for the education and training of seafarers for the safety operations of the world merchant fleet. The standards that might well be achieved at a minimum cost. What should we (developing countries) expect if the reactive attitude in the education and training would continue to maintain the grand father's clauses? We must accept changes by dedicating our time and resources in the re-design of curriculum that will move in pace with technological changes.

MET's in developing countries should not necessarily wait for international legislation to determine education standards. Computer applications and the use of simulators in the training process should be influenced by the social need of the 21st century. The century of science and technology. The technology of the near future may witness increasing applications of: -

- ◆ Information technology
- ◆ Distance education
- ◆ Video conferencing
- ◆ Internet and e-mails
- ◆ Computers and CD-ROM, and among all,
- ◆ Simulators and simulation as training tools.

The learning is better promoted using the above-mentioned technologies.

Included among them, the following advantages have been highlighted by the experts in this area: -

- Elimination of safety risks.
- Reduction in training time and cost.
- Effective form of training tool.
- Flexibility in the design of modules, and importantly,
- Its effectiveness in skill based training.

The application of *modern education* process in the use of modern technology may dictate the positions and status of marine engineers in the maritime industry of the future. For cost effective maintenance management, the off shore and land based industries are all moving towards automation and computer engineering. Ship owners have taken safety and efficiency in operation of *system ships* and the influence of rising labour cost into consideration. To determine the appropriate number of crew, degree of automation installed onboard, safety and cost will remain points of considerations. For some one to remain as a competent marine engineer in the future maritime industry, he/she may be required to possess a multi-skilled experience.

6.2. Recommendations.

The problems facing most MET institution in developing countries, such as Tanzania, are three-folds, **financial constrain, inadequate manning agency and lack of co-operation.** Following actions are recommended as possible solutions to these problems.

☛ Financial constrains:

→ All maritime service users should contribute to a funding system through small levies. This fund should be used to enhance maritime education and training. *If you want to run you must first learn how to stand. It is time now to learn how to fly by our own wings.* Some MET's have been relying greatly on funds from external donors to restructure the education system.

→ Such funds, besides government subventions, should be utilised in the purchase of training equipment, computers, simulators, digital and electronic projectors, training vessel(s), and for research activities.

→ Maritime Administrations should be much responsible for maritime affairs including maritime education and training.

→ There should be mutual arrangement from ship owners to provide room for sea service training of seafarers of the future.

→ Ship owners all over the world should provide financial and technical support in promoting maritime education and training in developing countries. Safety of their ships and the prevention of marine pollution will depend on the quality of training from seafarers supply nations, including amongst Africa countries.

☛ **Manning Agencies.**

The problems of seafarer's employment have been a cause of lack manning agencies. The decline of enrolment from some MET institutions, such as DMI in Tanzania has been noted, among other reasons, lack of proper arrangement for employment of its graduates. DMI has the capacity and ability to train and produce qualified personnel to compete in the seafarers supply market. The survival of any training institution depends largely to the end users of the services it provides. Africa has the potential of supplying qualified seafarers that may help reduce the shortage of seafarers in the world merchant fleet.

☛ **Co-operation**

Some MET institutions have found the going very difficult because of lack of co-operation. The economical constrains faced by most developing countries has been the reason for the decline of maritime education standards. Co-operation among institutions at national and or regional level may be the platform for maintaining maritime education standards. It may be possible to share financial and technical resources more efficiently and in a more cost-effective manner.

DMI, NIT and 'Bandari' College of Dar-Es-Salaam are all under a common parent ministry, the ministry of Transport and Communications. The objectives of the three institutions are to train personnel in transport sector and its related industries. Facilities in any of one of these institutions may be utilised in common and in a more productive way. Marine engineers in Tanzania could have their basic workshop training at Bandari College or at NIT. The exchange programme between DMI and Mbegani Fisheries Development Centre (MFDC) may promote skills in some training programmes such as refrigeration engineering.

Institutional co-operation at in East, Central and Southern African countries could benefit and improve the maritime services in the region. Student and or instructor exchange programmes among the maritime institutions in Malawi, Tanzania, Mozambique and South Africa may benefit every one involved in the maritime activities.

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APPENDIX A

WMU GRADUATES BY COUNTRY.

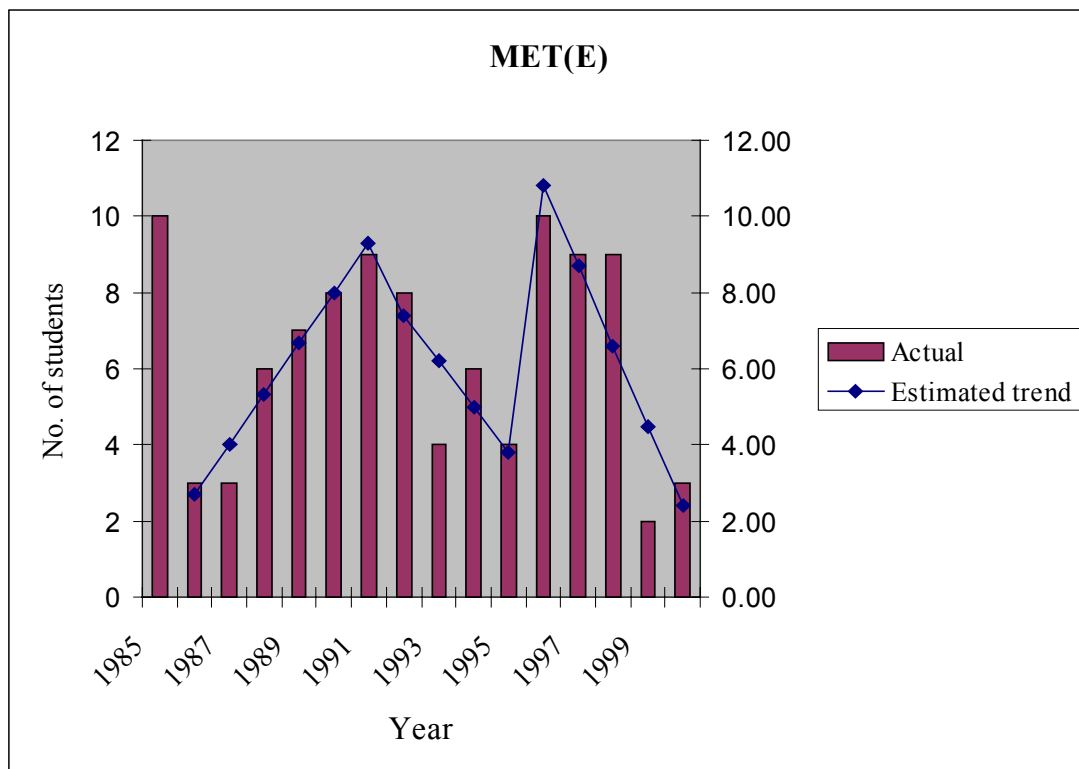
GRADUATES NATIONALITY BY COURSE OF GRADUATION					
No.	MET(E)	Graduates	No.	MET(N)	Graduates
1	ALGERIA	7	1	ALGERIA	1
2	BANGLADESH	4	2	ARGENTINA	1
3	CAPE VERDE	1	3	BANGLADESH	3
4	CHINA	6	4	BENIN	1
5	COTE D'IVOIRE	3	5	BRAZIL	1
6	CYPRUS	1	6	BULGARIA	1
7	EGYPT	1	7	CAPE VERDE	1
8	ETHIOPIA	2	8	CHILE	4
9	FIJI	2	9	CHINA	9
10	GHANA	3	10	CONGO	1
11	HONDURAS	2	11	COSTA RICA	1
12	INDIA	4	12	COTE D'IVOIRE	3
13	IRAN	1	13	EGYPT	5
14	KENYA	4	14	ETHIOPIA	2
15	LIBERIA	1	15	FIJI	2
16	LIBYAN ARAB JAMAHIRIYA	1	16	GHANA	4
17	MALAWI	2	17	GREECE	2
18	MALAYSIA	7	18	HONG KONG	1
19	MAURITIUS	1	19	INDIA	7
20	MEXICO	2	20	INDONESIA	1
21	MOROCCO	1	21	IRAN	8
22	MOZANBIQUE	4	22	KENYA	1
23	MYANMAR	3	23	LIBYAN ARAB JAMAHIRIYA	1
24	NIGERIA	4	24	MALAWI	1
25	PAKISTAN	5	25	MALAYSIA	6
26	PANAMA	1	26	MARSHALL ISLANDS	1
27	PHILIPPINES	5	27	MEXICO	4
28	PORTUGAL	1	28	MOZANBIQUE	4
29	SAMOA(WESTERN)	1	29	MYANMAR	3
30	SAUDI ARABIA	6	30	NIGERIA	7
31	SEYCHELLES	1	31	PAKISTAN	4
32	SIERRA LEONE	2	32	PANAMA	2
33	SRI LANKA	2	33	PHILIPPINES	9
34	TANZANIA	2	34	PORTUGAL	1
35	THAILAND	2	35	ROMANIA	1
36	TUNISIA	3	36	SAUDI ARABIA	4
37	TURKEY	1	37	SENEGAL	3
38	VIET NAM	1	38	SIERRA LEONE	2
39	YEMEN	1	39	SINGAPOLE	1
	Total	101	40	SOLOMON ISLANDS	1
			41	SOMALIA	1
			42	SOUTH AFRICA	1
			43	SRI LANKA	2
			44	TANZANIA	3
			45	THAILAND	2
			46	TOGO	1
			47	TRINIDAD AND TOBAGO	3
			48	TURKEY	2
			49	URUGUAY	1
			50	USA	3
			51	VENEZUELA	1
			52	VIET NAM	3
			53	YEMEN	1
			Total		139

Source: Registrar (1999). Malmo: World Maritime University.

APPENDIX B

TREND FOR ENGINEERS GRADUATED FROM MET COURSE (1985-2000).

Annex

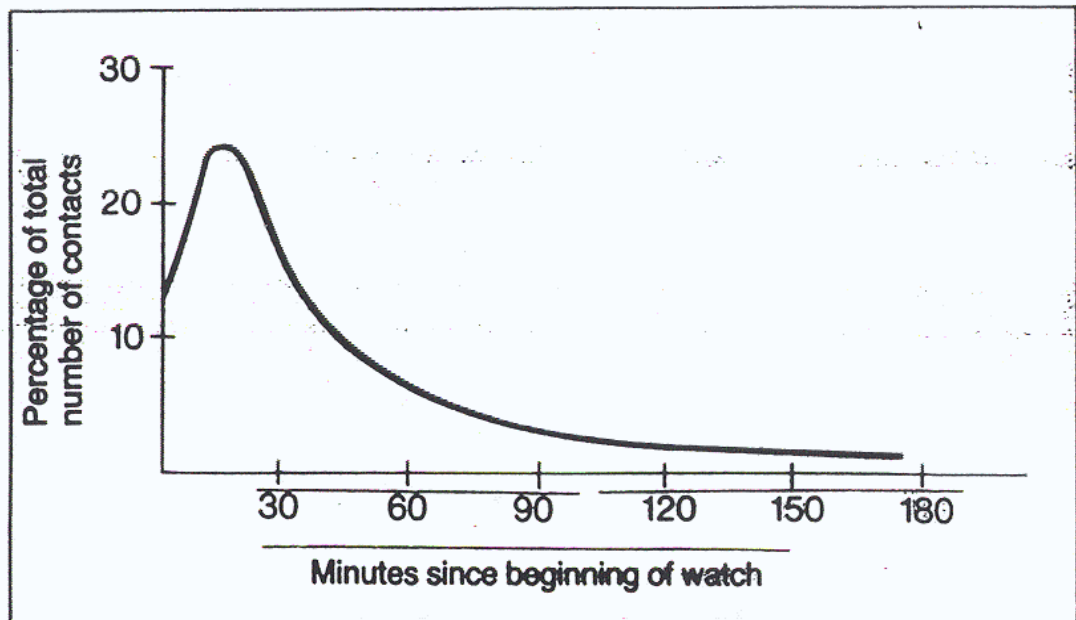


Source: Registrar (1999). Malmo: World Maritime University.

APPENDIX C

Attention and “Perceptual errors”

Ex. Signal detection and vigilance (attention span)



The influence of duration of watch (radar monitoring) on the percentage of signals that are detected on the screen

Source: Danish Maritime Administration.

APPENDIX D

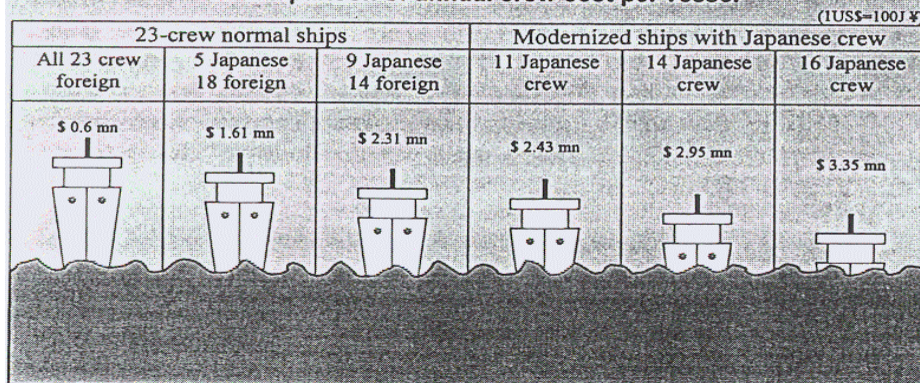
Box 7.1 The Japanese Experience of Cutting Labor Cost

It is interesting to see the Japanese experience in changing the tasks and functions of seafarers so that the number of crew can be reduced and cost saved. The experiment was carried out in four stages.

- *The first stage was started in 1980 by introducing a dual-purpose crew (DPC) system. They were able to cut the total number of seafarers on board from 23 to 18. This experiment proved to be successful and thus ships with 18 men were then institutionalized by law.*
- *The stage 2 commenced after the stage 1 was successfully implemented. The ships used in this stage were with newer automated devices. The aim was to eliminate one officer for which either the second mate or the third engineer officer was trained to combine the watch duties. Finally the total number on board was reduced to 16 men. The system, once again, was institutionalized by law in 1986.*
- *Soon after, the stage 3 began. The ships used in this stage had the bridge, the engine control room and the radio room all on the same deck with even newer automatic devices permitting centralized watches at sea. As a result, one watch officer and one DPC were cut and the ship was manned by 14 persons. This was institutionalized by law in 1988.*
- *The stage 4 was a bit different. Because it was selective as regards the type of ships and the route. Container ships, bulk carriers and car carriers were chosen. The engine control equipment and steering equipment were installed on the ships' bridge wings. With a new watch-officer system, the chief mate, engineer officer and the chief radio officer were utilized for watch on the bridge and in the engine control room. In parallel, the DPC was minimized. Currently this stage is being introduced which allows ships to sail with 11 men on board¹, all with high degree of polyvalence.*

When people were getting excited about the progress, the exchange rate changed ...

A comparison of annual crew cost per vessel



Source: Based on Akatsuka *The Japanese Shipowners' Association* 1996

¹ The crew includes one captain, one chief engineer, four watch officers, four dual-purpose crew and one ratine.

APPENDIX E



Maritime and Coastguard Agency

Day 2127,
Spring Place,
105 Commercial Road,
SOUTHAMPTON,
SO15 1EG

TEL : 01703 329231
DDI: 01703329231
GTN: 1513 231
Fax: 01703 329252

Mr H.S. Bakari
P.O. Box 634
Zanzibar
Tanzania

Dear Sir

Date 02 November 1999
Candidate reference :

Dear Mr Bakari
Class Two Motor Certificate of Competency

Thank you for your application.

We enclose a letter from our Chief Examiner explaining the policy regarding overseas training. We can accept certain overseas Certificates of Competency but, unfortunately, this list does not include those issued by the Tanzanian government.

Obviously, this affects your application and we regret that we cannot offer you entrance to the exam for the above qualification.

Your documents are now returned and a refund of your fee will follow in due course.

Please read the enclosed notes carefully as they explain why we are unable to proceed with your application as well as advising on how you may overcome this difficulty.

This rejection of your application is based solely on our rules regarding overseas training and certificates. We would welcome a further application from you after you have either completed acceptable training as explained in the notes or obtained a first certificate of competency from an acceptable STCW administration.

Yours sincerely



J.P. English
Seafarers Standards

