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MARINE ENGINEERING TRAINING IN INDIA - A PEDAGOGIC INTROSPECTION

A thesis submitted

by

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for the award of the Degree of

Doctor of Philosophy

DEPARTMENT OF SHIP TECHNOLOGY
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CERTIFICATE

I hereby certify that, to the best of my knowledge the thesis entitled ***Marine Engineering Training in India – A Pedagogic Introspection*** *is a record of bona fide research work carried out by* ***Sri K.A. Simon****, Part time research student under my supervision and guidance, in partial fulfillment of the requirement for the award of the Ph.D. degree in the Faculty of Technology. The results presented in this thesis or parts of it have not been presented for the award of any other degree.*

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26-03-2010

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DECLARATION

I hereby declare that the thesis entitled **Marine Engineering Training in India – A Pedagogic Introspection** is an authentic record of research work carried out by me under the supervision and guidance of Dr. E.M.S. Nair, Former Head, Department of Ship Technology, Cochin University of Science and Technology, Cochin, in partial fulfillment of the requirement for the award of the Ph.D. degree in the Faculty of Technology and no part thereof has been presented for the award of any other degree.

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ABSTRACT

Indian marine engineers are renowned for employment globally due to their knowledge, skill and reliability. This praiseworthy status has been achieved mainly due to the systematic training imparted to marine engineering cadets. However, in an era of advancing technology, marine engineering training has to remain dynamic to imbibe latest technology as well as to meet the demands of the shipping industry. New subjects of studies have to be included in the curriculum in a timely manner taking into consideration the industry requirements and best practices in shipping. Technical competence of marine engineers also has to be subjected to changes depending upon the needs of the ever growing and over regulated shipping industry. Besides, certain soft skills are to be developed and improved amongst the marine engineers in order to alter or amend the personality traits leading to their career success.

If timely corrective action is taken, Indian marine engineers can be in still greater demand for employment in global maritime field. In order to enhance the employability of our marine engineers by improving their quality, a study of marine engineers in general and class IV marine engineers in particular was conducted based on three distinct surveys, viz., survey among senior marine engineers, survey among employers of marine engineers and survey of class IV marine engineers themselves.

The surveys have been planned and questionnaires have been designed to focus the study of marine engineer officer class IV from the point of view of the three distinct groups of maritime personnels. As a result of this, the strength and weakness of class IV marine engineers are identified with regard to their performance on board ships, acquisition of necessary technical skills, employability and career success. The criteria of essential qualities of a marine engineer are classified as academic, technical, social, psychological, physical, mental, emergency responsive, communicative and leadership, and have been assessed for a practicing marine engineer by statistical analysis of data collected from surveys. These are assessed for class IV marine engineers from the point of view of

senior marine engineers and employers separately. The findings are delineated and graphically depicted in this thesis.

Besides, six pertinent personality traits of a marine engineer viz. self esteem, learning style, decision making, motivation, team work and listening self inventory have been subjected to study and their correlation with career success have been established wherever possible. This is carried out to develop a theoretical framework to understand what leads a marine engineer to his career attainment. This enables the author to estimate the personality strengths and weaknesses of a serving marine engineer and eventually to deduce possible corrective measures or modifications in marine engineering training in India.

Maritime training is largely based on International Conventions on Standard of Training, Certification and Watch keeping for Seafarers 1995, its associated Code and Merchant Shipping (STCW for Seafarers) Rules 1998. Further, Maritime Education, Training and Assessment (META) Manual was subjected to a critical scrutiny and relevant findings of the surveys are superimposed on the existing rule requirement and curriculum. Views of senior marine engineers and executives of various shipping companies are taken into account before arriving at the revision of syllabus of marine engineering courses. Modifications in the pattern of workshop and sea service for graduate mechanical engineering trainees are recommended. Desirable age brackets of junior engineers and chief engineers, use of Training and Assessment Record book (TAR Book) during training etc. have also been evaluated.

As a result of the pedagogic introspection of the existing system of marine engineering training in India, in this thesis, a revised pattern of workshop training of six months duration for graduate mechanical engineers, revised pattern of sea service training of one year duration and modified flow diagram incorporating the above have been arrived at. Effects of various personality traits on career success have been established along with certain findings for improvement of desirable personality traits of marine engineers.

Suggestions for further research as continuation to the present one are also indicated.

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LIST OF ABBREVIATIONS

CARE	Credit Analysis & Research Ltd
CDC	Continuous Discharge Certificate
CRISIL	Credit Rating Information Services of India Ltd.
DGS	Directorate General of Shipping
GME	Graduate Mechanical Engineer
ICRA	Information And Credit Rating Agency
IMO	International Maritime Organisation
IMU	Indian Maritime University
ISM	International Safety Management
MEO	Marine Engineer Officer
MERI	Marine Engineering Research Institute
META	Maritime Education, Training & Assessment
MS	Merchant Shipping
NCV	Near Coastal Voyages
STCW	Standard of Training, Certification & Watchkeeping
TAR	Training & Assessment Record
TQM	Total Quality Management

CHAPTER 1

INTRODUCTION

1.1 General

India is blessed with a long coast line of 7500 km and therefore it is quite natural that Indians ventured to sea from time immemorial. India has a glorious maritime past. 'Rig Veda' and 'Atharva Veda', the ancient literary records of the human race depict also the shipping scene of ancient India, among other matters. The maritime history of India dates back to 3000 B.C. It has been proved beyond doubt that shipping and shipbuilding were going on in India in the very early days. Indians traded in those days with Arabia, Egypt, Africa and Rome by vessels built of teak in India. Indians were known to be quite skillful in the art of shipbuilding too. The ancient Sanskrit manuscript, 'Yuktikalpataru' compiled by Bhoja Narapati stands testimony to it. (*Mookerji, R.K.*). [1]

There are reasons to believe that some kind of broad classification of ships, based on the size and type of construction existed in those days, namely, 'Samanya' and 'Vishesha'. They were sub-divided into further groups, depending on the trade, the type of wood used etc. Ships that undertook sea voyages were classified into 'Dirgha' type of ships which had a long and narrow hull and the 'Unnatha' type of ships which had a higher hull. Their rules, then known as 'Yukti', in Sanskrit which can be translated as 'logic' in English, delineate important particulars of the vessels.

From the above recorded history, it can be surmised with reasonable certainty that there existed a system in India for training the then pioneers in seafaring profession. Around 3000 BC, Kautilya had even established duties for the then port operators along the coastline. [2]

Modern India is considered to be a man-power supplying nation and is ranked sixth in supply of maritime personnel. It is all the more true in case of marine engineers. India

produces marine engineers not only to man Indian ships and other allied fields in the country, but also to cater to the needs of world shipping in general.

Around 3800 marine engineer cadets are trained in the country presently every year. Following are the main streams through which they are being presently trained:

a) 4 year Degree in Marine Engineering
b) 4 year workshop apprenticeship scheme
c) 2 year training for Diploma holders in Mechanical Engineering
d) One year training for Graduates in Mechanical Engineering
e) 2 year training for Graduates in Electrical Engineering
f) Near Coastal voyage streams

It is pertinent to note that these mariners are sailing over the high seas throughout the entire globe. Therefore, it is imperative that these engineers are properly trained and are adequately competent to perform their task. This calls for quality training of marine engineers in the country. STCW Convention and ISM Code have made great strides in improving the quality of seafarers.

Marine Engineering training is now being done by government and private training establishments in India. These institutions are to be approved by the Directorate General of Shipping before commencement of training of marine engineers. The necessary infrastructure such as workshops, laboratories, on board training facilities, class rooms, faculty etc are being inspected by the Directorate General of Shipping before the commencement of the course. Regular inspections are carried out during the conduct of the course to maintain the approvals given to the institutions. Syllabi for the courses conform to the requirements of STCW 95 and M.S. (STCW for Seafarers) Rules 1998. Final examinations are conducted by the respective training institutions and universities. However, examination for issue of various certificates of competency is carried out by the Directorate General of Shipping and its allied offices. [3,4]

In addition to the inspections by the D.G. Shipping and duly constituted academic councils and accreditation by quality standard institutions, grading of the training institutions are also being carried out by independent bodies such as ICRA, CRISIL and CARE to ascertain quality of training imparted to the budding marine engineers.

It is felt that, despite all the above, there is still scope to further improve the quality of marine engineering training by application of the principles of TQM in the field. The benefits of TQM programme, inter-alia, include greater competitive advantage and substantial financial savings due to 'cost of quality'.

Further, it is to be noted that the total quality is to be considered the fundamental business principle in any organization, more so in the maritime training field. Training institutions, shipping companies and regulatory bodies are increasingly grappling with total quality today to ensure a future for the serving seafarers. Anyone who ignores quality does so at the risk of loss of employment opportunities and business in future. [5, 6]

1.2 Background of the study

Mechanical power was introduced for propulsion and operations of ships in the early eighteenth century. By the beginning of the nineteenth century, steam propulsion of ships became a reality, thereby giving birth to the profession of marine engineering.

A marine engineer is a versatile engineer dealing with running and maintenance of all machineries on board ships. These include the propulsion plant, power generating plant, refrigeration and air conditioning systems, steering systems, control systems, deck machineries etc.

Present day ships are complex vehicles requiring exceptional number of specializations in many engineering disciplines such as Mechanical, Electrical, Refrigeration, Air Conditioning, Power Plant, Chemical, Electronics, Communication, Sound, Vibration and Civil. Therefore a marine engineer has to integrate relevant portions of all the engineering disciplines for conquering distances

by sea with the aid of propulsion systems. This makes marine engineering, a very versatile form of engineering. [7]

The learning process of a marine engineer has different aims, including what is stated by UNESCO in 1999:

Learn to know
Learn to be
Learn to do
Learn to be safe
Learn to protect
Learn to excel
Learn to live together

A marine engineer has to perform his tasks in an alien atmosphere, mostly in the middle of the ocean and that too at times in rough weather. He will have only limited resources at his disposal both by way of men and material. His social life is restricted to a handful of colleagues of varying ranks. Besides, no study or analysis appears to have been carried out about the personality traits of marine engineers leading to their career success.

1.3 Scope and objectives

Apart from the present curriculum of marine engineering training, new subjects of studies are felt to be introduced in the syllabus taking into consideration the emerging areas of technology and practices in shipping. Value addition to the existing criteria of quality of marine engineers is also to be identified and process of implementation has to be undertaken by the concerned. These topics are to be continuously improved, updated and modified in accordance with evolving industry standards and requirements and other market demands. Skill gaps if any of marine engineers are to be identified and filled up.

Therefore a study needs to be undertaken to assess and evaluate the existing system of marine engineering training in the country and to identify the areas of improvement.

Statement of the problem

Indian marine engineers lack certain qualities in their soft skills as well as in their technical capabilities, adversely affecting their acceptability by the shipping industry. No study or analysis has been carried out about the personality traits of marine engineers leading to their career success.

Objective of the study

(i) To review the existing rules and regulations in maritime training and based on that, critically assess the training requirements of marine engineers including the sea service.

(ii) To carry out introspection into the present training system of marine engineers in the country with a view to find out the drawbacks of the current system and to propose modifications in the curriculum of training of marine engineers, based on a survey conducted among senior marine engineers.

(iii) To study and find ways and means to improve upon the quality standards and employability of Indian marine engineers to meet the demands of the shipping industry, based on a survey conducted among the employers of marine engineers.

(iv) To study the additional requirements of a ship owners/operators regarding the employment and specialization of their marine engineers.

(v) To study the correlation between personality traits and career success of Class IV marine engineers based on a survey.

(vi) To arrive at necessary conclusions for improvement of quality of marine engineers.

Hypothesis of the study

(i) Significant modification will have to be brought about in the curriculum of training of marine engineers

(ii) There will be areas of quality standards of mariner engineers, where improvement is necessary based on the changing industry needs.

(iii) There will be significant positive relationships between personality traits and career success of class IV marine engineers.

Scope and limitation of the study

The study has been based on three separate surveys conducted amongst three distinct groups of maritime personnel.

(i) Senior marine engineers, mostly chief engineers of ships, have been given a set of questions suitably designed for carrying out a survey to identify the strength and weaknesses of junior marine engineers below the rank of MEO Class IV. 122 senior marine engineers have been chosen from four different metros of the country. A few senior marine engineers from Singapore and UAE have also been considered. However, all of them are Indians and have undergone Indian system of marine engineering training, examination and certification.

(ii) Employers of marine engineers i.e., ship owners and shipping companies have been approached with another set of questions to arrive at certain factors of employability of Indian marine engineers especially engineers of the level of MEO class IV. A total of 52 such companies responded.

(iii)Class IV marine engineers themselves have been approached finally to gauge their personality traits and their career success in order to arrive at the correlation between them. 51 certificated class IV marine engineers participated in this survey.

Due to the vast area of study geographically as well as technically, the scope of study has been limited to marine engineers up to the level of MEO class IV and that too of marine engineers of Indian training background. The research is therefore concentrated on class IV marine engineers following Indian system of marine engineering education and training only and not on any other class of marine engineers.

1.4 Definition of key terms

Merchant navy ship

Ships engaged in carriage of cargo for commercial trade purposes. This includes general cargo ships, bulk carriers, container ships, oil tankers, chemical carriers, gas carriers, passenger ships etc.

Foreign going ship

A ship, not being a home trade ship, employed in trading between any port or place in India and any other port or place or between ports or places outside India.

Home trade ship

A ship not exceeding 300 G.T. which is employed in trading between any port or place in India and any other port or place on the continent of India or between ports or places in India and ports or places in Sri Lanka, Maldives, Federation of Malaya, Singapore or Myanmar.

Near Coastal Voyage (NCV)

The coastal trade or voyages from any port or place in Bangladesh, India, Maldives, Myanmar and Sri Lanka to any other port or place in these countries including safe havens on such voyages.

Assistant engineer officer

Is a person under training to become an engineer officer and designated as such by national law or regulations.

Class IV marine engineer (MEO Class IV)

This is the lowest rank of a certificated marine engineer in charge of an engineering watch on board a merchant navy ship. He is competent to keep an independent watch of the machinery spaces of an appropriate main machinery. i.e., either motor or steam.

Class II marine engineer (MEO Class II)

He / she is eligible to be the second engineer of the merchant navy ship and is next in command to the chief engineer of the vessel.

Class I marine engineer (MEO Class I)

He / she is eligible to be the chief engineer of the ship who is the overall in charge of the administration and maintenance of the engine department and is responsible for the mechanical propulsion and operation and maintenance of the mechanical and electrical installations of the ship.

International Maritime Organization (IMO)

This is a special agency of United Nations Organization entrusted with the task of maintaining safe and secure shipping and clean oceans.

Standard of Training, Certification and Watch keeping (STCW)

This is the international convention of IMO dealing with manning of merchant navy ships including requirements of training and certification. This is considered to be the bench mark by all maritime countries.

MS (STCW for seafarers) Rules 1998

Legislation enacted in India in line with STCW Convention of IMO under Merchant Shipping Act 1958.

Shipping Company

The owner of the ship or any other organization or person such as the manager or bareboat charterer, who has assumed the responsibility for operation of the ship.

1.5 Organization of the thesis

The report of the research is presented in six chapters.

Chapter 1 gives the rationale of identifying the problem and its significance, statement of problems, definitions of key terms, scope and objectives of this work.

Chapter 2 deals with the international conventions and national legislations dealing with the training of marine engineers especially at lower levels over which the modifications are proposed.

The review of literature related to the topic of research and pedagogy is presented in chapter 3.

Methodology of the research is narrated in chapter 4. It also gives the details of the three surveys carried out, questionnaires used, sampling techniques adopted and statistics followed.

Chapter 5 illustrates the analysis of data and interpretations along with delineations of results, separately for each of the three surveys. Proposed pattern of workshop and on board training for engineering cadets are included in this chapter.

Chapter 6 depicts the major findings, conclusions and recommendations. Area for further research is also indicated.

Existing marine engineering training flow diagrams, competence and course subjects of existing pattern of workshop and on board training and list of approved marine engineering training institutes in India are given as Annex.

CHAPTER 2

TRAINING AND COMPETENCE OF A MARINE ENGINEER

2.1 Introduction

Rules and regulations of STCW related to the training and competence of marine engineers have been described in this chapter. A definite need for stating the criteria for essential qualities of a marine engineer has been felt and has been given under the following sub headings.

2.2 Criteria of qualities of marine engineers

The criteria of essential quality of a marine engineer can broadly be classified as academic, technical, social, psychological, physical, mental, emergency responsive, communicative and leadership. Each of them has been described under the subsequent headings.

2.2.1 Academic

A marine engineer trainee is to have sound academic knowledge in subjects such as Mathematics, Physics, Chemistry and English over which the necessary technical knowledge can be built up. The stipulated academic qualification has to be achieved within the specified age of the candidate.

2.2.2 Technical

A marine engineer has to be technically sound in order to perform well on board ships. Meticulous selection at entry level and rigorous training thereafter including in-service training and continuous professional development are therefore essential for marine engineers.

Following are the commonly used entry level qualifications for joining the pre sea training programme of the profession:

(i) 10 + 2 with Mathematics, Physics and Chemistry as main subjects and English as one of the subjects.
(ii) Diploma in mechanical engineering.
(iii)Degree in mechanical engineering or naval architecture.
(iv)Degree in electrical engineering.

The age limit for the above is 25 years in general.

Following are the pre sea training courses which the above incumbents will have to undergo:

(i) 4 year marine engineering course or 4 year training in an approved marine workshop for 10 + 2 candidates
(ii) 30 months Alternate Training Scheme in an approved academy for 10 + 2 candidates. This includes 9 months of sea service.
(iii) 2 years training in an approved marine workshop for diploma holders in mechanical engineering.
(iv) 1 year training in an approved marine workshop for degree holders in mechanical engineering or naval architecture.
(v) 18 months training in an approved marine workshop for electrical engineering graduates.

The above pre sea courses include the following four basic STCW safety courses:

(i) Fire Prevention and Fire Fighting.
(ii) Personal Survival Technique.
(iii) Personal Safety and Social Responsibility.
(iv) Elementary First Aid.

Continuous Discharge Certificate (CDC) will be issued to the candidates on satisfactory completion of the pre sea training to enable them to perform the requisite sea service on board ships. Besides, at this stage, candidates with degree in mechanical engineering, marine engineering or naval architecture will be eligible for

grant of exemption from Part A of Marine Engineer Officer class IV examination. The others will have to appear for the Part A examination of MEO class IV and secure a pass.

Sea Service

Six months sea service on board ships of merchant navy, in the capacity as assistant watch keeper or junior engineer is required to qualify to appear for the first level of Certificate of Competency, which is MEO Class IV Motor of Steam as the case may be. Before joining the ship, it is essential that the candidate has done, respective familiarization course in case of oil tanker, gas tanker or chemical tanker. The Training and Assessment Record Book (TAR Book) will have to be filled up suitably during the time of qualifying sea service mentioned above.

Post Sea Courses

On completing the requisite qualifying sea service, one has to do the following courses.

Three months preparatory course for MEO class IV.
Engine room simulator course.
Advanced fire fighting.
Medical first aid
Proficiency in survival craft and rescue boat.

Thereafter, he is eligible to appear for the Part B examination of MEO Class IV and secure a pass in the written examination of MEO Class IV in 4 functions. In addition, he has to secure pass in the oral examination in all the functions. On successful completion of the above examinations, the candidate becomes a certified Class IV Marine Engineer Officer capable of keeping independent engine room watch. In case of specialized ships such as oil tankers, chemical carriers and gas tankers, it is

requisite that the officer has undergone the respective advanced safety courses, subsequent to the familiarization courses mentioned earlier.

2.2.3 Social

A seaman should be able to adjust socially with others on board his ship. He should be able to fit in to a limited crowd by accepting his place in the hierarchy and into a special working environment as a member of a team. He should be able to withstand tough times with calmness. Tendencies like casteism, communalism, sectarianism and linguism should be kept under check by him. He should be prepared to endure long separation from the members of his family and friends ashore.

Firm rules laid down by the company regarding workplace relationships and monitoring of execution of these rules will go a long way in reducing the interpersonal problems. The ability to follow those rules should be an essential part of seafarer's personality.

Increased concern for safety, security and environment protection is another aspect which adds tension to the seafarers. As a result, interpersonal problems, violence on board, suicides, deserting of ship etc are on the rise.

Therefore, proper screening of the incumbents is done at the entry level to ensure proper social behavior of seafarer while on the high seas.

2.2.4 Psychological/ Attitude

Psychology is the emotional state of a person affecting his behaviour in a given context. It is a science by which one can measure, explain and if needed even change the behaviour of living beings.

Daniel Katz defines attitude as follows "An attitude is an individual's tendency or predisposition to evaluate an object in a certain way." It is said that the attitude of a seafarer and not necessarily the aptitude, that decides the altitude of his career. This shows the importance of attitude building of a marine engineer during his training.

Although attitude changes with lapse of time, it is widely felt that the trainees at the entry level are mostly not in possession of the right attitude for work on board ships. However, attitude can be changed by persuasion.

Technology and consequently the operational practices onboard ships are rapidly changing. In addition, there is pressure for achieving overall economic efficiency in order to overcome the competition. Individuals with proper aptitude and appropriate personality to meet the challenging requirements at sea are only selected. Besides, the need to have a psychometric test is felt necessary to ensure that the selected trainee is mentally and psychologically fit to cope up with the hardships and vagaries of the seafaring profession. Directorate General of Shipping has therefore introduced a test by name Merchant Marine Personality Evaluation Test (MMPET) at entry level. This is to evaluate the adaptability, emotional strength, tolerance level etc of the candidates.

2.2.5 Physical

Candidate has to be physically fit to be at sea. Therefore he has to comply with the minimum standards of health stipulated by the M.S. (Medical Examination of seafarers) Rules 2000. This includes eye tests for vision and colour blindness. It is to be noted that physical health is inextricably linked to mental health.

2.2.6 Mental

Mental agility and hygiene of a seafarer pertaining to his mind should be at a level to meet the demands of sea life, its capacities, challenges and limitations. He is to be of high self-esteem and optimism. A person with mental illness may have feelings of inferiority and lack of self-confidence. It is presumed that a mentally healthy person will balance his life with work, rest, recreation and other desirable activities such as hobby. A mentally healthy person will be able to sort out his problems on time, in order to keep himself free of anxieties. Good organization of daily work and life is essential on board ships.

2.2.7 Emergency responsive

Any seafarer, particularly a marine engineer has to swing in action immediately in case of an emergency on board the ship or with the machineries in particular. Appropriate remedial action without delay is of utmost importance to avert the possible damage of the incident or accident. Possible emergencies could be with the engines or with the ship as a whole. Qualities to meet emergencies such as engine failure, flooding, grounding, collision, man overboard, oil spillage etc. are essential for a marine engineer. Creative thinking and reasoning are required for a marine engineer to solve problems onboard.

2.2.8 Communication skill

Communication is a mutual exchange of information, feelings, perception and thoughts resulting in common understanding of concerned parties. In other words, it is the art of conveying or transferring information and instructions to achieve the desired objectives. It is widely accepted that communication problem exists on board ships

(i) Oral

In order to perform the work of a marine engineer satisfactorily, one has to communicate orally with the rest of the team of personnel on board the vessel. In this respect, proficiency of the common language on board assumes importance. The problem aggravates in case of multinational crew.

(ii) Written

Report writing and other correspondence are inevitable skills for a successful marine engineer in order to communicate formally with the company, agents, authorities and the likes. Knowledge of English language, being an accepted international language, is considered to be a requirement for practicing the profession of marine engineering.

Poor communication may result due to the following reasons:

(i) Not enough thought or planning given before communication

(ii) The purpose of communication is not established

(iii) Environment is not conducive for communication

(iv) Participation of others not being taken into account

(v) Tone of voice and apparent receptiveness by others being poor

(vi) Monitoring and feed back not being carried out properly

(vii) Communicator is not practicing what he is preaching.

Following solutions are to be adopted to overcome the above problems:

(i) Ensure proper understanding of intentions and instructions

(ii) Improve the language of the reports, introduce diagrams and photographs wherever practicable

(iii) Ask the receiver to repeat what he understood

(iv) Overall improvement of quality of communication.

2.2.9 Leadership

Leadership in one form or the other exists in all spheres of human activity. This is naturally evolved out of a social process and therefore, leadership is a social phenomenon. It is defined by a famous social thinker, Sackler Hudson as follows – "Leadership means influencing and energizing of people to work together in a common effort to achieve the purpose of enterprise."

This is considered as an important attribute for a successful marine engineer as he rises in the hierarchy.

2.3 Stake holders of quality of marine engineers

The following block diagram depicts the important agents deciding and influencing the ultimate quality of marine engineers.

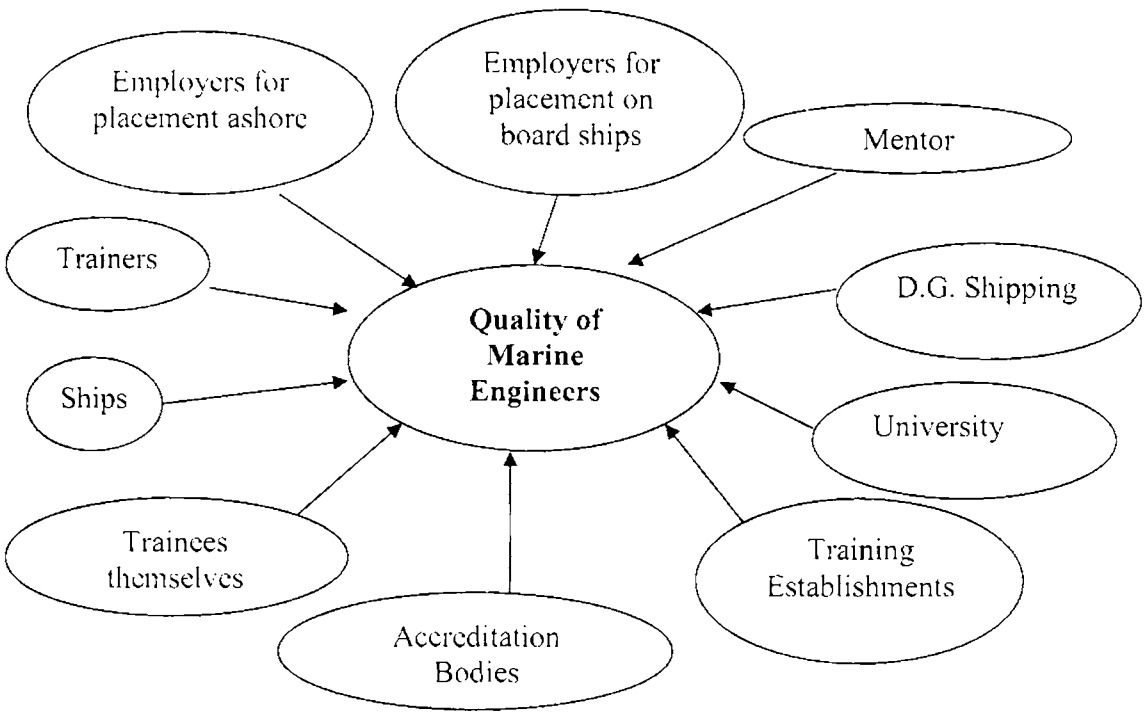

Fig. 2.1 Stake holders

It may be noted that the relationship between agents of quality of marine engineer is least or non existent presently. For example, take the case of relationship or connection between Directorate General of Shipping and University. Most of the universities to whom the maritime courses are affiliated feel that the ultimate authority in deciding on the courses are none other than themselves whereas the D.G. Shipping feels that they have the final say in all matters related to the maritime training. Both these agencies are, at the same time, apparently unaware of the specific needs of the shipping industry for whom these candidates are being trained. It is felt that the changing needs of the shipping industry with regard to the quality of the sea farers should be given priority in implementation over the other guidelines. The solution to this problem lies in the introduction of an independent body who could possibly go in between and coordinate matters to fulfill the quality requirements of the budding seafarers.

Similarly, it may be seen that there is no direct link between the employers of seafarers at sea and the training institutes in dealing with matters of the contents of the training. Suggestions for improvement of the curriculum of the seafarers should be sought from the employers on a continuous basis and the same should be implemented in the maritime training institutes in a time bound manner.

2.4 Qualities of marine engineers

Few points, inter-alia, to be counted to quantify the quality of marine engineers are given below:

(i) Basic educational qualification
(ii) Acquisition of professional competencies
(iii) Leadership trait
(iv) Initiative
(v) Attitude
(vi) Ability to react positively to emergencies
(vii) Health standards
(viii) Safety consciousness
(ix) Loyalty to employer
(x) Adherence to the policies of the Company
(xi) Ability to work as a member of the team
(xii) Good technical knowledge preferred but not the prime quality
(xiii) Ability to execute orders correctly
(xiv) Discipline
(xv) Trust in seniors
(xvi) Can be critical but not cynic
(xvii) Willingness to learn devoid of attitude that I know everything
(xviii) Willingness to put in hard work and extra hours in addition to his normal work
(xix) Pleasant and likeable personality
(xx) A helpful person
(xxi) Someone who talks less and works more.

(xxii) Calm character, not prone to panic when something goes wrong

(xxiii) Neat, clean and orderly. Keeps his surroundings clean and well organized

(xxiv) Ability and willingness to absorb knowledge without much spoon feeding

(xxv) Power of command

(xxvi) Ability to make others listen to one's point of view

(xxvii) Not argumentative

(xxviii)Willingness to accept responsibilities

(xxix) Willingness to own up to one's mistakes (not insisting one is always correct)

(xxx) Attitude to perform the task satisfactorily without considering return

(xxxi) Ability to work along with multinational crew

Meticulous and systematic selection procedure is to be introduced at entry level of marine engineering training, besides imparting appropriate training to them in order to instill/ acquire the desired qualities of a marine engineer.

Apart from the above, new subjects for studies are felt to be introduced in the curriculum taking into consideration the emerging areas of shipping. These subjects are to be continuously improved or modified in accordance with evolving industry standards and requirements and other market demands.

Therefore a study needs to be undertaken to assess and evaluate the existing system of marine engineering training in the country and to identify the areas for improvement.

2.5 Rules and regulations for training of marine engineers

The international convention on Standard of Training, Certification and Watch keeping for Seafarers (STCW) 1978 was adopted on 7th July 1978 and entered into force on 28th April 1984. This was amended three times i.e. in the years 1991, 1994 and 1995. The first two amendments were pertaining to Global Maritime Distress and Safety System (GMDSS) and special training requirement for personnel working on tankers respectively. They entered into force on 1st December 1992 and 1st January 1996 respectively. Resolution 1 of STCW Conference of July 1995 contains

amendments to the STCW. By Resolution 2 of the same conference, Seafarers Training, Certification and Watch keeping (STCW) Code was also adopted. The Code contains mainly two parts by name Part A and Part B. Part A deals with the mandatory provisions of the STCW convention stipulating the minimum standards in order to give full and complete effect to the provisions of the said convention where as Part B deals with guidance optional to the parties of convention in order to have uniformity of application amongst contracting parties. However, the articles of STCW 78 were not altered in the new convention.

Resolution 8 adopted in the Final Act of the conference encapsulates as follows, "Promotion of the technical knowledge, skills and professionalism of seafarers". Indian rules have been formulated in line with IMO regulations in this respect. These are promulgated as Merchant Shipping (STCW for seafarers) Rules 1998.

2.6 Outline of STCW Convention

2.6.1 Articles of STCW 95

International convention on Standards of Training, Certification and Watchkeeping 1978 as amended subsequently consists of 17 Articles, 14 Resolutions, 8 Chapters besides Part A and Part B of Seafarers Training, Certification and Watchkeeping (STCW code).

Article VI of the Convention deals with certificates of seafarers. It is reproduced below.

(i) Certificates of masters, officers or ratings shall be issued to those candidates who, to the satisfaction of the Administration, meet the requirements for service, age, medical fitness, training, qualification and examinations in accordance with the appropriate provisions of the annex to the Convention.

(ii) Certificates for masters and officers issued in compliance with this article shall be endorsed by the issuing Administration in the form as prescribed in regulation I/2

of the annex. If the language used is not English, the endorsement shall include a translation into that language.

Article IX delineates provision of equivalents for formal training of seafarers. This is reproduced as below.

(i) The Convention shall not prevent an Administration from retaining or adopting other educational and training arrangements, including those involving seagoing service and shipboard organization especially adapted to the technical developments and to special types of ships and trades, provided that the level of seagoing service, knowledge and efficiency as regards navigational and technical handling of ship and cargo ensures a degree of safety at sea and has a preventive effect as regards pollution at least equivalent to the requirement of the Convention.

(ii) Details of such arrangements shall be reported as early as practicable to the Secretary-General who shall circulate such particulars to all Parties.

2.6.2 Regulation of STCW 95

Regulation I/6

Training and assessment

Each party shall ensure that:

(i) the training and assessment of seafarers, as required under the Convention, are administered, supervised and monitored in accordance with the provisions of section A-I/6 of the STCW Code; and

(ii) those responsible for the training and assessment of competence of seafarers, as required under the Convention, are appropriately qualified in accordance with the provisions of section A-I/6 of the STCW Code for the type and level of training or assessment involved.

Engine department

Regulation III/1

Mandatory minimum requirements for certification of officers in charge of an engineering watch in a manned engine-room or designated duty engineers in a periodically unmanned engine-room

(i) Every officer in charge of an engineering watch in a manned engine-room or designated duty engineer officer in a periodically unmanned engine-room on a sea-going ship powered by main propulsion machinery of 750 kW propulsion power or more shall hold an appropriate certificate.

(ii) Every candidate for certification shall:

i. be not less than 18 years of age:
ii. have completed not less than six months seagoing service in the engine department in accordance with section A-III/1 of the STCW Code; and
iii. have completed approved education and training of at least 30 months which includes on-board training documented in an approved training record book and meet the standards of competence specified in section A-III/1 of the STCW Code.

Regulation III/2

Mandatory minimum requirements for certification of chief engineer officers and second engineer officers on ships powered by main propulsion machinery of 3,000kW propulsion power or more

(i) Every chief engineer and second engineer officer on a seagoing ship powered by main propulsion machinery of 3000 kW propulsion power or more shall hold an appropriate certificate.

(ii) Every candidate for certification shall:

i. meet the requirements for certification as an officer in charge of an engineering watch and:

i.i. for certification as second engineer officer, shall have not less than 12 month's approved seagoing service as assistant engineer officer or engineer officer, and

i.ii. for certification as chief engineer officer, shall have not less than 36 month's approved seagoing service of which not less than 12 months shall have been served as an engineer officer; and

ii. have completed approved education and training and meet the standard of competence specified in section A-III/2 of the STCW Code.

Regulation III/3

Mandatory minimum requirements for certification of chief engineer officers and second engineer officers on ships powered by main propulsion machinery of between 750 kW and 3,000 kW propulsion power

(i) Every chief engineer officer and second engineer officer on a seagoing ship powered by main propulsion machinery of between 750 and 3,000 kW propulsion power shall hold an appropriate certificate.

(ii) Every candidate for certification shall:

a) meet the requirements for certification as an officer in charge of an engineering watch and:

a.i for certification as second engineer officer, shall have not less than 12 month's approved seagoing service as assistant engineer officer or engineer officer, and

a.ii for certification as chief engineer officer, shall have not less than 24 months shall be approved seagoing service of which not less than 12 months shall be served while qualified to serve as second engineer officer; and

b) have completed approved education and training and meet the standard of competence specifies in section A-III/3 STCW Code.

(iii)Every engineer officer who is qualified to serve as second engineer officer on shops powered by main propulsion machinery of 3,000 kW propulsion power or more, may serve as chief engineer officer on ships powered by main propulsion machinery of less than 3,000 kW propulsion power, provided that not less than 12 month's approved seagoing service shall have been served as an engineer officer in a position of responsibility and the certificate is so endorsed.

Special training requirements for personnel on certain types of ships

Regulation V/1

Mandatory minimum requirements for the training and qualification of masters, officers and ratings on tankers

(i) Officers and ratings assigned specific duties and responsibilities related to cargo or cargo equipment on tankers shall have completed an approved shore-based firefighting course in addition to the training required by regulation VI/1 and shall have completed:

i. at least three months of approved seagoing service on tankers in order to acquire adequate knowledge of safe operational practices; or
ii. an approved tanker familiarization course covering at least the syllabus given for that course in section A-V/1 of the STCW Code, so however that, the Administration may accept a period of supervised seagoing service shorter than that prescribed by sub-paragraph i., provided:
iii. the period so accepted is not less than one month;
iv. the tanker is of less than 3,000 gross tonnage:
v. the duration of each voyage on which the tanker is engaged during the period does not exceed 72 hours; and

vi. the operational characteristics of the tanker and the number of voyages and loading and discharging operations completed during the period allow the same level of knowledge and experience to be acquired.

(ii) Masters, chief engineer officers, chief mates, second engineer officers and any person with immediate responsibility for loading, discharging and care in transit or handling of cargo shall, in addition to meeting the requirements of sub-paragraphs 1.i or 1.ii, have:

i. experience appropriate to their duties on the type of tanker on which they serve; and

ii. completed an approved specialized training programme which at least covers the subject set out in section A-V/1 of the STCW Code that are appropriate to their duties on the oil tanker, chemical tanker or liquefied gas tanker on which they serve.

(iii) Within two years after the entry into force of the Convention for a Party, seafarers may be considered to have met the requirements of sub-paragraph 2.ii if they have served in a relevant capacity on board the type of tanker concerned doe a period of not less than one year within the preceding five years.

(iv) Administration shall endure that an appropriate certificate is issued to masters and officers, who are qualified in accordance with paragraphs1 or 2 as appropriate, or that an existing certificate is duly endorsed. Every rating who is so qualified shall be duly certificated.

Emergency, occupational safety, medical care and survival functions

Regulation VI/1

Mandatory minimum requirements for familiarization, basic safety training and instruction for all seafarers

Seafarers shall receive familiarization and basic safety training or instruction in accordance with section A-VI/1 of the STCW Code and shall meet the appropriate standard of competence specified therein.

Regulation VIII/1

Fitness for duty

Each Administration shall, for the purpose of preventing fatigue:

(i) establish and enforce rest periods for watchkeeping personnel and

(ii) require that watch systems are so arranged that the efficiency of all watchkeeping personnel is not impaired by fatigue and that duties are so organized that the first watch at the commencement of a voyage and subsequent relieving watches are sufficiently rested and otherwise fit for duty.

Resolution 8

Promotion of technical knowledge, skills and professionalism of seafarers

Considering the importance of selection, training of and certification of seafarers, Administration shall ensure that the Companies

(i) establish criteria and processes for the selection of personnel exhibiting the highest practicable standards of technical knowledge, skills and professionalism;

(ii) monitor the standards exhibited by ship's personnel in the performance of their duties;

(iii) encourage all officers to participate actively in the training of junior personnel;

(iv) monitor carefully and frequently review the progress made by junior personnel in their acquisition of knowledge and skills during their service on board ship;

(v) provide refresher and updating training at suitable intervals as many be required; and

(vi) take all appropriate measures to encourage pride of service and professionalism on the part of the personnel they employ.

2.6.3 Codes of STCW 95

Section A-I/6

Training and assessment

(i) Each Party shall ensure that all training and assessment of seafarers for certification under the Convention is:

.1 structured in accordance with written programmes, including such methods and media of delivery, procedures, and course material as are necessary to achieve the prescribed standard of competence; and

.2 conducted, monitored, evaluated and supported by persons qualified in accordance with paragraphs 4, 5 and 6.

(ii) Persons conducting in-service training or assessment on board ship only do so when such training or assessment will not adversely affect the normal operation of the ship and they can dedicate their time and attention to training or assessment.

Qualifications of instructors, supervisors and assessors

(iii) Each Party shall ensure that instructors, supervisors and assessors are appropriately qualified for the particular types and levels of training or assessment of competence of seafarers either on board or ashore, as required under the Convention, in accordance with the provisions of this section.

In-service training

(iv) Any person conducting in-service training of a seafarer, either on board or ashore, which is intended to be used in qualifying for certification under the Convention, shall:

.1 have as appreciation of the training programme and an understanding of the specific training objectives for particular type of training being conducted;

.2 be qualified in the task for which training is being conducted; and

.3 if conducting training using a simulator:

.3.1 have received appropriate guidance in instructional techniques involving the use of simulators, and

.3.2 have gained practical operational experience on the particular type of simulator being used.

(v) Any person responsible for the supervision of in-service training of a seafarer intended to be used in qualifying for certification under the Convention shall have a full understanding of the training programme and the specific objectives for each type of training being conducted.

Assessment of competence

(vi) Any person conducting in-service assessment of competence of a seafarer wither on board or ashore, which is intended to be used in qualifying for certification under the Convention, shall:

.1 have an appropriate level of knowledge and understanding of the competence to be assessed;

.2 be qualified in the task for which the assessment is being made;

.3 have received appropriate guidance in assessment methods and practice;

.4 have gained practical assessment experience; and

.5 if conducting assessment involving the use of simulators, have gained practical assessment experience on the particular type of simulator under the supervision and to the satisfaction of an experienced assessor.

Training and assessment within an institution

(vii) Each Party which recognizes a course of training, a training institution, or a qualification granted by a training institution, as part of its requirements for the issue of a certificate required under the Convention, shall ensure that the qualifications and experience of instructors and assessors are covered in the application of the quality standard provisions of section A-I/8. Such qualification,

experience and application of quality standards shall incorporate appropriate training in instructional techniques, and training and assessment methods and practice, and comply with all applicable requirements of paragraphs 4 to 6.

Section A-I/8

Quality standards

National objectives and quality standards

(i) Each party shall ensure that the education and training objectives and related standards of competence to be achieved are clearly defined and identify the levels of knowledge, understanding and skills appropriate to the examinations and assessments required under the Convention. The objectives and related quality standards may be specifies separately for different courses and training programmes and shall cover the administration of the certification system.

(ii) The field of application of the quality standards shall cover the administration of the certification system, all training courses and programmes, examinations and assessments carried out by or under the authority of a Party and the qualifications and experience required of instructors and assessors, having regards to the policies, systems, controls and internal quality assurance reviews established to ensure achievement of the defined objectives.

(iii) Each Party shall ensure that an independent evaluation of the knowledge, understanding, skills and competence acquisition and assessment activities, and of the administration of the certification system, is conducted at intervals of not more than five years in order to verify that:

.1 all internal management control and monitoring measures and follow-up actions comply with planned arrangements and documented procedures and are effective in ensuring achievement of the defined objectives;

.2 the results of each independent evaluation are documented and brought to the attention of those responsible for the area evaluated: and

.3 timely action is taken to correct deficiencies.

(iv) The report of the independent evaluation required by paragraph 3 of regulation I/8 shall include the terms of reference for the evaluation and the qualifications and experience of the evaluators.

Section A-III/1

Mandatory minimum requirements for certification of officers in charge of an engineering watch in a manned engine-room or as designated duty engineers in a periodically unmanned engine-room

Training

(i) The education and training required by paragraph 2.3 of regulation III/1 shall include training in mechanical and electrical workshop skills relevant to the duties of an engineer officer.

On-board training

(ii) Every candidate for certification as officer in charge of an engineering watch in a manned engine-room or as designated duty engineer in a periodically unmanned engine-room of ships powered by main propulsion machinery of 750 kW or more shall follow an approved programme of on-board training which:

.1 ensures that during the required period of seagoing service the candidate receives systematic practical training and experience in the tasks, duties and responsibilities of an officer in charge of an engine-room watch, taking into account the guidance given in section B-III/1 of this Code;

.2 is closely supervised and monitored by a qualified and certified engineer officer aboard the ships in which the approved seagoing service is performed; and

.3 is adequately documented in a training record book.

2.6.4 Amendments to STCW

2006 Amendments to the STCW Convention, chapter I and VI and chapter VI of Part A of STCW Code have been adopted by resolutions MSC.203(81) and MSC.209(81) respectively on 18th May 2006 and shall enter into force on 1st January 2008.

(i) Following is added at the end of paragraph 1 ,Regulation I/1 after subparagraph 25

"26 ISPS Code means the International Ship and Port Facility Security code adopted on 12th December 2002, by resolution 2 of the conference of Contracting Governments to the International Convention for the Safety of Life at Sea (SOLAS),1974 as may be amended by the Organisation."

"27 Ship Security Officer means the person on board the ship, accountable to the master, designated by the Company as responsible for the security of the ship including implementation of maintenance of the ship security plan and liaison with the Company security officer and port facility security officers."

(ii) The existing title of chapter VI is replaced by the following:

"Emergency, occupational safety, security, medical care and survival functions"

(iii) The following new regulation VI/5 is inserted after the existing regulation VI/4.

"Regulation VI/5

Mandatory minimum requirements for the issue of certificates of proficiency for ship security officers

i. Every candidate for a certificate of proficiency as ship security officer shall:

i.i. have approved seagoing service of not less than 12 months or appropriate seagoing service and knowledge of ship operation; and

i.ii. meet the standard of competence for certification of proficiency as ship security officer, set out in section A-VI/5, paragraph 1 to 4 of the STCW Code.

ii. Administration shall ensure that every person found qualified under the provisions of this regulation is issued with a certificate of proficiency.

iii. Every Party shall compare the standards of competence which it required of ship security officers who hold or can document qualifications before the entry into force of this regulation with those specified for the certificate of proficiency in section A-VI/5 of the STCW Code, and shall determine the need for requiring these personnel to update their qualifications.

iv. Until 1 July 2009, a Party may continue to recognize personnel who hold or can document qualifications as ship security officers before the entry into force of this regulation."

2.7 Standards of competence

2.7.1 Marine engineer officer class IV

Every candidate for certification as officer in charge of an engineering watch in a manned engine-room or as designated duty engineer in a periodically unmanned engine-room on a seagoing ship powered by main propulsion machinery of 750 kW propulsion power or more shall be required to demonstrate ability to undertake, at the operational level, the tasks, duties and responsibilities listed below:

- Use appropriate tools for fabrication and repair operations typically performed on ships.
- Use hand tools and measuring equipment for dismantling, maintenance, repair and reassemble of shipboard plant and equipment.
- Use hand tools, electrical and electronic measuring and test equipment for fault finding, maintenance and repair operations.
- Maintain a safe engineering watch.
- Use English in written and oral form.
- Operate main and auxiliary machinery and associated control systems
- Operate pumping systems and associated control systems

- Operate alternators, generators and control systems
- Maintain marine engineering systems, including control systems
- Ensure compliance with pollutions-prevention requirements
- Maintain sea worthiness of the ship
- Prevent, control and fight fires on board
- Operate life-saving appliances
- Apply medical first aid on board ship
- Monitor compliance with legislative requirements

2.7.2 Marine engineer officer class II

Every candidate for certification as chief engineer officer and second engineer officer of sea going ships powered by marine propulsion machinery of 3000 KW power or more shall be required to demonstrate ability to undertake, at management level, the tasks, duties and responsibilities listed below.

- Plan and schedule operations
- Start up and shut down main propulsion and auxiliary machinery, including associated systems
- Operate, monitor and evaluate engine performance and capacity
- Maintain safety of engine equipment, systems and services
- Manage fuel and ballast operations
- Use internal communication systems
- Operate electrical and electronic control equipment
- Test, detect faults and maintain and restore electrical and electronic control equipment to operating condition
- Organize safe maintenance and repair procedures
- Detect and identify the cause of machinery malfunctions and correct faults
- Ensure safe working practices
- Control trim, stability and stress
- Monitor and control compliance with legislative requirements and measures to ensure safety of life at sea and protection of the marine environment

- Maintain safety and security of the vessel, crew and passengers and the operational condition of life-saving, fire-fighting and other safety systems
- Development emergency and damage control plans and handle emergency situations
- Organize and manage the crew

2.8 Engineering watch

Maintenance of safe engineering watch is the most important duty of a class IV marine engineer and hence it has been elucidated further.

Officers in charge of the engineering watch shall pay particular attention to:

- the observance of all orders, special operating procedures and regulations concerning hazardous conditions and their prevention in al areas in their charge;
- the instrumentation and control systems, monitoring of all power supplies, components and systems in operation;
- the techniques, methods and procedures necessary to prevent violation of the pollution regulations of the local authorities; and
- the state of the bilges.

Officers in charge of the engineering watch shall:

- in emergencies, raise the alarm when in their opinion the situation so demands, and take all possible measures to prevent damage to the ship, persons on board and cargo;
- be aware of the deck officer's needs relating to the equipment required in the loading of the cargo and the additional requirements of the ballast and other ship stability control systems;
- make frequent rounds of inspection to determine possible equipment malfunction or failure, and take immediate remedial action to ensure the safety of the ship, of cargo operations, of the port and the environment;

- ensure that the necessary precautions are taken, within their area of responsibility, to prevent accidents or damage to the various electrical, electronic, hydraulic, pneumatic and mechanical systems of the ship;
- ensure that all important events affecting the operation, adjustment or repair of the ship's machinery are satisfactorily recorded.

2.9 Indian Rules

Channels for becoming marine engineer as per Merchant Shipping(STCW for seafarers) Rules 1998

In order to implement the provisions of International Maritime Organisation (IMO) Convention on Standards of Training, Certification and Watchkeeping (STCW) '95 in India, Government of India gazetted Merchant Shipping (STCW for Seafarers) Rules 1998, supplemented by Training and Assessment Programme, popularly known as META Manual. These rules delineate various channels for training and producing Marine Engineers for fulfilling the needs of Indian as well as the requirements of world shipping.

Training and certification of marine engineers have been broadly classified into two categories namely Foreign Going and Near Coastal Voyages (NCV). 13 streams of training have been provided in Foreign Going category and 6 for NCV with a subsequent addition of two more streams of training in NCV. Therefore it is seen that there are totally 21 streams of training for marine engineers in India, aspiring to be engine room watch-keepers and beyond. Please see the Flow Diagram No 1,2,3 & 4 attached as Annex I.

Streams under foreign going voyages and near coastal voyages are described below.

2.9.1 Foreign going voyages

Following streams are provided in this category as per Flow diagram No.1 and Flow diagram No. 2 of META Manual under Rule 21 (2) (iv) of MS (STCW for Seafarers) Rules 1998. Please refer Flow diagram No.1 and Flow diagram No.2 of Annex I.

a) Sea going engine driver

A candidate holding certificate of competency as sea going engine driver issued under M.S Act is eligible to take up this stream leading to a pass in Marine Engineer officer (MEO) class IV. But a major hitch here is that he has to undergo 9 months of structured training in an approved marine workshop followed by a 6 months course as per STCW A-III/1, both of which are not being conducted now. So, for all practical purposes, this stream remains a hypothetical one for the aspiring candidates.

b) Naval Dockyard apprentice or Naval / Coast Guard service as Mech. 3

Candidates holding this qualification are eligible to appear for part A of MEO class IV, provided they complete the 6 months course as per STCW A-III/1, which is presently non- existent.

c) Diploma in mechanical engineering or ship building engineering

Candidates with these qualifications can, in principle, take up this stream leading to MEO class IV provided they undergo 2 years structured training in an approved marine workshop. As of now, no workshop is conducting such training. Hence this channel is presently kept closed.

d) Graduation in electrical and electronic engineering

These candidates will have to undergo 18 months structured training in an approved marine workshop before they can appear for MEO class IV part A examination. Since, hardly any workshop is presently offering this training, prospective marine engineers seldom use this stream.

e) Graduation in mechanical engineering / naval architecture

Induction of graduates in mechanical engineering into marine engineering profession is a time tested and proven system of producing marine engineers in India. Several workshops such as various Port Trust workshops and shipyards are offering the requisite 12 months structured training to help them obtain exemption from part A of MEO class IV. Thereafter they do 6 months sea

service as Assistant Engineer Officer and 3 months of Preparatory course and appear for MEO class IV Part B examination. Needless to mention that they have to do the necessary safety courses.

f) Cochin Shipyard training for graduate mechanical engineers

The entry qualification for this stream is same as that of (e) above, i.e., holders of an approved degree in mechanical engineering. The only difference with the training under (e) above is that, in this case, the 12 months training is split up into two parts. The first half is spent at Cochin Shipyard, Cochin and the other half subsequently on board ships. The desirable advantage of this scheme is that the gestation period of this training programme is minimum. In other words, a raw mechanical engineering graduate can be converted as a watch keeping MEO in a period of one year.

g) MERI, Mumbai training of GME

This training is more or less the same as shown in (f) above. Six months structured training of MERI is followed by 6 months of 'on board' training in this case. However, the second part may not take place in smooth continuation of the first part as giving berth for about 100 trainees at the same time may not be easy .The advantage for this stream is that gestation period is the minimum as in the previous case.

h) Four year degree course in marine engineering

This is a time tested and proven system of training marine engineer aspirants and this system has been in existence for over 50 years in India. The products of this system are very well received by the shipping industry here and abroad. The only disadvantage is that the gestation period is more in this case and hence this stream of training cannot meet the immediate demands of the fluctuating shipping scenario.

i) Four years apprenticeship in workshops

Although this stream is in existence for a long period, adequate theoretical input was not being imparted to the trainees. The quality of product of this training scheme was found not comparable with the standard of that of (g) or (h) above. Hence the products in this case tend to be sub-standard, particularly in the academic side. From experience, it is observed that these trainees take longer period to clear their subsequent examinations for issue of certificate of competency. In view of the above it is felt that the authorities may discourage the conduct of this stream in future.

j) Four years apprenticeship at marine institute

This is considered to be a substandard alternative to streams provided in (f) and (g). Institutions running these programmes may be either gradually phased out or upgraded to offer graduate programmes in order to merge (j) with (f) or (g).

k) Alternative training scheme

This is known as the sandwich programme in shipping parlance. 9 months of sea service is sandwiched in between two spells of institutional training of one year and 9 months duration. This stream is felt not ideal in India, due to certain operational difficulties. Introduction of 9 months of on board training as Engineer cadets in between 30 months course is the major difficulty. Getting training berths in ships for these cadets on a stipulated day and signing them off on completion of 9 months training together is practically impossible, unless dedicated ships are provided for this purpose.

l) Naval / Coast Guard Officers

The entry of Naval and Coast Guard Officers into the marine engineering training system is provided more as a rehabilitation need of defense personnel rather than the requirements of the merchant navy. The entry point is prior to the 3 months Preparatory course of MEO class IV Part B. The average age of regular trainees at that level is estimated to be around 22 years and that of Naval/Coast Guard Officers aspiring entry at the same level is well over 25. It is

thus obvious that the latter group would be starting the career with a disadvantage.

m) B.Sc. Maritime Sciences

This 3 year degree programme on polyvalent certification is the latest introduction to produce officers with training for both engine and deck department. On satisfactory completion of 3 year training, the incumbents can work either on engine or deck side. Degree is being presently awarded by the University of Mumbai.

2.9.2 Near Coastal Voyage

Following streams are provided in this category as per Flow Diagram 4 of META Manual, under Rule 25 (2) (iv) of MS (STCW for Seafarers) Rules 1998.

a) Engine room rating with watch keeping certificate

Certified rating forming part of an engine room watch is eligible to attend the Preparatory course of MEO class IV (NCV) provided he has put in 2 years sea service. This gives a chance for an ordinary engine room rating, to rise up the ladder to the level of an engineer officer of NCV, if he so desires and subsequently to foreign going category by making use of the bridge provided for that purpose. It may be pointed out here that all those ratings with the basic educational qualification less than 10^{th} standard cannot aspire to get into this stream.

b) Sea going engine driver / Naval rating MECH-III / ERA-III

Holders of any of the above certificates who have already passed their 10^{th} Standard are eligible to join the Preparatory course of 3 months duration as per Appendix M-III/5A of META Manual Volume II. Thereafter, they can follow the appropriate channel to attain the heights of the career.

c) **Second class engine driver under I.V. Act / Harbour Craft Rules**

The above group of engine drivers can switch over from I.V. Act / Harbour craft rules to MS Act, provided they have passed their Secondary School Certificate / 10^{th} Standard and have also put in one year sea service on sea going vessels. It is felt unlikely that many can come up the ladder through this stream, mainly due to two reasons: -

(a) Inadequate basic qualification.

(b) Getting sea service on sea going vessels.

d) **Pass in I.T.I. trade suitable for marine engineering training**

I.T.I Pass certificate holders in trade, suitable for this line are eligible to attend the MEO class IV (NCV) Preparatory course, provided they have 2 years sea service on sea going ships. Needless to mention that they have to undergo 4 basic safety courses prior to sailing. This stream can attract suitable young candidates, provided opportunities are available for sea service.

e) **Diploma in mechanical engineering / electrical engineering**

The basic difference between this case and that of (d) above is that sea service has been reduced by one year instead of two years. All the other requirements remain the same.

f) **Marine fitter in an approved marine workshop / naval dockyard**

This stream is to facilitate the shore fitters to take up suitable marine engineering training. Such fitters are eligible to attend Preparatory course of MEO class IV (NCV) after having done two years sea service on sea going vessels. Not many are observed pursuing this channel.

g) **Fishing vessel engine driver**

In addition to the above 6 streams of marine engineering training under NCV, as shown in flow diagram No.4 of Annex I, holders of Fishing Vessel Engine Driver certificates are also declared eligible to attend the Preparatory course of MEO class IV (NCV), provided they have put in one year of sea service. Many such candidates

who have passed out from Central Institute of Fisheries Nautical and Engineering Training (CIFNET) on completion of a formal course and hither to have no career prospects can pursue this stream. Therefore, this stream has a reasonably good response.

h) Fishing vessel engineer

The difference between this and (g) above is that one-year sea service specified in 'g' is not required in this case. This means that the fishing vessel engineer certificate holder is eligible to join the 3 months Preparatory course of MEO class IV (NCV) without any further sea service.

2.10 Comments

Although 13 streams in Foreign Going and 8 streams in NCV categories are provided in the META Manual, only a few streams are seen to produce marine engineers of expected quality in the required quantity. They are the 4 year marine engineering degree course and training schemes of graduate mechanical engineers. The graduates of 4 year marine engineering degree course is well received by the shipping industry more than the rest as they are tailor made to suit the requirements of the industry. Training scheme of graduate mechanical engineers is also favoured by the industry as these trainees have the basic engineering aptitude and background. Therefore, 4 year marine engineering programme is to be encouraged in the country to meet the long-term requirements of ships manning. Immediate demands of the market can be met by training the graduate mechanical engineers, since gestation period in this case is the minimum.

CHAPTER 3

REVIEW OF LITERATURE

3.1 Introduction

The literature survey commenced with the study of relevant works done in the field of maritime training by several authors and observations of many regarding the work environment of seafarers. Changes occurring in the field of training of marine engineer officers have been traced and analysed. Review of the research papers in the journals and review of proceedings of conferences and symposia have been carried out and given here under the various relevant subtitles.

3.2 Crew performance

The performance of the crew on board a ship largely depends on the sea conditions. This has been studied by *Stevans, S.C.* and *Parsons M.G.* The prevailing trend amongst the ship owners and operators are to reduce the crew strength on board to the minimum possible or to a level of what is stated in the 'minimum safe manning document', obviously due to economic reasons. Nevertheless, the required tasks on board will have to be performed by this limited number of crew. Failure to perform any of the tasks will tell upon the ships performance and even the seaworthiness of the ship. Every crew member on board is responsible for a portion of the total tasks in the ship. The unpredictability of bad weather and resultant motions induced on the vessels at sea can seriously affect the performance of the crew and normal operation of vessels and even damage the cargo. "Coincidental to those motions are a variety of physiological and biomechanical events that can quickly reduce even the best of efforts to a fraction of what they would be ashore on a stable platform. Ship motions limit a crew's ability to perform essential command, control, and communications functions, navigation tasks, maintenance responsibilities, and even the preparation of food. Additionally, and more importantly, emergency situations may become more threatening in a situation where only a portion of the crew is able to respond effectively." [8]

Since the beginning of the recorded maritime history, sea sickness has been documented as having an adverse effect on seamen. In fact, the Greek word "naus," meaning ship, is the root of the word "nausea" meaning "an inclination to vomit" *(Reason, J.T.* and *Brand, J.J.)*. "*Sickness* implies that it is a type of disease, when in fact it is a perfectly normal response of a healthy individual without any functional disorders. In its most extreme condition, motion sickness incapacitates those affected by it, but its less dramatic symptoms are more far-reaching. Many people suffer the misery of motion sickness without vomiting, and their decreased motivation and apathy makes these individuals safety concerns not only for themselves, but for others around them and for the very ship itself, depending on the nature of work for which they are responsible. Additionally, crewmembers otherwise immune to motion sickness often find themselves burdened with additional tasks and responsibilities to ensure proper functioning of the ship." [9]

(i) Females appear to become sick more often than males in a ratio of 1.7 to 1 (*Benson, A.J., Lawther, A & Griffin, M.J.*). The increase in susceptibility among females might be attributed to anatomical differences or an effect of hormones (*Reason, J.T.* and *Brand, J.J.*).

(ii) "It is somewhat comforting to know that, over time, habituation (or adaptation) occurs. Acquiring one's 'sea legs' may take anywhere from a few hours to several days, and in about 5% of the population, it does not occur at all. The time to adapt is generally influenced by individual differences and by the type of wave movements. [10, 11]

It is well known among seafarers, that a common remedy for seasickness is to situate oneself above deck or to gaze through a porthole to observe a steady horizon."

3.3 Rank progression

The difficulty of the rank progression is that the learning model of progressively more complex tasks for successive ranks requires a stable technology. It is also a craft

model of learning and conflicts with the much greater emphasis on formal education and training. The progression implies that training is actually doing the job, since the purpose is to become chief engineer. Although other factors such as lack of continuity affect on board training, this basic assumption concerning training accounts for the considerable difficulty in introducing and sustaining on board training programmes. These factors lead to a lack of adaptiveness in the conventional shipboard organization. (*Smith, M.H* and *Roggema, J*) [12]

3.4 Apprenticeship

The German apprenticeship programme is a partnership between education authorities and firms which has the dual aim of fulfilling the obligation of a young person to continue in part-time schooling until age 18 alongside an obligation to a company to learn and practice an occupation. It is as a result of this dual structure that much of what is tested in the German apprenticeship examinations is not required by an individual who merely intends to acquire good bricklaying skills. Apprenticeships are normally only available to young people and different sets of qualifications are available for adults. *(Hillary, S)*

Engineers are met by demands for better and more relevant competence. Consequently it is the institutions that educate them that have the responsibility to improve teaching and learning practices to promote generic skills and a more in-depth approach to learning. [13]

European Journal of Engineering Education Agency and structure in engineering education: perspectives on educational change (Gynnild V) [14]

3.5 Simulation training

The use of simulation in providing solutions to the problems of risk and crisis management and the optimal use of crew resources has a long established pedigree in maritime training. The first simulators were introduced for radar training over thirty years ago. Training in the proper interpretation of radar information started as a result

of a number of radar-assisted collisions in the 1950's, notably the collision between the passenger ship "Andrea Doria" and the "Stockholm". Those early simulators consisted of real radars, located in a set of cubicles, and fed with simulated signals. Individuals or teams could learn the skills of radar plotting under the guidance of an instructor working at a separate master console. Other navigational aids in the simulator were fairly basic and certainly did not include a visual scene.

The 1980s saw the introduction of Engine Room simulators and towards the end of that decade, cargo operations simulators also became available. These types of simulator have primarily been used to train officers in the handling of operations, including fault finding and problem diagnosis, and increasingly to train teams in the skills of systems, resource and risk management. Many types of simulator: bridge, engine and cargo control room, have tended to emphasize a physically realistic environment in which these exercises occur, although the use of PC-based simulators for training some tasks is increasingly widespread. In some parts of the world, simulators have been developed which have very high levels of physical fidelity, for example, multi-storey engine room mock-ups and bridge simulators including features such as 360 degrees day/night views, pitch and roll, and full vibration and noise effects.

The only mandatory requirements in the maritime domain for the development of the non-technical skills of crisis management are those of the International Maritime Organization's (IMO) Seafarer's Training, Certification and Watchkeeping Code (International Maritime Organization, 1995). Table A-V/2 of this code specifies the minimum standard of competence in crisis management and human behaviour skills for those senior officers who have responsibility for the safety of passengers in emergency situations. The competence assessment criteria detailed within the Code are not based on specific overt behaviours, but rather on generalised statements of performance outputs, and as such are highly subjective and open to interpretation. Although these standards of competence indicate that IMO recognises the need for non-technical management skills, both the standards and their assessment criteria are

immature in comparison with the understanding of non-technical skills, and their assessment, within an industry such as civil aviation.

A recent review of accident databases from the USA, UK, Canada and Australia confirms that human error continues to be the dominant factor in maritime accidents and reveals that in 70% of recorded incidents attributed to human error, failures in situation assessment and awareness predominate (ABS, 2004).

3.6 Engine room simulation

The main purpose of all simulators is to simulate the systems as much similar as possible for a good utilisation in education and training. The advantages of the utilisation of engine room simulator in marine engineering training are summarized as follows:

- The operations of the machinery are simulated as close as possible to their actual conditions,
- Training for both normal and abnormal condition "repeatedly" is possible,
- It is cost effective,
- It is time effective,
- It offers a flexible and controlled schedule of the training curricula,
- It makes controlled evaluation of the students possible.
- It makes standardization of a marine engineering education and training curricula possible

The biggest advantage of using Engine Room Simulator as a training tool is the possibility of creating malfunctions repeatedly to train students for increasing their troubleshooting skills.----

Engine room simulator training could be used to impart to marine engineer candidates, higher-level qualifications like:

- Teamwork among engineer officers (how to be part of a team)

- Leadership (how to organise the team)
- Safety culture and management of the risk in the machinery space (how to predict and prepare for an accident)
- Aspect of the human error (the causes, behaviours and results, human-machine interface etc.)
- Communication aspects (how to communicate in multicultural environment with standard use of English)

For example, the use of engine room simulator for team-management and for communication skills could very efficiently be arranged because of the opportunity of preparing the scenarios based on the type of the training and education. Furthermore, by providing a scenario of simulated severe accidents in the machinery space, marine engineer candidates will be able to experience the situation without any damage to training equipments. Through this type of training, marine engineer candidates can learn the safety culture for the management of the risk (i.e the aspect of human error). Simultaneously, the behaviours of the trainees during this type of training recorded on engine room simulator will provide the academic staff of the department of marine engineering with opportunities to do research on human factor issues for safety management.

Utilisation of engine room simulator in marine engineering curricula can have two main parts. These are:

- Engine room simulator as laboratory tool in marine engineering courses, and
- Utilisation of engine room simulator as a training tool.

(Role of Engine Room Simulator in Marine Engineering Training, 2006) [15]

3.7 Speech synthesis in simulator training

Speech synthesis has been widely implemented on virtual engine room in the latest version 4.5 which can be installed on a single PC connected to two monitors

displaying separate aspects of training programme....Generally, synthesized speech could be implemented in the following areas of simulator functionality:

- Imitation of an expert (typically a chief engineer) being present in the engine room and offering an instruction on what should be done now, what the current problem is, or a warning if necessary.
- Imitation of voice communication with a ship's bridge, together with the telegraph commands. This can be improved if speech recognition is implemented as well, making bi-directional communication possible.
- Imitation of communication with other members of the engine room crew (passing orders, collecting reports etc.)

.....Trainees experience shows that the synthesized speech which incorporates the above features creates a new dimension in simulated training. The most important advantage is that trainee starts to listen not only to the engine room mechanical sound but also to the spoken information which may be audible in the real engine room environment.

(Kluj S) [16]

3.8 Communication

The survey and study conducted by *Keane A* brought to light the importance of communication in a competitive industry.

"One of the most significant findings of this study was the high percentage of respondents (41%) who reported that ineffective writing causes problems in their place of work. This has serious cost implications for industry at a time when global competition is increasing the pressure to cut costs and improve efficiency.

Another significant finding was the very high emphasis on speaking skills. Respondents placed these first in order of priority. They mentioned oral presentations, but also gave high priority to the oral skills needed for effective participation in meetings, skills in group communication, negotiation, interviewing, and dyadic communication: telephone skills and listening The survey points to the need to focus more effectively on a range of interpersonal oral communication skills in

undergraduate communications courses: group communication, negotiation skills, listening skills, and telephone skills. Respondents placed these higher on their list of priorities than written skills. At present, assessment of undergraduate communications skills generally gives priority to report writing and, to a lesser extent, formal oral presentations." [17]

3.9 Management skills

(i) Most engineers' careers demand a variety of 'managerial' skills and expertise, particularly in two groups of topics: leadership, and the management of projects.

(ii) These demands vary with age and level of responsibility. Some management skills and knowledge are required early in engineers' careers. As might be expected, some are needed later.

(iii) Some topics classically included in 'management' courses are little used by most engineers, for example work study and operational research.

It is felt that management function of a marine engineer includes automation on board, and if so, as the extent of automation increases, the management content of a marine engineers work also increases and consequently the relevant curriculum and training. Furthermore, the benefits of automation can be fully exploited only if the engineers on board are capable of quickly analysing and assessing the problems and arrive at the correct interpretations. This demands that the marine engineers possess a high technical and professional competency to understand the complex machinery and the sophisticated equipment controlling it and administer an efficient overall control. *(Dudman A and Wearn S.H)* [18]

3.10 Sea time for assistant engineer offices

The present requirement of sea service for a marine engineer for career progression is as follows.

(i) 6 months sea service as assistant engineer officer after completion of an approved pre sea course before appearing for MEO class IV examination.

(ii) 12 months sea service as officer in charge of an engineering watch before appearing for MEO class II examination.

(iii) 18 months sea service after MEO class II, as officer in charge of an engineering watch before appearing for MEO class I examination.

According to a survey conducted by *Dhar, J.K* amongst marine engineers, teachers and examiners, it has been observed that "most examiners / teachers think that better learning can be achieved if we could follow as 12 + 12 + 12 programme. However this can be avoided and kept at present level of 6 months only if pre sea training of 4 years is strengthened.....Six months sea service before the operation level certificate has to be more pointed and well defined. Present TAR book for above is somehow found not serving its purpose in totality. The result is that 6 months are either found not sufficient or not utilised for the purpose meant for." [19]

3.11 Safety of ships

Seafaring has always been a dangerous and hazardous activity with the result that lives of many seafarers have been lost at sea while serving their respective employers and contributing to the world economy and humanity. This was reason enough for the ship operators to give due importance to safety of lives at sea. "But as Richard Cahill, an historian of shipping wrote in 1990, 'safety has never ranked very high in the scale of priorities of those who own ships.' This was particularly true during 18th and 19th centuries and until the middle of the latter, ship owners and their agents were not liable to criminal penalties for safety failures at sea. The law imposed no criminal liability on the ship owner who failed to manage, refit or equip his vessel properly or who sent it to sea overloaded or undermanned. Of course things have now changed." *(Veiga J.)* [20]

3.12 Difference between old and new type of training

According to *Thomas K.C.*, in the old type of maritime training, the quality standard was not enforced. Class room method of teaching by lecturing and written

presentation was the order of the day. Most of the cases, on the job training by traditional seafaring community was the accepted pattern of training.

Later it gave way to case study and role play method. It went on for some years. Although it is still in use, it has gradually reduced its applications.

The present trend is simulation method. It gives high motivation to the learner and it has greater transfer capacity of teaching. In modern maritime training, more emphasis is given to simulation than conventional written and oral presentation because it gives greater personal experience and direct involvement. [21]

3.13 Multinational crew

Seafarers are considered to be the first citizens of the global village although they may hold different national passports. The International Labour Organisation (2001), considering the living and working conditions of seafarers in the context of the rapidly changing nature of the shipping industry, commented: Most significant of all (changes) has been the eradication of national boundaries in the labour market for seafarers. Unwittingly and unintentionally, the shipping industry has found itself with the world's first working example of a relatively open labour market. Taken together, these changes signify little less than a revolutionary transformation of the shipping industry and the emergence of the world's first genuinely global industry.

A research study conducted by *Collins P.* and *Hogg J.M.* reveals that "multinational crews can work as well as, if not better, than crews of a single nationality. It was found that approximately 10% of vessels had crews onboard comprising more than five national groups but that these groups did not usually conform to national stereotypes, in terms of leadership potential or initiative taking. It was found that most seafarers themselves expressed a preference for working in mixed-nationality groups and that crew seemed to operate most efficiently in groups comprising more than three nationalities." [22]

3.14 Distance Learning

Distance learning for seafarers has been in existence at sea for several decades. It started with the correspondence course by exchanging letters and study materials. The exchange could be done only when the ship is in port and therefore it caused considerable delay. Eventually video recorders were used on board for educational and entertainment purposes. This was almost completely replaced by computers on board with internet connectivity. Television and radio broadcasting also contribute to distance education of seafarers, but this is not ideal as the ships involved may be spread across different time zones over the globe. Many maritime training providers are now resorting to e-learning methods at sea, based on the stringent STCW training requirements. Provision for on line tutor support is also available in addition to multi media CD – ROM packages.

3.15 Formation of Training System in India in recent times

The Government set up a Committee on Maritime Education and Training *(COMET)* in 1991 under the Chairmanship of Dr. C. P. Srivastava, the then Secretary General, International Maritime Organization (IMO) to recommend suitable changes in the present institutional framework for imparting maritime training in India. The Committee in its report submitted in May 1992 recommended establishment of an autonomous body to manage, control, supervise, direct and monitor the maritime training institutions running under Government control. The idea was to form a Society under the Societies Registration Act, 1860 to be designated as Indian Maritime University (IMU). The Government had established a Society Indian Institute of Maritime Studies (IIMS) on 6th June 2002, according to the recommendation of *COMET*. An Expert Committee was constituted including representatives of University Grants Commission (UGC) to look after the formation of an IMU. This committee recommended formation of IMU by an Act of Parliament.[23]

Thus, the Government introduced IMU Bill in Parliament in the year 2007. Accordingly, IMU was established at Chennai with campuses at Kolkata, Mumbai,

Visakhapatnam and later at Cochin. "Formation of IMU will facilitate and promote maritime studies, research and extension work with focus on emerging areas of studies including marine science & technology, marine environment, socio-economic, legal and other related fields, and also to achieve excellence in these and connected fields. It will promote advanced knowledge by providing institutional and research facilities in such branches of learning as it may deem fit, make provision for integrated courses in science and other key areas of marine technology and allied disciplines. As we have a sizeable number of private institutions imparting maritime education and training, the University will standardize the quality of such education and training though affiliation and academic supervision."

(Rajesh K) [24]

3.16 Quality of Training

If a nation wishes to be a super power, it is imperative to have a strong maritime presence, which includes the defence force, the merchant ships, the training establishments, the shipyards for both ship building and repairs and the research capabilities. According to *Wayte, S.S.R*, education is assessable. There are examinations, tests and credit systems to arrive at a conclusion that the knowledge has been imparted. How to assess training? The results of bad training become apparent only after the cadet has joined the ship as a seafarer. Since training cannot be easily assessed, it is the first place where a commercially oriented institution will look to cut corners and here lies the tragedy. Cutting down the quality of training is most certainly the wrong solution. [25]

3.17 Maritime training of yester years

The Dufferin was meant to train cadets for a sea career. The curriculum and style were based on merchant naval training ships of UK. The maximum age at entry was 16. The minimum educational level was two grades below school leaving certificate. At the end of the training, the cadet's educational standard was equivalent to Higher Secondary School Certificate, but this belied the other attributes he gained over the period: he was trained to be a professional seafarer, which is what he initially set out

to be. Subsequently marine engineering training was included in the syllabus. The first year was common to both streams. They branched out from the second year onwards. The deck cadets learnt chart work, navigation and other nautical subjects while engineers learnt to coordinate their hands and heads in workshop practice (chipping and filing). In the class room, it was engineering knowledge connected with coal as well as oil fired scotch and water tube boilers, steam engines with triple expansion. donkey pumps and the steering engine. There was also a fair bit of mechanical drawing. The quantity and content of this book knowledge was such that it sunk in the young minds. - - - Extra curricular activities allowed no spare time to study! 'Clean ship' was a regular duty spread over half an hour in the morning; but on Saturdays was a truly elaborate affair scrubbing the wooden decks clean with 'Holy Stone' and sand and hosing down with sea water. All brass work had to be polished. 'Clean ship' inculcated in us the habit of keeping our living surroundings, tidy and habitable or 'ship shape'. These activities, almost imperceptibly, also developed in us a sense of brotherliness and interdependence, although we were fiercely competitive when playing inter-top matches or while boxing. --- Training is a two way affair between the trainer and the taught. Staff members have to be dedicated and trainees must be keen students. The result was a group of well bred young men who were receptive to newer inputs. Jobs at sea were assured for them. This was a perfect situation rather like our 'Guru Shishya Parampara' but with modern touch. This relationship or comparison started declining later.

(Kamath R.A.) [26]

3.18 Fatigue

George, O recommends increase in sea time for cadets so that study would not be a burden but a joy. Constant preparations for competences and examinations take a heavy toll on seafarers. A review of the many accidents that occur at sea would reveal that fatigue caused many of them. Even in well managed and reputed companies, as we got into the late 90s, there would be officers keeping watch not fully alert due to insufficient rest. [27]

3.19 Additional subjects

A structured training scheme to impart an understanding of shipping business followed by focused study of specialized subjects such as dry cargo and tanker chartering, ship management, ship sale and purchase, marine insurance, shipping law, liner trade, port agency, multi model transport, shipping finance etc. prepares the youngsters to take up more responsible roles in the industry. Over the last few years, the number of students undergoing training for shore based jobs has increased. This also includes those sailing on board the vessels desiring to relocate ashore and the fresh graduates. But the majority of the students are from the practitioners in the market who want to acquire better understanding of various disciplines.

(Jagmeet M) [28]

3.20 Post retirement settlement

It is often said that a marine engineer is the 'complete' engineer. This is true since a ship, be it a luxury liner or a plain cargo vessel, boasts of a large array of equipment and systems. On board, he has to master every system from the simplest fresh water system to the most complex control systems of the ship. In between these two extremes lie numerous other systems. A marine engineer has not only to master these systems but also to maintain them at peak efficiency in a corrosive environment and an unforgiving sea. Once at sea, he does not have the help of land based support systems. He is on his own in tough situations and meets every challenge thrown at him.....A marine engineer is likely to quit after 10 to 15 years. During this period, industry would have grown, technology improved considerably, operating practices changed and concepts revised. So whatever he would have learnt in college would now be obsolete or changed drastically. For a marine engineer to straightway jump from sea to land is not likely to be easy. Therefore, a marine engineer who intends to switch to a land based job later in life must begin the preparatory process much before he quits sea life. He has to prepare himself by adding value to himself by learning and undergoing relevant training, which suit his aptitude, and the goals he wants to achieve.

A typical marine engineer works on a contract basis with the shipping firms. Normally there is a lay off of a few months between two contracts. This period has to be gainfully utilized to undertake management, technical, financial and entrepreneurial courses and learn latest trends in the industry if a marine engineer wants to have a smooth transition to land based jobs.
(Lowe L.A.) [29]

3.21 Personality and career success

From the traditional perspective, practical implications of studying the link between personality and career success appear to be limited. Even if researchers affirm that certain personality traits are significantly correlated to career success, people are unable to learn how to improve their personality to influence career success. From this point of view, the proposed model, based on social learning theories, has practical implications.

The knowledge that personality is a determinant of career success is of value for individuals, organizations and career consultants. For individuals, the model provides a rationale to assess their own personality strengths and weaknesses so as to develop appropriate career strategies to enhance success. It also provides directions for people to learn and modify their personality for career success. ... While there are arguments of whether the role of a person on career development is sculptor or sculpture, the congruence approach compromises the debate. Holland suggested that both vocational satisfaction and achievement depend on the fit between personality and environmental factors. However, the need for congruence appears to be self evident. It is not surprising that the fit in personality, values, needs, ability, family background and so forth is correlated with career success. In contrast, based on social learning theories, the proposed model suggests that certain personality traits have effects on career success even in incongruent situations because people can actively learn and modify their personality or behaviour. *(Lau, V. and Shaffer, M.)* [30]

3.22 Self esteem and occupational prestige

The potential for a link between self esteem and occupational prestige has long been recognized. Parson's (1940) functional role theory presented an early iteration of social identity theory. He posited that a person's self regard reflects the degree to which that person lives up to the norms and expectations of his or her culture. By extension since extrinsic career success is central in contemporary society, Parson further noted that people who obtain highly desirable positions are likely to experience increases in their self regard.....By extension, those with high self esteem will be especially attracted to high status occupations. By combining these perspectives, it is anticipated that there is a positive relationship between self esteem and the prestige of one's job, with self esteem increasing prestige and prestige increasing self esteem in turn. *(Kammeyer-Mueller, J.D.)* [31]

3.23 Team work improves competitiveness

Companies which have reorganised their workforce into teams claim substantial improvements in morale, job satisfaction, productivity and quality. These claims have resulted in interest from other organisations keen to share in the possible benefits. At the same time there is confusion over what exactly is meant by team working and concern on the part of managers, employees and their representatives over the possible drawbacks of embarking on what may be a radical change in work organisation.

To remain competitive organisations need to make optimum use of equipment and people if they are to thrive or even survive. Research carried out by Acas in conjunction with the Tavistock Institute suggests that team work is used by organisations for improvements in four key areas: productivity, quality, the use of new technology, and motivation.

Team work can increase competitiveness by:

- improving productivity
- improving quality and encouraging innovation

- taking advantage of the opportunities provided by technological advances
- Study what is involved in team working by carrying out research and visiting organisations operating in teams
- Be sure senior managers know how team working will contribute to the business strategy and are fully committed to team working
- Adopt a participative style of management in partnership with employees and their representatives
- Improving employee motivation and commitment
- Respond to the fear among managers and the workforce caused by devolving decision making and fewer levels of management
- Plan team work as a continuous process where plans are regularly adjusted as changes are evaluated

(*acas.org.uk*) [32]

3.24 Conclusion

The above are some of the scattered works done in India and abroad which are considered closer to the topic of the present study and investigation. It is felt that the area of study and investigation by this author is more or less in hitherto untravelled path, although distantly related. However, these works have given an insight into some of the aspects and qualities required of a watch keeper in particular and a seafarer in general.

Based on the literature review, the objectives of the study have been fine tuned and are presented as shown in paragraph 1.3.

CHAPTER 4

METHODOLOGY

4.1 Formulation of the problem

Indian marine engineers lack certain qualities in their soft skills as well as in their technical capabilities, adversely affecting their acceptability by the shipping industry. Significant modification will have to be brought about in the curriculum of training of marine engineers and there will be areas of quality standards of mariner engineers, where improvement is necessary based on the changing industry needs. Besides, there will be significant positive relationships between personality traits and career success of a class IV marine engineer.

In order to make recommendation in this regard, an introspection into the present training system of marine engineers in the country with a view to find out the drawbacks of the current system and to propose modifications in the curriculum of training of marine engineers, based on a survey conducted among senior marine engineers has been carried out. A survey has been conducted among the employers of marine engineers to find ways and means to improve upon the quality standards and employability of Indian marine engineers to meet the demands of the shipping industry. The additional requirements of ship owners/ operators regarding the employment and specialization of their marine engineers have been investigated. A survey has been carried out to establish the correlation between personality traits and career success of a class IV marine engineer.

Three surveys are envisaged in this research work. First survey deals with the study of competence of class IV marine engineers from the point of view of senior marine engineers. Second is an investigative study of class IV engineers as seen by the employers of marine engineers and third survey is designed to analyse and scrutinise the correlation between various personality traits of a class IV marine engineer and his career success.

4.2 Survey among senior marine engineers

Introduction

It is generally felt by the shipping industry, particularly by senior marine engineers, that the present day junior level marine engineers lack certain qualities even if they have been trained conforming to the requirements spelt out in STCW '95 Convention as well as M.S. (STCW for Seafarers) Rules 1998. Opinions were aired in various forums by the elders in the field about the desirable qualities of marine engineers classified under social, technical, psychological, communicative skills, leadership etc. over and above the requisite competencies acquired by them during the course of their formal training. Opinions appeared to differ in respect of additional technical inputs required to be imparted to a marine engineer trainee. Maritime training institutes and certification bodies had differing views on the pattern of workshop and sea services required for a trainee before he can appear for the first certificate of competency examination which is Marine Engineer Officer class IV. As per META Manual, the pattern of workshop and sea service for graduate mechanical engineer trainees is different from that of B.Tech. marine engineers. Besides, the need to fill up TAR book (Training and Assessment Record Book) by the trainees was also questioned by some quarters.

Another area where major differences of opinion exist is the preparatory course of trainees prior to appearing for MEO class IV examination.

In order to find out the views of senior marine engineers with regards to the above points, a survey has been undertaken by this author. A questionnaire was designed covering all the above points. Copy of the questionnaire is appended herewith.

4.2.1 Questionnaire for senior marine engineers

CONFIDENTIAL

Questionnaire

Kindly indicate your answer/ comments on the following questions. The answers/ comments may please be given in relation to budding marine engineers below the level of MEO class IV certificate of competency. Your input in this respect is felt to be invaluable for improving the quality of future marine engineers.

1. How many marine engineers below the level of MEO class IV have been working under you at a time while at sea?

2. Please comment on the performance of the marine engineers working under you/ in your company.
   Please tick on the appropriate box.

	Poor/	Satisfactory/	Good/	Very good
a) Social	☐	☐	☐	☐
b) Technical	☐	☐	☐	☐
c) Psychological/ attitude	☐	☐	☐	☐
d) Response to emergency	☐	☐	☐	☐
e) Communication skill – oral	☐	☐	☐	☐
f) Communication skill – written	☐	☐	☐	☐
g) Leadership	☐	☐	☐	☐

3. Do you think the marine engineers working under you/ in your company need additional input of technical knowledge during training?
   If yes, in what subject / skill? Please click the relevant ones from the following list.

   ☐Gas cutting skill
   ☐Pipe welding skill
   ☐Competency in down hand welding
   ☐Competency in overhead welding
   ☐Competency in TIG/MIG welding
   ☐Machine shop skill – turning
   ☐Smithy
   ☐Fitting
   ☐Sheet metal work

- ☐More exposure to overhauling
- ☐Pneumatics
- ☐Hydraulics
- ☐Maneuvering
- ☐Automation
- ☐Control system
- ☐Electrical
- ☐Electronics
- ☐Trouble shooting
- ☐Presentation skills/ personality
- ☐Interpersonal skills
- ☐Management techniques- Time management, personal management, resource management, maintenance management, stress & crisis management
- ☐Computer expertise
- ☐Leadership
- ☐Any other topics

4. Do you think it is desirable to have the following topics included in the syllabus of B.Tech marine engineering course?

   - ☐Design of machinery components
   - ☐Design of marine systems
   - ☐Computer aided design
   - ☐Cargo handling system
   - ☐Commercial shipping
   - ☐Marine Insurance
   - ☐Maritime fraud
   - ☐Vibration
   - ☐Public speaking
   - ☐Humanities
   - ☐Computer programming

5. The present system of marine engineering training for graduate mechanical engineers is by imparting one year of pre sea course in an approved marine workshop followed by 6 months of sea service prior to MEO Class IV examination. Do you suggest any alternative to this? Please click your choice from the following.

   - ☐Pre sea course of one year and 6 months sea service
   - ☐Pre sea course of 6 months and one year sea service
   - ☐Pre sea course of 6months and one year sea service covering minimum two ships
   - ☐Pre sea course of 6 months and 6 months of sea service

☐6 months sea service without pre sea course
☐One year sea service without pre sea course
☐One year sea service covering minimum two ships without pre sea course
☐18 months sea service without pre sea course
☐Any other proposal

6. In your opinion, is the existing system of 6 months sea service for B Tech graduates in marine engineering prior to MEO Class IV, in order? Please click your choice from the following.

☐6 months sea service
☐9 months sea service
☐12 months sea service
☐18 months sea service
☐12 months sea service covering minimum two ships
☐18 months sea service covering minimum three ships
☐Any other

7. Marine engineer trainees fill up Training and Record Book during the period of their training in approved marine workshop as well as during sea service. Should this system be continued?

☐Yes
☐No
☐Any other

8. Do you think the duration of 3 months of preparatory course prior to appearing for MEO Class IV Examination is sufficient? Please click your option from the following.

☐2 months preparatory course
☐3 months preparatory course
☐4 months preparatory course
☐No preparatory course
☐Any other

Name & Signature
Designation/ Rank
Company/ Organisation
Date

4.2.2 Conduct of survey

Respondents to the questionnaire have been chosen from major port cities and other geographically scattered areas in India and a few from abroad. A total of 122 marine engineers participated. It is pertinent to state that all the respondents are senior marine engineers, trained and certified by the certification system prevailing in India (certified by D.G. Shipping, Government of India). These marine engineers are either sailing on board ships or holding senior positions ashore with maritime administration, maritime training institutes, ship operating companies, ship manning agencies, classification societies etc. Following are the parameters contributing to the randomness of samples.

(i) Samples are drawn from all important port cities of the country.

(ii) Method of collection

Samples are collected by different methods.

(a) Collected during meetings, seminars and conferences of different nature. Hence one can never predict the nature or background of a participant. Therefore, it is random sample as selected from a list using random number tables.

(b) Collected addresses of senior marine engineers from different shipping companies and approached them individually to answer the questionnaire.

(c) Collected list of marine engineers from MMD offices and collected data.

(d) Approached chief/ second engineers attending chief engineer's revalidation course.

With regard to the factors of performance of marine engineer under question no.2, senior marine engineers were directed to respond to any one of the four grades ranging from 'poor' to 'very good' based on a ten point scale. 0 to 2 was taken as 'poor', 3-5 'satisfactory', and 6-8 as 'good' and 9-10 as 'very good'. For example, the social performance of the junior engineer is assessed based on his interaction and relationship with his peers, senior engineers, crew members, officers of deck department and supernumeraries on board, each being awarded two points, totaling to 10 points. Similarly, technical performance is assessed

based on five tasks which would have been assigned by the chief engineer to the junior engineer, each task securing two points. From the total points secured, the grading is arrived at from poor to very good.

The views and comments of senior marine engineers thus obtained are tabulated and analysed.

4.2.3 Statistical analysis of data

Question 1: Junior Engineers per ship

This question was put up to the senior marine engineers to find out the number of uncertified junior engineers working in a ship. These junior engineers or assistant watchkeeping engineers are put under the certified watch keepers in an engineering watch to enable them pick up the nuances of a watch keeper.

Out of the 106 number of senior engineers in whose case this question was applicable, 53 had only one junior engineer working under them, 27 had two, 22 had three and 4 had four junior engineers.

Table 4.1 Number of junior engineers per ship

Number of Junior Engineers	Number of responses	Percentage of responses
1	53	50.0
2	27	25.5
3	22	20.8
4	4	3.7
Total	**106**	**100.0**

Question 2 : Performance of a marine engineer according to senior engineers

Various attributes are rated 1 to 4 corresponding to 'Poor', 'Satisfactory', 'Good' and 'Very good' for each of the points. Please see Fig 4.1. It is seen that the graph hovers in between 2 and 3 indicating that the performance although satisfactory, is not 'good' enough. Special attention and thrust have to be given during training on

aspects such as leadership and attitude, both of which are ranked the lowest; closely followed by response to emergency and communicative skill- written. Excepting the social quality, it is to be noted that the score for other factors are all below the average value of 2.5 and therefore to be attended to.

Table 4.2 Performance of a marine engineer according to senior engineers

Factors	Response to Ratings				Total Responses	Total Score	Weighted Average Score
	Poor $x_1=1$	Satisfactory $x_2=2$	Good $x_3=3$	Very Good $x_4=4$			
Social	9	43	58	8	118	301	2.55
Technical	4	56	57	1	118	291	2.47
Psychological / Attitude	15	54	45	2	116	266	2.29
Response to Emergency	17	47	50	4	118	277	2.35
Communication Skill – Oral	15	45	56	2	118	281	2.38
Communication Skill – written	15	50	50	3	118	277	2.35
Leadership	21	66	28	2	117	245	2.09

Let x_1 to x_4 be the score corresponding to 'poor' to 'very good' respectively. Let w_1 to w_4 be the respondents corresponding to the above grades.

Then, the average score = $\sum w_i x_i / \sum w_i$ ...(4.1) [33]

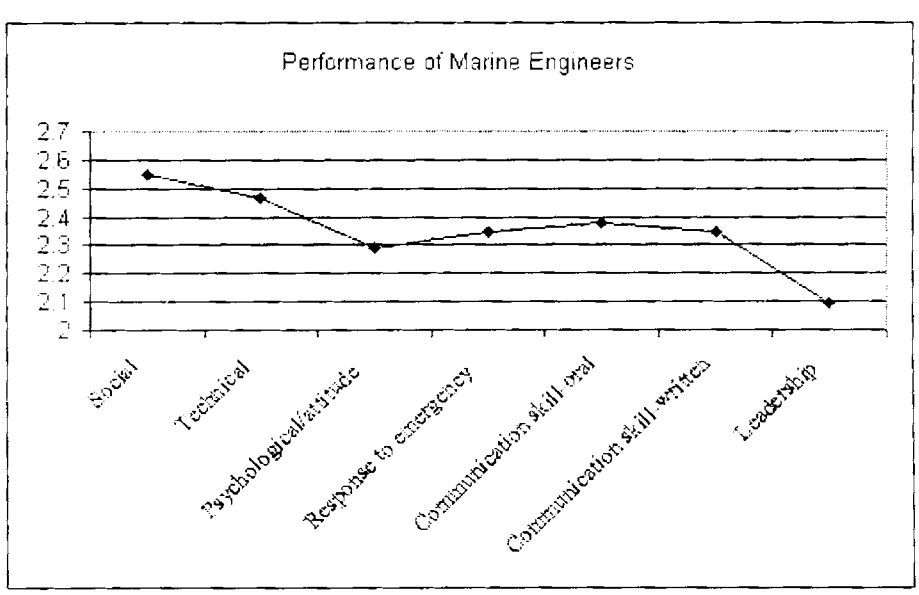

Fig. 4.1 Performance of a marine engineer as per senior engineers

Question 3: Technical skills of a marine engineer

This question is to seek the feeling of industry about the desirability of the additional technical skills for the junior marine engineers. 19 topics were given to choose from. From the 121 responses, it is seen from Table 4.3 and Fig 4.2 that more than 70% of respondents want the following skills to be given emphasis during the training:

(i) More exposure to overhauling
(ii) Pneumatics
(iii) Hydraulics
(iv) Electrical work

These are therefore to be given extra time during training of marine engineers.

Moderate response, between 50 and 70 percentage are in support of the following topics. These topics also are to be given its due share of time during the training.

(i) gas cutting skill
(ii) pipe welding skill
(iii) turning
(iv) fitting
(v) automation
(vi) control system
(vii) electronics
(viii) trouble shooting
(ix) management techniques

Table 4.3 Technical skills of a marine engineer

	No. of Responses	Percentage of Total Responses	Individual Percentage
Gas Cutting Skill	70	5.0%	57.9%
Pipe Welding Skill	78	5.6%	64.5%
Competency in down hand welding	57	4.1%	47.1%
Competency in overhead welding	39	2.8%	32.2%

Competency in TIG / MIG welding	22	1.6%	18.2%
Machine shop skill – turning	72	5.2%	59.5%
Smithy	13	0.9%	10.7%
Fitting	61	4.4%	50.4%
Sheet metal work	19	1.4%	15.7%
More exposure to overhauling	89	6.4%	73.6%
Pneumatics	87	6.3%	71.9%
Hydraulics	90	6.5%	74.4%
Manoeuvering	48	3.4%	39.7%
Automation	72	5.2%	59.5%
Control System	71	5.1%	58.7%
Electrical	89	6.4%	73.6%
Electronics	71	5.1%	58.7%
Trouble Shooting	69	5.0%	57.0%
Presentation Skills / personality	49	3.5%	40.5%
Interpersonal skills	48	3.4%	39.7%
Management techniques	65	4.7%	53.7%
Computer Expertise	54	3.9%	44.6%
Leadership	49	3.5%	40.5%
Any other topics	10	0.7%	8.3%
Total	**1392**	**100.0%**	**1,150.4%**

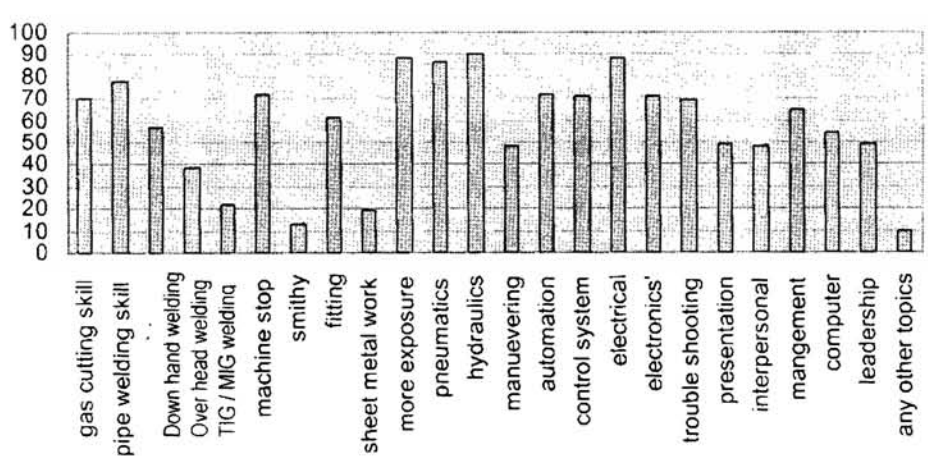

Fig. 4.2 Technical skills of a marine engineer

Question 4: Syllabus of marine engineering course

This multiple choice questionnaire has been made to find out as to how to improve upon the existing syllabus of B.Tech marine engineering course. Please see Table 4.4 and Fig 4.3 Out of the 119 senior marine engineers, who responded to these questions, more than 60% favour the inclusion of the topic of 'Cargo handling system' in the curriculum. More than 50% of the respondents are of the opinion that weightage may be given to the following topics too:

Design of marine systems

Commercial shipping

Marine insurance

Vibration

Public speaking

Therefore, it is felt that these topics have to be given weightage in the curriculum of B.Tech marine engineering.

It may be pertinent here to note that the requirement of dexterity in public speaking was expressed by the respondents under question No 2 as 'communication skill'.

Table 4.4 Syllabus of course

	Responses		Individual Percentage
	Number	Percentage of Total Responses	
Design of Machinery Components	46	7.2%	38.7%
Design of Marine Systems	63	9.9%	52.9%
Computer Aided Design	37	5.8%	31.1%
Cargo Handling System	82	12.9%	68.9%
Commercial Shipping	69	10.9%	58.0%
Marine Insurance	61	9.6%	51.3%
Maritime Fraud	37	5.8%	31.1%
Vibration	67	10.6%	56.3%
Public Speaking	66	10.4%	55.5%
Humanities	50	7.9%	42.0%
Computer Programming	57	9.0%	47.9%
Total	**635**	**100.0%**	**533.6%**

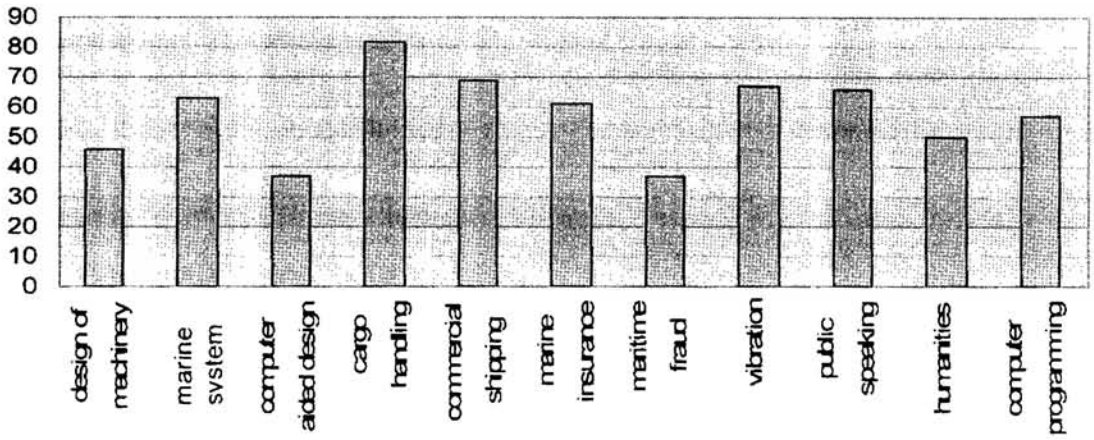

Fig. 4.3 Syllabus of course

Question 5: Pre sea and on board training

This question is specifically pertaining to the pre sea as well as on board training given to the graduate mechanical engineers (GME) before they appear for MEO class IV examination. The present system is by giving one year workshop training in an approved marine workshop such as Cochin Shipyard Ltd or Mazagon Docks followed by 6 months of sea service.

It is seen from table 4.5 and Fig 4.4 that the respondents have given their choice for any one of the 8 proposals of training. As much as 41% of the respondents have favoured 'Pre sea course of 6 months and one year sea service covering minimum two ships'. The next closest is favoured by 16% and interestingly for the same pattern, but with only a small difference that the number of ships during the sea service is not stipulated. This choice reads thus: 'Pre sea course of 6 months and one year sea service'. It is strongly felt that the above two choices being almost of the same pattern, is the clear and obvious selection by the learned and experienced marine engineers and therefore should be adopted. This amounts to a major deviation from the existing practice of orientation training of graduate mechanical engineers.

Table 4.5 Pre sea and on board training

Factors	Frequency	Percentage
Pre sea course of one year and 6 months sea service	13	11%
Pre sea course of 6 months and one year sea service	19	16%
Pre sea course of 6 months & 1 year sea service covering minimum 2 ships	50	41%
Pre sea course of 6 months and 6 months sea service	10	8%
6 months sea service without pre sea course	01	1%
1 year sea service covering minimum 2 ships without pre sea course	04	3%
18 months sea service without pre sea course	02	1%
Any other proposal	18	15%
Total	117	96%
Not responded	05	4%
Total	**122**	**100%**

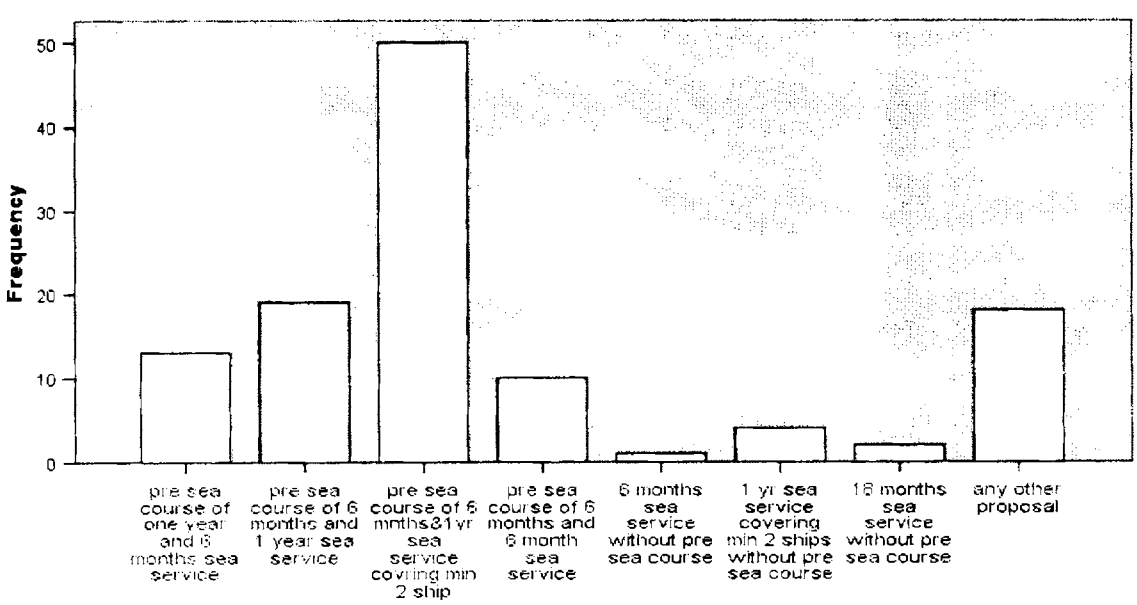

Fig. 4.4 Pre sea and on board training

Question 6: Sea service for graduate marine engineers

This pertains to sea service requirement of B.Tech. graduates in marine engineering. 31% of the participants opined that the present system of 6 months sea service for the B.Tech. marine engineering graduates can be continued whereas 29% felt that the sea service should be extended to 12 months. Please refer Table 4.6 and Fig 4.5

Table 4.6 Sea service for graduate marine engineers

	Frequency	Percentage
6 months sea service	38	31%
9 months sea service	16	13%
12 months sea service	35	29%
18 months sea service	2	2%
12 months sea service covering minimum 2 ships	24	20%
18 months sea service covering minimum 3 ships	3	2%
Any other	4	3%
Total	**122**	**100%**

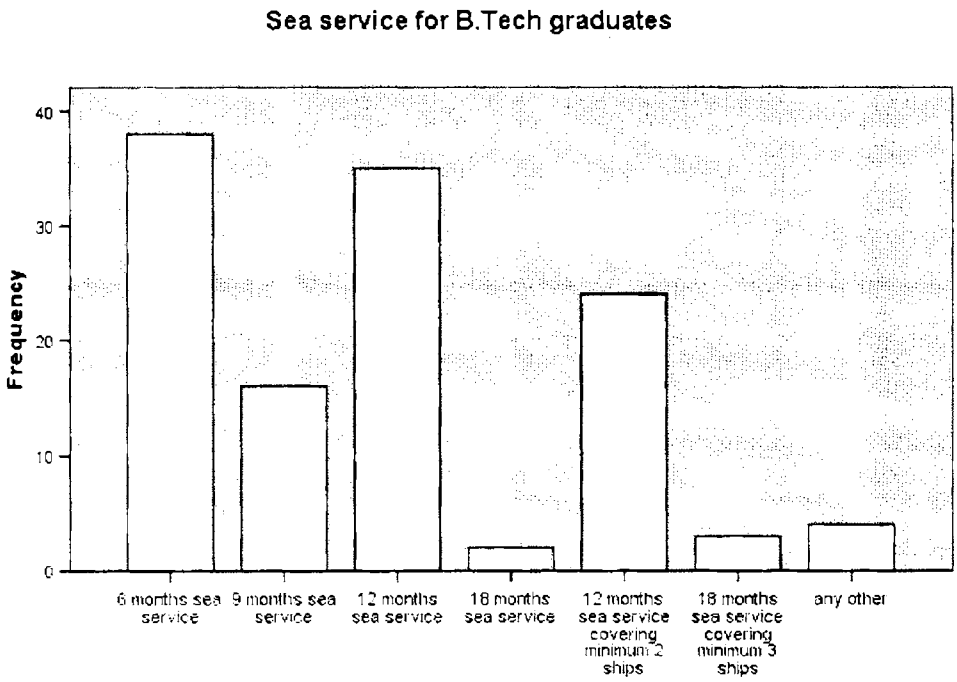

Fig. 4.5 Sea service for graduate marine engineers

Question 7: TAR book as per senior marine engineers

Marine engineering trainees keep a 'Training and Record Book' with them during their training as an official record of the training activities they undergo from time to time. With reference to Table 4.7 and Fig 4.6, 74% of the senior marine engineers feel that this practice should be continued, despite the fact that it may increase the work load of senior engineers on board. However, 20% of respondents say that TAR books are not necessary, given a choice.

Table 4.7 TAR book as per senior marine engineers

	Frequency	Percentage
Yes	90	74%
No	25	20%
Any Other	7	6%
Total	**122**	**100%**

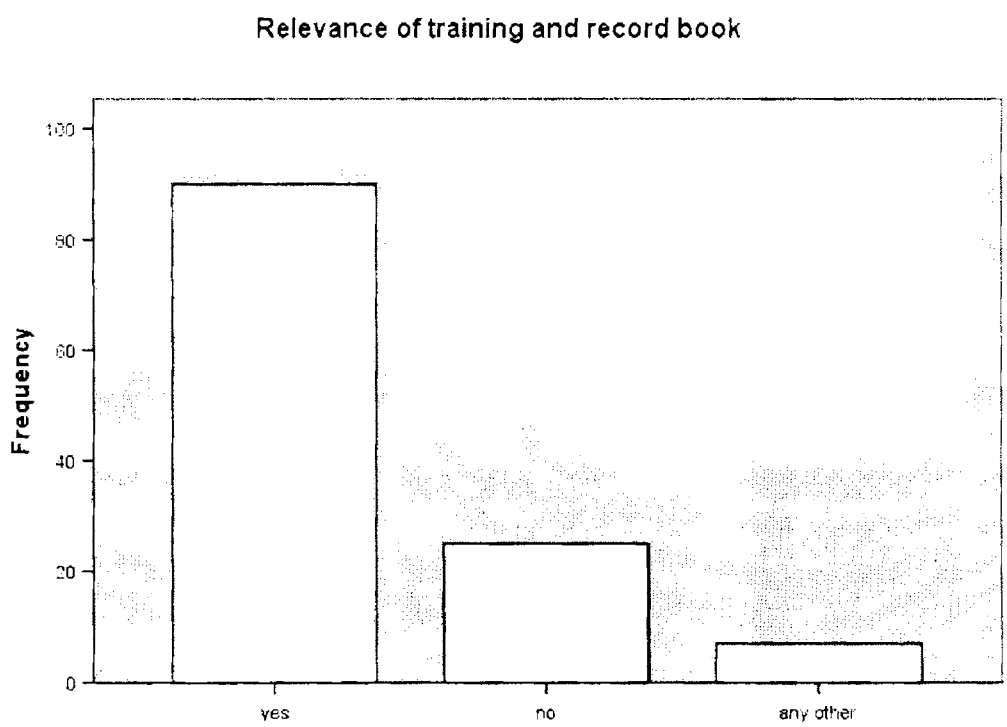

Fig. 4.6 TAR book as per senior marine engineers

Question 8: Preparatory Course

This question is about the 3 months Preparatory course, a trainee has to currently undergo upon completion of requisite workshop and sea service and before appearing for the MEO class IV Part B examination. Please see Table 4.8 and Fig 4.7. 62% of the respondents feel that the 3 months preparatory course shall be allowed to continue. The next lower group is only 15%, recommending 2 months of preparatory course. This group being way behind the earlier opinion, can safely be ignored. Therefore, duration of Preparatory course may continue to be for 3 months.

Table 4.8 Duration of preparatory course

	Frequency	Percentage
2 months preparatory course	18	15%
3 months preparatory course	75	62%
4 months preparatory course	16	13%
No preparatory course	8	7%
Any other	3	3%
Total	120	98%
Not Responded	2	2%
Total	**122**	**100%**

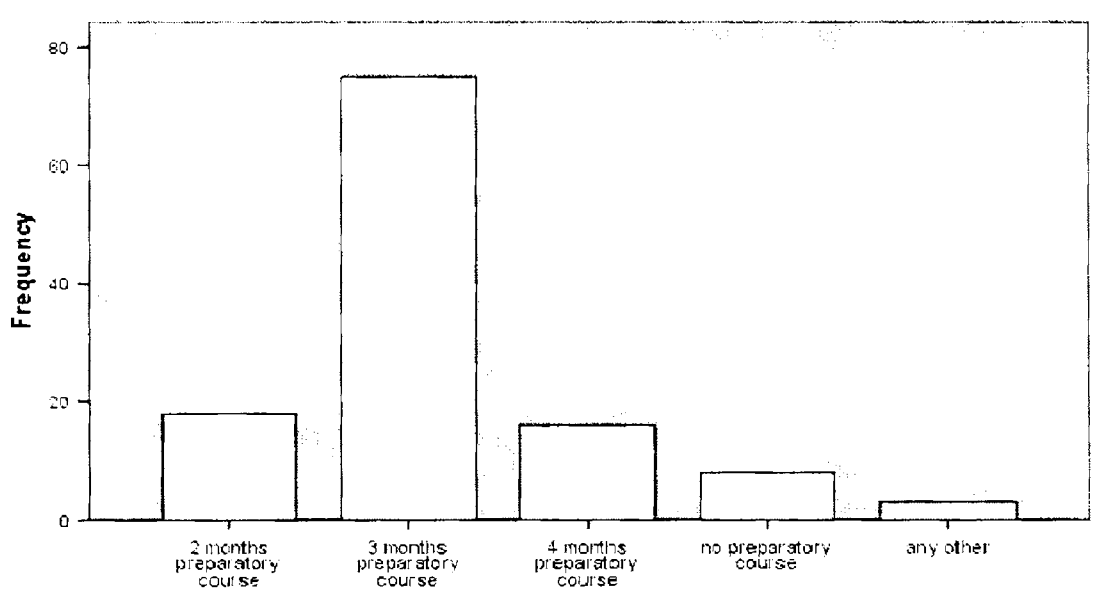

Fig. 4.7 Duration of preparatory course

4.3 Survey among employers of marine engineers

Introduction

Life of a marine engineer at sea is physically very strenuous and at the same time intellectually taxing. Therefore, the performance of a marine engineer is assessed based on several factors such as age, technical knowledge, aptitude, attitude, response to emergency, communication skill, leadership qualities, safety consciousness, duration of engagement, specialized training, motivation etc. The opinion of the employer with regard to the employability of marine engineers is felt important to shape up the pre sea and on board training of marine engineers.

The following questionnaire has been designed to collect the opinion of the HRD managers of various shipping companies and major ship operators of the world. The purpose is to find out the desirable profile of a practicing marine engineer in the eyes of an employer.

4.3.1 Questionnaire for employers

Kindly indicate your answer/ comments on the following questions. The answers/ comments may please be given in relation to the marine engineers working in your organization. Your input in this respect is felt to be invaluable for improving the quality of future marine engineers.

1. Your name and designation
2. Name of the company
3. Number of ships with the company [ ]
4. Average number of marine engineers per ship [ ]
5. Please indicate the desirable age brackets of junior engineers in your opinion

   ☐ 18-21 ☐ 22-25 ☐ 26-29 ☐ 30 and above

6. Please indicate the desirable age bracket of chief engineer in your opinion

   ☐ 25-34 ☐ 35-44 ☐ 45-54 ☐ 55 and above

7. Indicate your preference of gender of engineers

☐ Male ☐ Female ☐ Mixed crowd

8. Please comment on the performance of the marine engineers working in your company.

	Very poor	Poor	Satisfactory	Good	Very good
a) Physical	☐	☐	☐	☐	☐
b) Technical	☐	☐	☐	☐	☐
c) Psychological/ attitude	☐	☐	☐	☐	☐
d) Social	☐	☐	☐	☐	☐
e) Response to emergency	☐	☐	☐	☐	☐
f) Communication skill – oral	☐	☐	☐	☐	☐
g) Communication skill – written	☐	☐	☐	☐	☐
h) Leadership	☐	☐	☐	☐	☐

9. Marine engineer trainees fill up Training and Assessment Record Book during the period of their training in approved marine workshop as well as during sea service. Should this system be continued?

☐ Yes
☐ No

10. Please indicate the order of your priority out of the following desirable qualities of a marine engineer
(1, 2.....7)

☐ Loyalty
☐ Adherence to policy
☐ Technical skill
☐ Safety consciousness
☐ Team spirit
☐ Discipline
☐ Hard work

11. Do you prefer marine engineers to be employed

☐ on contract up to 6 months
☐ on continuous contract basis
☐ on permanent basis

12. Do you require marine engineers to specialize in any type/class of vessels

☐ Yes
☐ No

13. Do you groom your engineers to take up future assignments ashore

☐ Yes
☐ No

Signature & Date

4.3.2 Conduct of survey

All the prominent shipping companies of the world who have their offices in India and recruit marine engineers from here were approached for their response to the questionnaire. Almost all of them responded. This comprises of a total of 52 HRD Managers/superintendents. This is an exhaustive survey, practically census as the 52 HRD managers/employers of marine engineers in the country constitute almost all the shipping companies/ ship managers operating in India. Their responses are analysed and recorded as hereunder.

4.3.3 Statistical analysis of data

Question No 1, 2, 3 & 4: Shipping Companies

Table 4.9 Name of company and number of ships

Name of the Company	No. of Ships	No. of Engineers/ Ship	No. of respondents/ Company	Percentage of response
ABS Marine Services	8	3	1	1.9
Advani Hotels & Resorts (India) Ltd	1	2	1	1.9
American President Lines (APL), Singapore	115	7	1	1.9
Barber Ship Management, Cochin	160	5	1	1.9
Cochin Port Trust	6	1	1	1.9
Expedo Marine Services India (P) Ltd.	6	4	1	1.9
Executive Ship Management Cochin	62	5	1	1.9
Fleet Management Ltd, Hong Kong	181	5	1	1.9
Kinship Services India Ltd	3	4	1	1.9
Kinship Services Pvt Ltd	3	5	1	1.9
Lakshadweep Development Corporation Ltd.	17	3	3	5.6
Lots International Dubai	13	3	1	1.9
Lots Shipping Limited	13	3	1	1.9
Marine Management Services PVT Ltd.	17	4	1	1.9
Marmugoa Port Trust	4 tugs	2	1	1.9
MSC Shipping Co. (India) Ptd. Ltd., Cochin	145	5	1	1.9
Orion Agencies Limited,Gujarat	3	2	1	1.9
OMCI	48	5	1	1.9
Sealift Inc. New York	11	4	1	1.9

V Ships	950	5	1	1.9
The Shipping Corporation of India Ltd	117	5	20	38.0
Selandia Marine Services	135	5	2	3.6
Trans Asian Shipping Services (P) Ltd.	2	5	2	3.6
Tradex India	4	5	1	1.9
United Ocean Ship Management Pte. Ltd.	23	4	1	1.9
Univan Ship Management Ltd	45	4	1	1.9
Varun Shipping Co. Ltd.	20	4	2	3.6
Wallem Ship Management	305	5	1	1.9
Total			**52**	**100.0**

Question No. 5: Age bracket of junior engineer

This question is to arrive at the desirable age of a junior engineer in the views of an employer.

Table 4.10 Age bracket of junior engineer

Age	Frequency	Percent
18 - 21	3	6
22 - 25	43	84
26 - 29	4	8
Total	50	98
Missing	1	2
Total	**51**	**100**

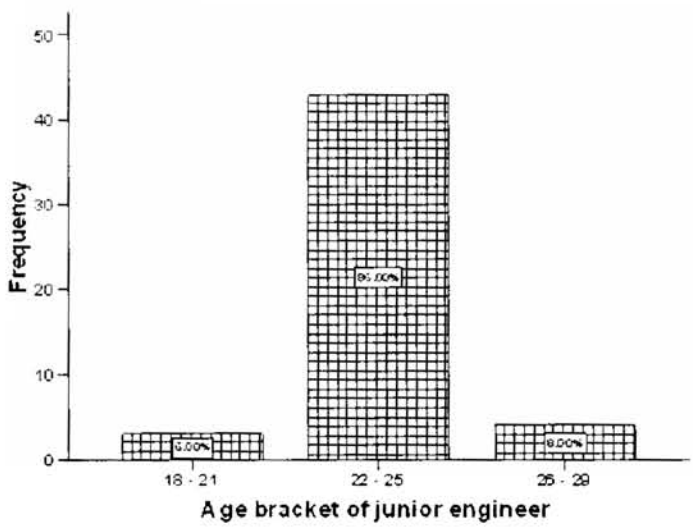

Fig. 4.8 Age bracket of junior engineer vs. frequency

The desirable age bracket of a junior engineer is given in the above frequency table. 6% of the respondents say that the desirable age of a junior engineer is between 18 to

21 years, a majority of 84% respondents opt for age bracket of 22 to 25 years and 8% respondents prefer age of a junior engineer to be between 26 and 29 years.

Question No. 6: Age bracket of chief engineer

This question is intended to arrive at the desirable age bracket of a chief engineer according to the employer. Please see Table 4.11 as well as Fig 4.9 below.

Table 4.11 Age bracket of chief engineer

Age	Frequency	Percent
25 - 34	3	6
35 - 44	40	78
45 - 54	8	16
Total	**51**	**100**

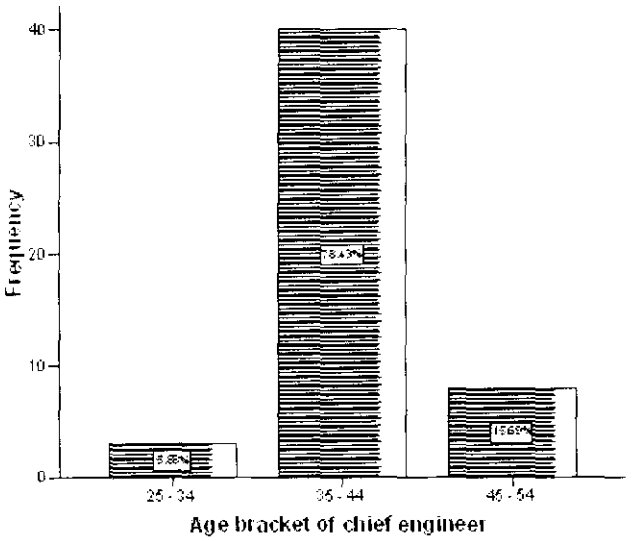

Fig. 4.9 Age bracket of chief engineer vs. frequency

The desirable age bracket of a chief engineer is given in the above frequency table. 6% of the respondents feel that the desirable age of a chief engineer is between 25 and 34 years, 78% of the respondents prefer age between 35 and 44 and 16% of respondents require age of a chief engineer to be around 45 to 54 years.

Question No. 7: Preference of gender of engineer

This question is put up to the employer to find out whether they prefer male or female engineers to work on board their ships. Their opinion is tabulated in Table 4.12 and shown graphically in Fig 4.10.

Table 4.12 Preference of gender of marine engineer

Gender	Frequency	Percent
Male	41	80
Mixed crowd	10	20
Total	**51**	**100**

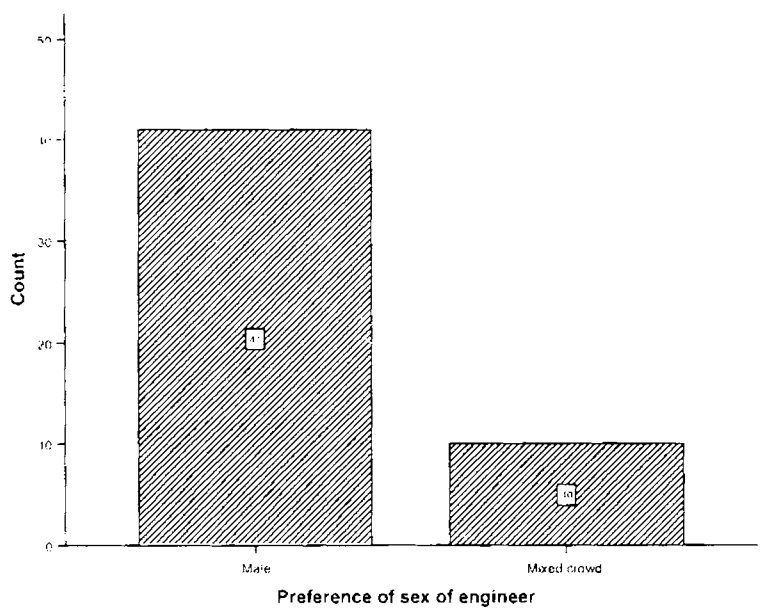

Fig. 4.10 Preference of gender of marine engineer

Question No. 8: Quality of a marine engineer

The quality or the lack of it of a marine engineer, working on board ships as observed by the employers are graphically depicted along with some comments in the following few pages. Each respondent representing the employer was given an option

to grade the engineer in respect of the particular quality ranging from very poor to very good in five steps. The respondents were advised to make their decisions based on a ten point scale. Points 0 to 2 was taken as 'very poor', 3 to 4 as 'poor', 5 to 6 as 'satisfactory', 7 to 8 as 'good' and 9 to 10 as 'very good'. For example, the physical performance is assessed based on his general health condition, personal endurance in working, absence of fatigue, ability to handle heavy machine parts, absence of working days lost on medical ground, each carrying two points totaling ten points.

Following aspects are considered:

(a) Physical

Table 4.13 and Fig 4.11 below give indication about the physical performance of engineers. 33% of the respondents say that the physical performance of their engineers is satisfactory, 57% say that the performance is good, 8% feel that the physical performance is very good.

Table 4.13 Physical performance of a marine engineer

Grade	Frequency	Percent
Satisfactory	17	33
Good	29	57
Very good	4	8
Total	50	98
Missing	1	2
Total	**51**	**100**

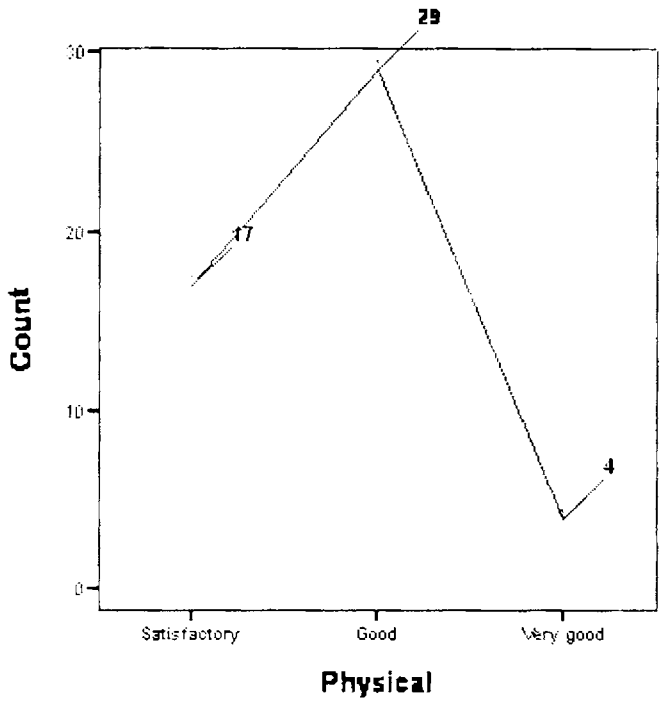

Fig. 4.11 Physical performance of a marine engineer

(b) Technical

The table below gives some indication about the technical skill of marine engineers. 8% of the ship owners feel that their engineers are technically poor, 37% think that the technical performance is satisfactory, 35% say that the performance is good and 18% admit that the technical performance of their engineers is very good as seen in Table 4.14 and Fig 4.12

The survey shows that there is room for further improvement in the technical input of the trainee marine engineer. This fact has also been partially evidenced in section 4.2.3 under question no. 3.

Table 4.14 Technical skill of a marine engineer

Grade	Frequency	Percent
Poor	4	8
Satisfactory	19	38
Good	18	35
Very good	9	18
Total	50	98
Missing	1	2
Total	**51**	**100**

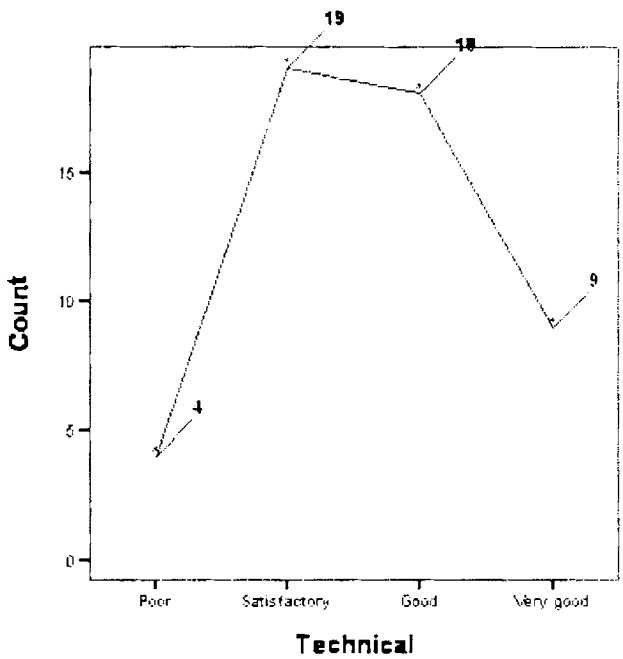

Fig. 4.12 Technical skill of a marine engineer

(c) Psychological / attitude

Table 4.15 and Fig 4.13 below give indication about the Psychological/attitude of marine engineers. 8% of the respondents indicate that the attitude of marine engineers are poor, 47% say that the attitude is satisfactory, 35% feel that the engineers are good in there attitude and 8% say that attitude wise, the marine engineers are very good.

This survey result brings out a fact that attitude building of marine engineers requires

more emphasis during their training period. It is generally believed by the manning companies in shipping that it is the attitude and not the aptitude that decides the altitude of a marine engineer.

Table 4.15 Attitude of a marine engineer

Grade	Frequency	Percent
Poor	4	8
Satisfactory	24	47
Good	18	35.
Very good	4	8
Total	50	98
Missing	1	2
Total	**51**	**100**

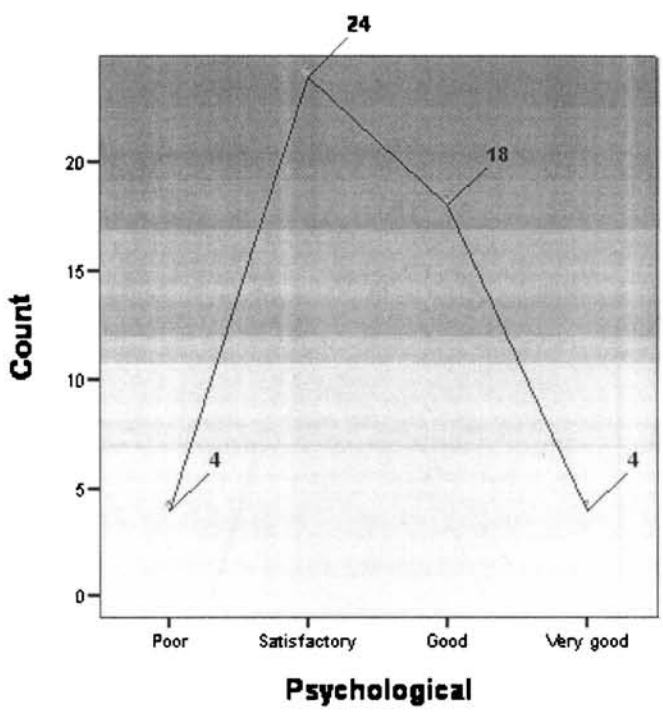

Fig. 4.13 Attitude of a marine engineer

(d) Social

The table as well as the graph below gives indication about the performance of the marine engineers socially. 8% of the employers feel that the marine engineer's performance is poor, 49% of respondents say their performance is just satisfactory,

33% indicate that the performance is good and only 6% say that the performance is very good.

This result leaves much to be desired in improvement of the social performance of Indian marine engineers. Therefore this need is also to be taken into account during the training of marine engineers. However it is noteworthy to state at this juncture that the engineers themselves feel that their social performance is in order as evidenced by the question 2 of section 4.2.3.

Table 4.16 Social behaviour of a marine engineer

Grade	Frequency	Percent
Poor	4	8
Satisfactory	25	49
Good	17	33
Very good	3	6
Total	49	96
Missing	2	4
Total	**51**	**100**

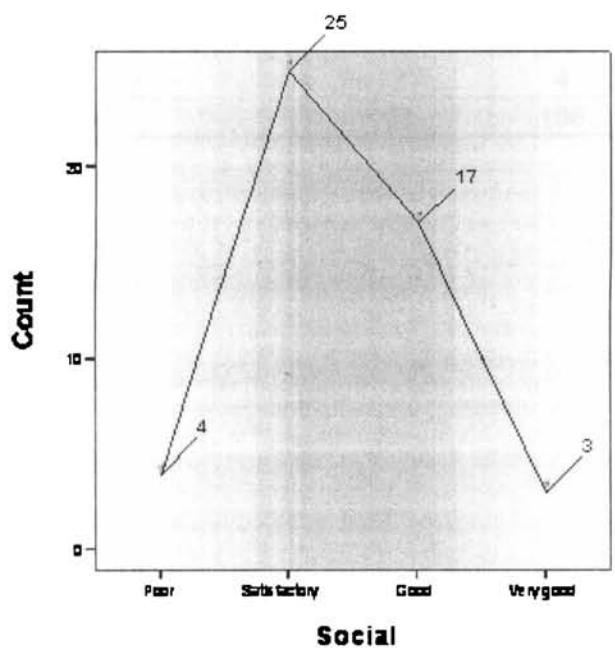

Fig. 4.14 Social behaviour of a marine engineer

(e) Response to emergency

Following table and graph give indication about how well the Indian marine engineers respond to emergency. 6% of the respondents state that the engineers perform poorly to emergency, 35% say performance is satisfactory, 43% are of the opinion that performance is good and 12% of the employers feel that the performance is very good.

Since more than half the employers are of the opinion that our engineers are either good or very good category, the training system is not necessarily be changed on this count.

Table 4.17 Emergency response

Grade	Frequency	Percent
Poor	3	6
Satisfactory	18	35
Good	22	43
Very good	6	12
Total	49	96
Missing	2	4
Total	**51**	**100**

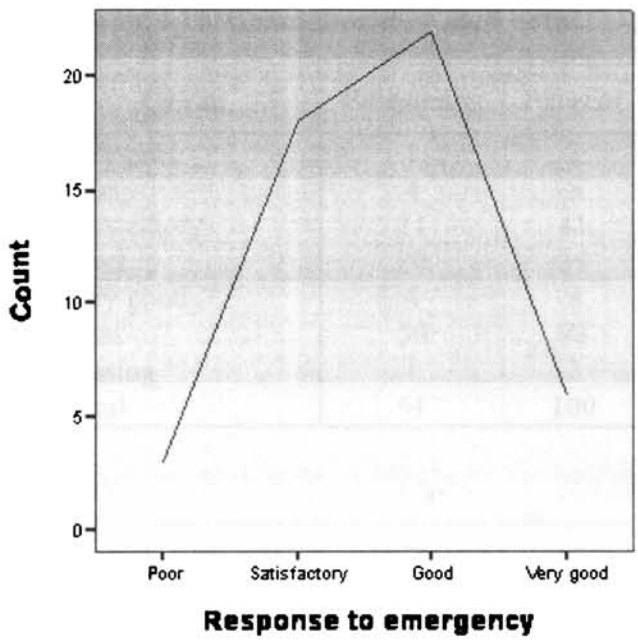

Fig. 4.15 Emergency response

(f) Communication skill – oral

Table 4.18 and Fig 4.16 below give indication about oral communication skill of marine engineers. 2% of the employers state that the oral communication skill of our marine engineers is very poor, 8% say engineers communication skill – oral is poor, 41% feel communication skill is satisfactory, 39% indicate communication skill - oral is good and 8% are of the opinion that the oral communication skill of our engineers is very good .

It is noted that only a total of 47% of the respondents are of the opinion that our engineers are in the category of good or very good, it is felt that something will have to be done to improve the oral communication skill of our marine engineers. This requirement has already been substantiated by the response of engineers themselves as shown in section 4.2.3, question no. 2.

Table 4.18 Communication skill - oral

Grade	Frequency	Percent
Very poor	1	2
Poor	4	8
Satisfactory	21	41
Good	20	39
Very good	4	8
Total	50	98
Missing	1	2
Total	**51**	**100**

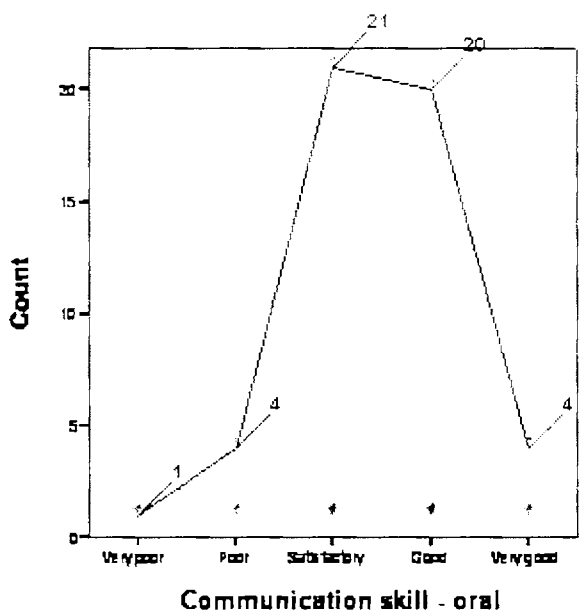

Fig. 4.16 Communication skill – oral

(g) Communication skill – Written

The table and graph shown below give indications about the communication skill (written) of engineers. 16% of the employers say that our marine engineers are poor in written communication. 39% feel that the communication (written) of our engineers is satisfactory, 33% say engineer's communication (written) is good and 8% say engineer's communication (written) is very good.

As only around 41% of the employers consider our marine engineers to be in the top bracket of written communicative skill, it is felt that this is another area where attention is to be paid to improve this skill amongst our engineers. This point has already been corroborated in the study conducted among marine engineers themselves.

Table 4.19 Communication skill - written

Grade	Frequency	Percent
Poor	8	16
Satisfactory	20	39
Good	17	33
Very good	4	8
Total	49	96
Missing	2	4
Total	**51**	**100**

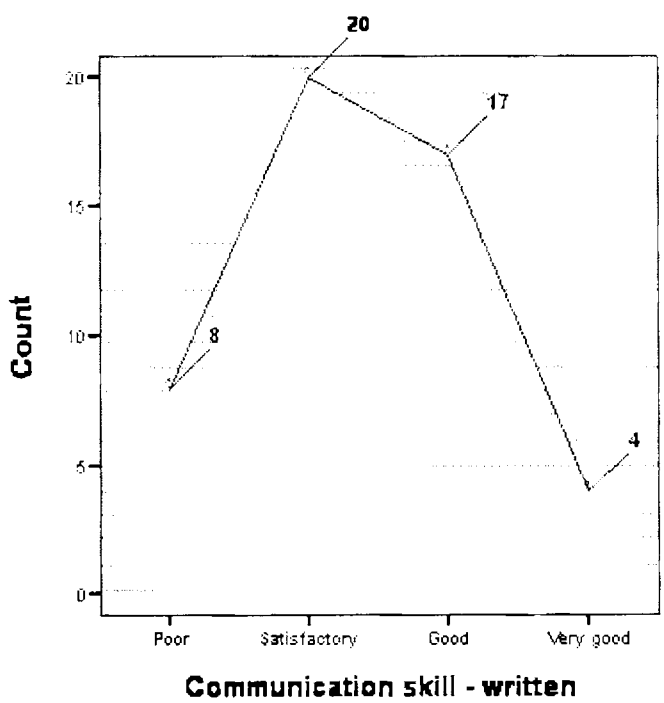

Fig. 4.17 Communication skill - written

(h) Leadership

Following is the finding of the author as a result of the survey of the employers with

regard to the leadership qualities of our marine engineers. 12% of the employers feel that the leadership quality of engineers is poor, 45% say leadership quality of engineers is satisfactory, 33% say leadership quality of engineers is good and 8% opine it is very good. Please refer Table 4.20 and Fig 4.18 in this respect.

Here again, the position of the leadership quality of marine engineers, in general is felt to be not up to the mark. Similar finding was revealed in the study conducted among the marine engineers also. Therefore it is concluded that emphasis is to be given on the aspect of leadership training during the marine engineering training.

Table 4.20 Leadership

Grade	Frequency	Percent
Poor	6	12
Satisfactory	23	45
Good	17	33
Very good	4	8
Total	50	98
Missing	1	2
Total	**51**	**100**

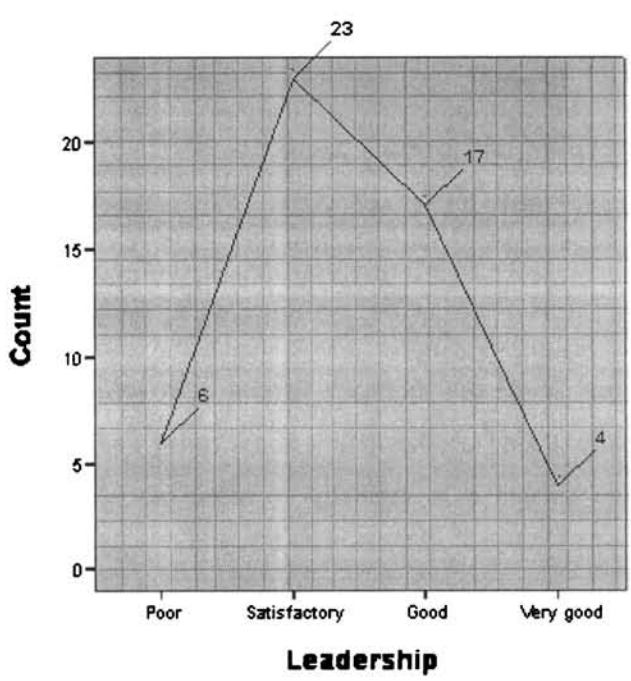

Fig. 4.18 Leadership

Question No. 9: Need for filling Training and Assessment Record book

Presently, marine engineer trainees need to fill up Training and Assessment Record book during their pre sea and on board training. This record book is subsequently countersigned by the training in charge or employer for authenticity before submission to the authorities in order to prove the eligibility for appearing for the relevant examination.

A question was put to the employers of marine engineers about veracity and need of doing this time consuming and laborious exercise by the trainees. Please see Table 4.21. 94% of the respondents i.e., 48 out of 51 employers feel that the marine engineer trainees should fill up Training and Assessment Record book during their training period. The balance 3 persons did not respond.

Therefore the practice of filling up and maintaining Training and Assessment Record book may be continued in future for all marine engineering trainees.

Table 4.21 TAR book according to employers

Response	Frequency	Percent
Favouring	48	94
Missing	3	6
Total	**51**	**100**

Question No. 10: Priority of qualities

Seven important qualities of a marine engineer are listed and the employers were requested to indicate their priorities in this question. This exercise is intended to give additional thrust for certain areas of qualities of a marine engineer over those of others during their training.

Following tables give an analysis of opinion about the relative desirable qualities of the marine engineers:

(a) Loyalty

Loyalty of an employee towards the employer is a desirable quality of a marine engineer. In the present scenario, changing the shipping companies by the marine officers have become quite common, particularly when a contract is signed by the employee each time he joins a ship.

Table 4.22 Loyalty

Ranking	Frequency	Percent
1	6	12
2	1	2
3	3	6
4	4	8
5	7	14
6	10	19
7	20	39
Total	**51**	**100**

Table 4.22 gives a profile of loyalty for class IV marine engineers. 12% rate loyalty as rank 1, 2% rate loyalty as rank 2, 6% rate loyalty as rank 3, 8% rate loyalty as rank 4, 14% rate loyalty as rank 5, 19% rate loyalty as rank 6 & 39% rate loyalty as rank 7. Since 39% of the respondent rate loyalty as rank 7, loyalty cannot be considered as important desirable quality.

(b) Adherence to policy

An ideal employee should uphold and endeavour to adhere to the policies of the shipping company for whom he works. Besides, as a senior engineer, he has the responsibility to implement the policies of the company in his ship. This assumes further importance in the light of ISM Code implementation on board vessel and maintenance of valid Safety Management Certificate.

Table 4.23 Adherence to policy

Ranking	Frequency	Percent
1	2	4
3	4	8
4	2	4
5	7	14
6	24	47
7	12	23
Total	**51**	**100**

Please refer Table 4.23. 4% rate adherence of policy as rank 1, 8% rate adherence of policy as rank 3, 4% rate adherence of policy as rank 4, 14% rate adherence of policy as rank 5, 47% rate adherence of policy as rank 6 and 23% rate adherence of policy as rank 7. Since 47% and 23% of the respondent rate adherence of policy as rank 6 & rank 7 adherence of policy cannot be considered as important desirable quality.

(c) Technical skill

Technical skill is an essential requirement of a successful marine engineer. The competence of a marine engineer is assessed and evaluated in order to issue him the relevant certificate of competence at the appropriate level.

Table 4.24 Technical skill

Ranking	Frequency	Percent
1	19	37
2	11	21
3	8	16
4	5	10
5	4	8
6	4	8
Total	**51**	**100**

As per Table 4.24, 37% rate technical skill as rank 1, 21% rate technical skill as rank 2, 16% rate technical skill as rank 3, 10% rate technical skill as rank 4, 8% rate technical skill as rank 5 and 8% rate technical skill as rank 6. Since 37% and 21% of

the respondents rate technical skill as rank 1 and rank 2, technical skill can be considered as an important desirable quality.

(d) Safety consciousness

Safety consciousness is another important attribute of a marine engineer. Therefore a marine engineer is given training to look after safety of life at sea, safety of ship and safety of cargo on board, strictly in that order. This will also fulfill one of the two major objectives of International Maritime Organisation viz., 'Safe shipping and clean seas'.

Table 4.25 Safety Consciousness

Ranking	Frequency	Percent
1	14	27
2	18	35
3	5	10
4	8	16
5	3	6
6	1	2
7	2	4
Total	**51**	**100**

Table 4.25 shows that 27% rate safety consciousness as rank 1, 35% rate safety consciousness as rank 2, 10% rate safety consciousness as rank 3, 16% rate safety consciousness as rank 4, 6% rate safety consciousness as rank 5, 2% rate safety consciousness as rank 6 and 4% rate safety consciousness as rank 7. Since 27% and 35% of the respondent rate safety consciousness as rank 1 and rank 2 respectively, safety consciousness can be considered as an important desirable quality.

(e) Team spirit

Team work is of utmost importance on board ships for smooth operation. This principle is also enshrined in the ISM Code and its implementation on board.

Table 4.26 Team spirit

Ranking	Frequency	Percent
1	4	8
2	6	12
3	10	19
4	6	12
5	11	21
6	7	14
7	7	14
Total	**51**	**100**

Please refer Table 4.26. 8% rate team spirit as rank 1, 12% rate team spirit as rank 2, 19% rate team spirit as rank 3, 12% rate team spirit as rank 4, 21% rate team spirit as rank 5, 14% rate team spirit rank 6 and 14% rate team spirit as rank 7. Since rating for team spirit is rather equally distributed, it can be considered as a desirable quality.

(f) Discipline

Only a disciplined team of engineers can maintain and operate a ship satisfactorily. This quality of a marine engineer is ingrained in him mostly during the pre sea training.

Table 4.27 Discipline

Ranking	Frequency	Percent
1	3	6
2	7	13
3	9	18
4	17	33
5	9	18
6	2	4
7	4	8
Total	**51**	**100**

As per Table 4.27, 6% respondents rate discipline as rank 1, 136% rate discipline as rank 2, 18% rate discipline as rank 3, 33% rate discipline as rank 4, 18% rate discipline as rank 5, 4% rate discipline as rank 6 and 8% rate discipline as rank 7.

Since rating for discipline is rather equally distributed, it is also to be considered as a desirable quality.

(g) Hard work

Despite automation and sophistication on board vessels, hard work of engineers to keep the ship going is a truth; particularly so in tiding over an emergency on board, such as fire, flooding, grounding, collisions, oil spillage or man overboard.

Table 4.28 Hard work

Ranking	Frequency	Percent
1	0	0
2	6	12
3	11	22
4	8	16
5	9	17
6	8	16
7	9	17
Total	**51**	**100**

Referring to Table 4.28, it is seen that 12% rate hard work as rank 2, 22% rate hard work as rank 3, 16% rate hard work as rank 4, 17% rate hard work as rank 5, 16% rate hard work as rank 6 and 17% rate hard work as rank 7. Since the rating for this is more of less equally distributed, hard work may be considered as a desirable quality.

Question No.11: Preference of employment of a marine engineer

Marine engineers are nowadays engaged by the ship owners/managers on contract basis. They are paid only during their period of engagement. The contract period is mutually agreed by the parties. In some cases this contract engagement could be on a continuous basis in the sense that the same engineer will be engaged by the same ship owners. However, few companies are appointing their employees on a permanent basis with fully paid earned leave in between engagement.

Table 4.29 Preference of employment

Engagement	Frequency	Percent
On contract up to 6 months	3	6
On continuous contract basis	14	27
On permanent basis	34	67
Total	**51**	**100**

As seen in Table 4.29 above, 6% prefer marine engineer to be employed up to 6 months, 27% prefer marine engineer to be on continuous contract basis and 67% prefer on permanent basis.

Question No. 12: Preference of a marine engineer to specialise in any class of vessels

Some companies prefer their engineers to specialise in certain type of ships of their fleet, so as to fully utilize the expertise of their engineers. Table 4.30 below shows that majority of the employers want their engineers to specialise in certain classes of ships.

Table 4.30 Specialisation

Specialisation	Frequency	Percent
Yes	34	67
No	15	29
Total	49	96
Missing	2	4
Total	**51**	**100**

Question No. 13: Grooming of a marine engineer

Some employees give occasional training to their sea going engineers in order to groom them for taking up shore assignments in future. According to Table 4.31, 73% of employers would like to groom their marine engineers for future shore jobs.

Table 4.31 Grooming of a marine engineer

Grooming	Frequency	Percent
Yes	37	73
No	12	23
Total	49	96
Missing	2	4
Total	**51**	**100**

4.4 Survey of personality traits of class IV marine engineers

Introduction:

The following six personality traits of class IV marine engineers are assessed numerically using established instruments adapted by *Robbins, S. P* and *Judge, T.A* .[34]

(i) **Self Esteem**: Self esteem is a measure of the individual's degree of liking or disliking for himself. People differ in the degree to which they like or dislike themselves. A number of studies confirm that high self esteemed people are more satisfied with their jobs than low esteemed people. The qualitative and quantitative estimation of self esteem of Class IV marine engineer has been done as per the scale developed by *Eagly, A.H* to measure self esteem over a scale from 0 to 100. [35]

(ii) **Learning style**: Learning style is a relatively permanent change in behaviour that occurs as a result of experience. Learning style of class IV marine engineers is evaluated as per scale of *Kahn, W.A.* [36]

(iii) **Decision making**: Decision is making of choices from among two or more alternatives. Every decision requires interpretation and evaluation of information. Data received from multiple sources and its needs are to be processed and interpreted. Decision making capability of class IV marine engineers is measured on personality scale developed by *Hellriegel, D.* [37]

(iv) **Motivation**: Motivation is the willingness to exert high levels of effort towards achievement of organisational goals, conditioned by one's ability to satisfy

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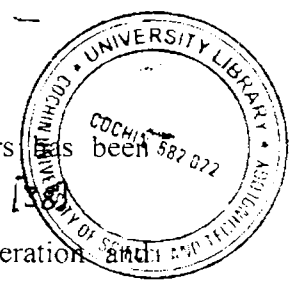

some individual need. Motivation of Class IV marine engineers has been estimated based on the scale adapted by *Steers, R* and *Braunstein, D.* [38]

(v) **Teamwork**: Teams have become an essential part in the operation and maintenance of ship's machinery. The output of the group in performing a task on board ships could be greater than the sum of individual outputs. Teams typically outperform individuals when the tasks being done require multiple skills, judgment and experience. Team work quality is measured using the scale of *Evans, N.J* and *Jarvis, P.A.* [39]

(vi) **Listening self-inventory**: Listening skill is considered to be an important desirable personality trait for a marine engineer, particularly class IV engineer. Listening self-inventory is estimated as per scale of *Glenn, E.C* and *Pood, E. A.* [40]

The career success score of the marine engineers has been assessed separately using an empirical formula. Quantitative and qualitative assessment of each of the above have been achieved from the responses to the questionnaires, designed specifically to arrive at the personality traits and the career success of class IV marine engineer. 31 certificated class IV marine engineers from Cochin and 20 from Mumbai, all in possession of certificate of competency as MEO class IV (Motor) participated in this survey.

The following six standard questionnaires adapted by *Robbins, S. P* and *Judge, T.A* to measure the corresponding personality traits and a seventh questionnaire for assessment of career success have been used for the survey.

4.4.1 Questionnaire on self-esteem

Instructions: Answer each of the following questions honestly. Next to each question write 1, 2, 3, 4, or 5 depending on which answer best describes you.

1 = Very often
2 = Fairly often
3 = Sometimes
4 = Once in a great while
5 = Practically never

___ 1. How often do you have the feeling that there is nothing that you can do well?
___ 2. When you talk in front of a class or group of people your own age, how often do you feel worried or afraid?
___ 3. How often do you feel that you have handled yourself well at a social gathering?
___ 4. How often do you have the feeling that you can do everything well?
___ 5. How often are you comfortable when starting a conversation with people you don't know?
___ 6. How often do you feel self-conscious?
___ 7. How often do you feel that you are a successful person?
___ 8. How often are you troubled with shyness?
___ 9. How often do you feel inferior to most people you know?
___ 10. How often do you feel that you are a worthless individual?
___ 11. How often do you feel confident that your success in your future job or career is assured?
___ 12. How often do you feel sure of yourself when among strangers?
___ 13. How often do you feel confident that some day people will look up to you and respect you?
___ 14. In general, how often do you feel confident about your abilities?
___ 15. How often do you worry about how well you get along with other people?
___ 16. How often do you feel that you dislike yourself?
___ 17. How often do you feel so discouraged with yourself that you wonder whether anything is worthwhile?
___ 18. How often do you worry about whether other people like to be with you?
___ 19. When you talk in front of a class or a group of people of your own age, how often are you pleased with your performance?
___ 20. How often do you feel sure of yourself when you speak in a class discussion?

4.4.2 Questionnaire on learning style

What's your learning style? For each of the following, circle the number that is most true for you.

1. When I learn a subject, I like to learn the theory first and then work on concrete applications; or do you prefer to work on concrete applications first and then learn the theory behind what you have done?

1	2	3	4	5
Theory first				Applications first

2. When I learn a subject, I like to get the "big picture" first and then learn specific details; I like to see how what I am learning relates to what I have already learned; or

do you prefer to learn the details first and then see how they are related to material you already know or have learned?

1	2	3	4	5
Big picture first				Details first

3. I expect study group members to use group time to:
(1) teach each other the "nitty-gritty" details and review problems;
(2) ask each other questions to prepare for an exam; or
(3) do everything that is necessary.

1	2	3

4. In drawing conclusions about a problem or case, I first seek facts and hard data before reaching a conclusion; or do you reach a conclusion and then seek facts that support your idea?

1	2	3	4	5
Data then conclusions				Conclusions then data

5. In drawing conclusions about a problem or case, I prefer to seek additional options and to postpone decision making as long as possible; or do you prefer to seek closure early land make a decision?

1	2	3	4	5
Seek additional options				Seek early closure

6. When I learn a subject I am satisfied to know the what of the subject; or do you also want to know the why of things?

1	2	3	4	5
What only				What and why

7. When confronted with a difficult task, I am willing to spend whatever time it takes to comprehend it; or do you set time limits, and if you haven't mastered the material you go on to another subject?

1	2	3	4	5
Whatever time it takes				Set time limits

8. In order for me to know a subject I must have "hands-on" experience.

1 2 3 4 5
Must have hands on Hands on unnecessary

9. When I learn a subject, I prefer that the instructor lays out material in a logical fashion: or do you prefer not to be told everything so that you have the opportunity to discover the ideas for yourself?

1 2 3 4 5
Want it all laid out Want opportunity for discovery

10. When I work in a team, how important is group harmony to me? It is:
(1) somewhat important;
(2) important; or
(3) very important.

1 2 3

11. How true of you is the following quotation: "I hear and I forget; I see and I remember; I do and then I learn"?

1 2 3 4 5
Very accurate Not accurate at all

12. Who, or what, is your most important learning resource?
(1) The instructor;
(2) The book; or
(3) Fellow students.

1 2 3

13. Is learning primarily an intellectual or a social activity?
1 2 3
Intellectual Social

4.4.3 Questionnaire on decision making

Part I

Circle the response that comes closest to how you usually feel or act. There is no right or wrong response to any of these items.

I am more careful about
a) people's feelings b) their rights

I usually get along better with
a) imaginative people b) realistic people

It is a higher compliment to be called
a) a person of real feeling b) a consistently reasonable person

In doing something with other people, it appeals more to me
a) to do it in the accepted way b) to invent a way of my own

I get more annoyed at
a) fancy theories b) people who do not like theories

It is a higher praise to call someone
a) a person of vision b) a person of common sense

I more often let
a) my heart rule my head b) my head rule my heart

I think it is a worse fault
a) to show too much warmth b) to be unsympathetic

If I were a teacher, I would rather teach
a) courses involving theory b) factual courses

Part II

Which word in the following pairs appeals to you more? Circle a or b.

a. Compassion	b. Foresight
a. Justice	b. Mercy
a. Production	b. Design
a. Gentle	b. Firm
a. Uncritical	b. Critical
a. Literal	b. Figurative
a. Imaginative	b. Matter-of-fact

4.4.4 Questionnaire on motivation

Circle the number that most closely agrees with how you feel. Consider your answers in the context of your current job or past work experience.

	Strongly Disagree				Strongly Agree
1. I try very hard to improve on my past performance at work/studies.	1	2	3	4	5
2. I enjoy competition and winning.	1	2	3	4	5
3. I often find myself talking to those around me about non work matters.	1	2	3	4	5
4. I enjoy a difficult challenge.	1	2	3	4	5
5. I enjoy being in charge.	1	2	3	4	5
6. I want to be liked by others.	1	2	3	4	5
7. I want to know how I am progressing as I complete tasks.	1	2	3	4	5
8. I confront people who do things I disagree with.	1	2	3	4	5
9. I tend to build close relationships with co-workers/fellow students.	1	2	3	4	5
10. I enjoy setting and achieving realistic goals.	1	2	3	4	5
11. I enjoy influencing other people to get my way.	1	2	3	4	5
12. I enjoy belonging to groups and organizations.	1	2	3	4	5
13. I enjoy the satisfaction of completing a difficult task.	1	2	3	4	5
14. I often work to gain more control over the events around me.	1	2	3	4	5
15. I enjoy working with others more than working alone.	1	2	3	4	5

4.4.5 Questionnaire on team work

Most of us have written a term paper. Some have been individual assignments i.e., the instructor expected each student to hand in a separate paper and your grade was determined solely by your own effort and contribution. But sometimes instructors assign group term papers, where students must work together on the project and share in the grade.

Think back to a recent experience in doing a group term paper. Now envision yourself at about the halfway point in the completion of that group assignment. Using your mind-set at this halfway point, answer the following 20 questions. This questionnaire measures your feelings about that work group.

	AGREE								DISAGREE
I want to remain a member of this group.	1	2	3	4	5	6	7	8	9
I like my group.	1	2	3	4	5	6	7	8	9
I look forward to coming to the group.	1	2	3	4	5	6	7	8	9
I don't care what happens in this group.	1	2	3	4	5	6	7	8	9
I feel involved in what is happening in my group.	1	2	3	4	5	6	7	8	9
If I could drop out of the group now, I would.	1	2	3	4	5	6	7	8	9
I dread coming to this group.	1	2	3	4	5	6	7	8	9
I weish it were possible for the group to; end now.	1	2	3	4	5	6	7	8	9
I am dissatisfied with the group.	1	2	3	4	5	6	7	8	9
If it were possible to move to another group at this time, I would.	1	2	3	4	5	6	7	8	9
I feel included in the group.	1	2	3	4	5	6	7	8	9
In spite of individual differences, a feeling of unity exists in my group.	1	2	3	4	5	6	7	8	9
Compared to other groups, I feel my group is better than most.	1	2	3	4	5	6	7	8	9
I do not feel a part of the group's activities.	1	2	3	4	5	6	7	8	9
I feel it would make a difference to the group if I were not here.	1	2	3	4	5	6	7	8	9
If I were told my group would not meet today, I feel bad.	1	2	3	4	5	6	7	8	9
I feel distant from the group.	1	2	3	4	5	6	7	8	9
It makes a difference to me how this group turns out.	1	2	3	4	5	6	7	8	9
I feel my absence would not matter to the group.	1	2	3	4	5	6	7	8	9
I would not feel bad if I had to miss a meeting of this group.	1	2	3	4	5	6	7	8	9

4.4.6 Questionnaire on listening self-inventory

Go through this 15-item questionnaire twice. The first time, mark the 'yes' or 'no' box next to each question. Mark as truthfully as you can in light of your behaviour in recent meetings or gatherings you attended. The second time, mark a plus (+) next to your answer if you are satisfied with that answer, or a minus (-) next to the answer if you wish you could have answered that question differently.

	Yes	No	+ or –
I frequently attempt to listen to several conversations at the same time.	___	___	___
I like people to give me only the facts and then let me make my own interpretations.	___	___	___
I sometimes pretend to pay attention to people.	___	___	___
I consider myself a good judge of nonverbal communications.	___	___	___
I usually know what another person is going to say before he or she says it.	___	___	___

I usually end conversations that don't interest me by diverting my attention from the speaker.	____	____	____
I frequently nod, frown, or whatever to let the speaker know how I feel about what he or she is saying.	____	____	____
I usually respond immediately when someone has finished talking.	____	____	____
I evaluate what is being said while it is being said.	____	____	____
I usually formulate a response while the other person is still talking.	____	____	____
The speaker's delivery style frequently keeps me from listening to content.	____	____	____
I usually ask people to clarify what they have said rather than guess at the meaning.	____	____	____
I make a concerted effort to understand other people's point of view.	____	____	____
I frequently hear what I expect to hear rather than what is said.	____	____	____
Most people feel that I have understood their point of view when we disagree.	____	____	____

4.4.7 Questionnaire on career success

1. Age bracket at the time of passing MEO class IV
   22 – 23 24 - 25 26 – 27 28 – 29 29 – 30

2. Technical and Communication Skill: Written
   No. of subjects cleared
   (MEO class IV) 1st attempt 2nd 3rd 4th 5th
   in Written Examination

3. Technical and Communication Skill: Oral
   No. of functions cleared
   (MEO class IV) 1st attempt 2nd 3rd 4th 5th
   in Oral Examination

4. Additional qualifications other than Basic Engineering Degree

   M.Tech / MBA / Other related qualifications including value added courses

5. Marital status Single / Married

Name :

Phone :

4.4.8 Conduct of survey

For the study of correlation of personality traits to career success of a class IV marine engineer, survey has been conducted among class IV marine engineers who have signed off and got down from merchant navy ships for the purpose of appearing for MEO class II examinations which is the next higher certificate of competency for a class IV engineer. 31 class IV marine engineers from Cochin and 20 class IV marine engineers from Mumbai who are in possession of MEO class IV (Motor) certificate are approached for data collection. Data has been collected whilst they were undergoing mandatory preparatory course at the approved maritime training institutes, in order to appear for MEO class II examination, which is conducted every month in India in Mumbai, Kolkata, Chennai and Cochin. Population appearing for the said examination per month in India is estimated as follows.

Seats available in MMD Mumbai per month	120
Seats available in MMD Kolkata per month	60
Seats available in MMD Chennai per month	60
Seats available at MMD Cochin per month	15
Total seats per month	**255**

Out of the above, a part of the population of 51 samples is drawn. This is a random selection of samples on account of the following features.

(i) One cannot predict as to who is going to sign off from ships for the purpose of appearing for the examination and when. Although the samples are collected from two cities i.e., Cochin and Mumbai, the respondents happen to be from different training establishments in marine engineering and hailing from different states of the country.

(ii) Out of those who signed off, one cannot predict that all those who sign off from ship will register for the examination.

(iii) One may not get seat for the preparatory course or MEO class II examination.

(iv) Probability of being absent from examination or missing preparatory course.

All the above chance of occurrences makes the samples a random selection and it represents a cross section of the population under study.

4.4.9 Statistical analysis of data

The data collected from the responses of the seven questionnaires 4.4.1 to 4.4.7 are assessed, decoded, enumerated and tabulated and are given as Table 4.32.

Table No. 4.32 Personality traits of class IV Marine Engineers

PERSONALITY TRAITS OF CLASS IV MARINE ENGINEERS

Sl. No.	Name	Self Esteem	Learning Style	Decision Making				Motivation (Dominant Need)			Team Work	Listening Self Inventory	Career Success Score %
Cochin		100		Sensation 10	Intuition 7	Think-ing 9	Feeling 7	Achievement 25	Power 25	Affili-ation 25	180	105	100
1	Pramod V.	75	Discovery learner	8	0	4	3	24	21	24	124	42	73.85
2	Anand Puthenveettil	78	Pragmatic learner	6	1	6	3	19	17	18	151	63	84.62
3	Ajay S. Pillai	95	Pragmatic learner	4	3	8	2	25	22	25	140	56	89.23
4	Sadique H. Mohammed	58	Discovery learner & lack of commitment	9	1	7	4	20	18	22	117	70	84.62
5	Saju P. Davis	74	Discovery learner	7	3	8	1	20	16	20	115	28	89.23
6	Joshy Joseph	59	Pragmatic learner & lack of commitment	7	3	7	3	16	15	18	132	42	84.62
7	Abid Ahammed .K.	78	Discovery learner	7	2	9	0	23	15	21	130	56	92.31
8	Tinju Thomas Kurian	80	Pragmatic learner	8	1	3	2	20	18	14	139	28	76.92
9	Rijesh Krishnan Nair	75	Discovery learner & lack of commitment	10	0	9	0	24	13	20	152	49	80.00
10	Renji Kuriakose Antony	78	Lack of commitment	10	0	7	3	22	21	19	130	42	90.77
11	S. Anish	80	Lack of commitment	10	0	8	2	23	20	21	130	63	72.31
12	Sankar Nataraj	73	Lack of commitment	10	0	9	0	22	18	22	178	63	73.85
13	Alfa Varghese	67	Lack of commitment	8	2	2	5	24	16	18	131	70	96.92

14	Geewar Joy	54	Discovery learner	6	3	7	2	18	12	19	134	49	75.38
15	Tojo Joseph	73	Lack of commitment	8	1	7	3	22	18	21	132	49	83.08
16	Dileep S. Pai	73	Lack of commitment	8	1	6	3	23	23	20	139	56	87.69
17	Antony N.J.	73	Pragmatic learner	6	3	5	2	20	16	13	124	56	53.85
18	Mithun Jose	78	Pragmatic & Discovery learner	4	3	5	3	21	18	18	170	77	87.69
19	John M. Sebastian	83	Lack of commitment	6	4	6	2	21	16	18	145	70	81.54
20	Saji C.C.	61	Lack of commitment	7	3	6	3	20	17	20	128	28	78.46
21	Santhosh Varghese	65	Pragmatic learner	4	4	7	2	19	17	17	133	42	87.69
22	Jishnu K.	79	Pragmatic learner	7	3	9	1	24	19	23	172	63	95.38
23	Vipin Rajeev	82	Lack of commitment	8	1	7	1	19	21	21	150	56	81.54
24	Pradeep Rajan	86	Pragmatic learner	4	2	7	2	21	21	20	163	63	80.00
25	K.C. Anil Kumar	82	Lack of commitment	8	1	6	3	24	17	24	164	84	95.38
26	Fredy Tom	79	Discovery learner	5	1	3	0	23	17	17	170	77	87.69
27	K. Amith Chandran	61	Discovery learner & lack of commitment	8	1	1	5	16	12	20	134	42	89.23
28	S. Neelakantan	83	Lack of commitment	8	1	5	3	21	20	21	155	84	67.69
29	Isaac Daniel	77	Pragmatic learner	8	1	7	2	19	14	18	145	84	73.85
30	R. Hari Krishna	78	Pragmatic learner & lack of commitment	6	3	7	2	20	17	17	150	42	69.23
31	A. Subramanian	78	Discovery learner	5	1	3	0	23	17	17	170	84	80.00

Mumbai

1	Amit M. Rajadhyaksha	77	Pragmatic learner	10		6	4	18	16	17	135	63	49.23
2	Kevin C.Fernandes	74	Discovery	6	2	2	1	20	17	16	124	49	81.53
3	Prashil Mardolkar	80	Pragmatic	8	1	8	0	21	19	22	153	28	80.00
4	Mishra Vineet	75	Pragmatic	8	1	6	1	22	24	22	136	42	75.38
5	Amar Shyam Ahuja	68	Discovery	9	1	7	2	21	21	19	135	77	92.30
6	J.P. Narayan		Pragmatic & Lack of Commitment	6	3	4	4	24	19	20	111	49	86.15
7	Majeed P.M.	63	Lack of commitment	9	1	8	1	20	19	24	144	70	72.31
8	Subhasish Mondal	62	Discovery	4	3	7	2	25	25	25	116	49	72.31
9	Gitte Nandkishore S	82	Pragmatic	8	1	8	2	23	21	21	155	56	79.23
10	Rajender Singh	72	Discovery	9	0	9	1	29	15	21	126	70	26.62
11	Rahul R. Shitole	68	Pragmatic	9	0	7	4	16	17	19	125	42	66.15
12	Rishikesh R. Mavinkurve	65	Discovery & Lack of commitment	7	2	2	5	24	19	17	136	42	66.15
13	Nabarun Sarkar	67	Lack of commitment	8	1	5	3	22	16	17	121	63	86.15
14	Subodh Ahire	67	Discovery	5	3	2	5	18	14	16	111	56	35.39
15	Jasminder Singh	49	Discovery	6	3	4	5	17	19	23	83	28	86.15
16	Govalkar Nazing	77	Lack of commitment	9	0	3	3	23	19	19	149	63	76.92
17	Abhishek Mukerjee	78	Discovery	8	0	8	2	17	8	11	101	49	47.69
18	Lookose Pappan	65	Discovery and lack of commitment	6	2	7	3	21	14	19	135	56	73.85
19	Kashikar M.G.	92	Pragmatic & Discovery	3	5	9		25	25	21	163	77	81.54
20	Yashodhan D Rege	84	Pragmatic & Lack of commitment	7	2	5	3	24	23	21	146	63	63.08

In order to investigate the possible relationship between various personality traits and career success of class IV marine engineer, following parameters are used in general.

Karl Pearson Coefficient of correlation

Karl Pearson Coefficient of correlation (r) is measured to check the presence of linear relationship between two variables, x and y. The mathematical formula for computing r is:

$$r = \frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{n(\sum x^2) - (\sum x)^2}\sqrt{n(\sum y^2) - (\sum y)^2}} \qquad (4.2)$$

where n is the number of pairs of data.

The value of r is such that $-1 \leq r \leq +1$. The + and – signs are used for positive linear correlations and negative linear correlations, respectively. If x and y have a strong positive linear correlation, r is close to +1. An r value of exactly +1 indicates a perfect positive fit. Positive values indicate a relationship between x and y variables such that as values for x increases, values for y also increase. If x and y have a strong negative linear correlation, r is close to -1. An r value of exactly -1 indicates a perfect negative fit. Negative values indicate a relationship between x and y such that as values for x increase, values for y decrease. If there is no linear correlation or a weak linear correlation, r is close to 0. A value near zero means that there is a random, nonlinear relationship between the two variables. Note that r is a dimensionless quantity; that is, it does not depend on the units employed. A perfect correlation of ± 1 occurs only when the data points all lie exactly on a straight line. If $r = +1$, the slope of this line is positive. If $r = -1$, the slope of this line is negative. A correlation greater than 0.3 is considered to be reasonably *strong* in the present study, whereas a correlation less than 0.3 is treated as *weak*. [41]

Significance level

The degree of reliability relates to the concept of significance level. The significance level refers to how likely it is that an error would be made. Psychologists generally accept a 5 percent error rate as reasonable. In order to decide whether differences are reliable, psychologists conduct statistical tests that provide a measure of confidence in their conclusions.

The relationship is considered significant if the value is less than 0.05. The smaller the significance level, the more significant the relationship. *Berman, S.M.* [42]

CHAPTER 5

INTERPRETATION OF SURVEY RESULTS

5.1 General

The data collected out of the survey conducted amongst the senior marine engineers, employers of marine engineers and class IV marine engineers have been tabulated in the previous chapter. From the responses of the participants of the random survey, some important observations are noted in order to make necessary changes in the curriculum of marine engineer's education and training.

5.2 Observation of senior marine engineers

Question 1: Number of junior engineers on board

Most of the ships have only one junior engineer on board the ship.

Question 2: Performance of marine engineer

Referring to Fig 4.1, it is seen that the performance graph of class IV marine engineer hovers between 2 and 3, indicating that the performance, although satisfactory, is not good enough. Leadership and attitude are ranked the lowest, followed by response to emergency and oral communicative skill. All factors below the level of weighted average of 2.5 will have to be attended to during training of class IV marine engineers. A new topic by name soft skills has been, therefore, added to the course subject under competence 5 as serial no. 5.4, Table 5.7.

Question 3: Additional technical input

A good majority of senior marine engineers wants junior engineers to be trained more in overhauling exercise of machines, pneumatics, hydraulics and electrical work. Course subjects are accordingly modified to include these topics under competence 6, 8 and 9 as serial no. 6.3, 8.6 and 9.1 of Table 5.7.

Question 4: Topics in the syllabus

Please refer Table 4.4 and Figure 4.3. More than 50% of the senior marine engineers feel that topics of cargo handling system, design of marine systems, commercial shipping, marine insurance, vibration and public speaking are also to be included in the curriculum. These too have been added under competence 5, 6, 11 and 15 as serial no. 5.4, 6.5, 6.6, 11.8 and 15.4 of Table 5.7.

Question 5: Pre sea and sea service

Fig 4.4 clearly shows that senior engineers favour pre sea course of six months and thereafter sea service of one year covering two ships. 41% of the senior marine engineers are of this view. All 15 competences as per IMO's STCW Code could still be covered satisfactorily even in case of introduction of this modification. It is to be noted that graduate mechanical engineers are the ones undergoing pre sea course presently. One year training in workshop is widely felt to be on the higher side for a mechanical engineer. On the other hand, six months sea service before class IV examination is felt to be not adequate for them. Nearly this much time is required for a fresh engineer to get familiarized with his first ship. Therefore, this period could be extended to one year as opined by the senior marine engineers. GME workshop training and sea service course subjects and hours of training are accordingly revised within the framework of the provisions of STCW convention and STCW code and at the same time, incorporating the inputs of senior marine engineers. Proposed pattern of six months GME workshop training is given as Table 5.7 and proposed pattern of one year on board training is given as Table 5.8. Changes of omissions and insertions are made distinguishable in these tables by using ***bold italics***.

Question 6: Sea service of B.Tech. marine engineers

Fig 4.5 indicates that the present system of sea service for graduates in marine engineering prior to MEO class IV examination can continue. The reasoning for this is that the marine engineering graduates are already exposed to ship-in-campus training and/or engine room simulators or some form of afloat training, so they do not require one year sea service as proposed for graduate mechanical engineers.

Question 7: TAR book

As is obvious from Table 4.7 and Fig 4.6, a good majority of senior marine engineers believe that the system of maintenance of TAR books by engineering cadets should be continued.

Question 8: Preparatory course

62% of the respondents are of the opinion that the present system of 3 months mandatory preparatory course before appearing for MEO class IV examination is to be continued. This is clear from Fig 4.7. This course has been done away with as of now, rather its mandatory nature has been dropped and course is made optional with a result that most of the aspiring class IV marine engineers are hesitant to do this course, with disastrous results in class IV examination. Hence, this course has to be made mandatory as was the case earlier. This view is evidently supported by the results of the survey.

5.3 Observations of employers of marine engineer

Question 1, 2, 3 & 4: Employers and company details

They deal with the particulars of the employer and the shipping company including the number of ships owned by the company and the number of marine engineers on each ship.

Question 5: Age bracket of junior engineer

Table 4.10 and Fig 4.8 indicate the ideal age bracket of junior marine engineer as 22 to 25 years. Therefore, the appropriate age of a junior engineer is considered to be between 22 and 25 years. In the present training scenario of marine engineers in India, it is observed that the important and popular channels for producing marine engineers as depicted by Flow Diagram 1 of Annex I, a junior engineer in normal case will be in the age bracket of 22 to 25 and therefore, conforms to the industry requirements.

Question 6: Age bracket of chief engineer

Three age brackets of chief engineers at sea with the desirability in the opinion of employers are depicted in Table 4.11 and Fig 4.9. It is seen that 35 to 44 years of age bracket is preferred by 78% of the respondents. This age bracket more or less fits into the existing scheme of training and certification of marine engineers as illustrated below.

A junior engineer has to put in sailing period of 6 months, 12 months and 18 months in order to become eligible to appear for the certificate of competency of MEO class IV, class II and class I respectively and subsequently attain the level of a chief engineer. Besides, he has to spend time to attend the requisite mandatory preparatory course before the examinations. For example, on fulfillment of the sea time, 4 months of preparatory course in an approved training establishment including a simulator course is a mandatory requirement before one can appear for MEO class II examination. Similarly, a two months preparatory course in an approved institution is necessary before one can appear for MEO class I examination. Personal study and preparation, if any, for the respective examinations will be in addition to what is mentioned above. Therefore, if the ideal age of a junior engineer is 22 years according to the industry requirements, then the engineer is likely to be more than 30 years by the time he completes his certification. He may have to wait for about 3 years before he can be promoted as the chief engineer of the ship. This period could also be utilized in piece meal, if felt necessary, for personal and social requirements such as wedding, domestic needs etc. Time is also required for undergoing specialized training to work on relevant type of ships as required by the shipping company. It is concluded that there exists an offset of few years of chief engineer's age bracket vis-a-vis the present training system in India. However, it still meets the industry requirements to a great extent.

Question 7: Gender of engineers

Preference of the employers with regard to male and female engineers on board their ships is assessed by a suitable question and observation is reflected in Table 4.12 and Fig 4.10.

80% of the respondents prefer male engineers, while 20% opine for mixed crowd of engineers for their ships. Although IMO and various maritime administrations the world over have taken steps to encourage women to go to sea, it is observed that the ship owners and ship operators and the shipping industry in general, in India, are still very conservative in their outlook in employing only male members on board their ships. They really consider females as 'weaker sections' and therefore, unfit to be at sea. This feeling is largely reflected in the present survey too.

In India, only a minuscule percentage of women are venturing out to sea even these days. Therefore, our training of marine engineers in the country is fully in accordance with the industry requirements in this regard.

Question 8(a): Physical

The physical performance of Indian junior marine engineer was assessed and found that more than half the respondents opine the physical performance to be good. Please see Table 4.13 and Fig 4.11.

It may be pertinent to mention here that the marine engineering students in India are subjected to a medical examination at the entry level as per M.S. (Medical Examination of Seafarers) Rules 2000 to make sure that the candidates are medically fit to undergo the rigors of training as well as to be at sea. Thus it may be inferred that the control at entry level has brought the desired results at the operational level of engineers. Therefore the existing medical examination and screening at the entry level may be maintained as such in future too.

Question 8(b): Technical

Table 4.14 and Fig 4.12 show that there is scope for improvement of technical skill of a junior marine engineer which was corroborated by the survey conducted amongst senior marine engineers too. Course subjects have been increased under competences 6, 8, 9 and 11 in view of this finding. Additions to the subjects have been shown in bold italics under each of the competencies in Table 5.7.

Question 8(c): Attitude

Grading of attitude given to the junior engineers is largely below the level of good as seen in Table 4.15 and Fig 4.13. Need to improve the attitude of junior engineer was felt in the earlier survey too. Please see section 4.2.3 under Question no. 2. Accordingly 18 hours of additional training under the heading of 'soft skills' as competence 5 of Table 5.7 has been introduced in the course.

Question 8(d): Social

As per Table 4.16 and Fig 4.14, the employers of marine engineers feel the social standard of junior engineers requires improvement but as per section 4.2.3, Question no. 2, the senior marine engineers feel that social quality of junior engineers is in order and up to the mark.

Question 8(e): Response to emergency

With reference to Table 4.17 and Fig 4.15, response to emergency of marine engineers falls either in 'good' or 'very good' category. Therefore, no change in the training pattern is now necessary with regard to the subject of response to emergency.

Question 8(f): Communication skills - Oral

Table 4.18 and Fig 4.16 reaffirm the earlier finding under section 4.2.3, Question no. 2 that the communication skill of junior engineers requires improvement. As mentioned earlier, the new topic 'soft skills' added to the course subject under competence 5 of Table 5.7 shall take care of this need in training of marine engineers.

Question 8(g): Communication skills - Written

Table 4.19 and Fig 4.17 show that written communicative skill of junior engineers needs further thrust during their training. 'Soft skills' added to the course subject under competence 5 of Table 5.7 shall take care of this requirement also. Besides, fulfillment of written assignments and other exercises including TAR book is also meant to improve the written communication.

Question 8(h): Leadership

The need to impart leadership training to the marine engineers is felt necessary on a

careful scrutiny of Table 4.20 and Fig 4.18. Similar observation was made on analysis of Fig 4.1 also where leadership quality has the lowest rating. Therefore, it is imperative that leadership training is imparted during marine engineering training. This is taken care of in 'soft skills' under competence 5 of Table 5.7.

Question 9: TAR book

The need to fill up the Training and Assessment Record book during pre sea and sea service before appearing for class IV examination was reiterated during this survey, apart from the survey conducted earlier among the senior marine engineers. As seen in Table 4.21, vast majority of employers support the view of maintaining the TAR book by the trainees. Therefore this practice may be continued.

Question 10: Priority of qualities

Seven important qualities of a marine engineer was rated in the order of their preference by the respondents in this survey under Question 10. The analysis of their priority shows that the following are desirable qualities of a marine engineer:

- Technical skill
- Safety consciousness
- Team spirit
- Discipline
- Hard work

Question 11: Employment of a marine engineer

Table 4.29 shows the preference of employers to appoint the marine engineers with regard to the terms of appointment. Although permanent employment at sea is not in vogue these days, the employers actually want their engineers to be on the permanent pay roll and not on contract basis.

Question 12: Specialisation of marine engineers

Shipping companies would like to have their engineers specialized in different types of ships such as tankers, chemical or gas carriers etc. Table 4.30 shows that 67% of employers would prefer specialisation of their engineers to man their fleet of ships.

Question 13: Grooming of marine engineers

While serving at sea, marine engineers have to be simultaneously groomed for taking up shore jobs such as superintendents, surveyors etc. As per Table 4.31, 73% of employers wish to groom their engineers for future assignments ashore.

5.4 Interpretation of performance of marine engineers

The performance of marine engineers as assessed from the data collected from the employers of marine engineers is summarised as under.

Table 5.1 Performance of marine engineers according to employers

Performance	Very poor $x_1=1$	Poor $x_2=2$	Satis-factory $x_3=3$	Good $x_4=4$	Very good $x_5=5$	Total response	Total Score	Weighted Average Score
Physical	0	0	17	29	4	50	187	**3.74**
Technical	0	4	25	17	3	49	166	**3.39**
Psychological	0	4	24	18	4	50	172	**3.44**
Social	0	4	25	17	3	49	166	**3.39**
Response of emergency	0	3	18	22	6	49	178	**3.63**
Communication skill – oral	1	4	21	20	4	50	172	**3.44**
Communication skill – written	0	8	20	17	4	49	164	**3.35**
Leadership	0	6	23	17	4	50	169	**3.38**

Let x_1 to x_5 be the score corresponding to 'very poor' to 'very good' respectively. Let w_1 to w_5 be the number of respondents corresponding to the above grades.

Then, the weighted average score = $\frac{\sum w_i x_i}{\sum w_i}$ ..... (5.1)

The factors with score above 3 (weighted average score) can be taken as satisfactory

Weighted average score of the performance of the marine engineers are given in the above table. Corresponding graph are drawn using the score. Graph rates physical performance of the marine engineer high compared to others.

From the table it is observed that the performance of marine engineers is satisfactory. However the communication skill - written has scored the least. Another area where the marine engineers are relatively weak is the technical skill.

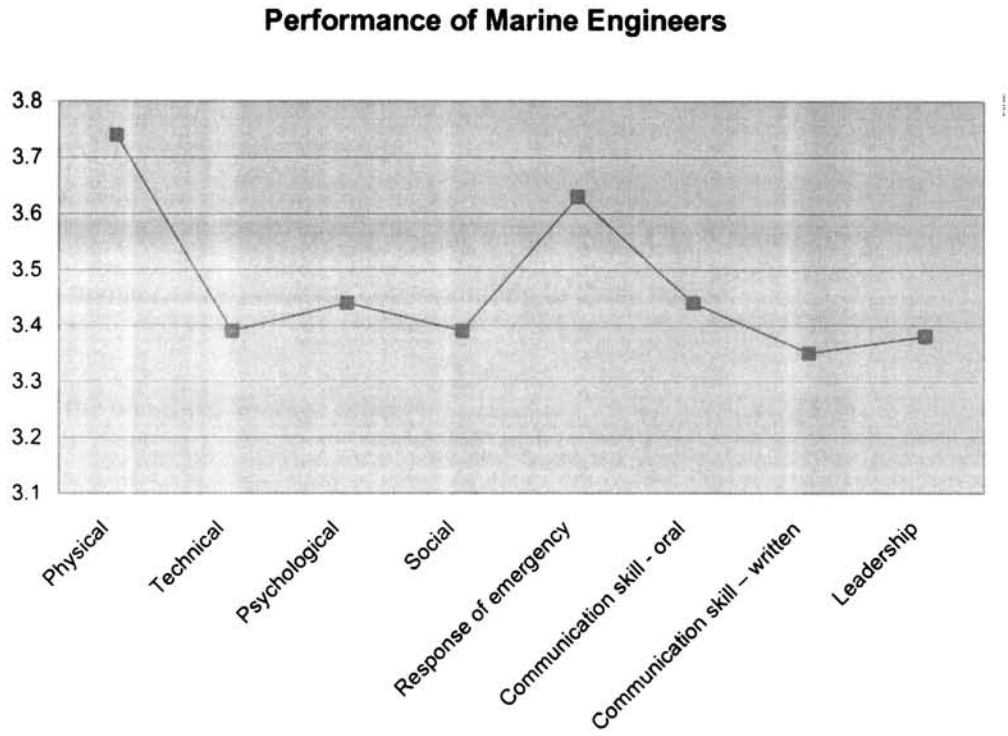

Fig. 5.1 Performance of marine engineers according to employers

Relative quality of a marine engineer

The desirable qualities of marine engineers as assessed from the data collected from the employers of marine engineers are summarised as under.

Table 5.2 Relative quality of a marine engineer

Desirable Qualities	Rank 1 $x_1=7$	Rank 2 $x_2=6$	Rank 3 $x_3=5$	Rank 4 $x_4=4$	Rank 5 $x_5=3$	Rank 6 $x_6=2$	Rank 7 $x_7=1$	Total Score	Weighted Average Score
Loyalty	6	1	3	4	7	10	20	140	**2.7**
Adherence of policy	2	0	4	2	7	24	12	123	**2.4**
Technical skill	19	11	8	5	4	4	0	279	**5. 5**
Safety consciousness	14	18	5	8	3	1	2	276	**5.4**
Team spirit	4	6	10	6	11	7	7	192	**3. 8**
Discipline	3	7	9	17	9	2	4	211	**4.1**
Hard work	0	6	11	8	9	8	9	175	**3.4**

As seen in Table 5.2 only six respondents give rank 1 to loyalty and so on. That is 6 respondents prefer loyalty as the most desirable quality of a marine engineer. But maximum number of respondents has given their first preference as Technical skill followed by Safety consciousness.

Let x_1 to x_7 be the score corresponding to the ranks 1 to 7 respectively. Let w_1 to w_7 be the number of respondents corresponding to these ranks.

Then, the weighted average score = $\frac{\sum w_i . x_i}{\sum w_i}$ .....(5.2)

Weighted average score of various desirable qualities are in the above table. The factors with score above 4(weighted average score) can be considered as the influential factors. Corresponding graphs are drawn by using the score. From the graph we can infer that Technical skill & Safety consciousness are two important qualities of a marine engineer.

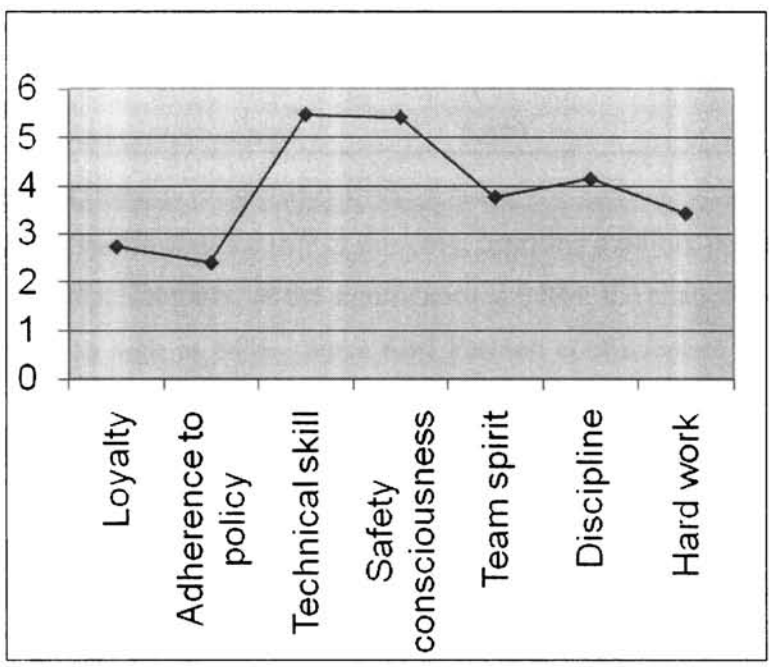

Fig. 5.2 Relative quality of a marine engineer

5.5 Personality traits of class IV marine engineers

Correlation between each of the personality traits and the career success of a class IV marine engineer has been tested by Anova method and by other suitable statistical tools.

5.5.1 Correlation between self esteem and career success

The self esteem measured over a scale of 0 to 100 for 51 class IV marine engineers are put to the Karl Pearson Coefficient of correlation test to establish any possible linear relationship with the career success of the respective candidates. The career success is treated as the dependent variable in relation to the self esteem. The result is shown in the following Table 5.3.

Table 5.3 Effect of self esteem on career success

Variables	Karl Pearson Coefft. (r)	Significance
Self esteem and career success	0.029	0.844

The correlation coefficient is 0.029 in this case, denoting a mildly positive but a weak linear relationship. Similarly, as the significance is 0.844, the chances of failure of the hypothesis are as high as 84%. Since Karl Pearson coefficient of correlation deals with only linear relationship, a second order relationship has been explored by best fit method. Accordingly, the graphical line as depicted in Fig. 5.3 emerged.

It is obvious from the curve that the career success has a slightly decreasing trend as the self esteem of class IV marine engineer increases. This can be due to over confidence resulting from increased self esteem.

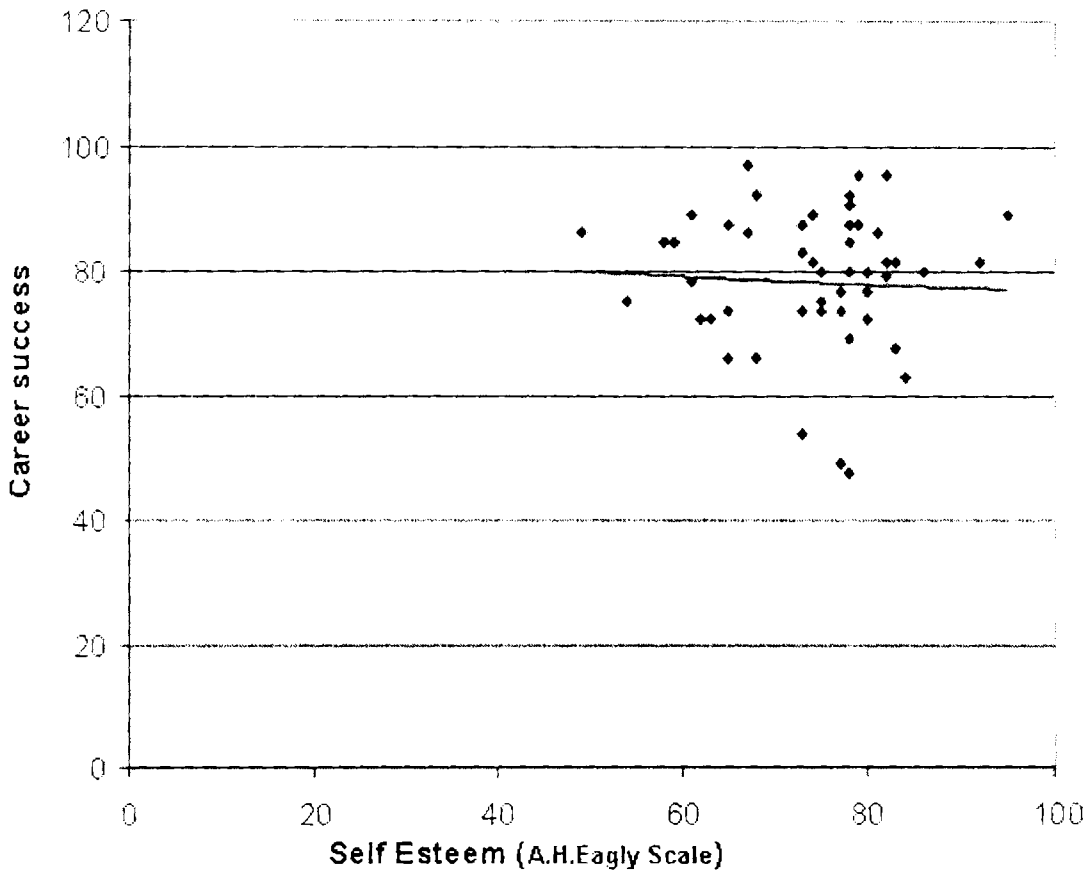

Fig. 5.3 Effect of self esteem on career success

5.5.2 Correlation between learning style and career success

The learning style of a marine engineer influences his career success. Pragmatic learner prefers to learn the application first and then learn the theory underlying application. Real world problem solving is his forte. The discovery learner prefers his instructors to allow him to discover the underlying principles rather than tell him the process in a lecture. Lack of commitment refers to people who are unwilling to spend the time it takes to master his subject (*Robins, S.P* and *Judge, T.A).*

The mean score for each category of learners in the present study is given in Table 5.4 and Fig 5.4. It is observed that the pragmatic learner has better chances of career

success. Average score of career success for them is 76.3%. However the highest score of 84.6 % is by the pragmatic cum discovery learners. It is observed that 35% of the marine engineers are pragmatic learners. It is also seen that marine engineers with lack of commitment also shows some substantial career success rate. This could be due to other factors such as passing the examination by luck etc. which are not considered in the scope of the study.

The training system should include methods and programmes that would ensure a certain level of commitment from the part of the marine engineers, once they complete the training. Career advancement scheme should be so devised that committed people get more weightage in the career advancement. This would encourage people with lack of commitment eventually to get more committed.

Table 5.4 Effect of learning style on career success

Modes of learning	Career success Mean Score %
Discovery learner	72.3
Discovery and lack of commitment	78.8
Lack of commitment	81.8
Pragmatic learner	76.3
Pragmatic & discovery learner	84.6
Pragmatic learner & lack of commitment	75.8

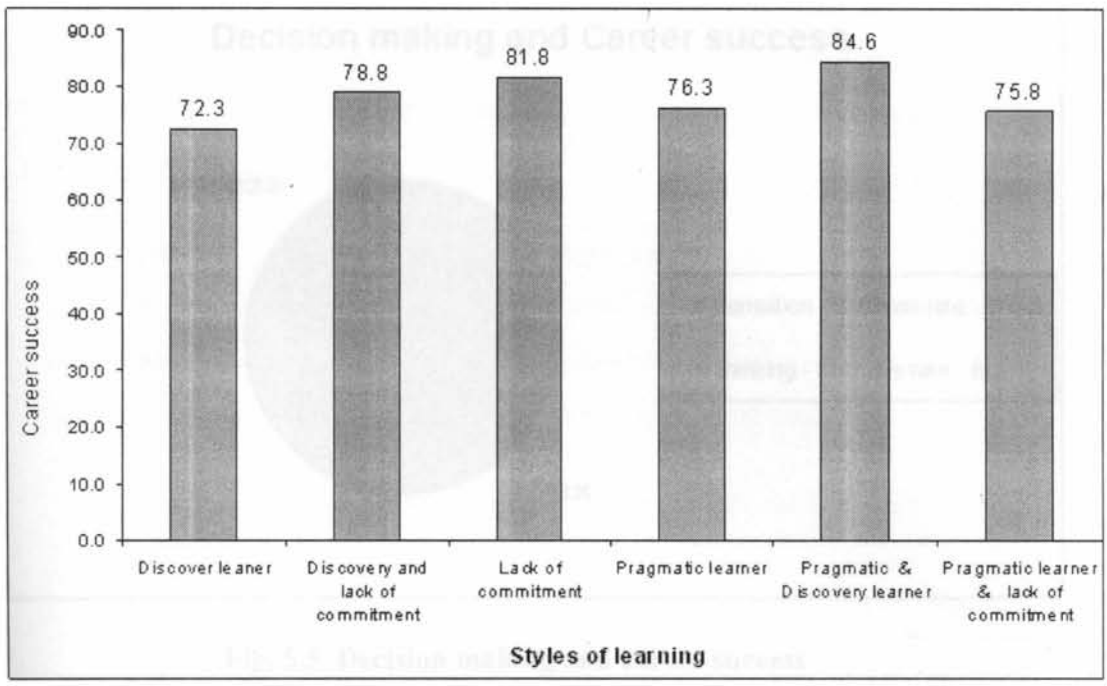

Fig. 5.4 Effect of learning style on career success

5.5.3 Correlation between sensation (decision making) and career success

Decisions are generally taken based on sensation, intuition, thinking or feeling and in every individual one of them may be predominant. The maximum score acquired by class IV marine engineer for each category is given in the Table 4.32. A high score on sensation indicates that one is realistic and sees the world in terms of facts. A high score on feeling means that one makes decisions based on gut feeling. Intuition is a feeling not necessarily supported by research. Intuitive decision making is an unconscious process without the proper application of mind. A high score on intuition indicates that he sees the world in holistic terms. He tends to be creative. A high score on thinking indicates a highly logical and analytical approach to decision making (*Robins, S.P.* and *Judge, T.A.)*

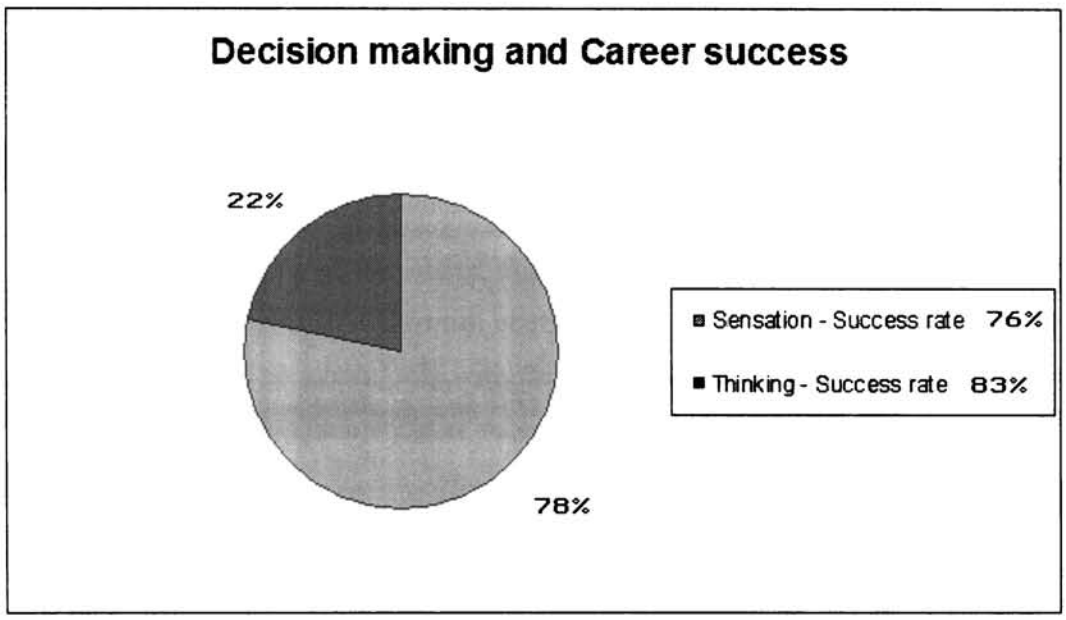

Fig. 5.5 Decision making and career success

In the present study, it has been observed that 78% of class IV marine engineers take decisions based on sensation. Their average success rate has been found to be 76%. The remaining 11 marine engineers i.e., 22% have scored high on thinking. Their success rate has been observed to be 83%. Please refer to Fig. 5.5. It is pertinent to note that class IV marine engineers depend less on 'intuition' and 'feeling' in the process of decision making.

As is obvious from the above, marine engineer trainees may be recommended to adopt thinking method in their decision making process.

5.5.4 Correlation between affiliation (motivation) and career success

Motivation of marine engineers are mainly for satisfying the dominant needs for achievement, power or affiliation, based on important personality characteristic of the individual. Achievers have the drive to excel in relation to a set standard. Those with the desire to have impact and to be influential and control others are in the category of

power. The desire for friendly and close interpersonal relationship is the dominant need for affiliation. 31% of the marine engineers under present scrutiny are found to be of this category. The respective dominant needs of Class IV marine engineers have been measured by an instrument created by *Steers, R* and *Braunstein, D*, the score ranging up to a maximum of 25.

Correlation of each of the above dominant needs against the career success was checked by applying Karl Pearson coefficient of correlation and found that the first two factors have no relationship with the career success of marine engineer. However, affiliation has direct link to career success which is significant.

Table 5.5 Effect of affiliation on career success

Variables	Karl Pearson Coefft. (r)	Significance
Affiliation and career success	0.349	0.012

The correlation coefficient is 0.349, which means affiliation and career success has a strong relationship.

A second order relationship has been established by best fit method, and the following curve shown below emerged. The curve affirms that those with increased affiliation as dominant need have an increasing rate of success.

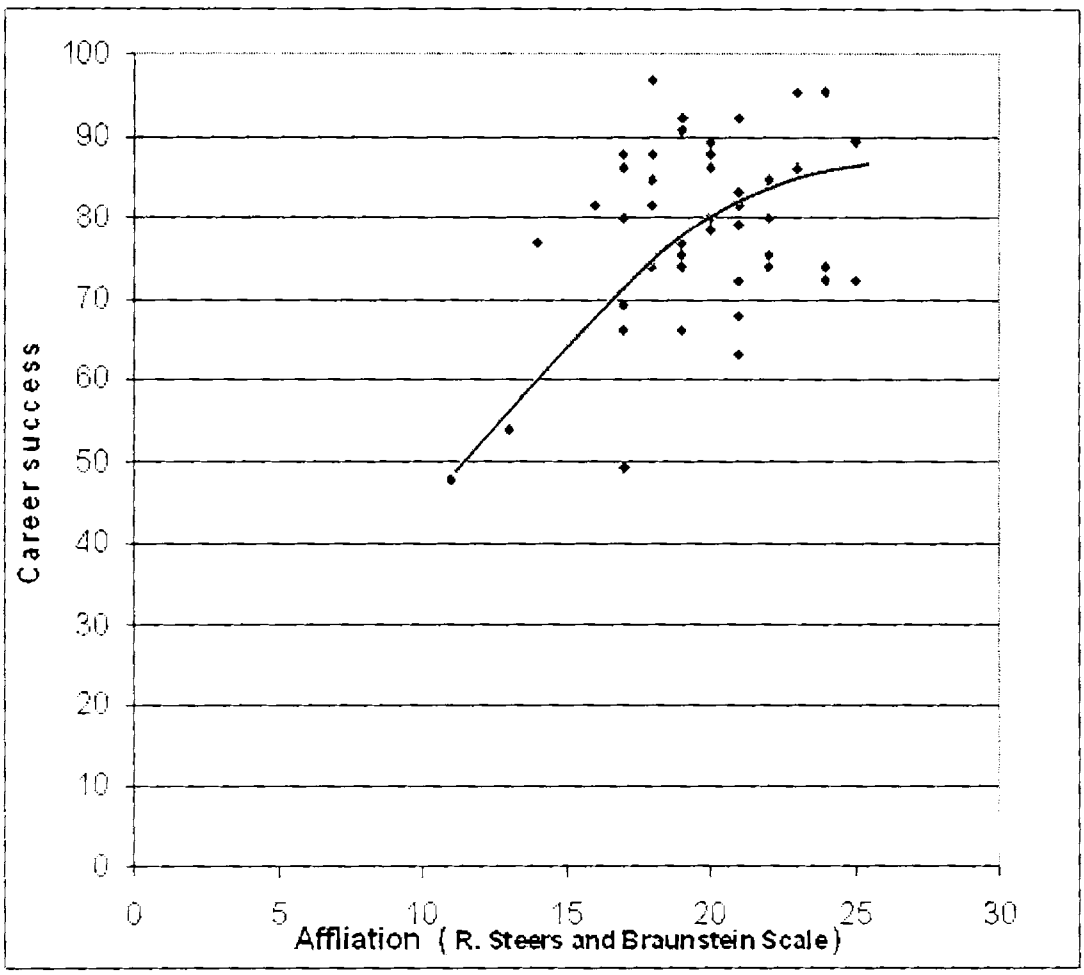

Fig. 5.6 Effect of affiliation on career success

5.5.5 Correlation between team work and career success

The ability of a class IV marine engineer to work in a team is measured on a scale developed by *Evans, N.J.* and *Jarvis, P. A.* ranging from 0 to 180. The higher the score, the more positive are his feelings about the group in which he functions.

On an analysis, no linear relationship could be identified between team work and career success of class IV marine engineer by Karl Pearson method as evident from the table below.

Table 5.6 Effect of team work on career success

Variables	Karl Pearson Coefft. (r)	Significance
Team work and career success	0.248	0.079

However on a further investigation, a higher order relationship between team work and career success has been observed. Please see Figure 5.7. The curve proves the hypothesis that team work improves career success of a marine engineer substantially.

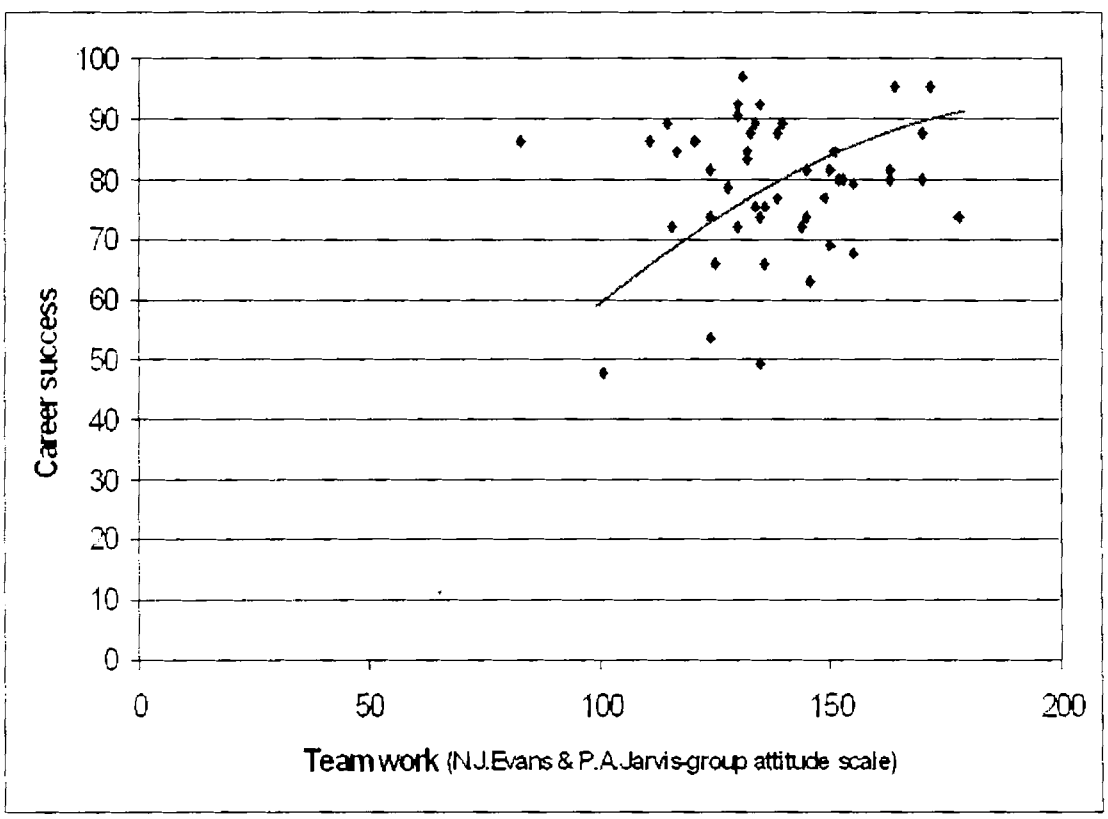

Fig. 5.7 Effect of team work on career success

5.5.6 Correlation between listening self inventory and career success

Listening skill of class IV marine engineer is graded on a scale developed by *Glenn, E.C.* and *Pood, E.A.*. The scale ranges to a maximum of 105 points. A score between 91 and 105 indicates good listening habits. Score below 76 indicates poor listener and need to work hard to improve the skill. Score between 77 and 90, suggest significant room for improvement.

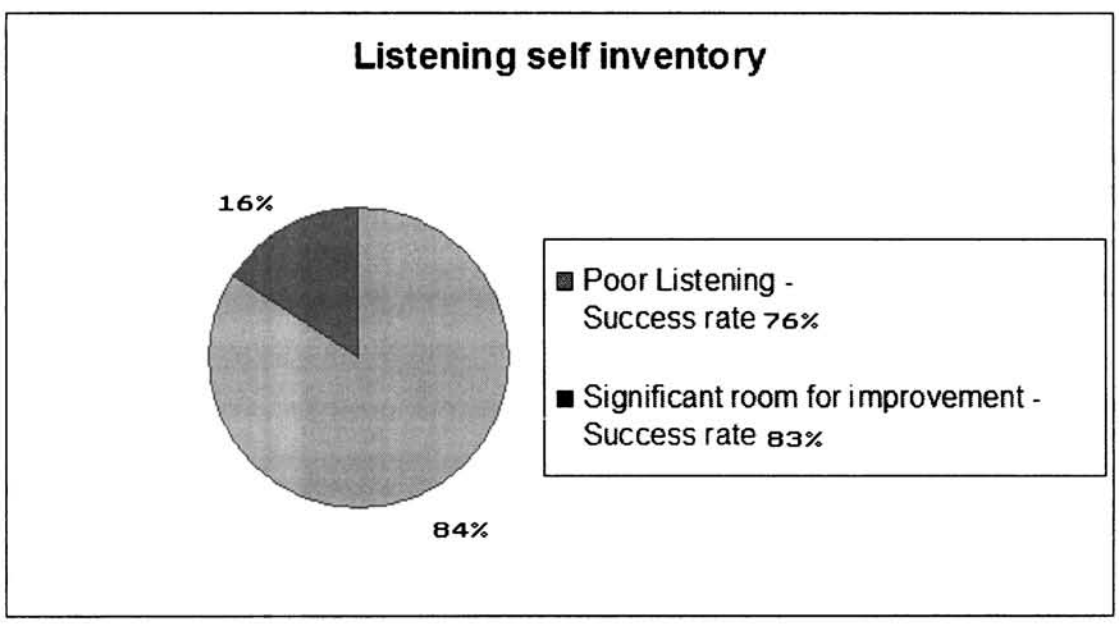

Fig. 5.8: Listening self inventory and career success

In the present study, 84% of marine engineers have scored less than 76 and therefore are considered poor listeners. The remaining 16% are in the category with significant room for improvement. In general, adequate input has to be given in the training programme of marine engineers to improve their listening skill.

However, no direct relationship between listening self inventory and career success could be established by Karl Pearson correlation method. But it is seen that while the success rate of poor listeners is only 76%, that of the better listeners is 83%.

5.6 Output of the present study

The existing pattern of GME workshop training of 12 months and on board training of 6 months as per META manual are given as Annex II and Annex III. In view of the observations made, the competence and course subjects listed in those tables have been reviewed thoroughly considering the views of the senior marine engineers.

Topics of design of marine system, commercial shipping, marine insurance, vibration, communication skills including public speaking have been incorporated in the proposed modified training.

Based on the present study, a revised pattern of GME workshop training of 6 months and on board training of one year duration are given as Tables 5.7and 5.8 respectively, incorporating relevant recommendations. The omissions and insertions have been made distinguishable in Tables 5.7 and 5.8 by ***bold italics***.

Table 5.7 Proposed pattern of GME 6 months workshop training

6 MONTHS WORKSHOP TRAINING FOR GRADUATES IN MECHANICAL ENGINEERING/ NAVAL ARCHITECTURE

Sr. No.	Competence and Course subjects	Hours of Training		
		Class Room	Lab	Training Workshop and Afloat
	FUNCTION - Marine Engineering at the Operational Level			
1	**COMPETENCE 1:** Use appropriate tools for fabrication and repair operations typically performed on ships			
1.1	Use of hand and power tools, basic workshop practice and basic fitting	..	..	
1.2	Machine tools and processes	..	..	*60*
1.3	Use of measuring instruments	..	..	
1.4	Fabrication, welding, joining and cutting	..	..	*70*
1.5	Properties of materials, lab testing and Industrial Chemistry	..	20	..
1.6	Safe working practices	10	..	..
	FUNCTION - Marine Engineering at the Operational Level			
2	**COMPETENCE 2:** Use hand tools and measuring equipment for dismantling, maintenance, repair and reassembly of shipboard plant and equipment			
2.1	Advance workshop practice	..	..	*50*
2.2	Marine equipment drawing, notations and interpreting the drawing etc.	20	..	..
2.3	Familiarisation with tools for Marine equipment assembly, repair and maintenance			*50*
2.4	Selection and use of correct type of hand tools, power tools and measuring equipment			
	FUNCTION - Marine Engineering at the Operational Level			
3	**COMPETENCE 3:** Use hand tools, electrical and electronic measuring and test equipment for fault finding, maintenance and repair operations.			
3.1	Use of electrical measuring and testing equipment in lab and workshop	..	2	20
3.2	Use of electronic instruments, measuring equipment and interpretation of results obtained.	..	3	24
3.3	Safe working practice	10	2	..

	FUNCTION – Marine Engineering at the Operational Level			
4.0	**COMPETENCE 4:** Maintain a safe Engineering Watch			
4.1	Principles to be observed in keeping a safe engineering watch on board the ship	*18*	..	..
4.2	Knowledge of details regarding operational guidance for Engineer Officer-in-charge of an Engineering Watch		..	..
	FUNCTION – Marine Engineering at the Operational Level			
5.0	**COMPETENCE 5:** Use of English in written and oral form (Communication skill and proficiency in Marine Vocabulary)	..	..	..
5.1	Oral communication	*18*		
5.2	Written communication			
5.3	Comprehension and speech			
5.4	***Soft skills including public speaking***			
	FUNCTION – Marine Engineering at the Operational Level			
6.0	**COMPETENCE 6:** Operate Main and auxiliary machinery and associated control systems			
6.1	Knowledge of main and auxiliary machinery on board, including steering gear, air compressor, boiler and refrigeration machinery	74	..	*10*
6.2	Preparation of auxiliary and main machinery for operation			
6.3	Location of common faults, machinery malfunction, troubleshooting, and action necessary to prevent damage, ***overhauling of machines***			
6.4	Machinery related software application on computer	..	30	..
6.5	***Design of marine system***	*8*		
6.6	***Cargo handling system***	*4*		
6.7	Safe working practices	6	..	..
	FUNCTION - Marine Engineering at the Operational Level			
7.0	**COMPETENCE 7:** Operate pumping systems and associated control systems			
7.1	Marine pumps, valves and piping systems – operation and maintenance	24	..	*40*
7.2	Familiarisation of ship's bilge, ballast and cargo oil pumping systems. The operations must be carried out according to established rules and procedures	24	..	24
7.3	Safe working practices	..	..	6

	FUNCTION – Electrical, Electronic and Control Engineering at the Operational Level			
8.0	**COMPETENCE 8:** Operate and maintain alternators, generators and control systems			
8.1	Marine Electro Technology, AC/DC Machines, power circuits, electrical switch gears and starters	12		
8.2	Lighting System and locating common faults on board	6	6	
8.3	Electronic monitoring and control equipment fitted on board. Study of semi-conductors diodes, transistors, amplifiers, thyristors and their testing. Ship's internal communication system and Electronic steering gear	18	24	*20*
8.4	Computer Application – Operating system	2	..	..
8.5	Operation, repair and maintenance of AC, DC machinery and circuit breakers	15	..	*30*
8.6	Routine testing and maintenance on electrical components – MSB fittings, lights, batteries and alarm systems – ***Electrical work***	10	12	*0*
8.7	Safe working practices	2	..	..
	FUNCTION - Maintenance and Repairs at the Operational Level			
9.0	**COMPETENCE 9:** Maintain Marine Engineering Systems including control systems			
9.1	Maintenance overhaul of heat exchangers, marine diesel engines, air compressor, boiler and refrigeration machinery. ***Hydraulics and pneumatics***	18	..	*140*
9.2	Dismantling, reassembling and try out of machinery	..	..	
9.3	Safe working practices	4	..	
	FUNCTION - Controlling the Operation of the ship and care for persons on board at the Operational Level			
10.0	**COMPETENCE 10:** Ensure compliance with pollution prevention requirements.			
10.1	Oily bilge separators, ODM equipment, and incinerator.	16		..
10.2	Sewage treatment plant	6		..
10.3	Outline of MARPOL Annexes	6		..
10.4	Safe working practices	3	3	..
	FUNCTION - Controlling the Operation of the Ship and care for persons on board at the operational Level			
11.0	**COMPETENCE 11:** Maintain seaworthiness of the ship			
11.1	Definition of principal terms used in Naval Architecture			
11.2	Geometry of ships and Hydrostatic calculations			
11.3	Transverse stability of ships			
11.4	Stresses in ships structures			
11.5	Resistance, Propulsion and powering of ships	82		

11.6	Inclining experiment and determination of G.M. of floating body			
11.7	Ship construction – Arrangement and Layout of accommodation. cargo spaces, machinery, spaces etc.	36		
11.8	***Vibration***	***4***		
	FUNCTION - Controlling the Operation of the ship and care for persons on board at the Operational Level			
12.0	**COMPETENCE 12:** Prevent, control and fight fires on board			
12.1	Chemistry of fire	***0***	..	..
12.2	Knowledge of fire fighting appliances		..	***0***
12.3	Approved Course in Fire Prevention Fire Fighting	..	..	..
12.4	Safe working practices	***0***	..	..
	FUNCTION - Controlling the Operation of the ship and care for persons on board at the Operational Level			
13.0	**COMPETENCE 13:** Operate life saving Appliances			
13.1	Approved course in Personal Survival Techniques	..	..	..
13.2	Knowledge of alarms and signals on board ship	10	..	***4***
13.3	Knowledge of life saving appliances and equipment		..	..
13.4	Swimming and Personal survival	..	..	..
13.5	Safe working practices	2	..	..
	FUNCTION - Controlling the Operation of the ship and care for persons on board at the Operational Level			
14.0	**COMPETENCE 14:** Apply Medical First Aid on board ship			
14.1	An approved course in Elementary First Aid	..	..	..
	FUNCTION - Controlling the Operation of the ship and care for persons on board at the Operational Level			
15.0	**COMPETENCE 15:** Monitor compliance with legislative requirements			
15.1	Basic working knowledge of the following IMO Conventions:- SOLAS, MARPOL, LOADLINE, COLREG AND STCW	24		
15.2	Role of Govt. of India in Control of Ships. Role of Classification Society		..	..
15.3	Outline of ISO-9000 and ISM Code			
15.4	***Commercial shipping, Marine insurance***	***8***		
	Total Hours	***500***	***102***	***542***
	Grand Total	***1144 Hours***		

Proposed total training period in workshop 26 weeks, i.e., 26 x 44 = 1144 hours.

N.B.: Additional subjects have been inserted in the above tables as ***5.4, 6.3, 6.5, 6.6, 8.6, 9.1, 11.8*** and ***15.4.***

Table 5.8 Proposed pattern of one year on board training before MEO class IV

Sr.No.	Competence and Course Subjects	Hours of Training on board ship
	FUNCTION – Marine Engineering at the Operational Level	
1.0	**COMPETENCE 1:** Use appropriate tools for fabrication and repair operations typically performed on ships	
1.1	Use of hand and power tools on board	*10*
1.2	Use of machine tools on board and process	*10*
1.3	Use of measuring instruments on board	*10*
1.4	Fabrication, welding, joining and cutting	*50*
1.5	Boiler water L.O./F.O. testing with test kits on board	*40*
1.6	Safe working practices	12
	FUNCTION – Marine Engineering at the Operational Level	
2.0	**COMPETENCE 2:** Use hand tools and measuring equipment for dismantling, maintenance, repair and reassembly of shipboard plant and equipment	
2.1	Familiarisation with tools for marine equipment assembly, repair and maintenance	*50*
2.2	Selection of correct type of hand tools, power tools and measuring equipment	*50*
	FUNCTION – Marine Engineering at the Operational Level	
3.0	**COMPETENCE 3:** Use hand tools, electrical and electronic measuring and test equipment for fault finding, maintenance and repair operations.	
3.1	Use of electrical measuring and testing equipment in electrical workshop on board ship	*20*
3.2	Use of electronic instruments, measuring equipment and interpretation of results obtained.	*20*
3.3	Safe working practices	8
	FUNCTION – Marine Engineering at the Operational Level	
4.0	**COMPETENCE 4:** Maintain a safe Engineering Watch	
4.1	Principles to be observed in keeping a safe engineering watch on board	*40*
4.2	Knowledge of details regarding operational guidance for Engineer Officer-in-charge of an Engineering Watch	*214*
	FUNCTION – Marine Engineering at the Operational Level	
5.0	**COMPETENCE 5:** Use of English in written and oral form **(The trainee has already attained this proficiency at intake level.)**	0

	FUNCTION – Marine Engineering at the Operational Level	
6.0	**COMPETENCE 6:** Operate Main and auxiliary machinery and associated control systems	
6.1	On board ship familiarization of main and auxiliary machinery including steering gear, air compressor, boiler and refrigeration machinery. Preparing main auxiliaries and marine engine for operations.	*140*
6.2	Location of common faults, machinery malfunction, troubleshooting and action necessary to prevent damage	*102*
6.3	Machinery related software application on computer	16
6.4	Safe working practices	24
	FUNCTION – Marine Engineering at the Operational Level	
7.0	**COMPETENCE 7:** Operate pumping systems and associated control systems	
7.1	Marine pumps, valves and piping systems operation and maintenance	*100*
7.2	Familiarisation of ship's bilge, ballast and cargo oil pumping systems. The operations are carried out according to established rules and procedures.	40
7.3	Safe working practices	8
	FUNCTION – Electrical, Electronic and Control Engineering at the Operational Level	
8.0	**COMPETENCE 8:** Operate and maintain alternators, generators and control systems	
8.1	Repair and Maintenance of AC, DC machinery, circuit breakers, switch gear and starters	56
8.2	Lighting System and locating common faults on board	16
8.3	Electronic monitoring and control equipment fitted on board. Ship's internal communication and electrical steering gear if fitted on board	*54*
8.4	Commissioning and performance testing of electrical equipment on board ship	*56*
8.5	Routine testing and maintenance on electrical components – MSB fittings, generators, lights, batteries and alarm systems	*62*
8.6	Safe working practices	4
	FUNCTION – Maintenance and Repairs at the Operational Level	
9.0	**COMPETENCE 9:** Maintain Marine Engineering Systems including control systems	
9.1	Maintenance overhaul of heat exchangers, marine diesel engines, air compressor etc.	*530*
9.2	Installation, re-assembling and testing of machinery on board ships	*502*
9.3	Safe working practices	8

	FUNCTION — Controlling the Operation of the ship and care for persons on board at the Operational Level	
10.0	**COMPETENCE 10:** Ensure compliance with pollution - prevention requirements.	
10.1	Oily bilge separators, ODM equipment, and incinerator.	24
10.2	Sewage treatment plant	*18*
10.3	Applications of MARPOL Annexes	8
10.4	Safe working practices	8
	FUNCTION — Controlling the Operation of the ship and care for persons on board at the Operational Level	
11.0	**COMPETENCE 11:** Maintain seaworthiness of the ship	24
	FUNCTION — Controlling the Operation of the ship and care for persons on board at the Operational Level	
12.0	**COMPETENCE 12:** Prevent, control and fight fires on board	
12.1	Knowledge of fire fighting appliances on board, their operation and maintenance procedures	*62*
12.2	Safe working practices	8
	FUNCTION — Controlling the Operation of the ship and care for persons on board at the Operational Level	
13.0	**COMPETENCE 13:** Operate life saving Appliances	
13.1	Knowledge of alarms and signals on board ship	8
13.2	Knowledge of life saving appliances and equipment on board	*12*
13.3	Safe working practices	8
	FUNCTION — Controlling the Operation of the ship and care for persons on board at the Operational Level	
14.0	**COMPETENCE 14:** Apply Medical First Aid on board ship	
14.1	An approved course in Elementary First Aid	8
	FUNCTION — Controlling the Operation of the ship and care for persons on board at the Operational Level	
15.0	**COMPETENCE 15:** Monitor compliance with legislative requirements	
15.1	Knowledge and application of various rules and legislative requirements in connection with SOLAS, MARPOL, LOADLINE, ISO and ISM Codes	8
	Total Hours	*2496*
	Grand Total	*2496*

Total proposed training period on board before Class IV – 52 weeks, i.e.,

52 x 6 x 8 = 2496 hours.

Similarly, the flow diagram for graduates in mechanical engineering or naval architecture, leading to MEO class IV in compliance with the requirements of STCW' 95 Code A-III/1, MS (STCW for Seafarers) Rules 1998 and META Manual has been revised based on the present study and presented as Fig. 5.9. The original flow chart is shown in Annex 1, Flow diagram 1, channel 5.

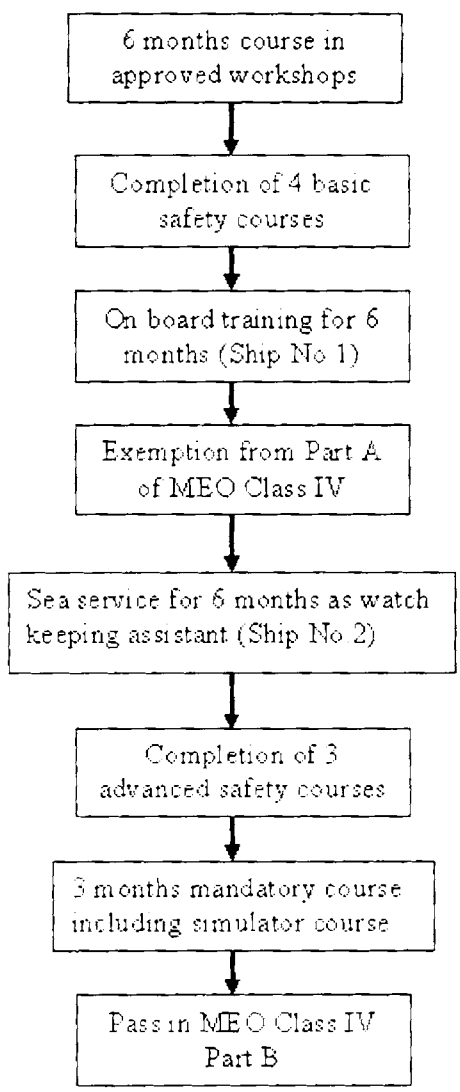

Fig. 5.9 Flow diagram for class IV marine engineer

CHAPTER 6

RECOMMENDATIONS

6.1 Introduction

This chapter contains an overview of the findings of the investigation, its conclusion based on the findings along with the training implications and finally suggestions for further research.

6.2 Hypothesis

(i) Significant modification will have to be brought about in the curriculum of training of marine engineers

(ii) There will be areas of quality standards of mariner engineers, where improvement is necessary based on the changing industry needs.

(iii) There will be significant positive relationships between personality traits and career success of a class IV marine engineer.

6.3 Tenability of hypothesis

The tenability of the hypothesis was verified based on the findings. It is seen that the hypothesis (i), (ii) and (iii) of above have been reasonably substantiated.

6.4 Conclusions and Recommendations

1. Leadership quality and attitude building are to be given more emphasis during training. Additional technical skills such as exposure to overhauling, pneumatics, hydraulics and electrical works are to be imparted to trainee marine engineers. Besides, curriculum of training is to be expanded adding a few topics such as cargo handling system, design of marine system, vibration, commercial shipping, marine insurance and public speaking. Syllabus has been proposed to be modified taking into consideration of these.

2. Sea service of graduate mechanical engineer must be increased to one year covering two ships. Workshop service shall be reduced to six months. Accordingly new Flow Chart has been devised. Practice of maintaining TAR book and Preparatory course before MEO class IV examination shall be continued. Appropriate age of junior engineer at sea is between 22 and 25 years and that of chief engineer at sea is 35 to 44. They should be preferably males and not females.

3. Physical performance of our marine engineers is satisfactory. However, the technical input and social performance of marine engineers are to be further improved in general. Response of our marine engineers to emergency situation on board ship is good. Oral and written communication skill needs to be improved. Technical skill, safety consciousness, team spirit, discipline and hard work are considered to be desirable qualities of a marine engineer. Of these, the first two are of utmost importance. Owners prefer their marine engineers to be on their permanent pay rolls. They want them to specialize systematically in each type of ships. Most of the employers plan to groom their marine engineers for shore jobs.

4. The career success has a decreasing trend as the self esteem of class IV marine engineer increases. Pragmatic learner has better chances of career success. It is observed that 78% of the class IV marine engineers take decisions based on sensation. However marine engineer trainees may be recommended to adopt thinking method in their decision making process, as their success rate is relatively higher.

5. Affiliation has direct link to career success which is statistically significant. Those with increased affiliation as dominant need have an increasing rate of success. 31% of the marine engineers under present scrutiny are found to be of this

category. Team work improves career success of a marine engineer substantially. 84% of class IV marine engineers are poor listeners. 16% are in the category with significant room for improvement. Therefore, training programme of marine engineers should include means to improve their listening skill.

6.5 Suggestions for further research

(i) The researcher has studied mainly the requirements of class IV marine engineers. The study could be extended to other levels of competency.

(ii) The present study is pertaining to only marine engineers following Indian system of training. Many Indian marine engineers are following the foreign system and therefore their system could be brought under scrutiny.

(iii) Additional pertinent factors of personality traits of class IV marine engineer could be considered to establish relationship with the career success. Besides, study could be further extended by including more parameters in the assessment of career success of a class IV engineer.

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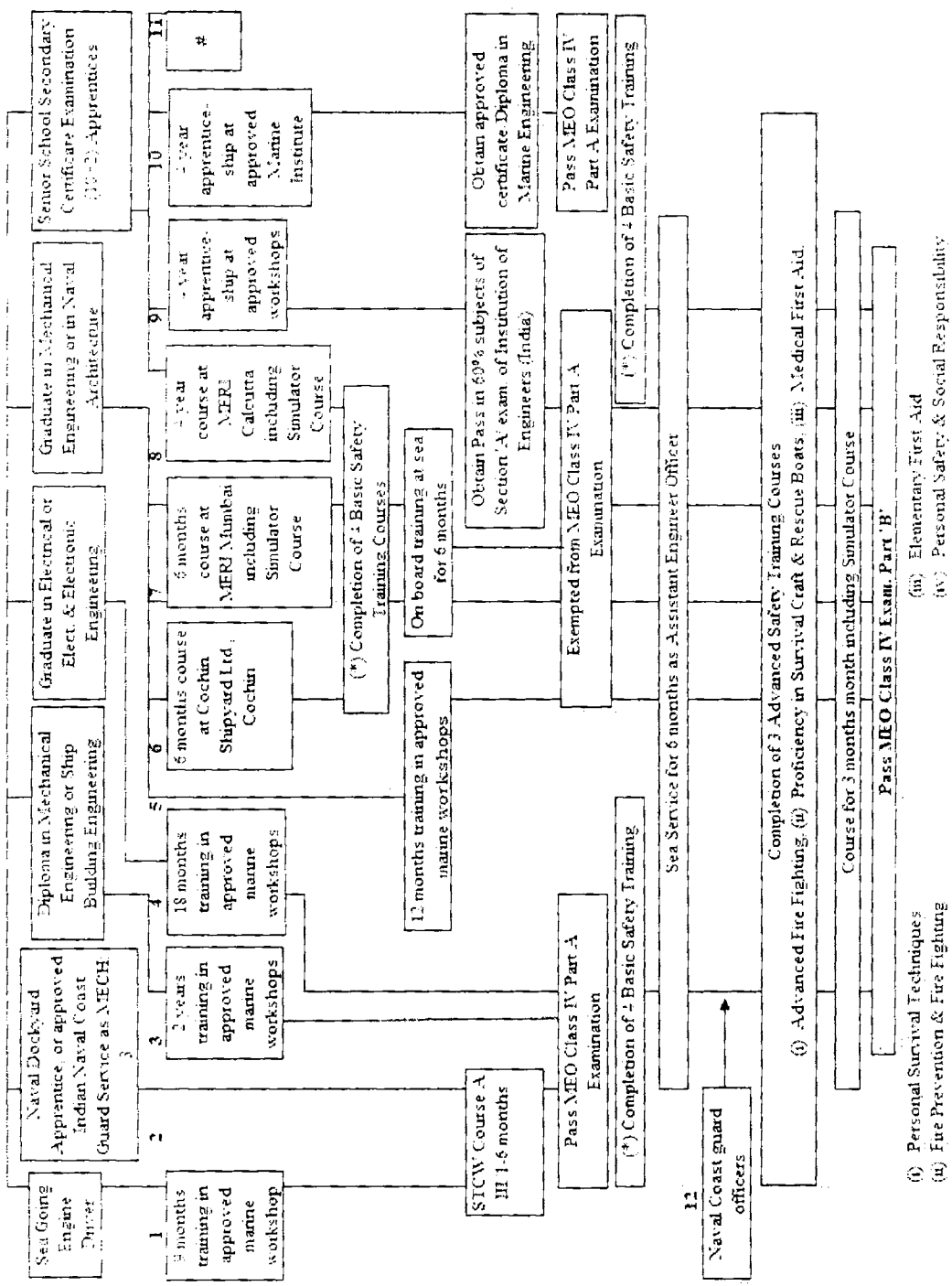
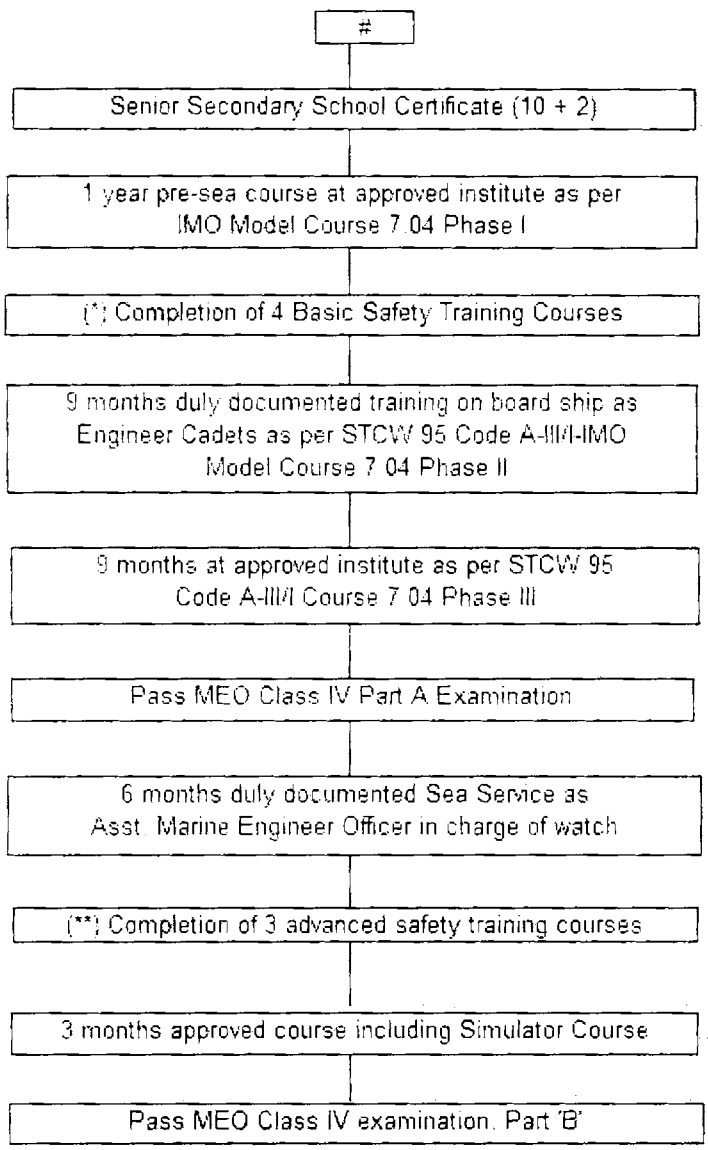
ANNEX I
FLOW DIAGRAM No.1



FLOW DIAGRAM No.2
Alternate training scheme (30 months)
(Reference STCW - 95 Code A-III/I)

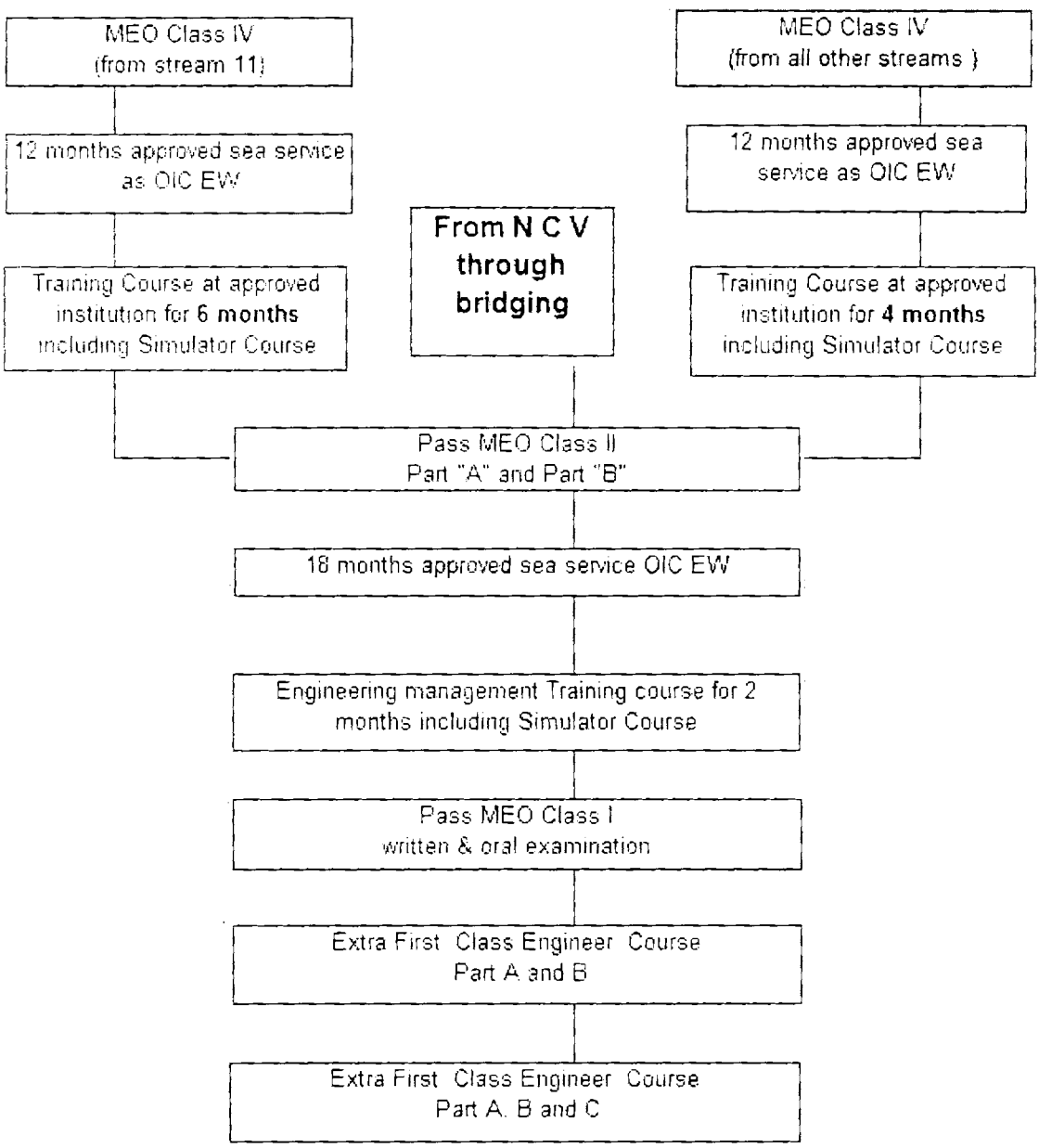


(*) (i) Personal Survival Techniques
(ii) Fire Prevention and Fire Fighting
(iii) Elementary First Aid
(iv) Personal Safety & Social Responsibility

(**) (i) Advanced Fire Fighting
(ii) Proficiency in Survival Craft & Rescue boats other than fast rescue boats
(iii) Medical First Aid

FLOW DIAGRAM No.3

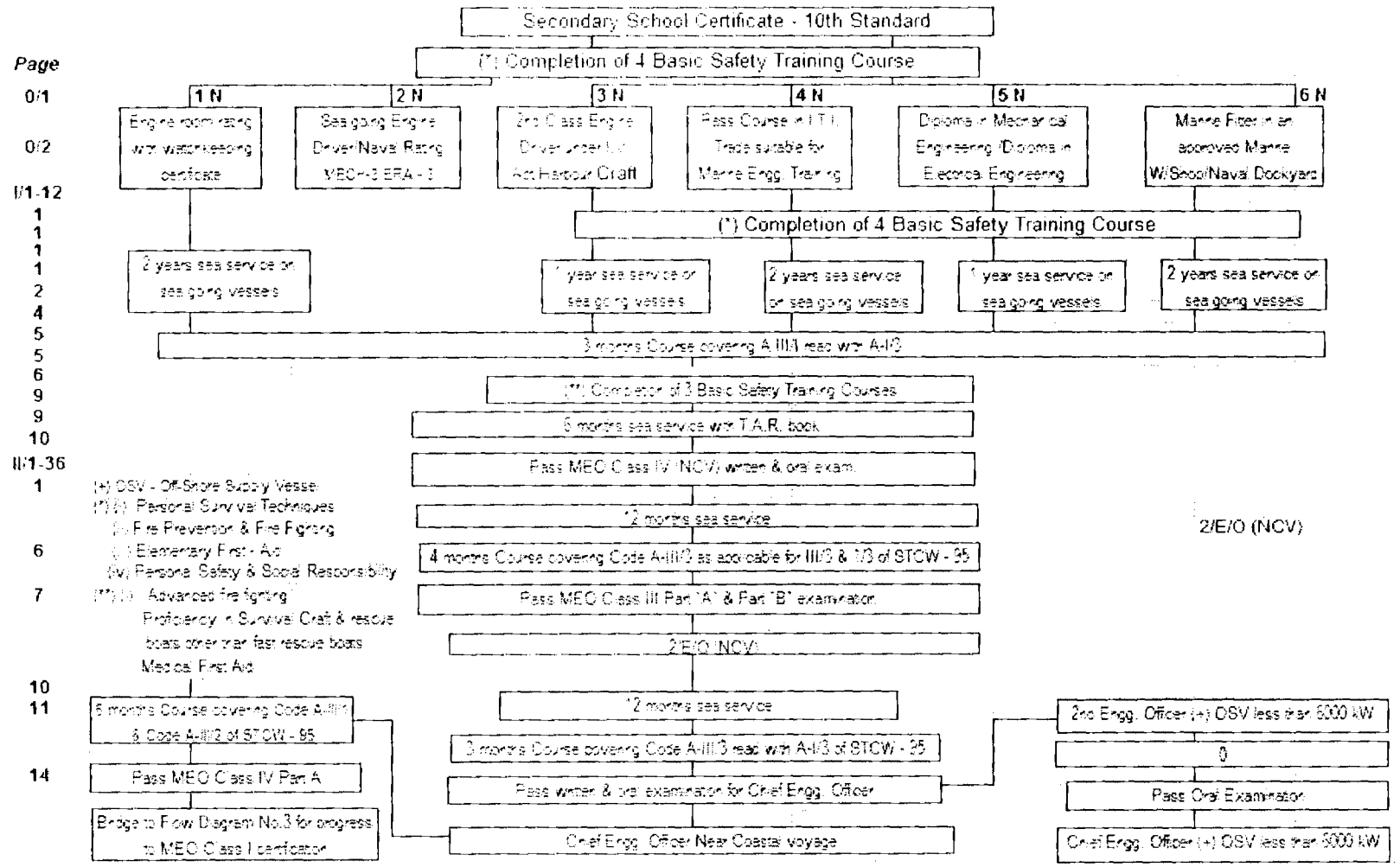
Progression from MEO Class IV to Extra First Class Engineer level of certificate



FLOW DIAGRAM No.4

Certification - Near Coastal voyage

(Less than 3000 kW propulsion power & offshore supply vessel less than 6000 kW propulsion power)



ANNEX II

EXISTING PATTERN OF GME WORKSHOP TRAINING
12 MONTHS WORKSHOP TRAINING FOR GRADUATES IN MECHANICAL ENGINEERING/ NAVAL ARCHITECTURE

Sr.No.	Competence and Course subjects	Hours of Training		
		Class Room	Lab	Training Workshop and Afloat
	FUNCTION - Marine Engineering at the Operational Level			
1	**COMPETENCE 1**: Use appropriate tools for fabrication and repair operations typically performed on ships			
1.1	Use of hand and power tools, basic workshop practice and basic fitting	..		
1.2	Machine tools and processes	..	..	120
1.3	Use of measuring instruments	..	..	
1.4	Fabrication, welding, joining and cutting	..	..	140
1.5	Properties of materials, lab testing and Industrial Chemistry	..	20	..
1.6	Safe working practices	10	..	..
	FUNCTION - Marine Engineering at the Operational Level			
2	**COMPETENCE 2:** Use hand tools and measuring equipment for dismantling, maintenance, repair and reassembly of shipboard plant and equipment			
2.1	Advance workshop practice	..	..	100
2.2	Marine equipment drawing, notations and interpreting the drawing etc.	20	..	..
2.3	Familiarisation with tools for Marine equipment assembly, repair and Maintenance			100
2.4	Selection and use of correct type of hand tools, power tools and measuring equipment			
	FUNCTION - Marine Engineering at the Operational Level			
3	**COMPETENCE 3:** Use hand tools, electrical and electronic measuring and test equipment for fault finding, maintenance and repair operations.			

3.1	Use of electrical measuring and testing equipment in lab and workshop	..	2	20
3.2	Use of electronic instruments, measuring equipment and interpretation of results obtained.	..	3	24
3.3	Safe working practice	10	2	..
	FUNCTION – Marine Engineering at the Operational Level			
4.0	**COMPETENCE 4:** Maintain a safe Engineering Watch			
4.1	Principles to be observed in keeping a safe engineering watch on board the ship	**24**	..	..
4.2	Knowledge of details regarding operational guidance for Engineer Officer-in-charge of an Engineering Watch		..	..
	FUNCTION – Marine Engineering at the Operational Level			
5.0	**COMPETENCE 5:** Use of English in written and oral form (Communication skill and proficiency in Marine Vocabulary)	..	..	..
5.1	Oral communication			
5.2	Written communication			
5.3	Comprehension and speech			
	FUNCTION – Marine Engineering at the Operational Level			
6.0	**COMPETENCE 6:** Operate Main and auxiliary machinery and associated control systems			
6.1	Knowledge of main and auxiliary machinery on board, including steering gear, air compressor, boiler and refrigeration machinery		..	
6.2	Preparation of auxiliary and main machinery for operation	**74**	..	**30**
6.3	Location of common faults, machinery malfunction, troubleshooting, and action necessary to prevent damage			
6.4	Machinery related software application on computer	..	**30**	..
6.5	Safe working practices	**6**	..	..
	FUNCTION – Marine Engineering at the Operational Level			
7.0	**COMPETENCE 7:** Operate pumping systems and associated control systems			
7.1	Marine pumps, valves and piping systems – operation and maintenance	**24**	..	**60**

7.2	Familiarisation of ship's bilge, ballast and cargo oil pumping systems. The operations must be carried out according to established rules and procedures	24	..	24
7.3	Safe working practices	..	..	6
	FUNCTION – Electrical, Electronic and Control Engineering at the Operational Level			
8.0	**COMPETENCE 8:** Operate and maintain alternators, generators and control systems			
8.1	Marine Electro Technology, AC/DC Machines, power circuits, electrical switch gears and starters	12	..	..
8.2	Lighting System and locating common faults on board	6	6	50
8.3	Electronic monitoring and control equipment fitted on board. Study of semi-conductors diodes, transistors, amplifiers, thyristors and their testing. Ship's internal communication system and Electronic steering gear	18	24	
8.4	Computer Application – Operating system	2	..	..
8.5	Operation, repair and maintenance of AC, DC machinery and circuit breakers	15	..	70
8.6	Routine testing and maintenance on electrical components – MSB fittings, lights, batteries and alarm systems	10	12	24
8.7	Safe working practices	2	..	..
	FUNCTION - Maintenance and Repairs at the Operational Level			
9.0	**COMPETENCE 9:** Maintain Marine Engineering Systems including control systems			
9.1	Maintenance overhaul of heat exchangers, marine diesel engines, air compressor, boiler and refrigeration machinery	18	..	720
9.2	Dismantling, reassembling and try out of machinery	..	..	
9.3	Safe working practices	4	..	
	FUNCTION - Controlling the Operation of the ship and care for persons on board at the Operational Level			
10.0	**COMPETENCE 10:** Ensure compliance with pollution prevention requirements.			
10.1	Oily bilge separators, ODM equipment, and incinerator.	16	10	..
10.2	Sewage treatment plant	6		..
10.3	Outline of MARPOL Annexes	6		..
10.4	Safe working practices	3	3	..

	FUNCTION - Controlling the Operation of the Ship and care for persons on board at the operational Level			
11.0	**COMPETENCE 11:** Maintain seaworthiness of the ship			
11.1	Definition of principal terms used in Naval Architecture	**82**		
11.2	Geometry of ships and Hydrostatic calculations			
11.3	Transverse stability of ships			
11.4	Stresses in ships structures			
11.5	Resistance. Propulsion and powering of ships			
11.6	Inclining experiment and determination of G.M. of floating body			
11.7	Ship construction – Arrangement and Layout of accommodation, cargo spaces, machinery, spaces etc.	**36**		
	FUNCTION - Controlling the Operation of the ship and care for persons on board at the Operational Level			
12.0	**COMPETENCE 12:** Prevent, control and fight fires on board			
12.1	Chemistry of fire	**20**	..	..
12.2	Knowledge of fire fighting appliances		..	**8**
12.3	Approved Course in Fire Prevention Fire Fighting	..	..	..
12.4	Safe working practices	**2**	..	..
	FUNCTION – Controlling the Operation of the ship and care for persons on board at the Operational Level			
13.0	**COMPETENCE 13:** Operate life saving Appliances			
13.1	Approved course in Personal Survival Techniques	..	..	..
13.2	Knowledge of alarms and signals on board ship	**10**	..	**8**
13.3	Knowledge of life saving appliances and equipment		..	..
13.4	Swimming and Personal survival	..	..	..
13.5	Safe working practices	**2**	..	..

	FUNCTION - Controlling the Operation of the ship and care for persons on board at the Operational Level			
14.0	**COMPETENCE 14:** Apply Medical First Aid on board ship			
14.1	An approved course in Elementary First Aid	..	..	..
	FUNCTION -- Controlling the Operation of the ship and care for persons on board at the Operational Level			
15.0	**COMPETENCE 15:** Monitor compliance with legislative requirements			
15.1	Basic working knowledge of the following IMO Conventions:- SOLAS, MARPOL, LOADLINE, COLREG AND STCW	**24**		
15.2	Role of Govt. of India in Control of Ships. Role of Classification Society		..	..
15.3	Outline of ISO-9000 and ISM Code			
	Total Hours	**486**	**112**	**1504**
	Grand Total		**2102 Hours**	

ANNEX III

EXISTING PATTERN OF 6 MONTHS TRAINING ON BOARD

Sr.No.	Competence and Course Subjects	Hours of Training on board ship
	FUNCTION – Marine Engineering at the Operational Level	
1.0	**COMPETENCE 1:** Use appropriate tools for fabrication and repair operations typically performed on ships	
1.1	Use of hand and power tools on board	1
1.2	Use of machine tools on board and process	1
1.3	Use of measuring instruments on board	1
1.4	Fabrication, welding, joining and cutting	5
1.5	Boiler water/L.O./F.O. testing with test kits on board	4
1.6	Safe working practices	12
	FUNCTION – Marine Engineering at the Operational Level	
2.0	**COMPETENCE 2:** Use hand tools and measuring equipment for dismantling, maintenance, repair and reassembly of shipboard plant and equipment	
2.1	Familiarisation with tools for marine equipment assembly, repair and maintenance	8
2.2	Selection of correct type of hand tools, power tools and measuring equipment	8
	FUNCTION – Marine Engineering at the Operational Level	
3.0	**COMPETENCE 3:** Use hand tools, electrical and electronic measuring and test equipment for fault finding, maintenance and repair operations.	
3.1	Use of electrical measuring and testing equipment in electrical workshop on board ship	8
3.2	Use of electronic instruments, measuring equipment and interpretation of results obtained.	8
3.3	Safe working practices	8
	FUNCTION – Marine Engineering at the Operational Level	
4.0	**COMPETENCE 4:** Maintain a safe Engineering Watch	
4.1	Principles to be observed in keeping a safe engineering watch on board	16
4.2	Knowledge of details regarding operational guidance for Engineer Officer-in-charge of an Engineering Watch	48
	FUNCTION – Marine Engineering at the Operational Level	
5.0	**COMPETENCE 5:** Use of English in written and oral form	0

	(The trainee has already attained this proficiency at intake level.)	
	FUNCTION – Marine Engineering at the Operation Level	
6.0	**COMPETENCE 6:** Operate Main and auxiliary machinery and associated control systems	
6.1	On board ship familiarization of main and auxiliary machinery including steering gear, air compressor, boiler and refrigeration machinery. Preparing main auxiliaries and marine engine for operations.	120
6.2	Location of common faults, machinery malfunction, troubleshooting and action necessary to prevent damage	72
6.3	Machinery related software application on computer	16
6.4	Safe working practices	24
	FUNCTION – Marine Engineering at the Operational Level	
7.0	**COMPETENCE 7:** Operate pumping systems and associated control systems	
7.1	Marine pumps, valves and piping systems operation and maintenance	80
7.2	Familiarisation of ship's bilge, ballast and cargo oil pumping systems. The operations are carried out according to established rules and procedures.	40
7.3	Safe working practices	8
	FUNCTION – Electrical, Electronic and Control Engineering at the operational Level	
8.0	**COMPETENCE 8:** Operate and maintain alternators, generators and control systems	
8.1	Repair and Maintenance of AC, DC machinery, circuit breakers, switch gear and starters	56
8.2	Lighting System and locating common faults on board	16
8.3	Electronic monitoring and control equipment fitted on board. Ship's internal communication and electrical steering gear if fitted on board	24
8.4	Commissioning and performance testing of electrical equipment on board ship	16
8.5	Routine testing and maintenance on electrical components – MSB fittings, generators, lights, batteries and alarm systems	32
8.6	Safe working practices	4
	FUNCTION – Maintenance and Repairs at the Operational Level	
9.0	**COMPETENCE 9:** Maintain Marine Engineering Systems including control systems	
9.1	Maintenance overhaul of heat exchangers, marine diesel engines, air compressor etc.	240
9.2	Installation, re-assembling and testing of machinery on board ships	212
9.3	Safe working practices	8

	FUNCTION – Controlling the Operation of the ship and care for persons on board at the Operational Level	
10.0	**COMPETENCE 10:** Ensure compliance with pollution - prevention requirements.	
10.1	Oily bilge separators, ODM equipment, and incinerator.	24
10.2	Sewage treatment plant	8
10.3	Applications of MARPOL Annexes	8
10.4	Safe working practices	8
	FUNCTION – Controlling the Operation of the ship and care for persons on board at the Operational Level	
11.0	**COMPETENCE 11:** Maintain seaworthiness of the ship	24
	FUNCTION – Controlling the Operation of the ship and care for persons on board at the Operational Level	
12.0	**COMPETENCE 12:** Prevent, control and fight fires on board	
12.1	Knowledge of fire fighting appliances on board, their operation and maintenance procedures	32
12.2	Safe working practices	8
	FUNCTION – Controlling the Operation of the ship and care for persons on board at the Operational Level	
13.0	**COMPETENCE 13:** Operate life saving Appliances	
13.1	Knowledge of alarms and signals on board ship	8
13.2	Knowledge of life saving appliances and equipment on board	8
13.3	Safe working practices	8
	FUNCTION – Controlling the Operation of the ship and care for persons on board at the Operational Level	
14.0	**COMPETENCE 14:** Apply Medical First Aid on board ship	
14.1	An approved course in Elementary First Aid	8
	FUNCTION – Controlling the Operation of the ship and care for persons on board at the Operational Level	
15.0	**COMPETENCE 15:** Monitor compliance with legislative requirements	
15.1	Knowledge and application of various rules and legislative requirements in connection with SOLAS, MARPOL, LOADLINE, ISO and ISM Codes	8
	Total Hours	**1248**
	Grand Total	**1248**

ANNEX IV

MARINE ENGINEERING TRAINING INSTITUTES IN INDIA

Maritime training and education in India started in December 1927 on board T.S. Dufferin at Mumbai. The training was initially for deck cadets. This training was extended to marine engineering cadets since 1935. Twenty five cadets each of nautical and engineering wings were admitted every year. The first and foremost marine engineering training institute ashore was established in 1947 at Taratalla Road, Calcutta to satisfy the growing need of marine engineers in India. This was a dream project of modern India. It started with an intake of 60 marine engineering cadets per year. This was initially named as Directorate of Marine Engineering Training (DMET). The headquarters is situated in Calcutta and a branch is organized at Mumbai, under Ministry of Shipping (Government of India). The Institute has been renamed as Marine Engineering and Research Institute on 2nd February, 1994. Presently, 120 young marine engineering graduates are passing out of the portals of this time tested and proven institution. This is now considered as one of the most acclaimed marine institutes around the world.

Four year degree course in marine engineering approved by AICTE (All India Council for Technical Education) is being successfully conducted here. The theoretical classes together with practical training in the workshops of the institute are being imparted here besides carrying out actual maintenance, repair and overhauling of ship machineries in the marine workshops and repair yards. On successful completion of the course, the institution offers B.Mar.E. degree through her affiliation to Jadavpur University, Kolkata.

Apart from sailing over the high seas around the globe traditionally, her alumni are occupying senior positions in the shipping industry all over the globe. She is also satisfying the present need of STCW-95 Convention of IMO. The institution constantly moulds the cadets into disciplined, dedicated and highly motivated marine engineers.

Maritime training institutes in India were mainly in the Government sector till the year 1996, when it was opened up for private sector participation. Since then, more than 100 maritime training institutes were established in India in a short span of 5 years time. These institutes conduct various pre sea and post sea courses and supply trained hands to the shipping industry world wide.

The above development influenced the marine engineering training too.

A.IV.1 Following are the training institutes conducting 4 year degree in marine engineering

1. Academy of Maritime Education and Training at Chennai, approved in 2001 for an annual capacity of 200 cadets.
2. Coimbatore Marine College at Coimbatore approved in 2004 for annual capacity of 80 cadets.
3. C.V. Raman College of Engineering at Mathura, Bhuvaneswar approved in 2005 for a capacity of 40 cadets per year.
4. K. M. School of Marine Engineering, Cochin University of Science and Technology, Cochin, approved in 2007 for a capacity of 30 cadets per year.
5. Euro Tech Maritime Academy at Cochin approved in 2007 for a capacity of 80 cadets per year.
6. Institute of Technology and Marine Engineering, Jhinga, Diamond Harbour Road, West Bengal approved in 2003 for 80 cadets.
7. International Maritime Institute Ltd, Greater Noida approved in 2005 for a capacity of 40 cadets.
8. Maharashtra Academy of Naval Education and Training, Pune approved in 2001 for 200 cadets.
9. Marine Engineering and Research Institute, Kolkata approved in 1952 for 150 cadets.
10. Mohamed Sathak Engineering College, Kilakarai, Ramnathapuram, Tamil Nadu approved in 2000 for 30 cadets.
11. M/s. GKM College of Engineering and Technology, Alapakkam-Mappedu Road, G.K.M. Nagar, Chennai - 63 approved in 2006 for 40 cadets.

12. PSN College of Engineering and Technology, Palayamkottai, Thirunelveli approved in 2004 for 30 cadets. In 2008 the approved intake was 60.
13. RL Institute of Nautical Sciences, Madurai approved in 2000 for 120 cadets.
14. Sri Venkateshwara College of Engineering, Sriperumbadur approved in 2002 for 30 cadets.
15. Tolani Maritime Institute, Talegaon, Pune approved in 2002 for 240 cadets.
16. Vel's Academy of Maritime Education and Training, Chennai approved in 2005 for 80 cadets.
17. The Praveenya Institute of Marine Engineering & Maritime Studies, (PRIME), Vishakhapatnam, Andhra Pradesh approved in 2006 for 40 cadets.
18. SAMS College of Engineering and Technology, #82 Panapakkam, Chennai approved in 2006 for 40 cadets.
19. International Maritime Academy, Korattur Village, Thiruvallur District approved in 2006 for 40 cadets and 80 cadets in the year 2008.
20. Sri Nandanam College of Engineering, Tirupattur, Vellore District, Tamil Nadu approved in 2007 for 40 cadets. Approved intake is 30 for the year 2008.
21. Narool Islam College of Engineering, Kumaracoil, Thuckalay, Tamil Nadu approved in 2007 for 40 cadets.

Total: 1730 cadets per year

Mazagon Docks Ltd. Mumbai has been approved for 25 trainees to undergo 4 year marine engineering workshop training.

A.IV.2 Following institutes are approved for conducting pre sea course for graduate mechanical engineers

1. Applied Research International, New Delhi approved in 2005 for 24 trainees
2. Chidambaram Institute of Maritime Technology, Chennai approved in 1999 for 48 trainees
3. Cochin Shipyard Ltd., Cochin approved for 100 trainees
4. Coimbatore Marine Centre, Coimbatore approved in 2003 for 60 trainees

5. Garden Reach Ship builders and Engineers Ltd., Kolkata approved for 100 trainees
6. Institute of Maritime Studies, Vasco-da-Gama, Goa approved in 1999 for 50 trainees
7. M/s Maritime Foundation, Chennai approved in 2002 for 48 trainees
8. M/s Academy of Maritime Education and Training, Chennai approved in 2002 for 24 trainees
9. Marine Engineering and Research Institute, Mumbai approved in 2001 for 120 trainees
10. Samundra Institute of Maritime Studies, Pune approved in 2005 for 160 trainees
11. Vel's Academy of Maritime Education and Training, Chennai approved in 2005 for 48 trainees.
12. RL Institute of Nautical Science, Madurai, Tamil Nadu approved in 2008 for 40 trainees.
13. Great Eastern Shipping Company Training Institute, Lonavala, Pune approved in 2006 for 80 trainees.
14. PSN College of Engineering & Technology, Tirunelveli approved in 2008 for 40 trainees.

Total: 942 trainees per year

A.IV.3 Institutes approved for conducting 2 year pre sea course for diploma holders

1. Dr. B.R Ambedkar Govt. Polytechnic, Port Blair approved in 2004 for 24 trainees
2. Institute of Maritime Studies, Goa approved in 2000 for 25 trainees
3. Chidambaram Institute of Maritime Technology, Chennai approved in 2001 for 24 trainees
4. Southern Academy of Maritime Studies, Chennai approved in 2002 for 48 trainees
5. Maritime Foundation, Chennai approved in 2002 for 24 trainees
6. Vel's Academy of Maritime Education and Training, Chennai approved in 2005 for 24 trainees.

Total: 169 trainees per year

A.IV.4 Institutes approved for conducting marine engineers Alternate Training Scheme (ATS)

1. Chennai School of Ship Management, Chennai approved in 1999 for 48 trainees
2. Don Bosco Maritime Academy, Mumbai approved in 1998 for 20 trainees and now discontinued
3. International Maritime Institute Ltd., UP approved in 1998 for 24 trainees and now discontinued
4. Interface College of Maritime Studies, Chennai approved in 1999 for 82 trainees and now discontinued

Total: 48 trainees per year

A.IV.5 Institutes approved for conducting pre sea Polyvalent Course

1. Marine Engineering and Research Institute, Mumbai approved for 40 cadets
2. Academy of Maritime Education and Training, Chennai approved for 300 cadets

Total: 340 cadets per year

A.IV.6 Institutes approved for conducting pre sea 3 year B.Sc. (Nautical Science) and 4 year B.S. (Nautical Technology)

1. T.S. Chanakya, Navi Mumbai approved for 90 cadets
2. Academy of Maritime Education and Training, Chennai approved for 96 cadets
3. Southern Academy of Maritime Studies, Chennai approved for 40 cadets
4. Vel's Academy of Maritime Studies, Chennai approved for 90 cadets
5. Indian Centre for Advancement of Research and Education, Haldia approved for 80 cadets
6. R.L Institute of Nautical Science, Madurai approved for 80 cadets
7. Tolani Maritime Institute, Talegoan, Pune approved for 40 cadets

Total: 516 cadets per year

- T91 -

The above mentioned institutes are the approved ones in the country to render structured training for marine engineers. However, this does not include the channels of marine engineering trainees for Near Coastal Voyages (NCV).

It is felt that the number of engineering cadets being trained in the country can gradually be raised over the years in view of the growing demand for Indian marine engineers all over the world. The BIMCO / ISF study, "*The world wide demand and supply of seafarers*" shows that currently there is a world wide shortage of 16,000 officers [illegible]

In view of the above study results, the number of officer trainees can accordingly be increased safely without compromising on the quality of engineer.