WORLD MARITIME UNIVERSITY
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A STUDY ON THE PREPARATION FOR THE INTRODUCTION OF THE DUAL PURPOSE TRAINING SYSTEM

By

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INDIA

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DECLARATION

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

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

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Abstract

The dissertation studies the preparations for the implementation of dual purpose training for the merchant marine officers in a country based on the needs of the maritime community and in the light of rapid developments in technology.

A brief study of the requirements under the STCW'95 when implementing the new course was done. Dual purpose training in a few countries was studied and the salient features identified. The IMO model courses at operational and management level for both nautical and engineer officers are used to propose the new course. Effective time management techniques are recommended in designing the course. The proposed dual purpose training course integrates both the nautical and engineering functions, avoiding overlaps in the syllabus. Use of modern teaching aids and means of modern communication though recommended, is not essential for the development of the course. The course is enriched with additional subjects to produce a better quality dual purpose officer on ships and also having broader career opportunities ashore.

In depth examinations reveal that the success of the implementation depends on the commitment and active participation of all the maritime communities. The effect of introducing dual purpose training on the maritime communities with regard to preparation time, approvals, certification system, infrastructure, course design, selection criteria of trainees, shipboard training and manning, labour and human factor issues have been elaborately discussed. The importance of the cooperation of the traditional officers and the establishment of work regime onboard ships is discussed. The need for human factor awareness courses in MET institutions is emphasised. Steps to be taken by the maritime communities to facilitate the introduction of dual purpose training have been identified and explained. A few recommendations are made to mitigate problems encountered during the implementation phase.

KEYWORDS: Dual purpose, DPT, Facilitate, Introduce, MA, MET, Seafarers, Shipping companies, Trainees.

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LIST OF ABBREVIATIONS

APRVL	Approval
ARPA	Automatic Radar Plotting Aids
B.Sc	Bachelor of Science
Exam	Examination
Cert.	Certification
COC	Certificate of competency
DGS	Directorate General of Shipping, Mumbai, India
DMA	Danish Maritime Authority
DPT	Dual purpose training
DPC	Dual purpose certification
GMDSS	Global Maritime Distress and Safety System
IIT-JEE	Indian Institutes of Technology-Joint Entrance Examination
IMLA	International Maritime Lecturers Association
LSM	Lloyd's Ship Manager
MA	Maritime administration
MERI	Marine Engineering and Research Institute
MET	Maritime education and training
MI	MET institution
MIWB	Maritiem Instituut Willem Barentsz, Terschelling
OOEW	Officer incharge of Engineering Watch
OOWN	Officer incharge of Navigating Watch
PCM	Physics, chemistry and mathematics
Regn	Regulation
Res.A.	Resolution Assembly
SC	Shipping Companies
SSTP	Structured Shipboard Training Program

STCW	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978, as amended in 1995 and 1997(STCW Convention) and Seafarer's Training, Certification and Watchkeeping Code (STCW Code) including resolution 2 of the 1995 STCW Conference as amended in 1997,1998, and 2000
TPC	Tonnes per centimetre
TRB	Training Record Book
U.K	United Kingdom
U.S.A	United States of America
WMU	World Maritime University.

Chapter 1

1. Introduction

1.1 Background

Quality Shipping needs quality seafarers. Ships are only as good as the men who man them. With rapidly changing marine technology, traditional compartmentalised training and education is no longer sufficient to accomplish the safe management of a ship. Rapid proliferation of high tech equipment and machinery requires merchant marine officers with a vision of a ship in totality.

A merchant marine career does not appear to be as attractive today. The youth have to be motivated to pursue this career. People living in developed and even developing countries are shying away from sea going careers due to various reasons like time away from family, boredom, difficulty in changing over to career ashore and mental stagnation. It is not always the money, but it is the professional pride and reputation enjoyed in the society that drive young people towards a specific career. Therefore, a career, which offers them more opportunities to fulfil their aspirations, is the need of the day.

Shipboard tasks today, extend beyond the capabilities of a traditional nautical or an engineer officer. Increasing use of automation and control systems for engine, cargo and navigational needs have diffused the differences between the nautical and engineering departments to a large extent. It is logical to expect an officer dependent on the use of equipment like hydraulic hatch covers, deck machinery, loading ramps, and steering engines to be capable of understanding the design, operation and safety requirements of such equipment. Similarly an officer handling cargo operations onboard a tanker, in addition to having knowledge of the complex pipeline system should also possess practical and theoretical knowledge of fluid behaviour in pumps, valves and systems (Hirschkowitz et al, 1992, p.5.2).

With the decreasing number of seafarers on modern ships, the officers must be trained to tackle the various tasks and problems faced onboard. The cross discipline training would be very helpful in evenly distributing duties during operational and maintenance peak work loadings, thereby reducing fatigue. Foreshaw (1990, p.7.2) stated, “Flexibility is the key word in manning the ships of the future”. The traditional manning structure is role based and offers little flexibility. This necessitates officers with knowledge of both nautical and engineering functions. Integration of both the shipboard departments while retaining the traditional specialisation is essential. The solution lies in training dual purpose officers to meet the present day needs of the maritime communities.

A dual purpose officer is an officer who has acquired a dual purpose certificate of competency from the maritime administration (MA). A holder of this certificate of competency would be capable of watchkeeping with equal competence in both the navigating bridge and the engine room. The level of training must be at least at par with both the traditional monovalent nautical and engineering certificate of competency holder.

1.2 Objectives

The introduction of dual purpose training (DPT) would be a big attempt by the developed countries to attract bright young people to join seafaring careers to man their high technology vessels and subsequently taking up positions in their shore establishments. For the labour supplying countries it is an opportunity to market the better-educated officers competitively in the global shipping market providing job opportunities to its citizens and contributing to their national economy.

The dissertation attempts to achieve the following objectives:

- Propose a structure for the introduction of an efficient DPT to produce better quality merchant marine officers in a country.
- Identify the impact of DPT on the maritime education and training (MET) institutions, MA, shipping companies and seafarers.
- Highlight measures to be taken for the facilitation of DPT and recommend solutions, if possible for any hurdles encountered.

The focus of this dissertation is mainly on the DPT course, shore based MET and onboard training, shipboard manning, labour issues and human factors. In view of the limited scope for coverage, the impact of the introduction of DPT, on the structure of the MA, financial implications for the MET institution, the reaction of seafarers union, and the staff ashore at the MA, MET institution and the shipping companies are considered as issues beyond the purview of discussion of this dissertation.

1.3 Methodology

This dissertation studies the preparations for introducing DPT in a country to produce dual purpose officers capable of manning all types of ships, irrespective of its age and size. The methodology adopted in Chapter 2 is to study and compare the DPT schemes presently being followed in a few countries namely Denmark, Japan, the Netherlands, and India and identifying their salient features. The studies were conducted either by visiting the MET institutions in these countries, by personal interviews or through electronic correspondence with senior training officers of these countries.

In Chapter 3, the requirements under STCW'95 for introducing DPT in a country are highlighted. The strategy adopted in the Netherlands, a country with vast experience in this field, is examined in detail for the implementation of the DPT course. Further, the IMO model courses for both operational and management level competency courses are examined to determine the effective time duration for the proposed DPT course. Drawing from the salient features of the DPT course in the four countries, adopting strategies from the system in the Netherlands and from a study of the IMO model courses, a structure for the implementation of an effective DPT is proposed.

A study of the impact of introducing DPT on the MA, MET institutions, shipping companies and seafarers is undertaken in Chapter 4. The steps to be taken to facilitate DPT have been discussed in Chapter 5. The study includes course approval and design, certification system, training needs, recruitment strategies, shipboard manning, shore management, its effects on the seafarers and the preparation period required. Wherever possible, attempts are made to recommend

measures to mitigate any impedance to the implementation process. The discussions in Chapters 4 and 5 therefore complement each other. Since, DPT is yet to come up in a big way and not much reference data is available, particularly on the subject being written, it is possible that some of the impacts of introducing DPT may not have been identified. However, within the limitations a sincere endeavour has been made.

In Chapter 6, conclusions are drawn from the discussions in Chapter 2,3,4 and 5. A few recommendations have been made that would facilitate the introduction of an effective DPT system in a country.

The entire chain of DPT system would have to be comprehensively covered by a quality standards system. The MA of a country would be responsible to ensure the compliance with the quality standards by all the maritime communities. This is a requirement for any MET course conducted within the purview of the STCW Convention. Hence the quality standards system has not been specifically discussed in this study.

Chapter 2

2. Dual purpose training

DPT first originated in the U.S.A. in 1965, more as an alternate training programme to offer seafarers better shore based career opportunities. It was then offered in France in 1967 and gradually spread to other countries mainly Denmark, Germany, Japan, the Netherlands, and the U.K. Recently, India and Singapore have also introduced DPT in their MET systems.

This Chapter examines the types of DPT being implemented. The reasons generally given for the shift to DPT is enumerated. Finally, a study is done on the DPT system being followed in Denmark, Japan, the Netherlands and India and comparisons are drawn.

2.1 Dual purpose training – status

Dual purpose officer is a ship's officer who has been trained to perform both nautical as well as the engineering duties onboard. Different countries started DPT for a variety of reasons and in mainly two different forms i.e. "Fully integrated officers" and "Semi integrated officers".

Fully integrated officers are educated and trained to meet the minimum requirements of both the nautical and engineering disciplines as under the amended STCW Convention and Code at management level and certified for the highest certificates of competency of both the nautical and engineering department. An officer with this highest management level certificate of competency is entitled to function in the capacity of a Master and/or a Chief Engineer onboard.

Semi integrated officers are educated and trained to meet the minimum requirements of either one of the nautical or engineering discipline under the STCW

Convention and Code at the management level and for the operational level duties in the other department. They are, hence certified to the highest management level certificate in one department and operational level certificate in the other department. In this case an officer with the highest management level certificate of competency can function either as a Master or as a Chief Engineer depending on the discipline and possesses operational level competency in the other discipline.

An officer trained under this integrated concept is known by various names in different countries, which are indeed confusing to those familiar with the traditional system. As an example Table 2.1 indicates the different terminology used to describe dual purpose officers in a few countries.

Table 2.1: Terminology for dual purpose officers in few countries

Country	**Terminology**
Denmark	Dual purpose officer
Netherlands	Maroff
Japan	Maritime officer
India	Polyvalent officer
France	Polyvalent officer
Germany	Ship Operation officer

The many reasons given for this shift to DPT in certain countries from the traditional and engineering discipline are as follows:

- To operate modern ships more efficiently and effectively with flexible manning systems.
- Higher the level of automation, fewer people are required onboard, human error is reduced.
- Higher efficiency due to better trained officers
- Even distribution of resources during periods of peak workload.
- Shorter turn around time, short stay in ports increases the frequency of work peaks necessitating flexible use of available manpower.
- Reduction in high manning costs due to reduction in crew size.
- Need to retain high cost national seafarers on national flagged ships in developed countries.

- Availability of better trained officers for jobs ashore
- Higher job satisfaction for officers with an opportunity to attain career aspirations.
- More opportunities for seafarers desiring to make a changeover from their sea career for jobs ashore.

In the labour supplying countries, the introduction of DPT has been largely due to the pressure from the ship-owners in the developed countries requesting for dual purpose officers to man their ships so that their operating costs could be further reduced.

2.2 Dual purpose training in Denmark, Japan, the Netherlands and India

2.2.1 Dual purpose training in Denmark

DPT was introduced in Denmark in 1997. The Danish Maritime Authority (DMA) and the shipping industry visualised DPT as a tool to operate modern vessels more efficiently and effectively. A higher qualitative profile of the officer by being trained in both the nautical and engineering functions was considered as a means to attaining higher efficiency. The impetus for DPT was the need to maintain Denmark's position as a seafaring nation with Danish seafarers onboard national ships. The DMA is responsible for the scope, objectives, syllabus of maritime education, approval of MET institutions, and the certification of seafarers (Lock, 2002,pp.1-3).

Maritime training in Denmark alternates between theoretical studies ashore at the MET institution and practical training at sea. There must be a signed written agreement between the student and a shipping company approved by the DMA (Lock, 2002,p.3). Students remain attached to one specific shipping company throughout their training and education.

The sequence of MET training ashore and shipboard service for DPT is as follows (Lock, 2002,pp.3-5):

1) For admission, the student in Denmark must hold a High School diploma (12 years of general education) or equivalent of sixth form college C-level diploma (UK), with the subjects mathematics, physics, chemistry, Danish and English. However, there is a provision to admit students with 10 years of general education with a special 6 months course in mathematics, physics, chemistry, English and Danish (Hemming, 2004)[1].
2) The first theoretical term of six months is at the MET institution. The contents of this session are in compliance with the requirements under STCW Convention and Code Chapter VI/1 and II/4 including additional national requirements.
3) Shipboard training for a period of six months during which the requirements of the first period of sea going service must be duly filled in and completed in an onboard Training Record Book (TRB) published by the DMA. Thereafter the student proceeds to the second theoretical term.
4) Shore based technical and workshop training for a period of six months in engineering documentation, material knowledge, workshop technology, vice and engineering work, thermal joining, occupational safety, maintenance, and wiring.
5) Second theoretical training of twelve months at the MET institution.
6) Sea service of twelve months for shipboard training with the approved TRB.
7) Third theoretical training of twelve months at the MET institution. The training programme is aimed at having a fully qualified officer at the operational level satisfying the requirements of all the functions of Chapter II/1 and Chapter III/1 of STCW Convention and Code. The certificate of competency as a dual purpose officer at the operational level can then be issued in accordance with Chapter II/1 and Chapter III/1.
8) After graduation from the MET institution, the student can serve as a dual purpose officer at the operational level.
9) It is required to have a minimum seagoing service of twelve months as a dual purpose officer at the operational level before the officer can enrol at the

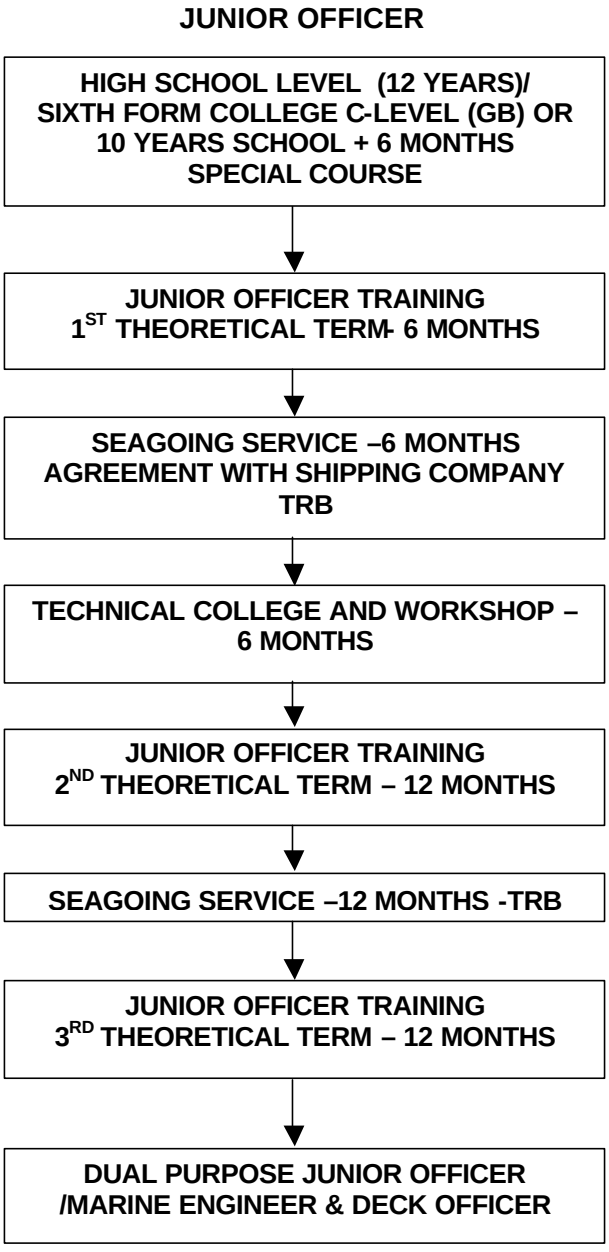
[1] Mr.Hemming, H. (DMA) advised through an email dated June 24, 2004 about the provision for admitting students with 10 years of schooling in to the DPT course in Denmark.

MET institution for an additional theoretical education for certification at the management level.

10) The MET program at management level is available in three tracks: Master Mariner, Chief Engineer or the dual purpose Ship's Manager. Each track has a relevant syllabus. The Master Mariner and Chief Engineer track is of 18 months duration and the syllabus has certain overlaps, which makes it possible to upgrade to the Ship's Manager certificate of competency if desired at a later stage without having to attend the entire programme. The Ship's Manager course is of 24 months duration.

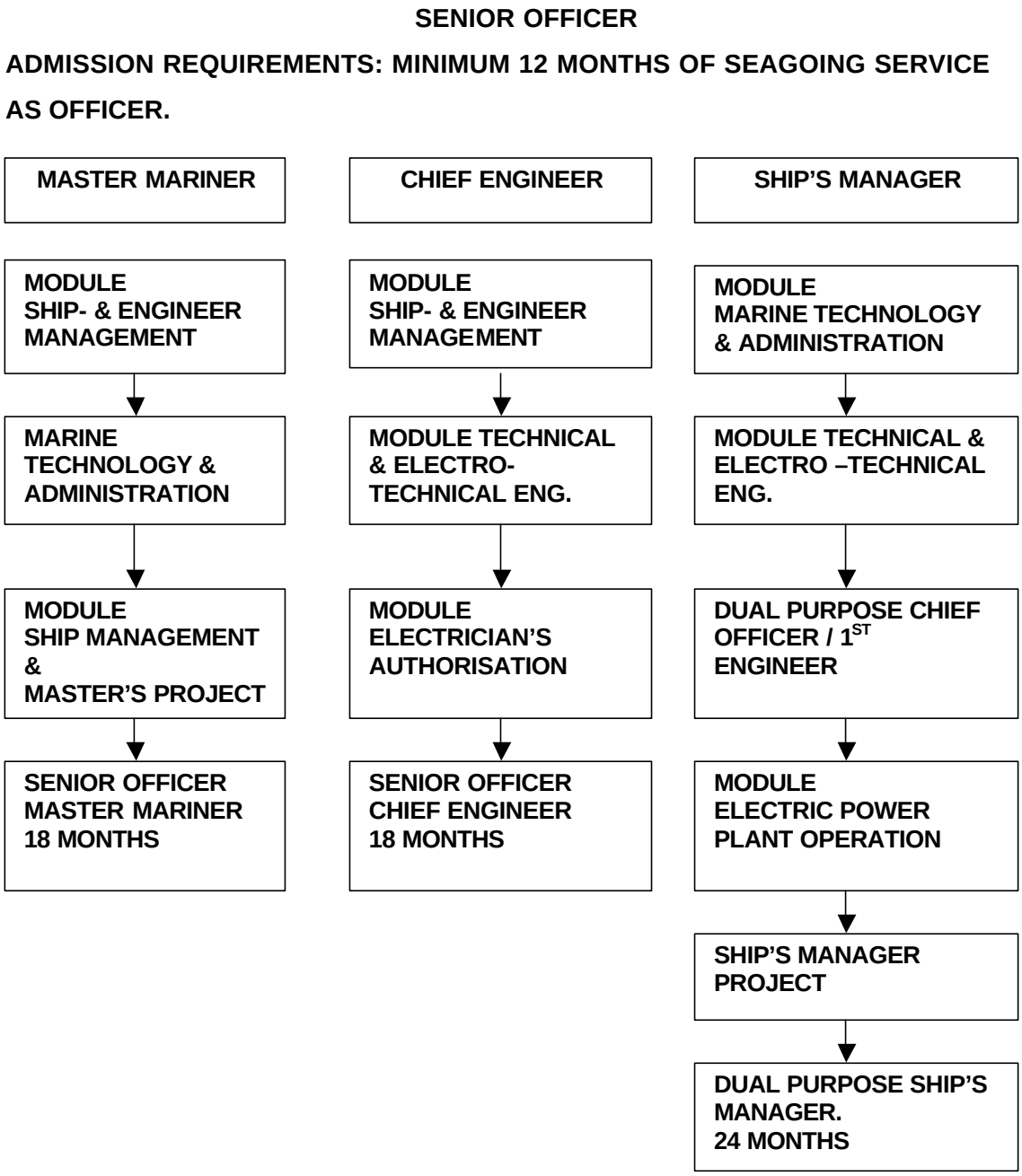
11) Upon successful completion of the MET Program at the management level, the officer shall be able to function as a ship's officer at the management level in the rank of a Chief Officer or Second Engineer or in dual capacity depending on the track chosen by the officer. After completion of the requisite seagoing service the officer can obtain certificates as Master, or Chief Engineer or the Ship's Manager meeting the requirements of STCW Convention under Regulation II/2 or III/2 or both II/2 and III/2.

Figure 2.1 illustrates the DPT for operational level watchkeeping officers and Figure 2.2 gives the same for the management level officers in Denmark.



(Source: (Lock, 2002), (Hemming, 2004))

Figure 2.1: Dual purpose officers training scheme at operational level in Denmark



(Source: Lock E, 2002)

Figure 2.2: Dual purpose officers training scheme at management level in Denmark

Although Denmark introduced DPT in 1997, it is presently continuing with the traditional monovalent nautical and engineering specialisations. According to Nordseth.A[2], DMA (2004), Maersk Line is the main employer of the dual purpose officers graduating in Denmark. The company enters into written agreements with the students assuring them onboard training. The Danish Maritime Authority, shipowners and the MET institutions in Denmark are committed to ensure the success of DPT.

2.2.2 Dual purpose training in Japan

In Japan, the thought process about the feasibility of DPT started in 1977 with the main purpose of reducing manpower onboard Japanese ships. A committee on the Modernization of the Seafarer's system was established in 1979 consisting of representatives from the MA, shipping companies, labour unions, academic and professional circles. Experiments were conducted in Japan from the year 1979 with dual purpose officers onboard ships with the motive of bringing down the manpower onboard (Japan Ministry of Transport, 1997, p.96).

A new Seafarers Law to implement DPT in Japan was enforced on 1st April 1983. The Mercantile Marine Universities of Tokyo and Kobe commenced DPT for merchant marine officers in 1984. There were two main reasons for Japan to consider introduction of DPT in its curriculum for merchant marine officers. The advancement of technology resulted in a high level of automation onboard ships with unmanned engine rooms, modernization of navigational equipment and cargo operations. Secondly, the high cost of Japanese seafarers resulted in chartering in of ships with cheaper crew from labour supplying countries. The need to revive the international competitiveness of Japanese shipping for business reasons and to retain Japanese seafarers onboard the ships resulted in this shift in training.

Modernization of the Seafarer's system was a measure taken to strengthen the international competitiveness of Japanese shipping by decreasing the number of

[2] Mr.Nordseth, DMA, mentioned that Maersk Line are the main employers of dual purpose officers in Denmark during his lecture in January, 2004 on the MET systems in Denmark at the World Maritime University, Malmo, Sweden.

Japanese seafarers onboard and reducing the high manning cost (Japan Ministry of Transport, 1997, pp.95-101).

The efforts to reduce manpower onboard Japanese ships continued until 1992 when an eleven man all Japanese crew was considered most efficient. However, a multinational crew rather than an all Japanese manned vessel was soon found to be more economically feasible in the face of intense international competition. The wage disparity between the two was the contributing factor. The gradual strengthening of the Japanese Yen against the U.S Dollar after the Plaza accord in 1985 further aggravated the situation.

Since, the purpose of introducing DPT in Japan was not meeting the desired objectives it was decided by the Maritime Universities in Japan to stop DPT and certification in 1999.

Japan has been practising many different schemes of MET for officers, which could lead to obtaining the various certificates of competency (Nakazawa, 2004)[3]. However, the discussion here is on the education delivered at the Maritime Universities in Japan leading to dual certification with a Bachelor of Science (B.Sc) degree.

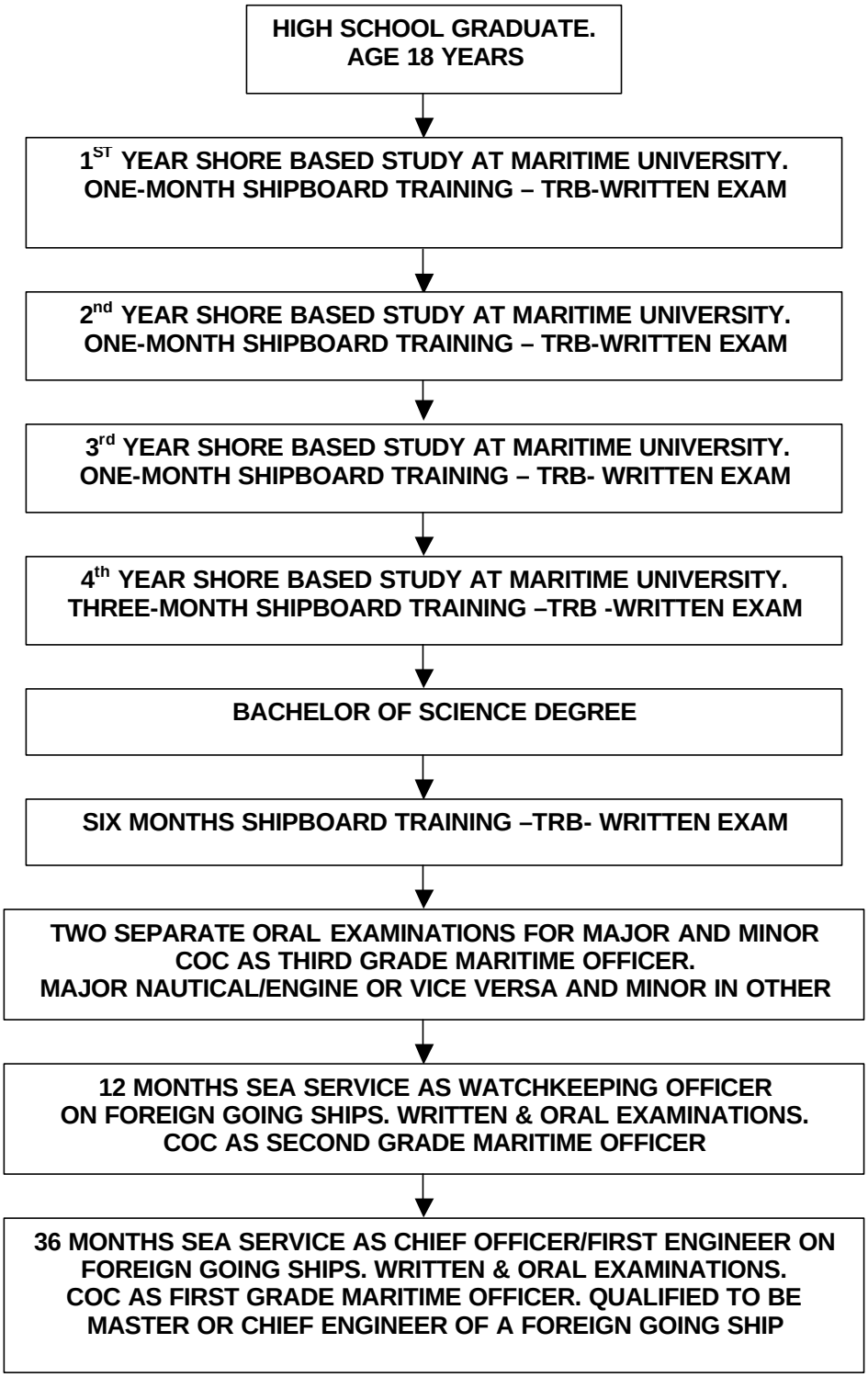
The Japanese system of DPT is semi-integrated in the sense that it results in a Major and Minor division. A student has the choice of specialising either in nautical or engineering subjects but must acquire operational watchkeeping qualifications in the department he does not choose to specialise.

The DPT which is a four and half-year program is described and schematically shown in Figure 2.3. (Nakazawa, 2004)[3]

1. The entry-level requirement for the DPT course is that the students must be High School graduates (12 years of general school) with an average age of 18 years.

[3] Prof.Nakazawa explained the Japanese system of DPC in a lecture on Japanese MET systems at the World Maritime University, Malmo, Sweden in February 2004.

2. The first three years of training consists of eleven months of shore-based studies each year at the University and one month of practical seagoing shipboard training on a training ship.
3. The fourth year consists of nine months of shore-based studies at the University and three months of practical seagoing shipboard training on a training ship.
4. The seagoing shipboard training is conducted on the training ships of the National Institute of Sea Training (NIST).
5. The University awards a B.Sc degree to the student on successful completion of four years of education.
6. After obtaining the B.Sc degree, the students who wish to obtain a certificate of competency is required to undergo a further six months of practical seagoing shipboard training course in order to obtain the certificate of competency as a Third Grade Maritime officer. The student is exempted from the written examination but he has to appear for oral examinations conducted by the Ministry of Land, Infrastructure and Transport. The certificate of competency as a Third Grade Maritime officer entitles the officer to sail on ocean going vessels as a watchkeeping officer.
7. On completion of the 12 months of seagoing service on ocean going ships of prescribed tonnage or engine power with the Third Grade Maritime officer certificate, the officer is required to appear for written and oral examinations conducted by the Ministry of Land, Infrastructure and Transport for certification as a Second Grade Maritime officer.
8. Similarly on completion of the prescribed seagoing service on ocean going ships of prescribed tonnage or engine power with the Second Grade Maritime officer certificate, the officer is required to appear for written and oral examinations conducted by the Ministry of Land, Infrastructure and Transport for certification as a First Grade Maritime officer, which is the highest certificate of competency.



(Source:Nakazawa,2004)

Figure 2.3: Japanese Maritime officers training scheme at the Mercantile Marine Universities

2.2.3 Dual purpose training in the Netherlands

DPT was introduced in the Netherlands in the year 1985 and the traditional nautical and engineering programmes have been stopped since 1988. The decision to implement DPT in the Netherlands was taken by way of a joint agreement between all sectors of the maritime industry namely the Dutch Shipowners Association, the trade unions representing the seafarers, the Ministry of Transport and the Ministry of Education (Arbeider, 2004)[4]. The introduction of DPT in the Netherlands was directed towards decreasing the running cost of Dutch flag ships by reducing the manning costs and thus being competitive in the field of international maritime transportation.

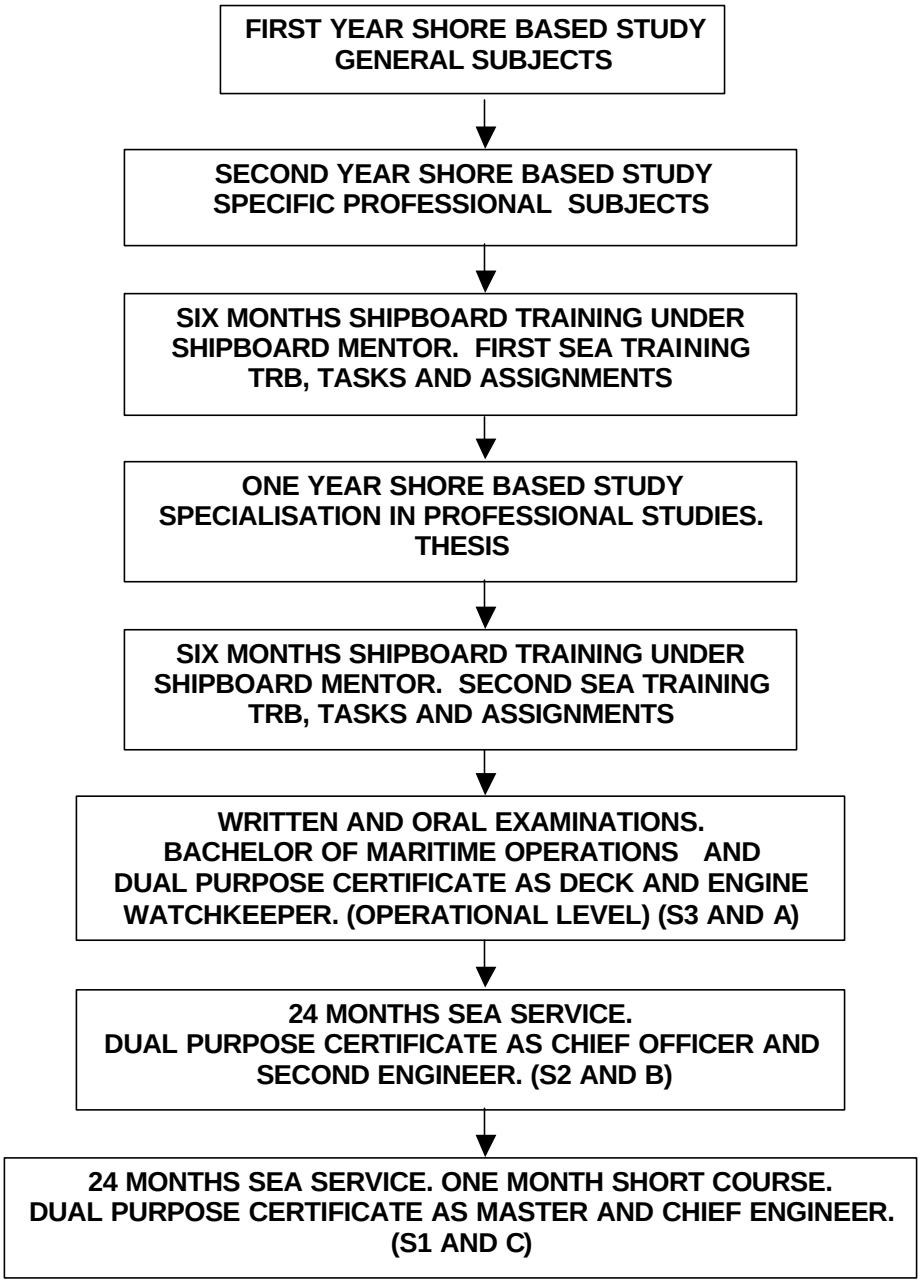
The Ministry of Education, Ministry of Transport and MET institutions are involved in the process of curriculum design and examination of the students. According to Capt.S.Cross[5] (2004), the MET institutions in the Netherlands enjoy a high degree of autonomy though they are responsible to the Ministry of Education and the Ministry of Transport.

The DPT system in the Netherlands consists of four years of training. This system has evolved through various forms since 1985 to achieve the objective of full integration of the nautical and engineering disciplines in the year 1999.

The scheme presently being followed is described and illustrated in Figure 2.4.

[4] Personal Interview with Prof.Arbeider, Visiting Professor from the Netherlands on March 25, 2004 at the World Maritime University, Malmo, Sweden.

[5] Personal Interview with Capt.Cross, Director, Maritiem Instituut Willem Barentz, Tershelling, the Netherlands on April 1,2004.



(Source: Cross, 2004)

Figure 2.4: Dual purpose officers training scheme in the Netherlands

1) At entry level, the students are required to have Pre-University education (12 years of general education) with mathematics and physics as subjects at the final passing examination.
2) The first two years of training is shore based at the MET institution. In the first year mainly general supporting subjects like basic safety courses, language skills, mathematics, and physics are taught. Only few job specific subjects like navigation, marine engineering are taught. Students are given simulator familiarisation training towards the end of the first year.
3) In the second year the students are taught specific job oriented subjects. At the end of second year the students acquire the knowledge and skills that make them ready for the shipboard training. They are theoretically more or less competent up to the operational level in the nautical and engineering department. Groups of two students are given 40 hours of simulator training.
4) On completion of the two years at the MET institution the student is required to undergo sea training for a period of six months under the supervision of a shipboard mentor. The student is required to spend equal intervals of time devoted to nautical and engineering duties. The student is also required to complete various tasks and assignments as given in an onboard TRB. Dutch shipping companies offer sponsorship for shipboard training.
5) This is followed by twelve months at the shore based MET institution where the student is given intensive specialisation in the professional subjects to meet the requirements of obtaining the certificate of competency as a fully integrated dual purpose officer i.e. Maroff in the Netherlands. The student is also required to submit a thesis on a relevant subject. Simulator training of 40 hours is given to the students where they work in groups of two for 20 hours and alone for 20 hours.
6) After twelve months of study at the MET institution the student is required to undergo a second shipboard sea training of six months as in step (4) above.
7) On completion of the four years training course, written and oral examinations are conducted jointly by the Ministry of Education, Ministry of Transport, and the MET institution and the students are awarded

   a) A Bachelor of Maritime Operations degree by the Ministry of Education

b) Certificate of competency at the operational level (S3 and A) of both the nautical and engineering disciplines enabling the student to function as a dual purpose officer by the Ministry of Transport.

8) On completion of two years of sea service the officer is awarded the dual purpose certificate of competency as Chief Officer and Second Engineer (S2 and B).

9) On completion of further two years of sea service and undergoing a short course of approximately four weeks updating on the latest advancements in shipping technology, which includes management aspects, collision regulations, Radar/ ARPA and Navigation Simulator course, the officer is awarded the dual purpose certificate of competency as Master and Chief Engineer (S1 and C).

It is important that the sea service period in the navigational and engine watchkeeping duties is in compliance with the sea service requirements as under Section A-VII/2 of the STCW Code for the officer to be eligible for the fully integrated certificate of competency as Master and Chief Engineer.

In the process of development of the DPT for MET institutions in the Netherlands, full integration of the nautical and engineering functions were achieved by compressing the course using the following techniques (Cross, 1990b, pp. 2,3):

a. Available time within the period of four years is first designated and then the subjects and objectives possible and required are filled in.
b. Deleting obsolete subjects like for e.g.: ropes and knots, Decca Navigator, Steam engines etc.
c. Reducing coverage of ships equipment and rigging, practical seamanship and technical workshop practice.
d. Using modern teaching aids like simulators, videos, and adopting efficient teaching methods.
e. Avoiding repetitive teaching of the same subject wherever feasible.

f. Maximum advantage is taken of the shipboard training period for practical training of students by having a shipboard mentor and a college mentor (one of the lecturers).

The students are assured of their seagoing service required during their training period by the MET institutions. This is done by prior arrangements with shipping companies in the Netherlands. However, after obtaining their certificates of competency, securing employment in shipping companies depends on the availability of vacancies. It is reported that presently there is a shortage of merchant marine officers in the Netherlands.

2.2.4 Dual purpose training in India

One may wonder what led India with its huge population, cheap labour and unemployment problems to commence DPT. India supplies high quality maritime labour especially officers with specialisation on tankers, gas and acid carriers, reefer, container and many other specialized ships. The Indian merchant marine officers have been in huge demand in the international market due to their English speaking skills and dedication to shipboard duties. The Government of India is determined to make India a global reserve of quality seafarers.

DPT was started in India at the Marine Engineering and Research Institute (MERI), Mumbai in 2003 in a drive to be competitive in the international maritime labour market. The Indian MET institution perceived DPT to be the natural way of progress in shipboard organisational structure in this fast moving technological era. With strong support from the MA and the Shipping Corporation of India Ltd, the national shipping company, the Indian MET institution ventured into this new area of maritime education and training.

The training of maritime personnel has been accorded highest priority by the Government of India. To ensure that the competence of Indian seafarers is accepted throughout the world improvements have been made from time to time in the training of seafarers in India (Indian DGS order1, 2003, p.1).

The process of selection of candidates and the DPT in India is illustrated in Figure 2.5 and is described below (Yadav, 2003,pp.1-4):

1) The selection of candidates is through an All India Competitive Joint Entrance Examination. This merit list is also used for admission to the colleges of the prestigious Indian Institutes of Technology.
2) The student must be a High School graduate (12 years of school) with a minimum of 60% marks in mathematics, physics, and chemistry and 50% marks in English. The age of the student at entry level should not exceed 20 years.
3) Three years of shore based training includes field visits to ports, ships, shipyards, and other maritime related industries.
4) The Mumbai University holds the final written examinations on completion of three years of shore based MET. A B.Sc degree in Maritime Studies is awarded to the student on successful completion.
5) This is followed by 18 months of shipboard training where the student undergoes training in both the nautical and engineering departments. The student is also required to complete various onboard training tasks and duties, which must be documented in an approved TRB.
6) Shipping companies sponsor the shipboard training of 18 months. At present the sponsorship is mainly by the national shipping company.
7) The student has the option of choosing to obtain either a dual purpose certificate or a monovalent certificate in either the nautical or engineering competency after shipboard training.
8) The dual purpose certification (DPC) process requires the student after the18 months of shipboard training to attend a course at the MET institution for another three months. On completion of this course, the student has to appear for both written and oral examinations prior to being awarded the certificate of competency as an officer in charge of an engineering watch in the polyvalent scheme. On the other hand, for obtaining the certificate of competency as the officer in charge of a navigating watch the student requires to appear only for an oral examination. On successful completion of both the nautical and engineering examinations, the student would be awarded the polyvalent certificate of competency at the operational level.

9) Presently polyvalent certification at management level is only at the planning stage in India.

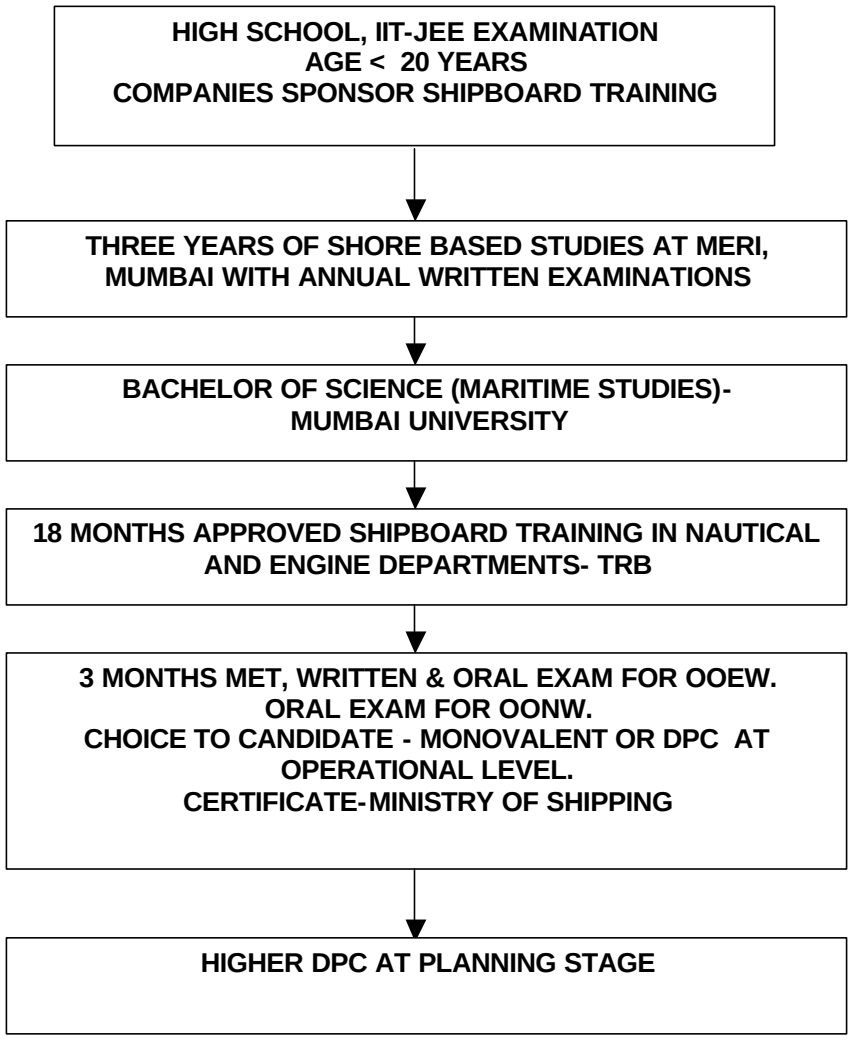


Figure 2.5: Dual purpose officers training scheme in India

2.2.5 Comparative study of dual purpose training in the four countries

A comparison of the DPT system in the four countries discussed is shown in Table 2.2. The most suitable elements from among them can be identified when considering the introduction of DPT in a country.

Table 2.2: Comparison of DPT in Denmark, Japan, the Netherlands and India

			DENMARK	JAPAN[1]	NETHERLANDS	INDIA
DPC System	**Commenced**		1997	1983	1985	2003
	Name		DUAL PURPOSE OFFICER	MARITIME OFFICER	MAROFF	POLYVALENT OFFICER
	Status of integration		Full- & Semi-Integrated	Semi-Integrated	Full-Integrated	Semi-Integrated[2]
	Levels of dual purpose COC		3	3	1	3
	Status of Monovalent COC		Exist	Exist	Stopped	Exist
MET System	**Age at entry**		18 Years	18 Years	18 Years	Less Than 20 Years
	Entry level qualification		High School Graduates[3]	High School Graduates	High School Graduates, Mathematics & Physics	High School Graduates, PCM>60, English >50 marks
	Entrance Examination		No	Yes	No	Yes,
	MET Scheme		Sandwich	Sandwich	Sandwich	Front Ended
	Shore based training for Watchkeeping COC	**Total**	54 Months	54 Months	48 Months	54 Months
		Onboard Training	18 months on Ocean Going Trading Ship	12 months on Training ship	12 months on Ocean Going Trading Ship	18 months on Ocean Going Trading Ship
	Award of B.Sc degree		No[4]	Yes	Yes	Yes
	Fee for study Paid by		Government	Government & Students	Government & Students	Students
	Subsidies to Students		Yes, as Salary	No	Yes, as Salary	No
Further studies and examination for further higher certificates			Required	Required	One month updating course is required. [5]	Required

Remarks:

1) The DPT system commenced in Japan in 1983. MET for DPT was conducted from 1984 to 1999 at Maritime Universities.

2) DPT at management level at planning stage in India.

3) Denmark also has a provision for students with 10 years of schooling to join with a 6-months special course in mathematics, physics, chemistry, English & Danish.

4) Danish Maritime Authority expects to award a B.Sc degree from 2005.

5) In the Netherlands there is no further examination for Higher Level Certificates, dual purpose officer has to undergo a one month course in shipping technology.

Table 2.2 can be summarized as follows:

1. All the four countries discussed have a minimum entry level requirement of 12 years of High School education. Denmark however, has a provision for admitting students with 10 years of school education. Entrance examination is held in Japan and India prior to entry into the DPT course. Denmark, Japan and the Netherlands have set the entry-level minimum age at 18 years. India has restricted the age to less than 20 years.
2. Japan, the Netherlands and Denmark have a sandwich system of MET for DPT wherein the student undergoes training at an MET institution and onboard a ship in rotation. In India, the front ended system is adopted wherein the student completes the training at the operational level in an MET institution and then proceeds for shipboard training.
3. Japan, the Netherlands and India confer a university degree to the students. The author considers this necessary in order to attract young men and women to a sea faring profession. It ensures recognition from the national education system and better possibilities for career advancement. Denmark is also expected to follow suit (Hemming, 2004)[6].
4. The Netherlands does not offer the option of attaining a monovalent certificate of competency. Denmark, Japan and India offer the option to students unable to cope up with both nautical and engineering training at management level to proceed on a monovalent track independent of DPT.
5. In Japan, Denmark and India the shore based MET and shipboard training together takes 54 months in order to attain the operational level certificate of competency. In the Netherlands it takes only 48 months to attain the operational level certificate of competency.
6. MET fees are borne by the government in Denmark and also a small salary is given to the students. In the Netherlands and Japan, both the government and students share the fee. In the Netherlands, the students are also given a salary by the government, which subsidizes the cost of training. In India, the

[6] Mr.Hemming from the Danish Maritime Authority informed the author on April 18, 2004 via email.

student bears the cost of education. No salaries are paid to the student during shore based MET training in India and Japan.

7. The students in Denmark and India have to undergo further studies at shore based MET institutions and appear for examinations to obtain management level certificates of competency. In Japan, after the MET at the Mercantile Marine Universities, there are no further studies for higher certification. However the students are required to undergo examinations on completion of the approved seagoing service. In the Netherlands, higher competency certificates are issued on completion of the requisite sea service. However, prior to obtaining the highest level management certificate, the officer is required to undergo a one month course on ‘shipping technology’ without any examination to update his knowledge.

Chapter 3

3. STCW and proposed dual purpose training

STCW'95 fully endorses the joint responsibility of the MET institutions, MA and shipping companies towards the training and certification of seafarers. In this Chapter, the linkage of STCW'95 with DPT, which is a mode of alternative training, is examined to understand the measures to be taken by MET institution and MA under the Convention. A comparative study of the DPT system in four different countries has been done in Chapter 2 to find the salient features of each of them. By studying the method of implementation of one of them in particular, an attempt is made in this Chapter, to propose the structure of the DPT course, which is among the important steps when introducing a new educational system in a country.

In proposing the system, a study is done of the IMO model courses at the operational and management levels to determine the time required for conducting the course. A method is devised to determine the overlaps between the entry-level qualifications of the students at the MET institution and the foundation course subjects recommended in the model course. The same method is used to determine the overlaps between the nautical and engineering functions. This avoids repetitive teaching of subjects by giving credit for the subjects and skills already acquired by the students leading to effective time management.

3.1 Dual purpose training and STCW'95

Traditionally MET has always been separated into two distinct departments i.e. nautical and engineering. The students in the nautical department are required to demonstrate standards of competence required under the provisions of the STCW Convention and Code in the following functions for the issue of their certificates of competency:

- Navigation

- Cargo handling and stowage
- Controlling the operation of ship and care of persons onboard
- Radio communications

Similarly the engineering students are required to demonstrate standards of competence in the following functions, namely

- Marine engineering
- Electrical, electronic and control engineering
- Maintenance and repair
- Controlling the operation of ship and care of persons onboard

DPT has to be introduced in any country under the framework of the STCW Convention as amended. Alternative certification is dealt with in Chapter VII of the STCW Convention and the STCW Code. The DPT is a method of alternative training. The name "alternative certificate" used in this dissertation refers to dual purpose certificate. The idea for the introduction of alternative certification came from those involved in the preparation for the amendment to the STCW Convention who envisaged the need of a functional approach to maritime education, training and certification on modern ships (Morrison, 1997,p.158).

Alternative certificates are to be issued only after all information in accordance with article IV and regulation I/7 of the STCW'95 Convention has been communicated to the IMO. Article IV requires transmission of the text of legislation dealing with all new certification, full details of the contents and duration of study courses, together with their national examination and other requirements for the certification process along with specimen copies of certificates issued in compliance with the Convention.

Regulation I/7 with reference to Section A-I/7 of the STCW Code includes concise information of relevant legal and administrative measures, a clear statement of the education, training, examination, competency assessment and certification policies applied, a concise summary of the courses, training programmes, examinations and assessments provided for each certificate issued, concise outline of the procedures followed by the authority responsible for administering the Convention to authorize, accredit or approve training and examination, medical fitness and competency

assessments conducted for the issue of certificates together with a list of authorizations, accreditations and approvals granted. All relevant information on any alternative certificate issued must be communicated to the IMO (IMO, 2001,pp.9, 27).

A dual purpose certificate holder must be able to serve on ships with the traditional form of shipboard management as well as on ships with dual purpose officers, which may have a different shipboard management system. The seafarers shall not be trained for specific shipboard arrangements in ways that would restrict their skills and ability to serve on different shipboard management systems according the STCW'95 Convention (IMO, 2001,p.51).

In order to ensure that dual purpose certificate holders can serve on all types of ships, the STCW Code requires full compliance with the competency requirements of either the nautical or the engineering discipline before competency in functions specified in the other discipline may be accredited after appropriate additional relevant education and training (IMO, 2001,p.147).

DPT proposed for implementation in a country should provide for full qualification of the officers. The functional approach without full qualifications will not attract seafarers, as it does not give much opportunity for career progression and fulfilment of personal aspirations. On the matter, Zade (2000,p.55) has stated

> Dual purpose MET is more effective as an integrated approach, programme for obtaining an engineering certificate after a nautical certificate or vice versa are not really dual purpose although they lead to two certificates of competency. Such one-after-the-other approach lacks the synergy of the at-the-same-time-approach.

According to STCW'95, DPC is not intended to be used to reduce the number of crew members onboard or de-skill seafarers. It does not justify the assignment of combined deck and engine room watch keeping duties to a single dual purpose

certificate holder during any particular watch. De-skilling would occur if the tasks required under a function is split up into several components and the duties and responsibilities are distributed among several seafarers. This is not permitted. (Morrison,1997,p.219). The principles for alternative training require that the competency of both deck and engine officers is maintained or enhanced.

3.2 Dual purpose training – Strategies in the Netherlands

The DPT course being conducted in the Netherlands has been selected as a reference due to the following reasons:

- The Netherlands has been among the very few countries to have successfully implemented DPT.
- They have been conducting the course for about twenty years.
- They produce fully integrated dual purpose officers in the shortest time. The MET syllabus right up to the management level is covered in a span of four years.
- They are totally committed to DPT.
- Dual purpose officers from the Netherlands are sailing on ships trading world over.

The other countries were not as suitable for the study due to the following reasons.

- DPT system was not very successful in Japan and hence was stopped in 1999. (Nakazawa, 2004,) [7]
- DPT was started in the U.S. envisaging it as a course to provide seafarers better shore opportunities in their future career (Cross, 2003,p.28). Many recruits join shore cadre jobs and coast guard after graduation, avoiding the merchant marine profession.
- DPT in France caters mainly to national fleet and has a low impact on international shipping. There is no evidence of dual purpose shipboard operations. The only benefit was for the management companies due to the immediate availability of a mate or engineer (Cross, 2003,p.27).

[7] Prof.Nakazawa mentioned during a lecture on Japanese MET systems at the World Maritime University, Malmo, Sweden in February 2004.

- Denmark started the system in 1997 and is confident that DPT is the future mode of merchant marine education. The sandwich system of training may not be easy to adopt in labour supplying countries. Although it appears too be a good system, more experience is required for proper evaluation.
- India started DPT in 2003 and perceivably, the examination system needs to be modified.

The Netherlands has successfully implemented the DPT system. The system offers no choice to the student to opt for a monovalent certificate. DPT course in the Netherlands leading to award of the degree of B.Sc is completed in a span of four years. The two four year separate courses for monovalent certification have been compressed into one four-year course resulting in a dual purpose certificate. According to Cross, (1990b, p.2), though it has put a heavy workload on the students, they have coped well with the system. Educational subsidy is available from the government to the students only for four years for a B.Sc degree under the education system in the Netherlands (Cross, 2004)[8].

The Dutch system completes all examinations required to attain a certificate of competency as a Master or Chief Engineer in the four years at the training school. There are no further examinations. Besides the requisite sea time, the students are required to complete a short one-month course in shipping technology. This includes an update of the latest technological advancements affecting the maritime community *(*Cross, 1990a,p.12*).*

The methodology adopted could appear to be creating data managers and equipment operators compliant with STCW requirements. There is a less in-depth study on various subjects (Cross, 1990b,p.9). Simulation based training is extensively used which is considered very effective and assists in saving classroom instructional time. The ability of real time hands on experience is difficult to replace,

[8] Capt.Cross,Director,Maritiem Instituut Willem Barentz, Tershelling, Netherlands remarked during a personal interview on April 1,2004.

but it is not economically feasible. Simulation exercises may be the best alternative under the circumstances.

From among the strategies adopted in the Netherlands the following points are suitable for consideration while introducing DPT in a country:

1. Allocate the available time and then fit in the various subjects and objectives to be attained.
2. Reduced coverage of traditional courses, which are considered to be only of nostalgic importance today. For example- ship equipment and rigging, practical seamanship and technical workshop practice was reduced. Rope work/ knots and study of steam engines was discontinued.
3. Reduced classroom teaching with use of intensive full mission and PC based simulator training, modern audio-visual teaching aids, and efficient conceptual training.
4. Avoid repetitive teaching of any subject by sequentially arranging inter-related subjects, which require cross-reference.
5. National policy to offer DPT as the only natural way of maritime education and training.
6. Government subsidy for maritime education.

3.3 Build up of dual purpose training based on IMO model courses

One of the factors, considered to be inhibiting the progress of DPT is perceived to be the belief that a longer time span may be required to produce a dual purpose officer.

A policy adopted to build up the process of DPT course curriculum is as follows:

- Compare the syllabus of the foundation course subjects in the IMO model course 7.03 and 7.04 for operational level officers with the entry level knowledge of the students in the subjects and determine the overlaps if any.
- Compare for similar overlaps in the nautical and engineering functions in the IMO model course 7.01 and 7.02 at management level and, 7.03 and 7.04 at operational level.
- Hold an entrance examination for selection to DPT to confirm the students' knowledge in the foundation course subjects.

- Add enrichment subjects to the syllabus by effective time management.

By carefully crosschecking the subject contents of the IMO model courses for overlaps, credit can be given for the prior knowledge possessed by the students in foundation course subjects and repetitive teaching of those subjects could be avoided. Similarly in the nautical and engineering functions, repetitive teaching can be avoided by integrated teaching of the inter-related subjects. The time allotted in teaching these subjects as recommended in the model courses can thus be proportionately reduced. This results in effective use of time, which can be better used to add enrichment subjects in the syllabus.

Due to the high reliability and technological improvements in navigational, cargo handling and engine room machinery in modern ships, coverage of topics, which are of lesser relevance now and rarely used, may be reduced. Subjects relating to technology, automation, and computer applications may be increased to enrich the knowledge level of the students. These measures would facilitate DPT to cater to the needs of modern merchant shipping. By efficient time management, it is not intended that there would be any dilution of the course contents.

MET institutions conducting the course may also adopt modern teaching methodology to help students learn faster and better. These include the efficient use of simulation equipment and techniques, audio-visual presentations, adequate library resources, facilities for practical hands-on training which includes workshop and shipboard training, and access to internet, multimedia. However, the absence of these tools would not restrict any MET institution from introducing DPT.

With regard to the overlaps in the nautical and engineering functions, once a subject has been vertically positioned, efforts must be made to horizontally integrate the various teaching modules of different subjects. By horizontal integration, it is meant that there should be a sequential structure of the subjects taught to the students. For example, spherical trigonometry should be taught just before astronomical navigation, Doppler effect before global positioning systems and echo sounder.

Related nautical or engineering subjects must follow after the teaching of a basic science subject. Repetitive teaching of the same subject should be avoided.

The recommended hours for lectures and teaching for each of the functions at the operational level required for DPT as per the IMO model courses are as shown in Table 3.1. "Controlling the operation of the ship and care of persons onboard" is a function where the syllabus is identical to both navigating and engineering officers. In addition, the students have to undergo foundation courses in mathematics and physical science for nautical officers, and basic engineering science, mathematics, thermodynamics, mechanical science and industrial chemistry for engineer officers to meet the standards necessary for application in the functional subjects. Table 3.2 & 3.3 gives the total hours recommended for these courses.

Table 3.1: Training hours for operational watchkeeping level

Functions	Total hours
Navigation at the operational level	811
Cargo handling and stowage	48
Controlling the operation of ship and care of persons onboard	138
Marine engineering	815
Electrical, electronic and control engineering	121
Maintenance and repair	410
Radio communications (GMDSS)	132
Total time in hours	2475

(Source: IMO model course 1.25, 7.03 &7.04,1999)

Table 3.2: Training hours for foundation courses- Nautical

Foundation course- nautical	Total hours
Mathematics	132
Physical science	304
Total	436

(Source: IMO model course: 7.03,1999)

Table 3.3: Training hours for foundation courses – Engineering

Foundation course – engineering	Total hours
Basic engineering science	50
Mathematics	100
Thermodynamics	90
Mechanical science	60
Industrial chemistry	45
Total	345

(Source: IMO model course: 7.04,1999)

Comparison of the IMO model courses 7.03 and 7.04 shows that the mathematics syllabus for nautical officers at operational level covers the entire mathematics syllabus of engineer officers. The nautical course in addition includes topics like spherical trigonometry, ellipse and hyperbola. Hence, the total course time of 132 hours required by the nautical stream may be considered for the DPT course. However, in the case of physical science syllabus under the nautical stream, it is observed that commonalities were restricted to basic engineering knowledge, thermodynamics and mechanical science of the engineering course, adequately covering subjects like mass and volume, dynamics, work, energy and power, fluids and heat. The 108 hours of studies required in these common subjects have been deducted from the total of 304 hours of training required for physical sciences in the nautical stream. The total hours of lectures and exercises effectively required for the basic foundation courses is summarised in Table 3.4.

Table 3.4: Training hours for foundation courses in DPT

Foundation course subjects	Total hours
Mathematics	132
Physical science	196
Basic engineering science	50
Thermodynamics	90
Mechanical science	60
Industrial science	45
Total	573

(Source: IMO model courses 7.03,7.04,1999)

The total time required for lectures and exercises as per the IMO model courses for the functions and the foundation courses at the operational level may be summarised as in Table 3.5:

Table 3.5: Training hours for DPT at operational level

Functions – nautical & engineering	2475 hours
Foundation courses	573 hours
Total	3048 hours

(Source: IMO model course 7.03,7.04,1999)

It is observed that the shore based part of IMO model course for the operational level qualifications in nautical and engineering departments can be completed in 508 instructional working days. This requires the students to have totally six hours of instructions including lectures and exercises daily at school.

The IMO model course for management level competencies of both the nautical and the engineering departments were similarly compared. The recommended total hours of training required for each function to attain the required level of competence is as shown in Table 3.6.

Table 3.6: Training hours for DPT at management level

Functions	Total hours
Navigation at the management level	379
Cargo handling and stowage	117
Controlling the operation of ship and care of persons onboard	211
Marine engineering	600
Electrical, electronic and control engineering	160
Maintenance and repair	60
Total time in hours	1527

(Source:IMO model course 7.01,7.02,1999)

It may be observed that the model courses have recommended nearly identical syllabus for both management level nautical and engineering candidates under the

function “Controlling the operation of the ship and care for persons onboard”. However ‘Preparation of contingency plans in response to emergencies and management of medical care’, a topic under this function has not been included in the syllabus of Chief Engineers and Second Engineers, which can be included in the DPT syllabus.

A total time of 1527 hours is required to comply with the recommended syllabus as per the model course for management level officers. This would require on the basis of a six-hour class per day schedule for five days a week about 255 instructional working days. In effect, it is observed that the entire shore based training curriculum of operational and management level of both the nautical and engineering departments could be completed within a time period of about 763 instructional working days.

However, unlike in the Netherlands, it is proposed that the operational and management level MET be conducted separately. This would enable the students to get sufficient seagoing practical experience to prepare them mentally for the responsibilities at management level.

It should also be borne in mind that STCW requirements are only the minimum standards required. The objective should be to improve the quality of the officers. Hence enrichment of these courses with other relevant subjects that would add value e.g. latest developments in technology and communications, human factors, and multicultural crew management should always be welcomed. In fact in many countries, the standards of training are higher than the minimum standards recommended by the STCW Convention.

3.4 Scope for effective time management during subject area training period

Effective time management could best be achieved by breaking down the traditional artificial barriers that seem to exist between the engine and nautical departments and considering the ship as a single unit. The inter-relation between the bridge, engine room and deck procedures, equipment and machinery could be better understood by integrating the teaching of the inter-related subjects together. The

most efficient fuel consumption achieved from efficient voyage time planning and effects of manoeuvring if machinery does not respond to power requirements advised from the bridge are examples of inter-related subjects that can be integrated.

Depending on the entry-level education of the student, there is a scope for utilizing the time allotted for foundation courses towards teaching enrichment courses. The four countries that were compared for DPT had set their minimum basic educational requirement of the students at the High School level (12 years of school). Denmark has a scheme for also permitting students with ten years of schooling to join DPT as explained in Chapter 2 section 2.2.1. The students in some countries are selected for DPT through competitive entrance examination. France with baccalaureate qualifications (Courcoux, 1990,p. 2) and India through the All India Institutes of Technology Joint Entrance Examination (Indian Directorate General of Shipping (DGS), 2004) have set the standards of entry at a high level.

In most countries, students with High School level basic education are considered to have received adequate training in many of the topics under the subject of mathematics, physical science, basic engineering science, thermodynamics, and mechanical science. These are subjects required for a comprehensive appreciation of the various competencies required under Section A-II/1, Section A-II/2, Section A-III/1 and Section A-III/2 of the STCW'95 Code. STCW does not specify any entry-level qualifications for prospective mariners, and this could be the reason for an elaborate syllabus for the foundation course subjects.

It is observed that the IMO model course recommends about 573 hours of classroom lectures and exercises for these foundation course studies, which requires about 96 working days with a six-hour schedule. In view of the knowledge already possessed by the students in these subjects, the time recommended for classroom learning of some of these subjects can be utilised more effectively. Without discounting the importance of the foundation courses, all that would be required is a revision of the topics already studied by the students.

3.4.1 Decision Making Table

For effective time management, a Decision Making Table is devised which can be used for comparing two different syllabus or functions and determining the overlaps between them. Repetitive teaching of these overlapping topics could be avoided resulting in better time management. The Decision Making Table is proposed to be used for comparing the syllabus of the education already undergone by the student at entry into the MET institution in a country with the model course syllabus for the basic sciences at the foundation course level and a reduction in the percentage of the instructional time at the MET institution can be suggested. Based on this comparison, the amount of instruction time required for effective teaching of a particular topic can be determined.

Table 3.7 illustrates an example of the structure of a Decision Making Table.

Table 3.7: Decision Making Table

Compliance with model course syllabus	Reduction in training hours
Full	100%
Near	75%
Partial	50 %
Slight	25 %
Nil	0%

If the entry-level knowledge of a student complies fully with a model course subject, then it need not be repeated at the MET institution. Similarly compliance of the knowledge with the model course syllabus as near, partial, slight and nil is determined and the module time is proportionately adjusted.

Similar comparisons can be made of overlapping courses in the nautical and engineering functional subjects where feasible. For example – At management level, naval architecture topics like transverse stability and TPC under the function Marine engineering are also covered under the function “Controlling the operation of the ship and care for persons onboard at operational level”. English language training

under the function of Navigation may be required in varying proportions of time for students in different countries. It may be observed that there is no dilution of the course contents of the IMO model course. The student must learn the need to know things from the point of view of the industry requirements and be specialised in their subject area. Efforts are made to achieve this with better time management.

To explain the use of the Decision Making Table, the Indian method of selection for DPT is used as an example. At entry level as stated in Chapter 2 section 2.2.4, the candidate is selected through an All India Competitive Joint Entrance Examination conducted by the Indian Institutes of Technology. A comparison is made between the syllabus (Appendix 1) at the entrance examination and the IMO model courses 7.03 and 7.04 syllabus for foundation courses. The Decision Making Table, as illustrated in Table 3.8, is used to arrive at a conclusion as to how much classroom teaching time may be reduced from the recommended IMO model course time due to overlaps in a particular subject.

Table 3.8: Example of using Decision Making Table for effective time management in classroom training

Subject Area	Topics not covered	Comparison: Compliance	Reduction in training hours
Mathematics	Spherical trigonometry	Near	75%
Physical science	Electronics	Near	75%
Basic engineering science	-	Full	100%
Thermodynamics	-	Full	100%
Mechanical science	-	Full	100%
Industrial chemistry	Require elaborate teaching.	Nil	0%

(Source: Indian IITJEE entrance examination syllabus (Appendix-1), and IMO model course 7.03 and 7.04)

From Table 3.8, it is observed that there is scope for reduction in the classroom teaching time for the foundation courses. While comparing the IMO model courses and the entrance examination syllabus it is observed that the total time allotted for teaching mathematics in the model course was 132 hours. Spherical trigonometry was the only subject in which the students did not have prior education and 28 hours

of teaching was allotted to it. Hence, it can be seen that only 28 hours of teaching is required in the classroom. As explained in Table 3.8, this indicates a 75% saving in time, i.e. about 99 hours can be used for teaching another subject. Under physical science, electronics is the only topic not covered and is allotted 50 hours teaching time of the total 196 hours, thus providing 75 % saving in time. It is observed that thermodynamics and mechanical science is fully covered in the entrance examination syllabus and hence teaching of these subjects may be avoided. Industrial chemistry was not included in the entry-level syllabus and that subject has to be taught in full during the DPT course at the MET institution.

3.5 Proposed structure for dual purpose training course in a country

It is proposed to introduce a DPT system in a country whereby the officer is fully qualified, competent and specialised in both nautical and engineering functions. The proposed DPT course would ensure that the student could demonstrate competence in all functions of both nautical and engineering functions at least as laid out in the IMO model course. The officer would be able to serve either as a dual purpose officer in shipping companies with a dual purpose manning system onboard or either as nautical or engineer officer on ships with traditional manning. DPT can be effectively introduced in a country with the existing teaching facilities, however modern teaching aids like integrated simulators and communication facilities may assist in faster learning.

It is observed that the shore based part of the IMO model course for the operational level qualifications in nautical and engineering departments can be completed at the MET institution in 508 instructional working days. It is proposed that operational level instructional classes may be conducted for 170 instructional working days in one calendar year. This would include a year with the students having six hours of lectures and exercises daily at school accounting for examinations, holidays and vacations. It is observed here that the complete DPT in a shore based MET institution to produce operational level dual purpose officers as per the syllabus recommended by the IMO model course can be completed in a time span of three years. This is considered a satisfactory time period to produce the desired dual purpose officer without any dilution of professional competence.

Similarly, a total time of 1527 hours is required to comply with the recommended syllabus as per the model courses for management level officers. This would require on the basis of a six-hour class schedule of five days a week about 255 days, which works out to about 18 months on the same basis as above.

It is observed that an MET institution offering the traditional monovalent certificate of competency along with a B.Sc degree takes the same time as is proposed for the DPT course. For example, the B.Sc (Nautical Sciences) programme in India is a three-year degree course followed by one-year sea going training to obtain a certificate of competency as an operational level navigating officer and a Marine engineering degree requires four years training at a shore based MET followed by one year sea going service (Indian DGS, 2004).

The DPT course proposed to be introduced in a country based on the above discussions is illustrated in Figure 3.1 and described as follows:

1. The admission to an MET institution should to be based on a competitive entrance examination, aptitude test and medical examination of the student. The competitive entrance examination will ensure that students with the right intellectual ability are selected. Aptitude test ensures that only students with the mental ability to withstand the stress and isolation of a sea career are selected. Medical fitness is a standard requirement for a career at sea. This would help in decreasing the percentage of students dropping out of the profession.
2. It is proposed to have a three-year shore based MET program with an annual examination. During the three-year shore based programme field visits may be arranged to ships, shipyards, maritime machinery and equipment manufacturing industries to enrich the student's knowledge.
3. The MA shall be responsible to hold annual written examinations, which may however, be assigned to the MET Institutions. If the course includes accreditation from a University for the award of a B.Sc degree then the University may hold the written examination. Practical examinations may be held at the MET institution to assess the ability of the students to carry out

shipboard tasks safely and for effectively demonstrating a proper understanding of the subjects like navigational watchkeeping, ship handling, cargo handling and stowage, GMDSS and machinery. Simulators would be useful tools in this matter.

4. The next step is a seagoing shipboard training for a minimum period of 12 months under agreement with a shipping company. During this period the student would be required to undergo a Structured Shipboard Training Program (SSTP) and complete various tasks, assignments and undergo shipboard tests under the guidance of a shipboard training officer and a mentor at the MET institution ashore. It would have been preferable to have 18 months of shipboard sea going training. However, since the STCW Code Section A-VII/2 has set minimum requirements as 12 months of shipboard training and also considering the reluctance of ship-owners to overstep the STCW requirements, 12 months has been proposed. Seagoing training tenures in between the MET institution training would have given hands on practical training to the students. However, it is difficult to obtain such commitment from shipping companies in the labour supplying countries from where the bulk of the recruitment of seafarers is being done. The shipowners are not only changing manning contractors at regular intervals, but also the country from where the manning is being done to lower their operational costs. A sandwich system of onboard training could be adopted only if it is possible on a permanent basis.
5. On successful completion of the sea training period, the student shall be awarded the B.Sc Degree by the University/Ministry of Education if the course is accredited to a University. Whether there is University accreditation or not, an oral examination would be held by the MA after the sea going service, for the issuance of an operational level certificate of competency as a dual purpose officer.
6. After obtaining seagoing experience as an operational level nautical watchkeeping officer for 12 months and another 12 months as an operational level engineering wachkeeping officer as under STCW Code Section A-VII/2, the officer would be eligible to join an MET institution for 18 months of shore based management level education. The syllabus for the management level

course would cover the IMO model courses for both nautical and engineering management level officers.

7. On successful completion of written, practical and oral examination, the officer could be granted a certificate of competency as a management level dual purpose officer–II.
8. After another 12 months of sea service as a Nautical officer and 12 months of sea service as a Second Engineer as under STCW Code, the officer could be granted a certificate of competency as a management level dual purpose officer-1. This would qualify the officer to do all the functions of the traditional Master and Chief Engineer officer onboard.

The proposed DPT will retain all the benefits of the traditional training and in addition, it would be enriched by subjects relevant to modern shipping in both the departments. It would give the student the necessary expertise, specialization and competence without increasing the course duration at the MET Institution for operational level certification. The officer shall be trained to serve on all types of ships, old or new, irrespective of whether it has the traditional manning structure or a modern day Integrated Bridge System. In order to achieve better transportability of MET for a shore career, it is preferable that a University accreditation be obtained so that the student is awarded a B.Sc degree upon successful completion.

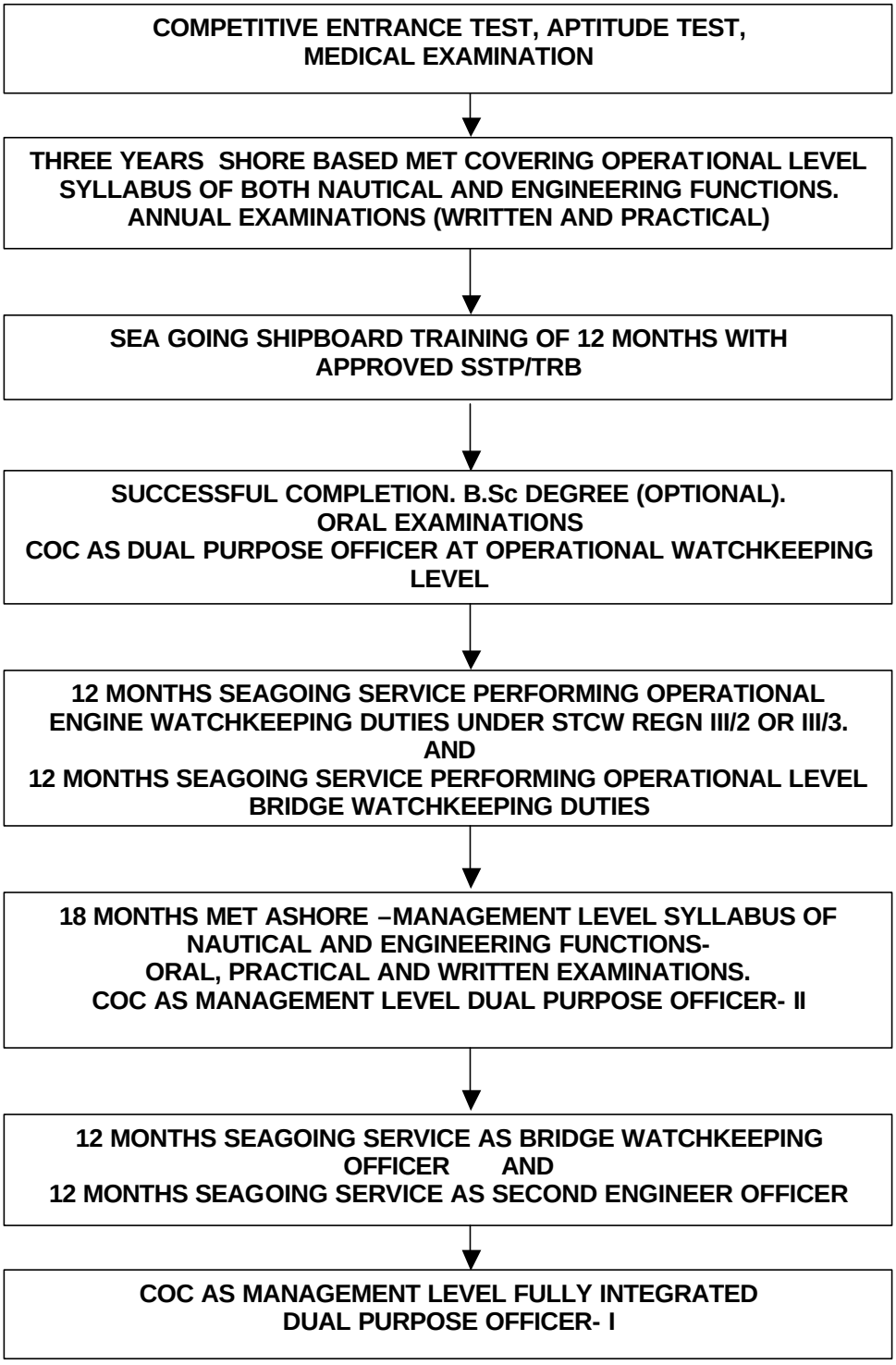


Figure 3.1: Framework for introduction of a dual purpose training system

Chapter 4

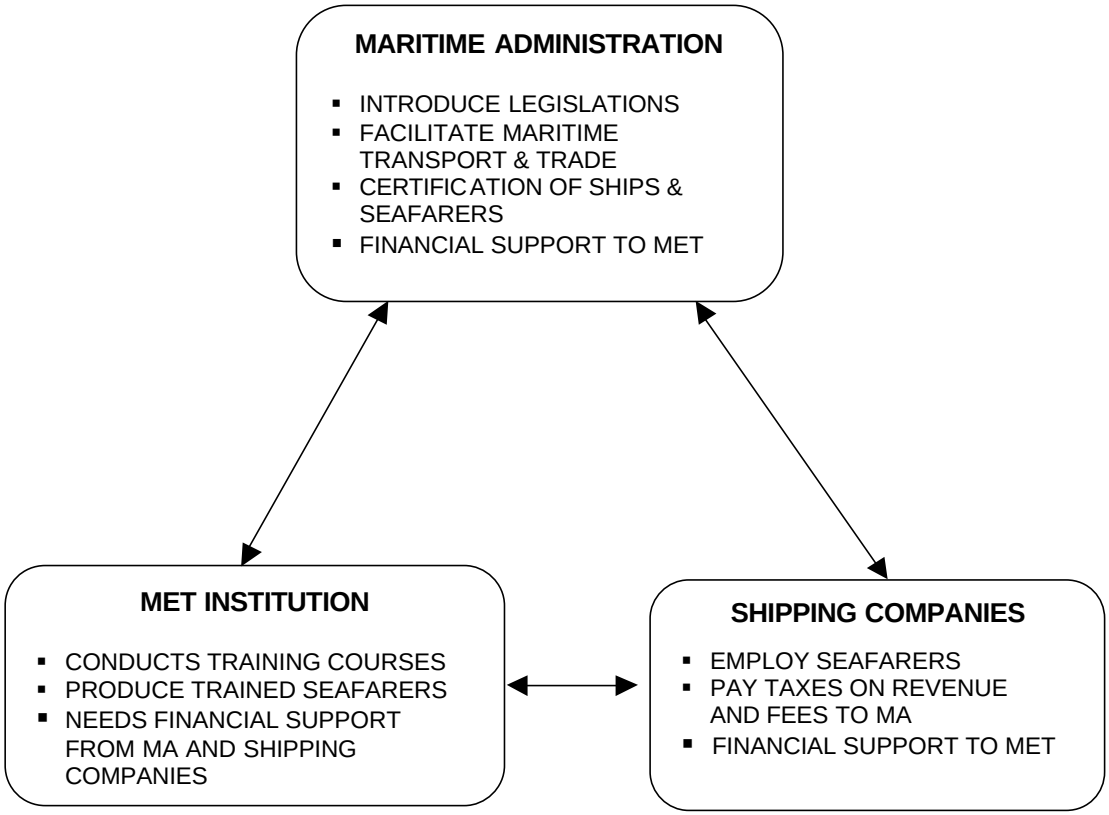
4. Impact of the introduction of dual purpose training on the maritime communities

Muirhead, (2003, p.1) stated, “there is nothing more difficult to handle, more doubtful of success, and more dangerous to carry through than initiating a new system”. Changing an existing system would be met with resistance from various quarters that consider any innovation to be a hindrance to their secure existence. Firm determination, clear objectives and goals are essential factors in initiating a change in the existing systems.

A single factor if any, that seems to be stifling the spread of DPT is the attitude of some of the traditionally trained mariners ashore up the echelon of power and decision-making. For some reason they stick to the philosophies like the often heard ‘oil and water cannot mix’ and hence engineers and navigators have to be separate entities. Preconceived notion that DPT cannot succeed based on one’s own career profile must change realising the needs of modern day shipboard operations. It is important that brakes may not be put on the wheels of progress.

Introduction of any changes to an existing system is bound to have an impact on the elements that support the system. The seafarers trained under the dual purpose system would be much more suitable for their career, especially capable of meeting the needs of the developments that take place onboard ships with rapidly changing technology. Many people can share one task onboard. Cyclic workloads of the two traditional departments onboard can be evened out. Human resources and technology can be effectively shared ensuring safer management and operation of ships.

MET institution, MA, and the shipping companies are the main communities that constitute the maritime industry. Nakazawa[9], (2004) has described the interdependence of these three communities, which is illustrated in Figure 4.1.



(Source: Nakazawa, 2004)[9]

Figure 4.1 : Interdependence of maritime communities

In any country, the MA is responsible for the enforcement of various maritime legislations, facilitation of smooth maritime transportation and trade, and certification of seafarers. The shipping companies recruit the graduates from the MET institution to man their ships and provide shipboard training to trainees. They also pay fees for services rendered and taxes on their profits earned to the MA. The MET institution conducts various courses in accordance with the prescribed syllabus for the various

[9] Prof.Nakazawa explained the interdependence of the maritime communities at a group discussion on MET Systems in various countries at the World Maritime University, Malmo, Sweden in February,2004.

examinations in compliance with the amended STCW, other relevant International Conventions and the National legislation to produce trained maritime personnel. In turn, the MET institution gets financial assistance from the MA and shipping companies.

The training process of dual purpose officers is a chain, which involves the three elements MA, MET institution and the shipping companies. It is essential to have a high quality commitment throughout the chain or the weakest link will fail and invalidate the overall effectiveness (Holder, 1994,pp.54, 55). It can be inferred from Figure 4.1 that a shift from the traditional maritime training of officers to DPT in a country can best be achieved, if it is undertaken by collective agreement between all sections of the maritime community.

In this Chapter, an effort is made to identify how the introduction of DPT in a country could affect the various maritime communities.

4.1 Impact on maritime administration

Maritime administration is the designated national authority, which governs the maritime related affairs in a country. MET in the country is a part of its responsibility. A decision to change over to a DPC system in a country requires the MA to initiate the process of facilitating the change.

MA has to establish national legislative sanction to any new maritime certification system in a country, in this case, the DPC system. While taking the policy decision, it would have to analyse the long-term benefits of changing over from the existing system. Guidelines on the introduction of the new system may be sought from countries already implementing the system and modified to suit national needs. The MA is also obliged to clearly define the desired objectives. This would allow the other maritime communities to appreciate exactly what is to be achieved.

The impact that the introduction of the DPT would have on the MA is enumerated below:

(1) Approval and conduct of the DPC system

a) Approval

The MA would be required to initiate and establish rules and regulations for the approval of the MET institution implementing DPT, the DPT course syllabus including SSTP and TRB, and the criteria for selection of trainees.

b) Certification

The MA is responsible for the conduct and assessment of examinations and certification. It would have to establish the rules and regulations for these examinations and for the issuance of the dual purpose certificate of competency. In some countries the examinations are conducted jointly by the MA and MET institution. If a University degree were to be issued, the Ministry of Education in the country would also be involved with the examination system. Proper coordination would have to be established between all the parties involved in the examination process.

The MA would also be required to establish rules and regulations for the examinations of existing traditional officers to enable them to convert their monovalent certificates of competency to dual purpose.

(2) Manning

With the introduction of DPC, the MA would be under considerable pressure from the shipping companies to consider a review of the existing guidelines on safe manning of ships. The shipping companies make huge investments on acquiring modern ships with a high level of automation and advanced electronic equipment, providing extremely high reliability. The amount of manual labour required onboard is thereby reduced giving them sufficient reason to seek for a reduction in manning with the better-qualified officers onboard. It would also be argued that it is the human being who would be providing most of the input data to the automatic machines, who is also said to be the cause of over 80% of all marine accidents. This would also justify the demand for a reduction in crew size that would lead to lesser human error. It may however, be noted that Chapter VII Regn VII/3 of the STCW

Convention clearly states that alternative certification shall not be used in itself to reduce the number of crew onboard.

(3) Labour issues

Changeover from the traditional system of shipboard manning is bound to raise the concerns of the seafarers unions in the country. The traditionally qualified people would be under the fear of unemployment due to the possibility of reduction in manning and reorganisation of the shipboard management structure. The traditional officers rendered redundant due to the changeover, would have to be relocated. There would also be apprehensions that dual purpose officers would be used as a tool by shipping companies to cut down costs by overloading them with shipboard tasks with lesser crew and reduced shore assistance. The MA has the responsibility of guarding the interests of the seafarers in a country and would have to address these issues by removing the misconceptions among the seafarers unions and shipping companies about DPT.

4.2 Impact on MET institution

MET requires continuous updating as technology and legal requirements are rapidly changing. Training must be fashioned to meet the modern shipboard requirements and ensure complete professional development of the officer. DPT requires an integration of the traditional system of separate nautical and engineering education. Viewing the whole ship's operation as a single object of learning, a dual purpose officer must be able to carry out any function onboard without discrimination as to a nautical or engineering skill.

The impact of DPT on an MET institution is enumerated below:

(1) Approval and conduct of the DPT system

(a) Approval

The MET institution conducting the DPT course must be approved. The approval should also extend to the course frame work, outline and teaching syllabus, SSTP, TRB, procedure for selection of the dual purpose trainees, and the qualifications of lecturers and instructors.

(b) Course Design

The MET institution would be required to frame the syllabus, outline and timetable for conducting the new course following the guidelines issued by the MA. The necessary courseware would also have to be prepared. The MET institution should adopt effective time management techniques as was discussed in Chapter 3 section 3.4, to complete the proposed DPT course efficiently within the proposed time span.

(c) Course for conversion of monovalent certificates

During the transition phase, the MET institution would also be required to facilitate the conversion of certificates of the existing monovalent officers onboard by introducing a training course for them.

(d) Selection of trainees

A dual purpose officer would have much higher on the job demands than a traditionally trained officer. The officer would have to display competence in a wide range of skills and knowledge, and performance failure cannot be tolerated. Improper selection can ruin a student's career. It would also adversely affect a shipping company. The MET institutions would be required to conduct an appropriate selection process of the dual purpose trainees following the criteria approved by the MA.

(e) Structured Shipboard Training Program

The proposed course recommends sponsorship by shipping companies to students admitted to an MET institution so that they are assured of shipboard training. In countries like Japan and Poland, the MET institutions offer shipboard training to the students in their own training ships. Since, MET institutions around the world do not commonly possess training ships, shipboard training discussed herein is on trading ships.

It is also proposed that the MET institution must carry out the SSTP for the trainees. STCW Code Section A-VII/2 requires that the trainee receives onboard training and it should be documented in an approved TRB. An MET lecturer would have to be assigned to monitor the progress of the shipboard training of each trainee. It is

understood that some of the bigger shipping companies have developed an in-house facility to conduct SSTP for traditional monovalent training. There is no problem with such an arrangement for DPT if it is approved by the administration. However, considering the enormity of the task under DPT, unless the shipping company has a dedicated training facility, MET institution would be considered most suitable.

(f) Examinations

Although it is the MA that would be responsible for the conduct and assessment of examinations, in some countries the MA and the MET institution would conduct it jointly. The MA would assign certain tasks in connection with the conduct and assessment of examinations to the MET institution. This may require a change in the routine work schedule of the MET lecturers and instructors.

(2) Infrastructure of MET institution

The nautical and engineering training, which was traditionally done separately at the MET institution would now have to be integrated. The MET institution would generally be having in place both the teaching staff and the other infrastructure necessary for conducting both the traditional nautical and engineering courses. However, in certain countries the nautical and engineering institution are located at different places, which may now have to be relocated to a convenient place.

(3) Human factor awareness

The dual purpose trainees may face a few problems during their shipboard training tenure in the implementation phase of DPT, mainly with regard to the establishment of a work regime and the reluctance of traditional officers to facilitate shipboard training. It is also possible that with many diverse subjects being introduced to students, some of the lecturers may give less coverage to the dual purpose syllabus as compared to the traditional syllabus. This could have an adverse effect on the students. Specialisation is the desired outcome and should not give way to generalisation. Similarly at the implementation stage of the new system if both traditional and DPT are being conducted together, the lecturers may get disoriented with the requirements of both the systems.

4.3 Impact on shipping companies

As the end user, considerable responsibility for the effective and successful implementation of the DPT lies with the shipping companies. The shipowners would be interested in DPT, as a cost benefit analysis would show that the quality of the officers onboard would give better financial results. Shipping companies must however, anticipate and plan for the ensuing effect the changes in the system of MET would bring about in the organisational structure onboard and ashore.

Introduction of DPT could have the following impact on shipping companies:

(1) Approval and conduct of the DPT system

(a) Course design

The goal of DPT is to produce a better-qualified and more suitable officer onboard and for shore employment in the maritime industry. Hence, the course design is very important for the shipping companies. The utility and quality of the officer depends on the course contents. Since DPT has a major impact on the shipping companies, although they are not directly responsible for the course development, they should be consulted in the course designing process by the MET institution and the MA.

(b) Implementation of shipboard training

The shipping companies would be required to facilitate DPT onboard by establishing a work regime onboard for the trainees. The trainees would have to be given approved seagoing training for at least six months each in both the nautical and engineering departments as required by STCW Code section A-VII/2. During this time period, they would be required to complete their shipboard training program. STCW Code section B-II/1 recommend that the shipping company set aside appropriate periods for the completion of the onboard training program within the normal operational requirements of the ships. The company would be required to provide facilities ashore and onboard to facilitate the SSTP of the dual purpose trainees. Good education and training would not only help the seafarers to develop their own abilities but would also be of immense benefit to the shipping company.

(2) Manning

(a) Safe Manning

The immediate effect of implementation of the DPT on the shipping companies would be to seek a reduction in the minimum safe manning standards on their ships to economise on operational costs. Better-qualified officers onboard, increased automation and technological applications resulting in high reliability and reduced manual labour would be some of the reasons for this demand. From the shipping companies point of view, this would be an important issue with the introduction of DPC.

It may be possible for shipping companies to obtain a reduction in the manning standards provided they are able to satisfy the MA regarding their compliance with the guidelines on the 'Principles of Safe Manning' as per IMO Res A.890 (21) and the requirements of Chapter VIII of the amended STCW Convention and Code regarding fitness for duty and watchkeeping arrangements.

(b) Flexibility

With DPT, shipping companies would have the opportunity to recruit better quality officers who would be trained to be equally competent to serve on all types of ships old or new, whether having the traditional organisation structure or the dual purpose manning system. The fully integrated system of dual purpose officers provides much more operational flexibility.

DPT would offer shipping companies who may want to continue operating their ships with the traditional nautical and engine departments the option of:

- Employing the officer available immediately as a deck officer or engine officer thereby reducing standby time.
- Employing the officer on the same ship partly as a nautical officer and partly as an engineer officer.
- Flexibility onboard ship by way of the officers being able to work in either department in the event of any need.

  (Chobelet, 1990,p.5).

An additional advantage of the dual purpose officer for the shipowner is the possible reduction of the necessary personnel reserve and through this a reduction in cost (Zade, 2000,p.55).

(c) Change in shipboard organisational structure

Dual purpose training would be expected to bring about a change in the shipboard organisational structure. It is envisaged that with the implementation of the DPT, the shipboard organisational structure would be somewhat as illustrated in Figure 4.2. However, the IMO and the maritime administrations would have to devise fresh guidelines on minimum safe manning for ships with dual purpose officers and achieve harmonisation of the shipboard organisational structure.

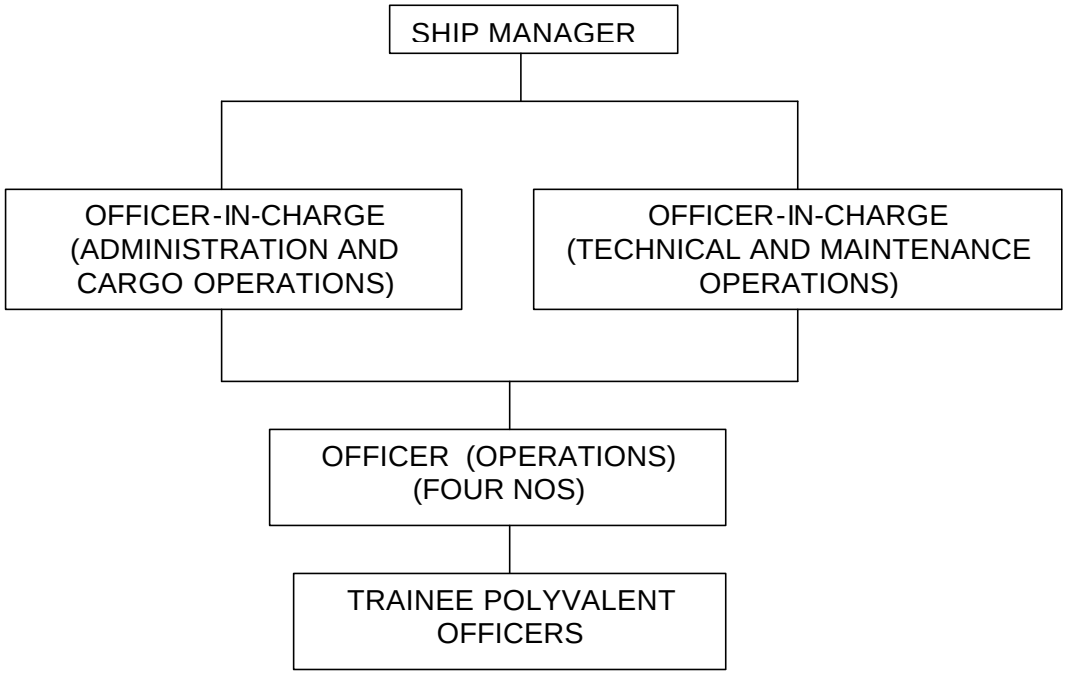


Figure 4.2: Expected shipboard organisational structure

The traditional shipboard organisational structure has the Master, Chief Engineer Officer, Chief Officer, and Second Engineer Officer as the management team. With the reduced manning levels onboard modern ships this may not be desirable. On a ship with dual purpose officers it would be possible for shipping companies to reduce the top-heavy nature of the ship's management team by having three officers

in the management team. The Ship Manager would be in command of the ship and would be designated as the Master. In an interview Dolleris, President of the Danish Engineers' Association (Lloyd's list, 2003) stated, "There will only need to be one manager onboard. He may well be called the captain but will not be like the captain that we know today".

(3) Reorganisation of shore management structure

The introduction of DPT may necessitate a reorganisation of the structure of the shipping companies themselves. They may be able to merge many of the activities, which were hereto dealt with separately. For example, the fleet personnel department of a company, which would normally deal separately with nautical and engineer officers, could now be merged. There could also be better coordination between technical and commercial departments. DPT would provide shipping companies an opportunity to employ better-qualified personnel ashore possessing knowledge of both the nautical and engineering functions as compared to the traditional personnel with compartmentalised knowledge, to meet their operational needs.

(4) Human factor issues

Although the company may be very committed to implement DPT, the problem of the traditional officers not cooperating with the onboard training program could arise. It would be a natural tendency for the existing traditional officers onboard to show disinterest in training the dual purpose trainees, as it would be considered a threat to their own career. In an ideal situation, these traditional officers would be required to play an active part in the development of the new scheme by way of commitment and by demonstrating competency for development of the system onboard. The dual purpose officers could also be affected by poor work place ergonomics, loss of focus, loss of situational awareness, and delays in career progression. These problems would have to be addressed by the company.

4.4 Impact on seafarers

Seafarers will be most affected by changes in the training schemes, examinations, certification, regulations and working practices (Holder, 1994, p.46).

On the subject of the impact of DPT on seafarers Foreshaw, (1990,p.7.2) stated,

> Dual training of ship's officers provides flexibility to a higher degree than ever before. Whatever the operational requirements of the high technology ships of the future, a dual trained officer will be better equipped to adapt to changing work loads and to manage a very expensive unit of industrial plant. In the unlikely event that the concept is a total failure nothing material will be lost, because trainees are able to revert to their preferred discipline.

The impact of DPT on the seafarers is enumerated below:

1. Education & training

(a) The syllabus of both the traditional nautical and engineering functions is compressed into the DPT course and proposed to be completed in nearly the same time span as a traditional monovalent MET training course. Hence, the quantum of studies for the student would be much more under DPT. The students would have to adapt to the change in the curriculum and also gauge their ability to cope with the study schedule while opting for DPT.

(b) The dual purpose trainees would have to depend upon sponsorship from shipping companies assuring them of onboard training by facilitating SSTP and establishing a dual work regime.

2. Examination and certification

With the introduction of DPT, the traditional officers would be required to undergo a course at the MET institution and appear for an examination to changeover to DPC for their continued employment.

The examination process of dual purpose officers would be longer with twice the number of examinations than the traditional course. The examinations should be scheduled in such a manner that they do not create high stress among the students. Although a certain level of stress can motivate the students to perform better during

their academic training, continuous stress could bring down performance and also result in high drop out rates.

3. Labour issues

(a) Motivation

Dual purpose training would motivate the merchant marine officers to fulfil their aspirations both onboard and ashore through their acquiring multiple skills. With dual purpose manning system onboard ships, an officer can aspire to reach the rank of a Master backed by the knowledge of both the nautical and engineering sciences. The nature of their qualification offers them greater opportunities to acquire shipboard employment in either nautical or engineering departments, even in shipping companies following the traditional shipboard manning system. The waiting period for jobs would be reduced providing greater job security. Opportunities ashore would be many fold and without boundaries for the new officer. Dual purpose officers could also be motivated to enhance their knowledge and skills further by the prospects of better remuneration and service conditions from their employers as compared to the traditional officers. A dual purpose officer could earn higher prestige and respect in the industry. Most ships are already manned by dual purpose ratings. With officers also being dual purpose the whole ship would be integrated and there would a better understanding of each other resulting in better harmony onboard.

(b) Employment generation

With the growing tendency among merchant marine officers today to change over to a career ashore after a stint of 8 to 12 years at sea, DPT would be very helpful in acquiring a good all round working knowledge of the industry. A career at sea is bound to be temporary for most dual purpose officers. This may be a desirable proposition, as it would help in employment generation for the youth and also maintain a low age profile of the seafarers. The opportunities for jobs ashore or self-employment for dual purpose officers would be greatly enhanced as they would have a wider knowledge base with improved administrative, technical and diagnostic skills. It would just be natural for the officers to quit sea career sooner than in the past.

(c) Skills of ratings

With dual purpose officers onboard, it can be expected that shipping companies would moot for a reduction in the number of ratings. Although a high degree of integration has been achieved with dual purpose ratings onboard ships, few efforts have been made to upgrade the competence and skills of the ratings. With the rapid change in shipboard technology and automation, the need for traditional skills and manual labour has been reduced to a great extent. Presently the workload onboard is lopsided with a near intolerable work pressure and responsibilities entrusted on the officers. In a competitive shipping environment an unproductive element would be rendered redundant. This calls for an upgrading of the skills of the ratings to complement the workload on the dual purpose officers.

4. Human factor

(a) In the initial few years of implementation, DPT can be expected to create artificial new barriers onboard ships. As mentioned in this Chapter section 4.3, the traditionally trained officers onboard may not be appreciative of the change and would discourage the implementation of the DPT. Until such time as ships are manned by dual purpose officers, 'hands on' training of these trainees in both the nautical and engineering departments would have to be under the supervision of a traditionally qualified engineer or nautical officer. The natural human tendency for existing traditional officers would be to offer resistance to the change since it threatens their own career. This could lead to the dual purpose trainees experiencing pressure to conform to one of the two disciplines and thereby wanting to drop out of the DPT system.

(b) It is also possible that the dual purpose trainees and officers would behave high headedly with the traditional officers onboard. Their false sense of perfection towards their future career at sea, considering themselves to be better qualified than the traditional officers can lead to disharmony onboard in the transition phase.

(c) The dual purpose officer has a wide range of knowledge of the different jobs onboard. The variations in the work environment help to sustain a high level of

interest. Diversion from routine monotonous regular daily duties would provide a relaxing effect. Dual purpose manning onboard also helps in reducing the fatigue factor among the officers during period of peak workloads in the engine room, navigating bridge or during cargo operations by spreading out the duties over a wider number of people.

(d) The possible reduction of manning onboard may burden a dual purpose officer with additional workload. Further, dual purpose officers may face many diverse problems simultaneously relating to both the nautical and engineering functions. On such occasions they may get confused and lose focus of their priorities. On the one hand, DPT could reduce human error and help in decision making by creating better awareness among the officers onboard of the limitations of the equipment on the bridge and engine room machinery. On the other hand, it may be possible that situational awareness, which is so very crucial on the Navigating Bridge could be diluted. For example;

- The various other displays on ships with an Integrated Bridge System like the Engine and Radio communications display panels could divert the attention of the officer.
- Rotating a person to different tasks would reduce prioritization of more responsible tasks

Retention of skills requires rotation of the officer onboard. Similarly, acquiring specialisation in a particular area would require focussed attention. This paradoxical situation could lead to some officers demonstrating unusual behaviour. The human behaviour in emergency situations onboard is crucial for the safety of the ship. Dual purpose officers would require proper guidance and training to cope with these problems.

(e) Although the MET institution may provide well-designed training programmes, it may be observed that during the implementation phase of DPT, these officers may not be able to realise their full potential by putting their knowledge into practice due to the existing traditional organisational structure onboard. It is also possible that during the initial years of implementation of DPT the young officers may experience delay in their career progression path. The traditional officers onboard would be able

to perform the functions related only to their area of specialisation. Therefore it would be difficult to rotate the dual purpose officers between the nautical and engineering departments. This would result in a delay in securing the required sea going service period to be eligible to appear for their examinations. These transitional problems could have a demoralising effect on the officer.

(f) With the increasing shift in decision making and planning from ship to shore due to the developments in communication technology, the highly qualified officers onboard could find themselves having lesser decision making authority. Similarly automation could result in reduced use of their cognitive skills. This would result in the dual purpose officer being easily frustrated and loosing interest in the profession.

The above-mentioned human element problems could create potentially unsafe conditions onboard. These problems must be addressed during the DPT at the MET institution. The trainees should be made fully aware of the situations and problems they would face in their profession and how to best cope with it.

It is observed that the seafarers are the most affected by the change in the system of MET in the country. It is for the other three maritime communities to take the necessary steps to facilitate the process of change for them. During discussions with merchant marine officers in India, the U.K., and the Netherlands on the feasibility and success of DPT, it was observed that a majority of the traditionally trained officers in India and the U.K were not sure of the success of the DPT. Some were of the opinion that the traditional training was doing fine and they were unable to visualise the need for changes to the existing system. Officers in the Netherlands were comfortable with the DPT. Interestingly, it is said that the students at MIWB, Terschelling (Cross, 2004)[10] and MERI, Mumbai (Dhar, 2004)[11] are very confident in handling their tasks onboard the modern ships and many of them wonder as to why dual purpose officers were not onboard all the while.

[10] Personal interview with Capt.Cross, Director,Maritiem Instituut Willem Barentz, Tershelling ,the Netherlands on April 1,2004.

[11] Personal interview with Shri.J.K.Dhar, Principal, MERI, Mumbai, India on June 1,2004.

The overall impact of introducing DPT on the maritime communities is illustrated in Figure 4.3.

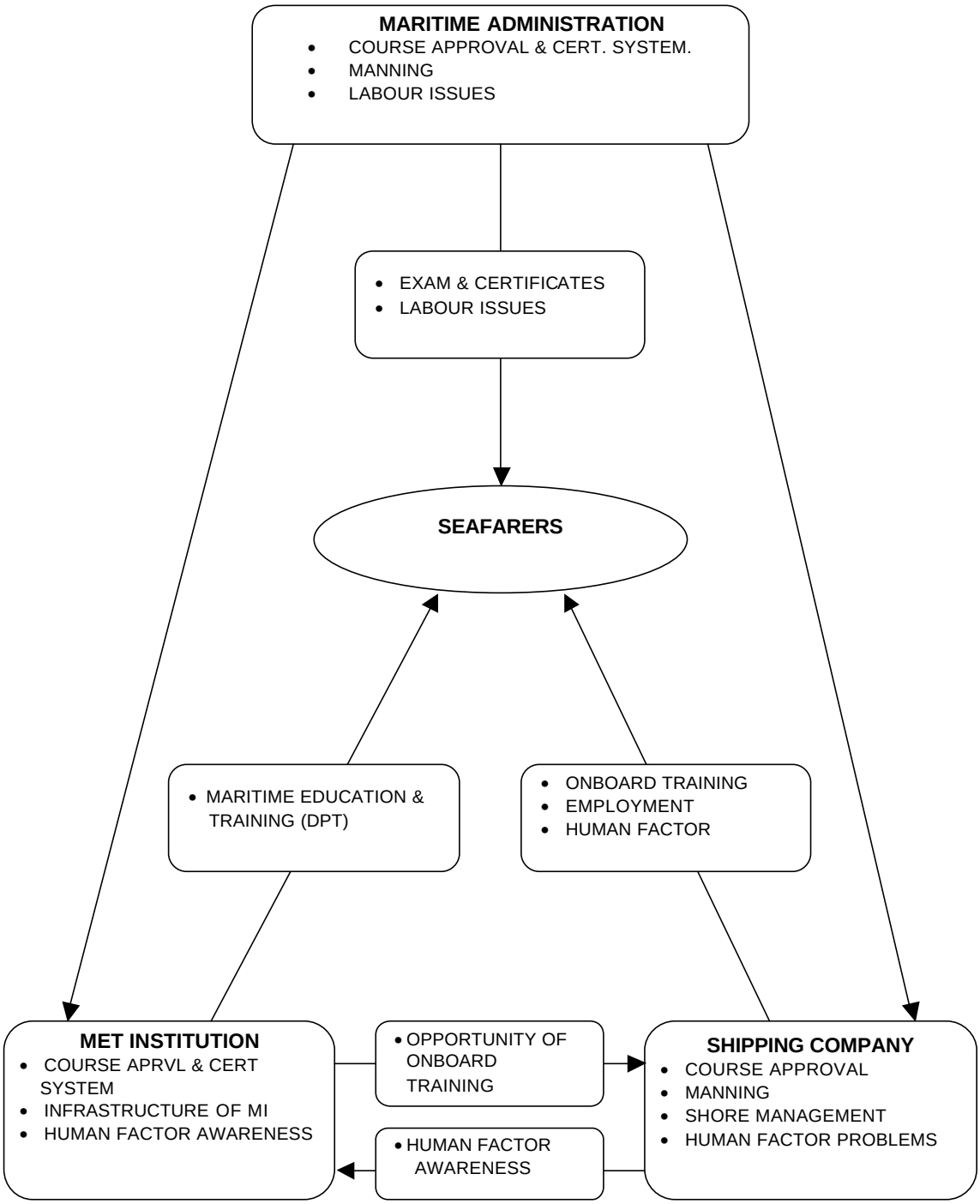


Figure 4.3: Impact of introducing dual purpose training on maritime communities

Chapter 5

5. Steps to be taken upon introduction of dual purpose training by the maritime communities

The DPC system is to be validated by bringing it under the national legal framework to give authority to the MA to commence implementation. Thereafter, the MET institution and shipping companies also have to take the necessary steps to facilitate the process of change in the MET system of a country. The quality of the dual purpose officer depends on the steps taken by these three maritime communities. The MA and the MET institution would have to counter the arguments against the introduction of the DPT by the critics claiming loss of traditional specialisation. The quality of the officer trained at the MET institution and onboard ships, should be able to counter this claim. A change in culture of the way ships are managed and operated, both ashore and afloat is that, which will ensure the success of DPT. Economics of ship operations would inexorably lead shipowners towards dual purpose manning.

As explained in Chapter 3, it would be prudent to draw guidelines from the experience of other countries, which have already implemented DPT. It would also be appropriate for a team of representatives from the maritime communities to visit a few countries where DPT has already been implemented and study the system.

In Chapter 4, the impact of the introduction of DPT on the maritime communities has been discussed. The issues discussed were the approval procedures for the MET institution, course syllabus, shipboard training and manning, selection of trainees, examinations, labour and human factor. In view of the impact of DPT on the maritime communities, in this Chapter, an attempt is made to identify the steps that would have to be taken to facilitate effective DPT in a country by the MA, MET institution and the shipping companies. The seafarers only bear the impact of

changes in a system. The preparation period required for the effective implementation of DPT is also examined.

5.1 Steps to be taken by the maritime administration

Once the MA has been granted the authority to commence DPC in the country under the national law, they have the obligation of initiating the steps to accelerate the process of change in the system of maritime education in the country. Enumerated below are the steps to be taken by the MA:

(1) Approval and conduct of the DPC system.

(a) Approval

The MA is required to issue approval to start a new education programme at an MET institution after proper verification that the institution has the infrastructural ability to conduct the course. They would be required to issue guidelines on the requirements for the grant of approval to the MET institution. Generally, in order to obtain an approval to conduct the course, the following information would have to be furnished to the MA (Indian DGS Order 1, 2003, p.3).

- Objectives of the programme including long term macro issues and short term challenges.
- Business plan of the institute.
- Basic infrastructure facilities available i.e. campus, office, class rooms, library, teaching aids, simulators, computers, practical and workshop facilities, hostels, playgrounds, swimming pool, facilities for learning of fire fighting and life saving systems, kitchen and medical services.
- Number and qualifications of faculty members should be appropriate for the course.
- Source of funding for the course to meet the initial capital expenditure and recurring cost.
- Plan for accreditation of the DPT course from the University/Ministry of Education if a degree is granted along with the certificate of competency.
- Proposed schedule of classes and the duration of the course.
- Proposal for establishment of quality standards system.

Any training and assessment of seafarers under the STCW Convention is to be administered, supervised and monitored in accordance with the STCW Code. The MA would be required to develop the DPT course syllabus in compliance with the requirements of STCW'95 and national requirements. The course syllabus should also consider inclusion of subjects relevant to current shipboard practices and technology. It should be ensured that there are no dilutions or gaps in the course contents. The MET institutions, the shipping companies and Ministry of Education (if accredited) should also be involved in the course design, as they would be affected by the new course. The MA while prescribing the syllabus must address the importance of effective time management in conducting the DPT as suggested in Chapter 3 section 3.4. Further, the MA would also be required to issue guidelines on the conduct and approval of SSTP for the dual purpose trainees.

The MA of a country, while introducing DPT should pronounce it as the natural way of maritime education. For DPT to really succeed in a country, the MA must take a policy decision that it would be the only system of maritime education for issuance of certificates of competency. No fresh batch of trainees under the monovalent training scheme should be started after the implementation of DPT. If there was an option for the students between polyvalent and monovalent certification, there would remain a tendency among many students to choose the easier unchallenging monovalent route in a probably not very conducive shipboard implementation stage which would be against the objective of training better quality officers.

A course syllabus for converting the certificates of the existing monovalent officers to dual purpose certificates would also have to be devised and approved by the MA. In framing the course, the Decision Making Table described in Chapter 3 section 3.4.1, may be used to compare the DPT and the monovalent course syllabus.

The selection criteria for the dual purpose trainees must also be established by the MA taking into account the appropriate entry level education, availability of people for the seafaring profession and medical standards. With modern ships having high level of automation and technological applications being considered more suitable for dual purpose officers, a higher academic entry level standard for students would

be required to teach these subjects at the MET institution within the proposed time span. It is preferable to have an entry level qualification of at least 12 years of general school education with mathematics, physics and chemistry as subjects.

(b) Certification

As mentioned in Chapter 4 section 4.1, the MA would be required to establish the rules and regulations for the conduct and assessment of examinations for certification under the new course. The administration would also be required to formulate procedures for the examination and certification of monovalent officers in order to convert their existing certificates to dual purpose certificates. They also have to ensure that all training and assessment for certification of the course is conducted, monitored and evaluated by suitably qualified persons and in accordance with the requirements of the section A-I/6 of STCW'95 Code.

The MA would be required to make arrangements for conducting and scheduling oral, written and practical examinations. The written and practical examinations may be arranged at the MET institution. Although the MA is responsible for administering the examination, it may assign a part of its task to MET lecturers, or suitable experts in the subject area. If University accreditation were obtained for the DPT course resulting in the issue of an academic degree, the University may conduct the written examination. The MA would conduct the oral examinations. It would be worth considering involving experts from the maritime industry and the senior lecturers at the MET institution as external examiners in the panel of oral examiners. The practical examinations could be held at the MET institution at its facility of workshops, laboratories or simulators. The examination process requires close coordination between the parties involved, namely the MA, MET and the University.

During the implementation stage, the MA would be required to make special arrangements for holding the oral examinations of the dual purpose officers. The oral examinations would have to be conducted by at least two examiners, one specialized in nautical sciences and the other in engineering. A problem foreseen is that in many countries there is a shortage of nautical and engineering examiners. It may be a difficult process to get the two of them together to hold an oral

examination. It would not be appropriate to hold two separate oral examinations, as it would be against the objective of integration. However, this process may go on until the MA has dual purpose officers as examiners. One possible solution to this problem would be to conduct the oral examinations with an examiner from the MA and an external examiner from the maritime industry, one specialized in nautical and the other in engineering functions.

(2) Manning

The MA would be required to establish new guidelines on the issue of safe manning of ships and shipboard organisational structure with the introduction of DPC. Prior to granting permission for any reduction in minimum safe manning for vessels with dual purpose officers, the MA must carefully evaluate the proposed safe minimum manning scale presented by the shipping company for compliance with the IMO Res. A. 890(21) giving guidelines on “Principles of Safe Manning” and the requirements of fitness for duty and arrangements for watchkeeping as under Chapter VIII of the amended STCW Convention and STCW Code.

It must be evaluated as to whether the personnel onboard the ship are sufficient and competent to undertake all tasks, duties and responsibilities for the safe operation of the ship, for the protection of the marine environment and for dealing with emergencies. Other factors to be considered should also include the type and age of ship, condition and trading pattern of the vessel, the equipment onboard and work place ergonomics.

Manning of ships with dual purpose officers would offer the shipping companies an opportunity to reduce the manning level onboard. The additional personnel held onboard some vessels for operational reasons, in excess of the minimum safe manning requirements could be avoided, for example a fourth officer or a fourth engineer or an electrical officer. It may also be possible to merge the rank of Master and Chief Engineer officer. Since both these officers would possess the same qualifications, the presence of two officers without watch keeping responsibilities can be avoided.

It is accepted that the bottom line for any commercial enterprise is its economic viability. While not rejecting the demand of the shipping companies for reduction in safe manning standards in totality, it is necessary that they should be made aware of the disastrous consequences of under-manning a vessel or manning with poorly trained people. DPT should not be viewed as a means of reducing manpower irrationally onboard but as an investment in quality seafarers.

Shipowners need to be educated on their misconceptions about reduction in manning assisted by technology or with repair squads at ports. The belief that automation replaces human beings is not very true. Rather, it places the human in a more demanding role by increasing the mental workload. It must be realised that the philosophy of having a dual purpose officer on a ship to reduce manning is negated when one considers that the human mind of the officer is not only affected by internal factors such as perceptual, mental or physical capabilities but also external factors such as stress and fatigue. Shipping companies should be made aware of the limitations of human endurance. Efforts must be made to avoid human error so that there is no negation of the benefits of automation.

It would not be a very cost effective proposition in the long term to reduce manning for economical considerations by providing assistance through shore repair squads at various ports. These shore repair squads have no inherent interest in the ship and are therefore, not motivated enough to undertake the work assigned professionally. The ships' staff would finally have to complete many of the jobs left incomplete. Well-trained dual purpose officers onboard are the men on the scene and are familiar with the machinery and equipment due to their day-to-day interaction with them. They would be best suited to tackle a shipboard problem unless it is a problem, which calls for a specialised technician from the manufacturer of an equipment.

(3) Labour issues

While embarking on revolutionary steps like reducing manning and changing the shipboard organisational structure, the MA would be required to address the concerns of the seafarers. Effective use should be made of the media to create

awareness among the seafarers and the general public about the necessity of having to shift to DPT. The overall benefits of maritime education as a dual purpose officer to both the officer and the shipping companies must be emphasised. It should be strongly conveyed that technological developments give the industry hardly any choice than to change the system of MET for its economic survival and growth. The growth of the industry would in return also generate more employment. The benefits of the new training system by virtue of better employment opportunities at sea and ashore with the growth of the maritime industry should be conveyed to them. Any changes in the shipboard manning structure would best be done with the concurrence of the MA, seafarers unions and the shipping companies.

The issue of the traditional officers being rendered redundant is serious and needs to be addressed. The administration has the social responsibility of relocating the traditional officers rendered redundant by the changeover to the new system. As mentioned in this Chapter section 5.1, the MA must have a scheme in place, which would enable the traditional officers to acquire DPC. It should also be noted that many of them would be of a higher age profile and it may also be difficult for them to get back to books and examinations. The MA must make endeavours along with the shipping companies to relocate these officers to help them gain alternative source of employment within and outside the maritime industry where their specialised knowledge would be utilised e.g. MET institutions, pilotage services, survey firms, chartering firms, and the hotel industry in addition to the shipping company and the MA itself.

The problem of unscrupulous shipping companies over tasking the dual purpose officers on ships must be addressed. The MA should ensure that there would be no circumvention of the minimum periods of rest required by seafarers as mandated by Section A-VIII/1 of the STCW Code. The MA should make the matter clear by developing guidelines for minimum safe manning taking into account a new shipboard organisation with dual purpose officers, which would help dispel such fears among seafarers. Appropriate deterrent measures must be established for companies infringing the requirements of minimum periods of rest.

5.2 Steps to be taken by the MET institution

The MET institution sets in motion the decision of the MA to change the education and training system. The quality of the dual purpose officer and the success of the DPT depends to a great extent on the commitment of the lecturers at the MET institution. The MET institution must consider the following points when preparing to introduce DPT:

(1) Approval and conduct of DPT system

(a) Approval

To obtain approval to commence the DPT course, the MET institution must comply with the rules and regulations established by the MA with regard to the commencement of the new course furnishing details as mentioned in this Chapter section 5.1. The MET institution must have the infrastructural facilities, teaching aids, adequate number of qualified and experienced lecturers and financial capacity to conduct the course. While selecting students for the DPT Course the institution must ensure that the selection criteria satisfies the guidelines issued by the MA. Detailed teaching syllabus and course contents with distribution of hours per topic should be drawn up and approved.

(b) Course design

As described in Chapter 3 section 3.3, the DPT course syllabus at the operational level should at a minimum include the syllabus under the IMO model courses for both operational level nautical and engineering officers. Similarly, the management level DPT syllabus must include the management level syllabus of both the traditional officers. The DPT course designed should provide a deep and broad base of theoretical and practical training to the students. The course should also be attractively designed to offer scope for employment to the officer ashore in other sectors of the maritime industry. It should, if possible give an introductory coverage to subjects like economics, logistics, and management skills so that the students can acquire specialisation when required in their career. The courseware would have to be prepared for the new subjects and the courseware used for the traditional courses would have to be modified to suit the needs of DPT.

As explained in Chapter 3 section 3.4.1, for effective time management, DPT course design must avoid any overlaps between the entry-level qualification and the foundation courses in the IMO model course. Similarly, overlaps between the nautical and engineering functions must be avoided. The course must be well paced and the time gained must be used for enrichment subjects that add value to the course. Curriculum design should also include an approved SSTP as required under the STCW Code Section A-VII/2, including methods and media of delivery, procedures and course material as necessary to achieve the prescribed standard of competence. The SSTP should be complete with an approved TRB underlining the shipboard learning tasks, assignments and tests.

DPT being facilitated due to the impact of technology, more focus may be given to automation and computer applications in the DPT syllabus than was given under the traditional system of education. However, DPT can be introduced in a country, as was mentioned in Chapter 3 section 3.5 with the existing teaching aids available in a MET institution conducting the traditional monovalent certification. Modern teaching aids like integrated simulators and distance learning tools using satellite communication technology can make onboard training and understanding faster though these facilities are not essential to introduce DPT in a country. MET institutions must endeavour to harness and embrace new methodologies and technologies of training.

Cross, (1990b,p. 8) stated that with DPT "There is a need for a complete merger of both the traditional departments at the MET institution with team teaching preferably technical and nautical together, especially on procedures and simulators". The course schedule should be designed such that the inter-related subjects of nautical and engineering disciplines are taught step by step to enable the student to get a broad overall knowledge which is the desired outcome of DPT. The course syllabus and timetable of the various subjects should be discussed with all the lecturers and their opinions should be sought. An effort to foster team spirit and cooperation must be established between the nautical and engineering lecturers to avoid development of traditional departmental behaviour among the students.

MET institutions should endeavour to combine nautical and engineering courses, for example Bridge and Engine Resource Management courses can be combined and named Ship Resource Management course. In addition to bringing about a psychological change among students, it can result in;

- Tasks being shared by each officer understanding the interdependency of bridge and engine room operations.
- Information exchanged and understood uniformly by each officer.
- Enhanced cooperation and fellowship.

Integrated learning could reduce human error, a cause for high percentage of maritime accidents. It would help develop better situational awareness among the officers onboard. It would also make them aware of the limitations of the bridge and engine room machinery, which would help in decision-making.

MET institutions must prepare the dual purpose trainees to serve on modern ships with a high level of automation and electronic applications. It would be the responsibility of the MET institutions to ensure that the DPT system produces the right kind of technological officers demonstrating maximum effectiveness onboard all types of ships. The students should also be aware of the limitations of technology and the consequences of over reliance.

The lecturers in the MET institutions may not have exposure to the working of modern shipboard equipment, which would be required to efficiently teach the course. Training courses may be arranged to educate the MET lecturers on the operation, functions and limitations of shipboard equipment in coordination with the equipment manufacturers and classification societies. Similarly, facilities may also be provided for MET lecturers to make short voyages on ships to gain a first hand knowledge of the functioning of the modern equipment and to conceptualise effective methods for DPT.

Effective DPT must be dynamic. Technology is rapidly changing and therefore the course syllabus and teaching must be continuously reviewed in order to eliminate what is redundant and incorporate materials reflecting current practice. The course syllabus must be updated to meet the requirements of effective DPT.

(c) Course for conversion of monovalent certificates

As mentioned in Chapter 4 section 4.2, MET institution must also conduct a course to facilitate the conversion of the monovalent certificates to dual purpose. The syllabus for the course should be prepared by careful comparison of the DPT syllabus and the monovalent course syllabus in the country. This will ensure that there are no gaps in the syllabus. An approximate time frame can be estimated by a comparison between the IMO models courses for the monovalent nautical and engineering courses and the DPT course as illustrated in Chapter 3 Table 3.1, 3.2, 3.3, and 3.4 for the operational level watchkeeping course and Table 3.6 for the management level course. The Decision Making Table can also be used as a time management tool as explained in Chapter 3 section 3.4.1. The time required for the conversion of a nautical and engineering operational level monovalent certificate to dual purpose certificate was evaluated and is illustrated in Table 5.1 and Table 5.2.

Table 5.1: Training hours – Nautical operational level to operational level dual purpose certificate

Functions	Total hours
Physical science	137
Marine engineering	815
Electrical, electronic and control engineering	121
Maintenance and repair	410
Total	1483

Table 5.2: Training hours – Engineering operational level to operational level dual purpose certificate

Functions	Total hours
Mathematics	32
Physical science	196
Navigation at operational level	811
Cargo handling & stowage	48
Radio communications (GMDSS)	132
Total	1219

From Tables 5.1 and 5.2, it is observed that 1483 hours of training is required for conversion of an operational level nautical certificate and 1219 hours of training is required for the conversion of an engineering operational level certificate to a dual purpose certificate. As explained in Chapter 3 section 3.5, based on a six hour class per day schedule and 170 instructional working days in a year, it would require around 18 months for the nautical certificate holder and 15 months for the engineering certificate holder. However, the officer would be required to undergo at least six months of seagoing training in bridge watchkeeping or performing engine room duties prior to appearing for the examination as required under Section A-VII/2 of the STCW Code.

Similarly, from Tables 5.3 and 5.4 it is observed that it would require 820 hours of training for the nautical certificate holder and 496 hours for the engineering certificate holder to convert a management level monovalent certificate to a management level dual purpose certificate. This would convert to about 10 months and 6 months respectively at the MET institution. However, the officer with the monovalent management level certificate would first have to attain the operational level dual purpose certificate and subsequently the management level dual purpose certificate. Prior to obtaining each of these certificates the officer will be required to comply with the seagoing service requirements as described in Section A-VII/2 of the STCW Code.

Table 5.3: Training hours – Nautical management level to management level dual purpose certificate

Functions	Total hours
Marine engineering	600
Electrical, electronic and control engineering	160
Maintenance and repair	60
Total	820

Table 5.4: Training hours – Engineering management level to management level dual purpose certificate

Functions	Total hours
Navigation at management level	379
Cargo handling & stowage	117
Total	496

(c) Selection of trainees

Apart from the routine competitive entrance examinations generally held for admission to the MET institutions, the candidates should be subjected to a psychometric test to determine the aptitude for their chosen career as mentioned in Chapter 3 section 3.5. It is extremely important to recruit people with the right attitude, so that they can be trained for the skill required. A new recruit should have the mental ability to withstand emotional stress, isolation, and boredom faced at sea. This could also help reduce the phenomena of high drop out rates as witnessed at some MET institutions.

It would be preferable if the entry level for admission to the DPT course were set at High School level i.e. 12 years of general school with physics, mathematics and chemistry as subjects at the passing examination. This will ensure that the student has a good background of the basic science subjects, although it is understood that the level of education is not uniform in all countries. It was observed during the study that with 12 years of schooling, the youth in the developed countries had many career opportunities ashore and hence, a sea career was not very attractive. On the other hand, in some countries it may be difficult to recruit sufficient number of students having this level of education. A solution for this problem would be, as practised in Denmark, to recruit students with 10 years of schooling through an entrance test and subject them to a special course in mathematics, physics, chemistry and English (if necessary) to bring them up to the level required to cope with the syllabus of the DPT course. Depending on the entry-level skills and prior technical education of the students, the course plan and syllabus may be designed reducing emphasis on topics already learnt by the students.

MET institutions could also consider the option of broadening the window of entry to DPT by welcoming engineering and science graduates from a wide range of subjects. In addition to their educational background, the maturity level of these recruits would be higher, although adaptability to a career at sea may be easier at a younger age.

(d) Shipboard Structured Training Program

The SSTP would have to be designed by the MET institution following the guidelines issued by the MA and must be approved. To facilitate SSTP, the MET institution would be required to allocate a lecturer as a mentor to monitor the progress of each trainee. The MET institution would be required to prepare the course material for the SSTP. A shipboard TRB would have to be designed, which describes the various tasks, assignments and tests that the trainees would have to complete during their shipboard training.

The lecturer appointed to monitor the progress of the trainee would have to evaluate the assignments, test papers, and technical journals and advise the trainee if any inadequacies are observed. He must ensure that the trainee is getting the necessary exposure in both the nautical and engineering functions onboard. The trainee must be kept motivated by the mentor (lecturer) at the MET especially in the first few years of implementation because it is possible that the shipboard staff may not encourage DPT.

(e) Examinations

The MA may assign to the MET lecturers the task of assessing and evaluating the written and oral examinations. Practical examinations would invariably be conducted at the facilities in the MET institution. The MET institution would have to make arrangements for the practical examination of the students in navigational watchkeeping, ship handling, manoeuvring, cargo handling and stowage, GMDSS and machinery on simulators, in workshops and laboratories.

(2) Infrastructure of MET institution

In countries where the nautical and engineering institutions are located at different places, they may have to be merged for conducting DPT. The teaching and support staff would require relocation and reallocation of duties. Infrastructural resource problems e.g. adequate classroom, teaching aids and equipment, hostels for students, and accommodation for staff may arise, which would have to be anticipated and resolved. Additional lecturers may have to be employed by the MET

institution conducting simultaneously the DPT course and the course for traditional officers to convert their monovalent certificates to dual purpose.

(3) Human Factor Awareness

The dual purpose trainees must be made well aware at the MET institution of the problems that they would encounter with regard to their shipboard training during the initial phase of the implementation. The traditional officers may not be inclined to cooperate with the SSTP. The trainees would be regarded as a threat to their job security by some of the existing officers. It must be impressed upon the trainees to not let the knowledge gained by them through DPT give them a notion that they are more knowledgeable than the traditional officers in their future shipboard career. They must be educated on the virtues of humility and good shipboard behaviour to facilitate their own training and have a harmonious inter-personnel relationship onboard.

The MET institution must make the students aware of the possibility of delays in career progression due to traditional watchkeeping regime onboard at the implementation stage. The students must be made aware of the possibility of loss of focus on priorities and situational awareness due to the diverse tasks a dual purpose officer may have to deal with.

Training courses to educate the officers so as to increase their knowledge and awareness of the human element issues in safe ship operations must address fatigue management, environmental, operational, physiological and psychological factors. On this subject Patterson et al (2002,p.5) has stated “Overloading of the cognitive faculties of an operator is not a problem that can be solved exclusively through training but needs investigation into ergonomics and work processes as well in order to ‘engineer’ the overloading out of the system”.

Situations leading to lecturers getting disoriented or not giving comprehensive coverage to the course syllabus during the transition phase, by their teaching students of both the traditional and the DPT course at the same time should be avoided, preferably with lecturers being dedicated for DPT. If this is not feasible, the

lecturers must be convinced through panel discussions or seminars that the purpose of introducing DPT is to produce an officer with comprehensive knowledge of all functions on the ship.

5.3 Steps to be taken by the shipping companies

Being the main beneficiary of DPT, the shipping companies have the responsibility to facilitate the DPT system. The measures to be taken by the shipping companies are as follows:

(1) Approval and conduct of DPT system

(a) Course Design

As discussed in Chapter 4 section 4.3, the DPT course design is very important for the shipping companies. The shipping companies must advise the MET institutions and the MA of the specific training requirements for their ships so that these topics could be considered for inclusion in the course design. Companies may also be required to provide facilities for MET lecturers to make short voyages on ships to have a working knowledge of the functioning of the modern equipment and to conceptualise effective methods for DPT.

(b) Implementation of shipboard training

As explained in Chapter 4 section 4.3, shipping companies would be required to facilitate onboard training and establish a work regime for the trainees. Morrison (1997, p.53) stated "Onboard training should be regarded as a continuous learning process and treated as an important part of the ship's day to day operations". The sea training phase of the trainee dual purpose officers is a very crucial part of the complete training programme. The sea training period is the first exposure that the trainees get with their chosen career. Hence, it is the responsibility of the companies to ensure that the shipboard officers who could be from the traditional system of maritime education are committed to the development of the new system. It is their attitude to training and diligence to duty that can stimulate and motivate the young aspiring officers to make a satisfactory progress towards a future of full functional integration.

The ideal situation to help develop the attitude of functional integration onboard would have been for the trainee to be guided by a single mentor. However, this situation will only be reached when fully integrated dual purpose officers are manning the ship (Harms, 1990,p.8). Hence at the implementation stage, the officers would have to be trained by two officers, one from the nautical department and one from the engine department. It would be ideal if a company could identify committed traditional officers who would be willing to train the dual purpose trainees so that they can be posted onboard ships under them.

On this subject Rob Bruce (2003)**,** a dual trained officer who was a dual purpose trainee in 1990 stated in an interview on his career profile that:

> It was my experience that the companies who were sponsoring dual cadets in the early nineties, which included; BP, Shell, Trinity House, P&O Containers, Clyde Marine and Cunard failed to properly explain their vision for the future to those at sea. Seafarers, generally have a problem with change and in the absence of a proper explanation they are left to make up there own reasons why their company should choose to change what in their eyes amounts to a "perfectly" good traditional system of training that was already in place. The natural conclusions drawn are that the company were trying to cut costs and manning levels, meaning their livelihoods were at risk. This was not the best foundation upon which to build a new training programme.

The companies would be required to convince the traditional officers onboard that the changing shipboard technological environment and the consequent level of knowledge required by the nautical and engineer officers leaves with no choice than to change to DPT for the economical operation of the industry. This is necessary to ensure the cooperation of the traditional officers to effectively implement the shipboard training of the dual purpose trainees.

As mentioned in Chapter 4 section 4.2, an approved onboard training program may be established by the MET institution or by a shipping company. In any event, the company must build the infrastructure to facilitate onboard training. The shipping company has to nominate a company training officer who would be responsible for the overall administration of the training program, monitoring and documenting the progress of the trainees ashore, and coordinating with the MET institutions. In the implementation stage, two shipboard training officers would have to be nominated, normally the Chief Officer and the Second Engineer, to ensure that the objectives of the training program are met with and the tasks and assignments in the TRB are completed in time.

These shipboard training officers should periodically review the various tasks performed and determine the progress of the trainee. The trainee dual purpose officer should be assigned both nautical and engineering duties at equal intervals, probably weekly intervals to enable them to complete their assignments and seagoing service period in either departments. Arrangements would have to be made for the to and fro transmission of course materials, the technical journals, assignments, and test answer papers of the trainees to the MET institution for evaluation at regular intervals.

An example of a committed shipping company facilitating the training of dual purpose trainees is the A.P.Moller-Maersk group, Denmark. They provide sponsorship to dual purpose cadets. During their first sea going service period, they are trained on their cadet training vessels under a cadet training officer on the company norms, standards, values and culture. They have three-weekly rotation between the deck and engine room duties onboard with classroom lectures on professional subjects and also covering the tasks and objectives of the TRB. Classrooms with modern teaching aids and Internet facilities are provided. The ship's management and crew onboard also participate in the training program (Maersk Post (3), 2002, p.7).

(2) Manning

(a) Safe Manning

While there would be scope for reduction in manning with DPT, as explained in Chapter 4 section 4.3 and Chapter 5 section 5.1, the elimination of any one person in the shipboard organisational structure should not unduly increase the workload on other officers. There should be no gaps in the knowledge levels of the other officers who are expected to perform the duties of the replaced officer. To achieve such a standard, the established work regime must ensure that all dual purpose officers are involved in attending to and solving all onboard operational problems. This would also be educative to junior officers.

Morrison, (1997,p.159) discussing the impact of STCW'95 has stated that:

> The safeguards built into the Convention regarding the use of alternative certificates do not prohibit the reduction of crew size. However, any such reduction must be based on a comprehensive review of the functions to be carried out onboard and the determination of the resources necessary to perform those functions. Only through detailed analysis can reduction be justified, in other words economies can only be gained by making better use of resources onboard.

The shipping companies to attain reduction in crew size would have to propose a safe manning scale of their ship to the MA. The administration should evaluate very carefully that the proposed manning satisfies the guidelines and criteria as mentioned in this Chapter section 5.1 prior to granting any permission for reduction in manning.

(b) Change in shipboard organisational structure

To facilitate the expected change in the shipboard organisational structure as in Chapter 4 section 4.3, the shipping companies must establish a dual purpose work regime onboard. The work regime should ensure that the officers get the watchkeeping experience in both the nautical and engineering departments as

required under Section A-VII/2 of the STCW Code. A daily work regime of 4 hours of watchkeeping duty in the nautical and another 4 hours in the engine room would be satisfactory for operational level officers while the ship is at sea. This would expose the officers to both nautical and engineering activities on a daily basis and continuously enhance the duality of their skills. Another option would be to rotate the officers at regular intervals or after every voyage. Further, the dual purpose officers would assist any of the two Officers-in-charge in the daily maintenance operations. All officers should be involved in attending to and solving onboard operational problems, which would give them confidence to handle and overcome tasks onboard independently.

Clear lines of responsibility must be established in the new shipboard organisation structure with respect to navigation, engineering, cargo, stability, safety and communications. The Ship's Manager or the Master would have the overall responsibility of the vessel and would be personally responsible for the navigation, safety and communications. The Officer-in-charge (Administration and Cargo Operations) would be responsible for the day to day administration of the ship, stability, cargo operations, procurement of stores and spares, and voyage planning whereas the Officer-in-charge (Technical and Maintenance) would be responsible for the maintenance of all shipboard equipment and machinery. The functions of these officers could be interchanged, if required. Clear lines of responsibility in addition to permitting the officers to focus on their duties, would also help them to develop a proper handing over/taking over procedure onboard.

(3) Reorganisation of Shore Management Structure

With the implementation of DPT, the shipping companies would gradually be able to employ personnel with a wider knowledge of the shipping industry. They would be able to economise on the running cost of their shore establishments by employing dual purpose officers. They would gradually be able to merge the various departments that were earlier dealt with by a traditional specialist. The fleet personnel department of a company, which would normally be handling nautical and engineering officers separately, would now be merged. Similarly, the commercial departments and technical departments could work with improved coordination and

understanding or they could even be merged. In addition to economy in operations, this would result in better efficiency, as every decision would be taken weighing its pros and cons by a person who has a better understanding of the subject matter.

(4) Human factor

Shipping companies have the responsibility to address the workplace problems of their employees. The problem of traditional officers onboard reluctant to participate in the onboard training program has been adequately covered in this Chapter section 5.3.

The dual purpose officers may also face various problems. For example;

(a) Poor work place ergonomics rendering DPT ineffective and impractical to use.
(b) Diverse nautical and engineering tasks resulting in loss of focus on priorities and loss of situation awareness.
(c) Reduced use of cognitive skills, due to less shipboard decision-making and automation.
(d) Delays in career progression caused by inability to establish work regime onboard due to the presence of traditional monovalent officers onboard.

The problem (a) is normally to be addressed at the shipyard during the design stage of the vessel or by reorganising the navigating bridge layout. Regarding (b) & (c) companies must address this issue during their pre-joining briefing of the officers. The shipping companies should also conduct seminars on human factor issues, where guidance is given by experts in the field to the students to cope with these problems. To address the issue of delay in career progression as mentioned in (d), the company must have transitional plans to minimise these problems. Relieving traditional officers after short tenures onboard say about three months with a traditional officer of the other discipline could be a solution to facilitate interdepartmental rotation of the dual purpose officers i.e. a nautical officer with a engineer officer and vice versa. The cost of repatriation of the traditional officers at short intervals may be a deterrent for the shipping companies but the overall benefits of the new shipboard organisation should be the overriding factor.

(5) Employment

To attract the youth to a career at sea, shipping companies must offer them a stable career structure. It appears that during the implementation stage, shipping companies employing officers on permanent employment terms would be more suitable for DPT. These companies would be able to set up shipboard work regime facilitating career progression paths for the officer and also gradually establishing a dual purpose manning system onboard.

In shipping companies offering contractual terms of employment, the dual purpose officers would sense a lack of commitment on the part of shipowners towards their career progression path. There would be no assurance of continued employment with the same company. Shipowners operating their ships through manning companies may also change their manning agents or even shift manning from one country to another, which would not be conducive for DPT. Similarly officers hired on contractual terms to operate ships may not have any inclination for the additional task of onboard training of the dual purpose trainees. Hence, shipping companies recruiting officers on contractual terms may find it difficult to man their ships with dual purpose officers during the initial implementation phase in a country and for a few years thereafter, until such time as dual purpose officers are available in the market place in sufficient numbers.

5.4 Preparation period for dual purpose training

It would not be prudent to abruptly change the MET system in a country. When introducing DPT, it is important to consider the preparation period required to commence implementation and conduct the course in a planned manner. The complete changeover to a dual purpose manning system onboard ships is estimated to take about 10-12 years as was observed in the case of the Netherlands. Once a decision is taken by the MA to introduce DPT, steps would have to be taken to facilitate its implementation. A consensus on the decision to change the system of MET would have to be reached with the other maritime communities. The maritime communities would require a certain preparation time to embrace the change in the system of MET in the country.

The MA would be required to take measures for the recognition of DPT under the legal regime of the country. It would have to frame the rules and regulations for the certification of officers. The syllabus for the DPT course, and the course for the conversion of the traditional monovalent certificates to dual purpose would have to be devised in consultation with the MET institution and the shipping companies. The MA would have to evaluate the ability of the existing MET institutions to conduct the DPT prior to granting approval to commence the course. The MET institution would have to make a detailed teaching syllabus, courseware and schedule for the DPT and the monovalent certificate conversion courses. There should be sufficient number of lecturers and instructors with suitable qualifications to conduct the course. Any infrastructural deficiencies observed in the MET institution to conducting the DPT course would have to be addressed. The MET institution would also have to establish a selection procedure for the students following the criteria approved by the MA. The MA and MET institution would have to request the shipping companies to assist in the implementation of DPT by sponsoring the trainees and assuring them facilities for shipboard training and a suitable work regime.

The above-mentioned preparations have to be done prior to the commencement of the DPT course. It is estimated that a time period of about six months would be required to complete the pre-introduction preparation. If necessary additional time may be granted to ensure that DPT is introduced in a proper and planned manner.

The general population in the country should be informed through the media of the changeover to the new system along with the reasons for the same, only after the preparations are completed. The selection process of the students may be initiated such that the DPT course may be commenced from the next academic year of the country. This phase is estimated to take about two months.

Once the DPT course is commenced, it must be evaluated on a continuous basis. This is critical to the development and improvement of the course. Any lacuna observed in the established rules and regulations must be promptly amended by the MA. The DPT course proposed consists of three years at the shore based MET institution, followed by one year of seagoing shipboard training. The MA would be

required to make preparations to conduct examinations. The first annual written examinations of the trainees would be after one year of the commencement of the course. Subsequently, annual examinations would be conducted every year. The MET institution would have three years of lead time to prepare the course materials and infrastructure for the SSTP since the first batch of dual purpose trainees would undergo shipboard training after three year of shore based training. Similarly, the shipping companies would have three years to plan for the changes in the shipboard work regime to facilitate DPT and for developing the infrastructure ashore and onboard for SSTP. This would also be an adequate time for shipping companies to convince the existing officers of the need to change the MET system and enlist their cooperation in the onboard training of dual purpose trainees. The existing officers can also be motivated to change over to DPC during this time period.

The MA must notify the monovalent certificate holders about the procedure for changeover to DPC. The MET institution should endeavour to commence the course to facilitate the conversion of monovalent certificates to operational level dual purpose certificates as soon as possible, preferably not later than the second academic year of the introduction of the DPT course. This would ensure the presence of a few dual purpose officers onboard, when the trainees join for shipboard training. Onboard training under a dual purpose officer is considered to be more effective. The management level conversion course would have to be commenced after about four years of the commencement of the DPT course.

The MA would have a preparation time of four years prior to the oral examination of the dual purpose trainees. In the four year period, the MA could also issue guidelines for minimum safe manning of ships with dual purpose officers. The problem of relocating officers, who are rendered redundant due to DPC would have to be addressed by the MA and the shipping companies on a continuous basis over the period of complete changeover to DPC.

Chapter 6

6. Conclusions and Recommendations

"May your hands always be busy
May your feet always be swift
May you have strong foundations
When the winds of changes shifts".

A verse from the song "Forever Young" by the famous singer Bob Dylan (1974) aptly describes the need for change in the maritime education and training today.

Technology and modern competitive shipping demands a shift from the traditional compartmentalised manning onboard ships to the dual purpose manning system. DPT is gradually being introduced in many countries for various reasons ranging from attracting young people to a seafaring career, efficiency with better-qualified officers to economy in operations.

This dissertation has been centred on proposing an effective method to introduce DPT in a country. Efforts have been made to identify the impact of the introduction of DPT on the maritime communities. Measures have been suggested to overcome the challenges faced when a shift is made to the dual purpose manning system. The result from this study proposes the ways and means of introducing an effective DPT system.

6.1 Conclusions

The following conclusions were arrived at from the studies on the preparations for the introduction of an effective DPT system:

- A country preparing to introduce DPT should draw guidelines from the experience of other countries, which have already implemented the system. It would be prudent to send few representatives from the maritime communities to

visit some of these countries to study the implementation and functioning of the DPT system.

- DPC is dealt with under alternative certification in Chapter VII of the STCW Convention and STCW Code. A country preparing to introduce DPT is required to communicate all measures taken with respect to legislations, examinations and certification process to the IMO.
- Effective implementation of DPT would require commitment, involvement and collective agreement of all the maritime communities. Introduction of DPT affects the MA, MET and the shipping companies with respect to course approval, quality standards, training, examinations, restructuring of both shipboard and shore organisations, safe manning, labour and human factor issues. The seafarer is dependent on the MA for examination and certification, on the MET institution for education and training, and on the shipping companies for onboard training and employment. The dual purpose officers should be trained to be equally competent in all the functions of the nautical and engineer officers as required by STCW'95, and have the ability to serve on any ships with either dual purpose or traditional manning.
- A study of the DPT system in Denmark, Japan, the Netherlands and India revealed that all of them follow a different pattern of training. Drawing from the salient features of the DPT in these countries and in particular, from the implementation strategy adopted in the Netherlands, a structure of the DPT course for introduction in a country has been proposed. The notable strategies adopted in the Netherlands were reduced coverage to obsolete subjects, reduced classroom time with modern teaching aids, and avoiding repetitive teaching of any subject.
- The IMO model courses have been examined to determine the time required to conduct the DPT course. A Decision Making Table has been devised to facilitate effective time management by avoiding overlaps between the entry-level qualifications of the students and the IMO model courses and similarly between the nautical and engineering functions. Simulator training would also be an effective time management and training tool.
- The proposed course consists of three years of shore based MET followed by a seagoing service of 12 months for operational level DPC. On completion of 24

months of sea service, serving as a nautical and engineer watchkeeping officer for equal periods, the officer would be eligible for enrolment at the MET institution for an 18 months management level DPT course. The proposed syllabus comprehensively covers the IMO model courses for both operational and management level officers. It is also proposed to add value to the course by including economics, logistics, management, multicultural crew environment adaptability, and human factor problems in the syllabus. This would also provide enhanced opportunities for transportability to a career ashore.

- The proposed onboard training period of 12 months during DPT is front-ended. A sandwich system may have been preferable, as it would give hands on practical training during the shore based course at the MET institution. However, it is perceived that in the labour supplying countries where the bulk of the recruitment of seafarers is being done, the sandwich system may not be feasible. In the competitive manning environment, the shipowners are not only changing manning contractors at regular intervals, but also the country from where the manning is being done. A sandwich system of onboard training could be adopted only if it can be done on a permanent basis. Shipping companies offering permanent employment are more suitable for the initial implementation of DPT.
- The MA, being responsible for initiating the change in the MET system of a country would be required to obtain national legislative sanction for the DPT course. They would also be required to establish rules and regulations, for the approval of the MET institution proposing to conduct DPT, for the conduct and assessment of examinations for certification, and also for the selection criteria of students for admission to DPT. An MET institution proposing to commence DPT must be approved. The MA must also approve the course design at the MET institution, the SSTP and TRB. The MET institution should have a proper selection process to ensure that the student has an aptitude for a seafaring career and the intellectual ability for the DPT course.
- The syllabus of the DPT course would have to be carefully designed by the MA in consultation with the MET institution complying with the STCW'95, IMO model courses, and national requirements. The suggestions from shipping companies regarding topics for inclusion in the syllabus may also be considered. The

course syllabus should be continuously reviewed and kept updated to meet the changing needs of the maritime industry.

- The MA would be required to approve a training course to facilitate the conversion of the monovalent certificates held by the existing traditional officers. The MET institution would have to introduce the aforesaid conversion course in addition to the DPT course. The training course to convert the operational level nautical and engineering certificates of competency to operational level dual purpose certificates would take about 18 months and 15 months respectively. Similarly to convert the management level certificates, it would take about 10 months and 6 months respectively for the nautical and engineering certificate holders. The officer would have to satisfy the seagoing training required under Section A-VII/2 of the STCW Code prior to enrolling at the MET institution for the operational and management level conversion course.
- The arrangements for the conduct and assessment of examinations and certification would have to be made by the MA. The oral examinations during the implementation stage would have to be conducted by two examiners, one specialised in nautical and the other in engineering. With the shortage of examiners experienced in many countries it may not be an easy task to have two examiners from the administration at the same time. However, separate oral examinations should be avoided by enlisting the services of experts from the industry.
- The shipping companies and the MET institutions would be required to facilitate effective onboard training of the dual purpose officers. The progress of a trainee must be monitored and reviewed by an assigned MET lecturer and the shipboard training officers. The shipping companies should provide facilities for onboard training by establishing a work regime onboard for training in both nautical and engineering departments and for to and fro dispatch of course materials.
- The MA and the shipping companies must take every measure to convince the traditional officers of the need and benefits of changing over to DPT. The participation of these officers in the shipboard training of the dual purpose trainees is very important for the success of the new system.

- DPT can be introduced with the existing teaching aids at an MET institution. A good teacher can never be replaced. It is not necessary to procure expensive modern teaching aids for institutions under financial constraints. Modern teaching aids like integrated simulators and communication facilities however, facilitate faster learning and understanding.
- Shipping companies would propose for a reduction in the minimum safe manning with dual purpose manning onboard ships. While considering the proposal, the MA must carefully evaluate that the personnel onboard are sufficient and competent to undertake all duties and responsibilities for the safe operation of the ship, for protection of the marine environment and for dealing with all emergencies. Compliance with the guidelines on “Principles of Safe Manning” (IMO Res. A 890(21), 2000) and the requirements of fitness for duty under Chapter VIII of the STCW Convention and Code must be carefully examined. There could also be a possibility of restructuring the shipboard organisational structure due to the number of officers onboard with the same qualification.
- The social problem of redundancy of the traditionally qualified officers should be addressed and opportunities should be made available for them to attain DPC. The MA and shipping companies must take measures to relocate those officers who are unable to obtain dual purpose certificates by providing alternative sources of employment.
- The introduction of DPT in a country requires proper planning and preparation. It is estimated that the initial preparations, which would include legislation, approvals, rules and regulations for DPC, syllabus, preparation of courseware and selection criteria would require at least a minimum period of six months for the MA and the MET institutions. On completion of the initial preparations, the selection process of the students may be initiated in time to commence the course at the beginning of the next academic year. Once the course is commenced, the MA would have one year to prepare for the annual written and practical examinations, and four years for the oral examinations. The MET institution would have three years to prepare for the SSTP of the dual purpose trainees. The shipping companies would similarly have three years to prepare a

work regime for shipboard training and for developing the infrastructure to facilitate SSTP both onboard ships and ashore.

- DPT could also gradually result in organisational changes in the shore establishments. There could be a reduction of the staff in the MA, MET institutions and shipping companies due to the possible merger of the departments, which used to address nautical and engineering issues separately.
- DPT exposes the trainee to diverse tasks. During normal circumstances, diverse tasks have a stimulating effect by taking one away from routine monotonous activities. However, in crunch situations, diverse problems can lead to losing focus on priorities and lacking situational awareness, which could be aggravated by poor work place ergonomics. These human factor problems could lead to dual purpose officers demonstrating unusual behaviours. Proper training based on research in human factor problems is needed in such matters at the MET institutions. It should be realised that human behaviour in emergency situations is crucial for the safety of the vessel.
- DPT may be the impetus required to attract the younger generation to take up a sea going career providing them with the option of either pursuing a long sea going career or to diversify into opportunities ashore. The multi-skilled dual purpose officers would have greater opportunities to achieve their career goals at sea and ashore. It could lead to a short career at sea. This may be considered a desirable proposition by virtue of it having the potential to generate employment for the youth and also maintaining a lower age profile of the seafarers.

6.2 Recommendations

1. The MA of a country while introducing DPT may take a policy decision that it would be the only system of maritime education. No fresh batch of trainees under the monovalent training scheme may be commenced after the implementation of the DPT. Options permit students to adopt the path of least resistance and would not facilitate the realisation of the objective.
2. Dual purpose training should be introduced in an integrated manner with both the nautical and engineering functions being studied together for it to be

effective. The functional approach of learning one specialisation after the other may neither achieve the desired result nor would it attract any seafarers.

3. A psychometric test may be conducted at the time of entry to the MET institution to determine the aptitude and ability of the dual purpose trainees to cope with the pressures faced in the career. An entrance test is recommended to ensure that the student has the intellectual ability to handle the dual purpose study regime.
4. Shipping companies should offer sponsorship to dual purpose trainees and provide them with a work regime onboard to facilitate the development of dual skills.
5. Steps may be taken to avoid delays in the career progression of dual purpose officers in the transition period due to the traditional manning system onboard ships. As a solution, it is recommended that the traditional officers serving onboard the ship should be relieved at intervals of every three months with a traditional officer of the other discipline. The cost is perceived to be small when compared to the overall benefits.
6. The oral examinations for both nautical and engineering functions must be conducted together to achieve the objective of DPT. The services of experts from the maritime industry may be utilised for academic lectures and oral examinations.
7. MET institutions and maritime administrations should endeavour to obtain a University accreditation for the DPT course by way of a Bachelors' degree. DPT would make the officers multi-skilled but would fall short of national recognition without the award of an academic degree. The University accreditation in addition to national recognition would provide an opportunity for the officers to further their academic qualifications in pursuit of fulfilling their career aspirations. Subjects like economics, logistics, and management may be included in the syllabus of the DPT to add value to the course. This would also offer greater career opportunities ashore for the officers.
8. Human factor problems associated with the introduction of DPT must be communicated to the students through a short course at the MET institution. Shipping companies must hold the same for their traditional officers. This will

help them cope better with the difficulties that they may encounter at the implementation stage.

There would be no obstacles to the introduction of DPT in any country where facilities already exist for the traditional monovalent certification of merchant marine officers. The establishment of a new MET institution for DPT would not require much greater investment on infrastructure than required for establishing a traditional MET institution with both nautical and engineering courses conducted separately.

DPT will create a professional environment onboard ships based on teamwork. Teamwork will result in improved safety, environment-friendliness and efficiency, thus supporting the development of Quality Shipping. With its overall benefits, it is expected that once DPT is introduced in a country, the dual purpose officers will find favour with all shipping companies. Shipping companies would be prudent to opt for the change to dual purpose manning rather than be reactive and be forced to change. An appreciation of the changing needs of the industry is required by the traditionally trained maritime community to facilitate introduction of DPT.

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Appendices

Appendix 1

Syllabus for entry-level examination of dual purpose training in India (IIT-JEE,2004).

SYLLABUS FOR SCREENING TEST AND MAIN EXAMINATION – JEE 2004

The Syllabus for JEE-2004 is modified. It is common for the Screening Test and the Main Examination.

PHYSICS

General

Units and dimensions, least count, significant figures; Methods of measurement and error analysis for physical quantities pertaining to the following experiments: Experiments based on using vernier calipers and screw gauge (micrometer), determination of g using simple pendulum, Young's modulus by Searle's method, Specific heat of a liquid using calorimeter, focal length of a concave mirror and a convex lens using u-v method, Speed of sound using resonance column, verification of Ohm's law using voltmeter and ammeter, and specific resistance of the material of a wire using meter bridge and post office box.

Mechanics

Kinematics in one and two dimensions (Cartesian coordinates only), projectiles; Circular motion (uniform and non-uniform); Relative velocity.

Newton's laws of motion; Inertial and uniformly accelerated frames of reference; Static and dynamic friction; Kinetic and potential energy; Work and power; Conservation of linear momentum and mechanical energy.

Systems of particles; Centre of mass and its motion; Impulse; Elastic and inelastic collisions.

Law of gravitation; Gravitational potential and field; Acceleration due to gravity; Motion of planets and satellites in circular orbits.

Rigid body, moment of inertia, parallel and perpendicular axes theorems, moment of inertia of uniform bodies with simple geometrical shapes; Angular momentum; Torque; Dynamics of rigid bodies with fixed axis of rotation; Rolling without slipping of rings, cylinders and spheres; Equilibrium of rigid bodies; Collision of point masses with rigid bodies.

Linear and angular simple harmonic motions.

Hooke's law, Young's modulus.

Pressure in a fluid; Pascal's law; Buoyancy; Surface energy and surface tension, capillary rise; Viscosity (Poiseiulle's equation excluded), Stoke's law; terminal velocity, streamline flow, Bernoulli's theorem and its applications.

Wave motion (plane waves only), longitudinal and transverse waves, Superposition of waves; progressive and stationary waves; Vibration of strings and air columns. Resonance; Beats; Speed of sound; Doppler effect (in sound).

Thermal physics

Thermal expansion of solids, liquids and gases; Calorimetry, latent heat; Heat conduction in one dimension; Elementary concepts of convection and radiation; Newton's law of cooling; Ideal gas laws; Specific heats (C_v and C_p for monatomic and diatomic gases); Isothermal and adiabatic processes, bulk modulus of gases; Equivalence of heat and work; First law of thermodynamics and its applications (only for ideal gases). Black body radiation: absorptive and emissive powers; Kirchhoff's law, Wien's displacement law, Stefan's law.

Electricity and magnetism

Coulomb's law; Electric field and potential; Electrical Potential energy of a system of point charges & of electrical dipoles in a uniform electrostatic field, Electric field lines; Flux of electric field; Gauss's law and its application in simple cases, such as, to find field due to infinitely long straight wire, uniformly charged infinite plane sheet & uniformly charged thin spherical shell.

Capacitance; Parallel plate capacitor with and without dielectrics; Capacitors in series and parallel; Energy stored in a capacitor.

Electric current: Ohm's law; series and parallel arrangements of resistances and cells; Kirchhoff's laws and simple applications; Heating effect of current.

Biot-Savart law and Ampere's law, magnetic field near a current carrying straight wire, along the axis of a circular coil and inside a long straight solenoid; Force on a moving charge and on a current carrying wire in a uniform magnetic field.

Magnetic moment of a current loop; Effect of a uniform magnetic field on a current loop; Moving coil galvanometer, voltmeter and ammeter and there conversions.

Electromagnetic induction: Faraday's law, Lenz's law; Self and mutual inductance; RC, LR and LC circuits with d.c. and a.c. sources.

Optics

Rectilinear propagation of light; Reflection and refraction at plane and spherical surfaces; Total internal reflection; Deviation and dispersion of light by a prism; Thin lenses; Combinations of mirrors and thin lenses; Magnification.

Wave nature of light: Huygen's principle, interference limited to Young's double slit experiment.

Modern physics

Atomic nucleus; Alpha, beta and gamma radiations; Law of radioactive decay; Decay constant; Half-life and mean life; Binding energy and its calculation; Fission and fusion processes; Energy calculation in these processes.

Photoelectric effect; Bohr's theory of hydrogen-like atoms; Characteristic and continuous X-rays, Moseley's law; de Broglie wavelength of matter wave.

CHEMISTRY

Physical Chemistry

General topics: The concept of atoms and molecules; Dalton's atomic theory; Mole concept; Chemical formulae; Balanced chemical equations; Calculations (based on mole concept) involving common oxidation-reduction, neutralisation, and displacement reactions; Concentration in terms of mole fraction, molarity, molality and normality.

Gaseous and liquid states: Absolute scale of temperature, ideal gas equation; Deviation from ideality, van der Waals equation; Kinetic theory of gases, average, root mean square and most probable velocities and their relation with temperature; Law of partial pressures; Vapour pressure; Diffusion of gases.

Atomic structure and chemical bonding: Bohr model, spectrum of hydrogen atom, quantum numbers; Wave-particle duality, de Broglie hypothesis; Uncertainty principle; Quantum mechanical picture of hydrogen atom (qualitative treatment), shapes of s, p and d orbitals; Electronic configurations of elements (up to atomic number 36); Aufbau principle; Pauli's exclusion principle and Hund's rule; Orbital overlap and covalent bond; Hybridisation involving s, p and d orbitals only; Orbital energy diagrams for homonuclear diatomic species; Hydrogen bond; Polarity in molecules, dipole moment (qualitative aspects only); VSEPR model and shapes of molecules (linear, angular, triangular, square planar, pyramidal, square pyramidal, trigonal, bipyramidal, tetrahedral and octahedral).

Energetics: First law of thermodynamics; Internal energy, work and heat, pressure-volume work; Enthalpy, Hess's law; Heat of reaction, fusion and vaporization; Second law of thermodynamics; Entropy; Free energy; Criterion of spontaneity.

Chemical equilibrium: Law of mass action; Equilibrium constant, Le Chatelier's principle (effect of concentration, temperature and pressure); Significance of ΔG and ΔG° in chemical equilibrium; Solubility product, common ion effect, pH and buffer solutions; Acids and bases (Bronsted and Lewis concepts); Hydrolysis of salts.

Electrochemistry: Electrochemical cells and cell reactions; Electrode potentials; Nernst equation and its relation to ΔG; Electrochemical series, emf of galvanic cells; Faraday's laws of electrolysis; Electrolytic conductance, specific, equivalent and molar conductance, Kohlrausch's law; Concentration cells.

Chemical kinetics: Rates of chemical reactions; Order of reactions; Rate constant; First order reactions; Temperature dependence of rate constant (Arrhenius equation).

Solid state: Classification of solids, crystalline state, seven crystal systems (cell parameters a, b, c, α, β, γ), close packed structure of solids (cubic), packing in fcc, bcc and hcp lattices; Nearest neighbours, ionic radii, simple ionic compounds, point defects.

Solutions: Raoult's law; Molecular weight determination from lowering of vapor pressure, elevation of boiling point and depression of freezing point.

Surface chemistry: Elementary concepts of adsorption (excluding adsorption isotherms); Colloids: types, methods of preparation and general properties; Elementary ideas of emulsions, surfactants and micelles (only definitions and examples).

Nuclear chemistry: Radioactivity: isotopes and isobars; Properties of α, β, and γ rays; Kinetics of radioactive decay (decay series excluded), carbon dating; Stability of nuclei with respect to proton-neutron ratio; Brief discussion on fission and fusion reactions.

Inorganic chemistry

Isolation/preparation and properties of the following non-metals: Boron, silicon, nitrogen, phosphorous, oxygen, sulphur and halogens; Properties of allotropes of carbon (only diamond and graphite), phosphorus and sulphur.

Preparation and properties of the following compounds: oxides, peroxides, hydroxides, carbonates, bicarbonates, chlorides and sulphates of sodium, potassium, magnesium and calcium; Boron: diborane, boric acid and borax; Aluminium: alumina, aluminium chloride and alums; Carbon: oxides and oxyacid (carbonic acid); Silicon: silicones, silicates and silicon carbide; Nitrogen: oxides, oxyacids and ammonia; Phosphorus: oxides, oxyacids (phosphorous acid, phosphoric acid) and phosphine; Oxygen: ozone and hydrogen peroxide; Sulphur: hydrogen sulphide, oxides, sulphurous acid, sulphuric acid and sodium thiosulphate; Halogens: hydrohalic acids, oxides and oxyacids of chlorine, bleaching powder; Xenon fluorides; Fertilizers: commercially available (common) NPK type.

Transition elements (3d series): Definition, general characteristics, oxidation states and their stabilities, color (excluding the details of electronic transitions) and calculation of spin-only magnetic moment; Coordination compounds: nomenclature of mononuclear coordination compounds, cis-trans and ionization isomerisms, hybridization and geometries of mononuclear coordination compounds (linear, tetrahedral, square planar and octahedral).

Preparation and properties of the following compounds: Oxides and chlorides of tin and lead; Oxides, chlorides and sulphates of Fe^{2+}, Cu^{2+} and Zn^{2+}; Potassium permanganate, potassium dichromate, silver oxide, silver nitrate, silver thiosulphate.

Ores and minerals: Commonly occurring ores and minerals of iron, copper, tin, lead, magnesium, aluminium, zinc and silver.

Extractive metallurgy: Chemical principles and reactions only (industrial details excluded); Carbon reduction method (iron and tin); Self reduction method (copper and lead); Electrolytic reduction method (magnesium and aluminium); Cyanide process (silver and gold).
Principles of qualitative analysis: Groups I to V (only Ag^{+}, Hg^{2+}, Cu^{2+}, Pb^{2+}, Bi^{3+}, Fe^{3+}, Cr^{3+}, Al^{3+}, Ca^{2+}, Ba^{2+}, Zn^{2+}, Mn^{2+} and Mg^{2+}); Nitrate, halide (excluding fluoride), sulphate, sulphide and sulphite.

Organic chemistry

Concepts: Hybridization of carbon; Sigma and pi-bonds; Resonance and hyperconjugation; Shapes of molecules; Structural and geometrical isomerism; Optical isomerism of compounds containing up to two asymmetric centers (R,S and E,Z nomenclature excluded); IUPAC nomenclature of simple organic compounds (only hydrocarbons, mono-functional and bi-functional compounds); Conformations of ethane and butane (Newmann projections); Keto-enol tautomerism; Determination of empirical and molecular formula of simple compounds (only combustion method); Hydrogen bonds: definition and their effects on physical properties of alcohols and carboxylic acids; Inductive and resonance effects on acidity and basicity of organic acids and bases; Polarity and inductive effects in alkyl halides; Reactive intermediates produced during homolytic and heterolytic bond cleavage; Formation, structure and stability of carbocations and free radicals.

Preparation, properties and reactions of Alkanes: Homologous series: Physical properties of alkanes (melting points, boiling points and density); Combustion and halogenation of alkanes; Preparation of alkanes by Wurtz reaction and decarboxylation reactions.

Preparation, properties and reactions of alkenes and alkynes: Physical properties of alkenes and alkynes (boiling points, density and dipole moments); Acidity of alkynes; Acid catalysed hydration of alkenes and alkynes (excluding the stereochemistry of addition and elimination); Reactions of alkenes with $KMnO_4$ and ozone; Reduction of alkenes and alkynes; Preparation of alkenes and alkynes by elimination reactions; Electrophilic addition reactions of alkenes with X_2, HX, HOX and H_2O (X=halogen); Addition reactions of alkynes; Metal acetylides.

Reactions of benzene: Structure and aromaticity; Electrophilic substitution reactions: halogenation, nitration, sulphonation, Friedel-Crafts alkylation and acylation; Effect of o-, m- and p-directing groups in monosubstituted benzenes.

Phenols: Acidity, electrophilic substitution reactions (halogenation, nitration and sulphonation); Reimer-Tieman reaction, Kolbe reaction.

Characteristic reactions of the following (including those mentioned above): Alkyl halides: rearrangement reactions of alkyl carbocation, Grignard reactions, nucleophilic substitution reactions; Alcohols: esterification, dehydration and oxidation, reaction with sodium, phosphorous halides, $ZnCl_2$/conc.-HCl, conversion of alcohols into aldehydes and ketones; Aldehydes and Ketones: oxidation, reduction, oxime and hydrazone formation; aldol condensation, Perkin reaction; Cannizzaro reaction; haloform reaction and nucleophilic addition reactions (Grignard addition); Carboxylic acids: formation of esters, acid chlorides and amides, ester hydrolysis; Amines: basicity of substituted anilines and aliphatic amines, preparation from nitro compounds, reaction with nitrous acid, azo coupling reaction of diazonium salts of aromatic amines, Sandmeyer and related reactions of diazonium salts; carbylamine reaction; Haloarenes: nucleophilic aromatic substitution in haloarenes and substituted haloarenes – (excluding Benzyne mechanism and Cine substitution).

Carbohydrates: Classification – mono-, di-, and polysaccharides (glucose, sucrose and starch only); Hydrolysis of sucrose.

Amino acids and peptides: General structure and physical properties.

Properties and uses of some important polymers: Natural rubber, cellulose, nylon, teflon and PVC.

Practical organic chemistry: Detection of elements (N,S, halogens); Detection and identification of the following functional groups: hydroxyl (alcoholic and phenolic), carbonyl (aldehyde and ketone), carboxyl, amino and nitro; Chemical methods of separation of mono-functional organic compounds from binary mixtures.

MATHEMATICS

Algebra

Algebra of complex numbers, addition, multiplication, conjugation, polar representation, properties of modulus and principal argument, triangle inequality, cube roots of unity, geometric interpretations.

Quadratic equations with real coefficients, relations between roots and coefficients, formation of quadratic equations with given roots, symmetric functions of roots.

Arithmetic, geometric and harmonic progressions, arithmetic, geometric and harmonic means, sums of finite arithmetic and geometric progressions, infinite geometric series, sums of squares and cubes of the first n natural numbers.

Logarithms and their properties.

Permutations and combinations, Binomial theorem for a positive integral index, properties of binomial coefficients.

Matrices as a rectangular array of real numbers, equality of matrices, addition, multiplication by a scalar and product of matrices, transpose of a matrix, determinant of a square matrix of order up to three, inverse of a square matrix of order up to three, properties of these matrix operations, diagonal, symmetric and skew-symmetric matrices and their properties, solutions of simultaneous linear equations in two or three variables.

Addition and multiplication rules of probability, conditional probability, independence of events, computation of probability of events using permutations and combinations.

Trigonometry

Trigonometric functions, their periodicity and graphs, addition and subtraction formulae, formulae involving multiple and sub-multiple angles, general solution of trigonometric equations.

Relations between sides and angles of a triangle, sine rule, cosine rule, projection rule, Napier's rule, half-angle formula and the area of a triangle, inverse trigonometric functions (principal value only).

Analytical geometry

Two dimensions: Cartesian coordinates, distance between two points, section formulae, shift of origin.

Equation of a straight line in various forms, angle between two lines, distance of a point from a line. Lines through the point of intersection of two given lines, equation of the bisector of the angle between two lines, concurrency of lines, centroid, orthocentre, incentre and circumcentre of a triangle.

Equation of a circle in various forms, equations of tangent, normal, and chords.

Parametric equations of a circle, intersection of a circle with a straight line or a circle, equation of a circle through the points of intersection of two circles and those of a circle and a straight line.

Equation of a parabola, ellipse and hyperbola in standard form, their foci, directrices and eccentricity, parametric equations, equations of tangent and normal.

Locus Problems.

Three dimensions: Direction cosines and direction ratios, equation of a straight line in space, equation of a plane, distance of a point from a plane.

Differential calculus

Real valued functions of a real variable, into, onto and one-to-one functions, sum, difference, product and quotient of two functions, composite functions, absolute value, polynomial, rational, trigonometric, exponential and lorgarithmic functions.

Limit and continuity of a function, limit and continuity of the sum, difference, product and quotient of two functions.

Even and odd functions, inverse of a function, continuity of composite functions, intermediate value property of continuous functions.

Derivative of a function, derivative of the sum, difference, product and quotient of two functions, chain rule, derivatives of polynomial, rational, trigonometric, inverse trigonometric, exponential and logarithmic functions.

Derivatives of implicit functions, derivatives up to order two, geometrical interpretation of the derivative, tangents and normals, increasing and decreasing functions, maximum and minimum values of a function, applications of Rolle's Theorem and Lagrange's Mean Value Theorem.

Integral calculus

Integration as the inverse process of differentiation, indefinite integrals of standard functions, definite integrals and their properties, application of the Fundamental Theorem of Integral Calculus.

Integration by parts, integration by the methods of substitution and partial fractions, application of definite integrals to the determination of areas involving simple curves.

Formation of ordinary differential equations, solution of homogeneous differential equations, variables separable method, linear first order differential equations.

Vectors

Addition of vectors, scalar multiplication, scalar products, dot and cross products, scalar triple products and their geometrical interpretations.