WORLD MARITIME UNIVERSITY
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EFFECTIVE DUAL PURPOSE TRAINING FOR COMPETENT SEAFARERS AND COMPETETIVE SHIPPING

By

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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.

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ABSTRACT

Title of Dissertation: **Effective Dual Purpose Training for Competent Seafarers and Competitive Shipping**

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Dual purpose training for ships' officers has been developing in several traditional maritime countries in line with integrated operation on merchant vessels. This dissertation is a study of training approaches and necessary conditions to make the dual purpose training effective in training highly qualified dual-competent officers.

The study begins with a brief look at recent trends in world shipping, particularly several methods taken to improve international competitiveness. A shift in emphasis is observed from short-term cost-driven policies to long-term quality policies. A closer look is taken at the integrated shipboard operation as a feasible quality option as well as grounds for the dual purpose training.

A comparative analysis of different dual purpose training schemes is made among three maritime nations: Denmark, the Netherlands, and Japan. Considerable differences are observed concerning types and forms of the training schemes. Additionally, a SWOT analysis is introduced to identify the internal and external environments of the three schemes and to assist in developing strategies for successful dual purpose training in general.

The study ends with presenting essential factors to make the training programs effective and efficient for both dual-disciplined officers and the shipping industry, including suggestions to forge favorable environment for the dual purpose training.

Key words: Dual purpose training, Integrated shipboard operation, MET, Competitiveness, Competence, Quality

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LIST OF ABBREVIATIONS

ARPA	Automatic Radar Plotting Aids
BIMCO	Baltic and International Maritime Council
CBT	Computer Based Training
COC	Certificate of Competency
DIS	Danish International Register of Shipping
DMA	Danish Maritime Authority
DRS	Danish Register of Shipping
DWT	Deadweight Tonnage
ECDIS	Electronic Chart Display and Information System
FOC	Flag of Convenience
GMDSS	Global Maritime Distress and Safety System
GT	Gross Tonnage
IBS	Integrated Bridge System
ILO	International Labour Organization
IMO	International Maritime Organization
INS	Integrated Navigation System
ISF	International Shipping Federation
ISL	Institute of Shipping Economics & Logistics
ISM (Code)	International Ship Management Code
IST	Institute for Sea Training
ITF	International Transport Workers' Federation
Maroff	Maritime Officer
MECS	Ministry of Education, Culture and Science (The Netherlands)
MET	Maritime Education and Training
MIWB	Maritiem Instituut Willem Barentsz
MOE	Ministry of Education (Japan)
MOT	Ministry of Transport (Japan)

MTPW	Ministry of Transport, Public Works and Water Management (The Netherlands)
NIS	Norwegian International Register of Shipping
OECD	Organisation for Economic Co-operation and Development
OOW	Officer in Charge of the Navigational Watch
SIMAC	Svendborg International Maritime Academy
STCW	Standards of Training, Certification and Watchkeeping for Seafarers
SWOT	Strengths Weaknesses Opportunities Threats
TRB	Training Record Book
UMS	Unmanned Machinery Space
UNCTAD	United Nation Conference on Trade and Development

Chapter 1

Introduction

Traditionally, maritime education and training (MET) has provided courses of study for students with two approaches. One approach is academic study consisting of nautical science, technical science, and other maritime related subjects, which often lead to an academic degree. The other approach is vocational training, which helps students obtain necessary competence for seafarers, leading to a certificate of competency (COC). Therefore, MET should not only respond to changes in social and technological demands for higher education in general but also comply with requirements of the shipping industry for qualified seafarers.

Since steam propulsion was introduced on board, merchant vessels have had a division of two departments, a deck and an engine department. Deck officers take care of navigation of a ship and cargo handling while engineering officers look after operation and maintenance of onboard machinery. Two different ship's officers require different knowledge and competence, and therefore different training programs at MET institutions.

However, in the late 20th century, a new type of shipboard operation, integrated operation of two departments by dual purpose officers, started in several traditional maritime countries, such as Denmark, the Netherlands, and Japan. Although circumstances behind the commencement of new systems varied, high labor costs, a decline in international competitiveness of the national flag fleet, and technological advancement on board were common to all countries. It was expected that the integrated shipboard operation would enable those countries to regain the competitiveness while maintaining quality operation by highly qualified national officers. Technological innovation on board has reduced human workload providing a basis of the flexible shipboard organization.

Dual purpose training was created in response to need for dual-competent officers required for the integrated shipboard operation. In the Netherlands, the new MET scheme is still evolving through constant review and adjustment. Denmark has recently introduced the dual purpose concept with strong support from the shipping industry and government. On the other hand, in Japan, integrated officer training was discontinued due to changes in national shipping policies. Analyses of the different training schemes will reveal critical factors that contribute to effective dual purpose training for competent dual-disciplined officers and competitive shipping of high quality. The new training scheme requires new approaches to teaching and learning activities, efficient teaching aids, and constant review and adjustment in close cooperation with the shipping industry and government.

Chapter 2

Competitive Environment of the World Shipping

2.1 Changes in the World Shipping

World trade has been growing since the late 19th century, and consequently the shipping industry has assumed an international nature. However, the shipping industry and world trade had been controlled by several maritime powers until the mid-20th century. Although maritime transportation was already international industry, it had not taken on multinational aspects yet. In general, ships were built, owned, registered, and operated nationally. The operation of those ships was regulated under national laws of flag States and international conventions which had emerged since the late 19th century. In addition, those ships were mainly manned with seafarers who were the nationals of flag States.

World shipping, which had been dominated by traditional maritime countries, began to change after the mid-20th century, especially after the oil crises in the 1970s. The economic crises caused drastic reduction in the world seaborne trade, which, coupled with speculative purchase of ships in the early 1970s, resulted in considerable over-tonnage in the world fleets. Consequently, freight rates fell, so did freight returns, which made shipping companies confronted with intense international competition and need for cost reduction. There were some measures for shipowners to take in order to remain competitive: reducing operating costs such as crew costs and maintenance costs, saving voyage costs such as fuel costs, lowering unit shipping costs by economies of scale, and obtaining tax preference.

However, due to the imminent pressure to reduce shipping costs accompanied by deregulation of the world financial and labor market, most shipowners sought solutions by choosing less demanding options; many shipowners minimized total operating costs by flagging out their fleets to foreign registries, mainly to open registry countries, where they could reduce taxes applying to their shipping and recruit cheaper crews from labor supplying countries around the world. The shift from national flags to open flags resulted in adding a multinational nature to the world shipping industry. It became quite possible for a ship to be built, owned, registered, and operated all in different countries (Couper, 2000).

2.2 Current State of the World Shipping

2.2.1 World Merchant Fleet

The process of globalization in the shipping industry caused major structural change in the world fleet. Although approximately two-thirds of the world merchant fleet is still controlled by traditional maritime countries, more than half of all merchant ships are now registered in countries which are not those of beneficial owners in the maritime powers. According to the ISL Shipping Statistics, at the beginning of 2003, the total world merchant fleet, comprising ships of 300 GT and over, stood at 39,415 ships with a total tonnage of 552.7 million GT or 816.4 million DWT. The number of ships in the world fleet has increased by approximately one percent annually in the past decade. As far as ships' registries are concerned, 63.1 percent of the total world tonnage were not registered in the country of beneficial owners but "flagged out". For comparison, the share of flagged-out ships had increased from 60.6 percent at the beginning of 1999. As for the controlled fleet, OECD countries controlled, in terms of deadweight tonnage, 63.5 percent of the total world merchant fleet, while the foreign flag share of the OECD controlled tonnage was 69.5 percent. As of January 1, 2003, the total tonnage of the major open flags, namely Panama, Liberia, the Bahamas, Malta, and Cyprus, accounted for 47.7 percent of the total world merchant fleet. Leading flags are Panama and Liberia with a total tonnage representing 32.0 percent of the total world tonnage (ISL, 2003).

2.2.2 World Merchant Seafarers

The BIMCO/ISF Manpower Update 2000 estimates that worldwide supply of seafarers is 404,000 officers and 823,000 ratings while the worldwide demand for seafarers is 420,000 officers and 599,000 ratings giving a global shortage of 16,000 officers and a surplus of 224,000 ratings. The officer shortfall can be attributed to inadequate recruitment and training of officers due to the global oversupply of ships and structural recession after the late 1970s. Many shipowners, particularly in OECD countries, reduced crew costs, which included costs for training, resulting in failure to adequately recruit and train "the missing generation of the 1980s and 1990s", which would inevitably have its consequences in the new century (Petersen, 2000, p.80).

The current moderate shortage of officers does not mean that ships cannot sail due to the officer shortage but many ships have to be operated with insufficient back-up or fewer officers than optimum manning level (Petersen, 2000). However, the 2000 Manpower Update forecasts that the officer shortage will worsen unless measures are taken to increase recruitment and training or reduce wastage. Indeed the level of recruitment and training has improved from one officer trainee in 13 officers in 1995 to one in ten in 2000, but the 2000 Manpower Update recommends that the level needs to further increase to one in seven in order to meet anticipated additional demand for officers. On the other hand, reduction of wastage rate, particularly cadet wastage rate, would obviously contribute to increasing the supply of qualified officers. Approximately 30 percent of officer trainees fail to complete their training period, which could be reduced by improving the maritime education and training process and making a seafaring career more attractive for young trainees.

The world fleet still largely relies on officers from OECD countries; in particular, around 47 percent of senior officers originate from those countries. However, there has been a continuous decline in the OECD officers and there will be more substantial reduction anticipated in the near future owing mainly to retiring senior officers and inadequate replacement with junior officers from those countries. As Figure 1 illustrates, more than 40 percent of OECD officers are over 50 years old, and 18 percent are aged over 55; OECD officers are retiring at a growing rate within 10 years. When Figure 2 is examined, it may be expected that retiring OECD senior officers will be replaced with officers from Asian and Eastern European countries within the next ten years. However, as the 2000 Manpower Update points out, the consistent trend that a small number of Asian officers choose to remain at sea after the age of 50 is also observed, which makes it difficult to assume that officers from those countries will sufficiently replace retiring OECD senior officers. The provision of equally skilled and experienced officers is a matter of urgency.

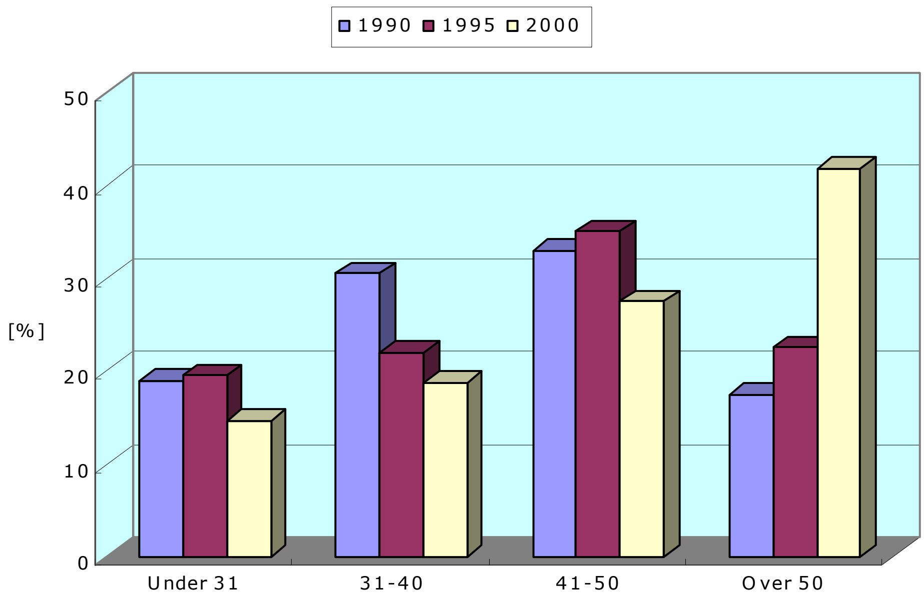

Figure 1 – Age profile of OECD officers

Source: Institute for Employment Research, University of Warwick. (2000). *BIMCO/ISF 2000 Manpower Update*, Coventry, UK: Author.

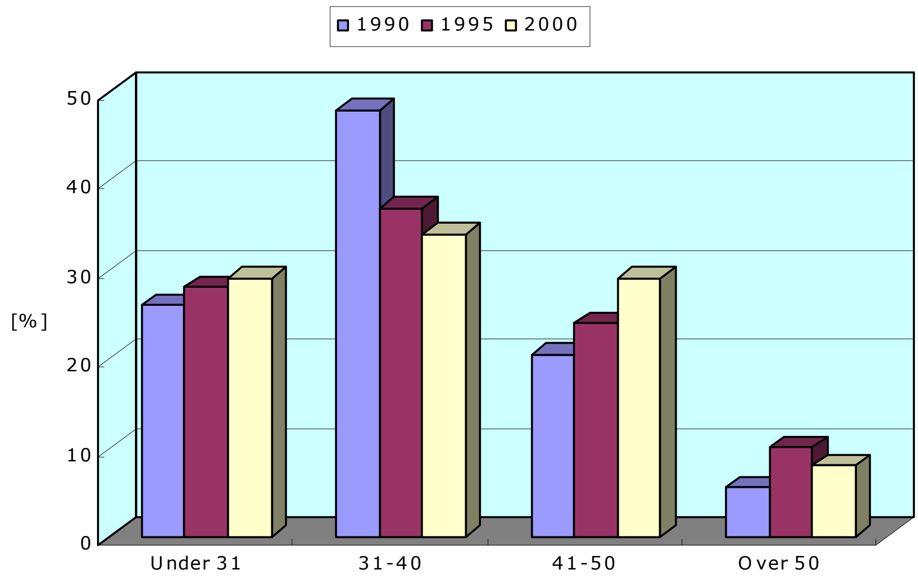

Figure 2 – Age profile of Far East Asian officers
Source: Institute for Employment Research, University of Warwick. (2000). *BIMCO/ISF 2000 Manpower Update*, Coventry, UK: Author.

2.3. Measures to Remain Competitive

A prolonged downturn in the world seaborne trade and over-tonnage in the 1980s caused intense competition in the world shipping, driving shipowners to drastic cost reduction. The need for cost reduction led both to technological advancement and emergence of new ship registries. Ships have been steadily growing larger and more specialized to fully exploit economies of scale. In addition to the use of low-quality fuel oil and improvement of propulsive efficiency, fuel economies of marine diesel engines have significantly improved. Introduction of automated systems on board, such as unmanned machinery spaces and integrated bridges, has enabled crew reduction. In contrast to those technical solutions, which require considerable time and capital investment, flagging-out is a much easier option for shipowners to produce immediate benefits. Significant labor cost saving could be obtained by simply switching flags to open registries, which would enable shipowners to employ cheaper crews.

2.3.1 Comparison of Cost Reduction Methods

Effectiveness of different cost reduction methods can be compared through examining a simplified ship costs equation.

$$
\begin{aligned}
TC &= K + OC + VC \\
&= K + (CC + C_1) + (FC + C_2)
\end{aligned}
$$

Where: TC = total ship costs
K = capital costs
OC = operating costs
VC = voyage costs
CC = crew costs
C_1 = the other operating costs (constant)
FC = fuel costs for main engines
C_2 = the other voyage costs (constant)

Table 2 presents the effect of different cost reduction methods applied to original conditions of an example ship, whose particulars are shown in Table 1. Technological advancement is made in the method 1; fuel efficiency of the main engine is improved to reduce the bunker costs. On the other hand, crew costs are targeted in the method 2 and 3; while the crew number is reduced in the method 2, the same number of cheaper crew is employed in the method 3. For the sake of simplicity, the other costs items are assumed to be constant. When Table 2 is examined, it is evident that hiring cheaper crew is the most effective cost reduction method for shipowners. In addition, it is also a less burdensome way of cost reduction than the other two, which will, in practice, incur capital expenditure for more efficient main engine or automated systems. Furthermore, it took about ten years for diesel engine manufacturers to improve the fuel efficiency of slow-speed marine diesel engines from 210 to 175 [g/(kW.h)]. Therefore, it is natural for most shipowners to target cheaper crews in order to reduce costs.

Table 1 – Particulars of the example ship

Model elements		Particulars of the example ship			
Example number		Original	Method 1	Method 2	Method 3
Ship type		Handymax bulk carrier			
Ship size [DWT]		40,000			
Crew composition	Officers	9 OECD	9 OECD	6 OECD	9 Asian
	Ratings	10 Asian	10 Asian	8 Asian	10 Asian
Main engine output [kW]		8,000			
Fuel efficiency [g/(kW.h)]		210	175	210	210
Days of operation		270 days per annum			

Source: The author

Table 2 – Cost reduction of the example ship

Costs categories		Annual costs of the example ship [Million USD]			
		Original	Method 1	Method 2	Method 3
Capital costs		3.40			
Operating Costs		2.30	2.30	2.11	1.82
	Crew costs	(0.90)	(0.90)	(0.71)	(0.42)
	The others	(1.40)			
Voyage Costs		3.35	3.10	3.35	3.35
	Fuel costs*	(1.52)	(1.27)	(1.52)	(1.52)
	The others	(1.83)			
Total annual costs		9.05	8.80	8.86	8.57
Cost reduction [%]			2.8	2.1	5.3

* Fuel oil price is assumed 140 [USD/tonne]

Source: Calculated by the author based on data in Stopford, M. (1997). *Maritime Economics, second edition*. New York: Routledge., and Drewry Shipping Consultants. (2001). *Ship operating costs annual review & forecast*. London: Author.

2.3.2 Options Available

In order to obtain labor cost saving by hiring low-cost crews, shipowners in traditional maritime countries had flagged out their fleets to open flag registries, which led to the decline in national flagged ships and seafarers. Subsequently, those countries developed new second registries and tax systems to revive their national shipping. Shipowners are now offered more options than before to remain competitive. Such options as open registry, second registry, and tonnage tax system, will be further examined in the following sections.

2.3.2.1 Open Registry

Open registries are the registries of flag States which allow their maritime flag registration to shipowners from another country, offering flexibilities in ship operation. Some, but not all open registries are considered under several criteria to be "flags of convenience (FOC)" by the International Transport Workers' Federation (ITF). While open registries offer simple registration procedures, low or non-existent tax, and no practical restrictions on nationality of crew, they are primarily interested in income from ship registration payments.

Although it has been argued that open flag registered ships are operated below standards in terms of ships safety and working conditions for seafarers, some data indicate that flagged-out ships are not necessarily synonymous with substandard ships. The average age of open flag registered ships was 14.7 at the beginning of 2003, which was about four years younger than that of national flag registered ships. In addition, the IMO data on ship detention by Port State Control shows that, of the 39 States whose detention to inspection rate exceeded world average rate of 6 percent in 1998, only eight were open flag States whose combined gross tonnage represented 20 percent of the total open flag registered ships. Therefore, it is only a few open flags that have worse safety records than the world fleet average (ILO, 2001). It should be recognized that while some established open flag States have a concern over the quality of their registers, others exploit the register market where shipowners wish to decrease the regulatory requirement costs (Alderton & Winchester, 2002).

Although it is the flag State that has obligations as well as sovereign rights over ships flying its flag, some open flag States have little administrative capability to enforce legal requirements; therefore, the implementation of existing international regulations has been left to the shipowners' responsibilities (Couper, 2000). Some shipowners who flagged out their ships still ensure their compliance with international regulations providing appropriate standards of ship safety and working conditions for crews. However, others may well be merely interested in hiring low-cost crews and avoidance of their own national laws and fiscal systems. The shipowners' implementation of the ISM Code and the STCW Convention, which stipulate the responsibility of companies for safe operation of ships, is crucial particularly for open flag registered ships.

2.3.2.2 Second Registry

Second registries were created by traditional maritime countries in response to increasing competitive pressure from open flags and continuous flagging-out of their national fleet. While these registries offer flexibilities in ship operation which are similar to those of open registries such as reduced taxation and the employment of foreign seafarers on local wages, they still retain some aspects of national laws and regulations, and effective control of the maritime administration (ILO, 2002). As Table 3 shows, unlike major open registries, most registered tonnage in the second registry is owned by shipowners in the primary country of registry.

Table 3 – Participation of shipowners in the primary country of registry

Country or territory of registry	Total tonnage registered [million DWT]			Participation of nationals of countries of registry or nationals of countries having privileged relationship with country of registry [%]		
	2001	2002	2003	2001	2002	2003
Open registries						
Panama	162.3	171.9	168.5	0.0	0.0	0.0
Liberia	75.2	73.1	68.4	0.0	0.0	0.0
Bahamas	44.9	45.3	44.1	0.5	0.0	0.0
Malta	44.5	42.1	36.4	0.1	0.1	0.0
Second registries						
Isle of Man	8.7	9.6	8.8	59.1	53.1	64.7
Netherlands Antilles	1.5	1.3	1.4	32.8	35.1	41.1
NIS*	28.1	28.7	27.4	85.0	85.5	86.4
DIS*	7.6	8.2	8.8	99.2	97.8	96.2

*NIS (Norwegian International Register of Shipping) DIS (Danish International Register of Shipping)
Source: UNCTAD. (2003). *Review of maritime transport, 2003.* Geneva: Author.

Second registries can be divided into two types; one is often termed offshore registry while the other is called international registry. Offshore registries are foreign registries based in territorial dependencies or associated self-governing territories such as Netherlands Antilles and the Isle of Man. There is a visible link between the territory with its primary State through the context of laws. Taking the Isle of Man for instance, the principal shipping legislation in place is the United Kingdom Merchant Shipping Act. On the other hand, international registries, which have been developed since the late 1980s, are based within the primary countries themselves such as Norwegian International Register of Shipping (NIS) in Norway and Danish International Register of Shipping (DIS) in Denmark. The main purpose of the international registry is to maintain national flagged tonnage by encouraging shipowners to remain under the national flag while offering deregulations such as lower taxation and the relaxed crew requirements. However, ITF has declared some second registries to be flags of convenience due to the increased level of deregulation, particularly the relaxed requirements for crewing.

2.3.2.3 Tonnage Tax

The tonnage tax system was first introduced in several traditional maritime countries in Europe, such as Norway, the Netherlands, and the United Kingdom. In most cases, the need for the new tax regime derived from serious concern about the declining shipping industry with continuous decrease in national registered ships and seafarers. The purpose of introducing the new tax system is to provide the shipping industry with a user-friendly and virtually tax exempt environment (Grey, 1999). The tonnage tax system can be considered as industry-specific fiscal support, by which the government assists the shipping industry which otherwise would have little chance to revitalize itself (Grey, 1999; Selkou & Roe, 2002). In fact, the Netherlands succeeded in luring many Dutch shipowners back to their national registry after introducing the tonnage tax in 1996, and the increase of national flag share in the UK is also attributable to the introduction of the new tax regime in 2000.

In the tonnage tax system, a shipping company is charged on a fixed notional profit calculated according to the net tonnage of its ships, which is in contrast to the normal corporation tax regime where taxable profit is based on actual profit earned from its shipping activities. A company opting for the new system will have the benefit of paying a predetermined low amount of tax, which will ensure the company the certainty of knowing the amount of tax payable. In addition, the company has more freedom to decide when to buy ships and how to finance them without being driven by tax considerations such as the need for depreciation (Selkou & Roe, 2002).

Taking the United Kingdom for example, the pragmatic new tax regime coupled with streamlined procedures for the UK register has provided the UK shipping industry and UK flag with comparative advantage. In the UK tonnage tax regime, a shipping company can be qualified for the system if the company operates “qualifying ships” which are “strategically and commercially managed” in the UK. Even though it is not mandatory for a “qualifying ship” to fly the UK flag, use of the UK flag is one of the criteria for “strategic and commercial management” in the UK. As a result, several UK shipowners re-registered their fleets under the Red Ensign, which led to astonishing increase in the national flag share in the UK controlled fleet from 28.7 percent in 1999 to 42.9 percent in 2003 (ISL, 2003).

What is unique to the UK tonnage tax regime is its clear link with training and employment for UK seafarers. A shipping company opting for the regime will be required to provide one officer training place a year for every 15 officer posts of all tonnage tax ships or to make cash contribution to a training fund. As training takes approximately three years for each trainee, the ratio of a cadet to officers will become one cadet for every five officer posts, which is even higher than the recommended level of one in seven officers by the 2000 BIMCO/ISF Manpower Update. This unique training requirement is an obvious attempt to reverse the decline in skilled UK seafarers at sea and in shipping staff with sea experience in the City of London, which in turn contributes financially to the UK Treasury in the long run

(Selkou & Roe, 2002).

2.4 Summary

World shipping has become more and more competitive since the late 1970s making shipowners more cost-conscious. Most shipowners in traditional maritime nations flagged out their fleets to open registry countries in order to reduce labor costs by hiring cheaper crews. Moreover, shipowners also reduced costs and efforts to recruit and train young officers of their own countries. Consequently, some 70 percent of OECD controlled ships have been flagged out, and serious shortage of OECD officers is expected in the future.

Despite the fact that hiring cheaper crews from labor supply countries is the most effective and easiest cost reduction method, many traditional maritime countries have introduced new shipping policies such as the international registry and tonnage tax regime in order to reverse the decline in national flagged fleets and seafarers. Those measures enable national flagged ships to improve competitiveness while maintaining employment of national officers.

Apart from the support measures for national shipping, some traditional maritime countries have developed integrated shipboard operation for the same purpose, that is, the maintenance of both fleet competitiveness and high quality operation by competent national officers. In the next Chapter, some aspects of technological advancement which enabled the integrated operation on board, and advantages and concerns of the streamlined shipboard operation will be discussed.

Chapter 3

Integrated Shipboard Operation

3.1 Demands for Quality Shipping

Since shipping is an international industry, most operating cost items in total ship costs are determined internationally. One exception is crew costs, which reflect national wage rates and are crucial for the international competitiveness of a ship (King, 2000). According to this principle, many shipowners in traditional maritime countries, where seafarers' wages are high, have flagged out their fleet to employ cheaper seafarers from labor supply countries. Although the employment of cheaper crews by flagging-out brings substantial saving in operating costs in the short term, low quality operation by temporarily hired international crews resulting from the shipowners' desire for cost reduction could cause many problems in the long term. Lower standards operation is less cost-effective in the long run, and it is difficult to meet the international requirements for maritime safety and pollution prevention. Furthermore, the flagging-out and international manning seriously affect the bases of shipping industries in established maritime nations by hindering sound recruitment and retention of highly qualified maritime experts on board and ashore.

Greenhalgh emphasizes that there is greater understanding of the lack of benefit in simply seeking the short-term cost reduction by hiring cheaper labor. If the cheapest possible crew is chosen as casual labor on board, it is difficult to expect commitment and professionalism of the crew, which are essential to high quality ship operation. Concentration on saving direct operating costs and hiring cheaper crews may well result in low motivation and a lack of commitment to higher standards, which can lead to operational problems and more serious marine casualties or pollution. A ship of lower standards has higher risk of breakdowns, delay, and off-hire time, which will cause more repair costs, indemnity for liabilities, higher insurance premiums, and possibly lower residual value of the ship. Although it is difficult to quantify the long-term costs compared with the short-term saving, growing social and legislative pressure for quality shipping will increase the long-term costs to make the short-term saving less cost-effective (as cited in Cutting costs, 2002).

While shipowners in traditional maritime nations strived to compete for the low cost operation in the 1980's and 1990's, they failed to adequately recruit and train qualified national seafarers causing a long-term structural problem to the industry. As the BIMCO/ISF Manpower Update 2000 predicts, there is a gradually worsening shortage of officers, particularly of senior level OECD officers, and insufficient replacement with junior officers from those countries. In addition, sensational press coverage of horrific marine casualties or pollution, many of which are caused by low quality ship operation and maintenance, gives a negative image of shipping to the public, which makes it difficult to attract young people to a seafaring career. All of them affect not only maintenance of maritime excellence and expertise on board but also provision of maritime experts with seafaring experience for shore-based shipping sectors.

There is an alternative measure for traditional shipping countries to compete internationally while maintaining high standards. In addition to the governmental support measures, it is effective to operate automated modern ships with an integrated shipboard organization, which consists of fewer highly trained dual purpose national officers and skilled general purpose ratings. It is true that international regulations such as the STCW Convention and the ISM Code contribute to enhancing the quality of seafarers from labor supplying countries by setting the international standards of training and competence for seafarers and by stipulating the responsibility of shipping companies for ensuring crews' competence, but it is difficult for labor supplying countries to train and certify their seafarers to the same standards as the traditional maritime nations (Lane, 1998). Training in labor supplying countries may be adequate for conventional ships; however, automated high-tech ships should only be entrusted to qualified seafarers who are trained through high standards of maritime education.

High quality ship operation with the integrated shipboard organization can only be effected by satisfying essential conditions: supply of technologically advanced ships, establishment of the new shipboard organization and ship-to-shore relationship, and implementation of new maritime education and training. Those conditions require considerable investment and efforts; however, all of them are vital for competitive national fleets, adequate recruitment and retention of seafarers, and sustainable national shipping sectors. While the short-term cost-driven policy on crewing may well be costly in the long term, the long-term gain is worth the short-term investments for high quality.

3.2 Technological advancement

Technologically advanced ships are a prerequisite for the integrated shipboard operation, or it would be more correct to say that necessity for the new shipboard organization has emanated from technological innovations. New technology has been introduced into ships in order to reduce human workloads, enhance human performance, and reduce the human error-related accidents, so that the technological evolution on board ships naturally necessitates re-allocation of crew's tasks and changes in the shipboard organization (THALASSES, 2000).

The technological innovation on board, which initially started in the engine room, has gradually spread over all shipboard functions, namely, navigation, cargo handling, and communication. Automation and remote monitoring of machinery have made full time engine room watches no longer necessary. A navigation bridge with integrated systems has become a ship's operation center. The introduction of

GMDSS (Global Maritime Distress and Safety System) has made radio officers unnecessary. Satellite communications have facilitated integration of a ship into a company's control network.

Figure 3 illustrates a concept of the integrated ship control system, which consists of the Integrated Bridge System (IBS), the Unmanned Machinery Space (UMS), and the satellite communication system. The IBS and UMS are already integrated by themselves; however, they become components of the further integrated ship control system. The satellite communication system on board represents ship-to-ship and ship-to-shore communication, which will enable much further integration of the ship into the corporate and transportation network.

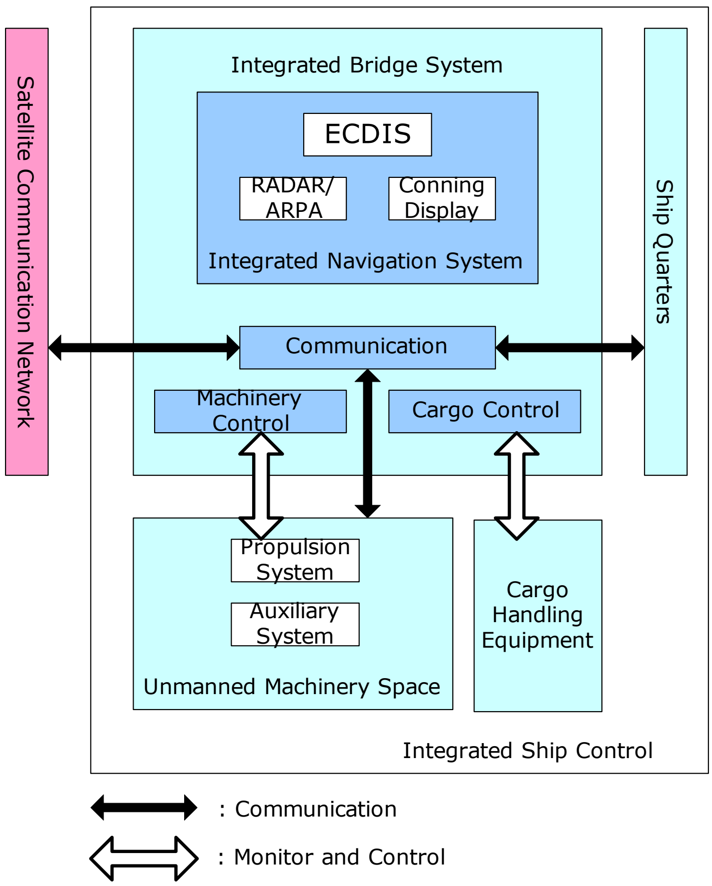

Figure 3 – Integrated ship control

Source: Evaluation of the impacts of new technologies in maritime transport in the human element through the creation of a constructive technology assessment network [Thalasses]. (2000). *D8: Final Report*. Thessaloniki, Greece: Author.

3.2.1 Unmanned Machinery Space (UMS)

The introduction of engine room automation, such as remote control and monitoring systems, subsequently led to the Unmanned Machinery Space (UMS) operation, where constant watch-keeping was no longer necessary. Engineering officers were relieved of the traditional four-hour-on, eight-hour-off watch-keeping, and engaged in maintenance work during the daytime. As a result, they were provided with a longer rest period and uninterrupted sleep each day except for the duty-night when one engineer is on call to respond to emergency situations. In addition to the automation, reliability and durability of onboard machinery have significantly increased, resulting in extended maintenance intervals. Consequently, the workload of engineering officers has reduced while their productivity has increased due to the improved working conditions. Therefore, it became reasonable for engineers to share the duties of navigational watch-keeping.

3.2.2 Integrated Bridge System (IBS)

As defined in the performance standards for navigation equipment by the International Maritime Organization (IMO), the Integrated Bridge System (IBS) is a combination of the Integrated Navigation System (INS) and other systems, such as machinery control, cargo control, communication, and safety and security control system, which are interconnected to enable centralized monitoring and control from the workstation. The INS, as a component of the IBS, is a combination of navigation equipment, which is interconnected to support safe and efficient navigation by evaluating several data inputs and providing timely information to the officer in charge of the navigational watch (OOW).

With the INS, many routine and repetitive navigational tasks, such as chart updating, position plotting, and steering can be automated. As a result, the workload of an OOW can be reduced, and more time can be spent on decision making instead of gathering and processing information (THALASSES, 2000). With the IBS, the navigation bridge functions as a ship's control center where fewer qualified personnel can monitor and control all essential shipboard functions, such as navigation, propulsion, and communication (National Research Council, 1990).

3.2.3 Satellite Communications

Satellite communications, in combination with the broad-band internet technology, have had three major impacts on modern ships. Firstly, the introduction of GMDSS has abolished the position of radio officers by making the operation of communication equipment easier and performable by any navigational watch officer. Secondly, with satellite communications, even an ocean going vessel is no longer an isolated unit. Rather, being permanently on line, the ship has been incorporated into a world-wide communication network, which enables immediate contact between the ship and shore management. Functions of the modern shipboard organization will be determined by reallocating management responsibilities between ship and shore. Thirdly, as the internet connection is becoming affordable at sea, regular correspondence with shore and even distance learning is possible for seafarers, which can be effective measures to eliminate social isolation of seafarers.

3.3 Integrated Shipboard Organization

The integrated shipboard organization has a completely different structure from the traditional shipboard organization. The former has a more flexible team structure while the latter is based on a rigid departmental structure. Figure 4 shows organization charts of the typical traditional departmental structure and integrated structure.

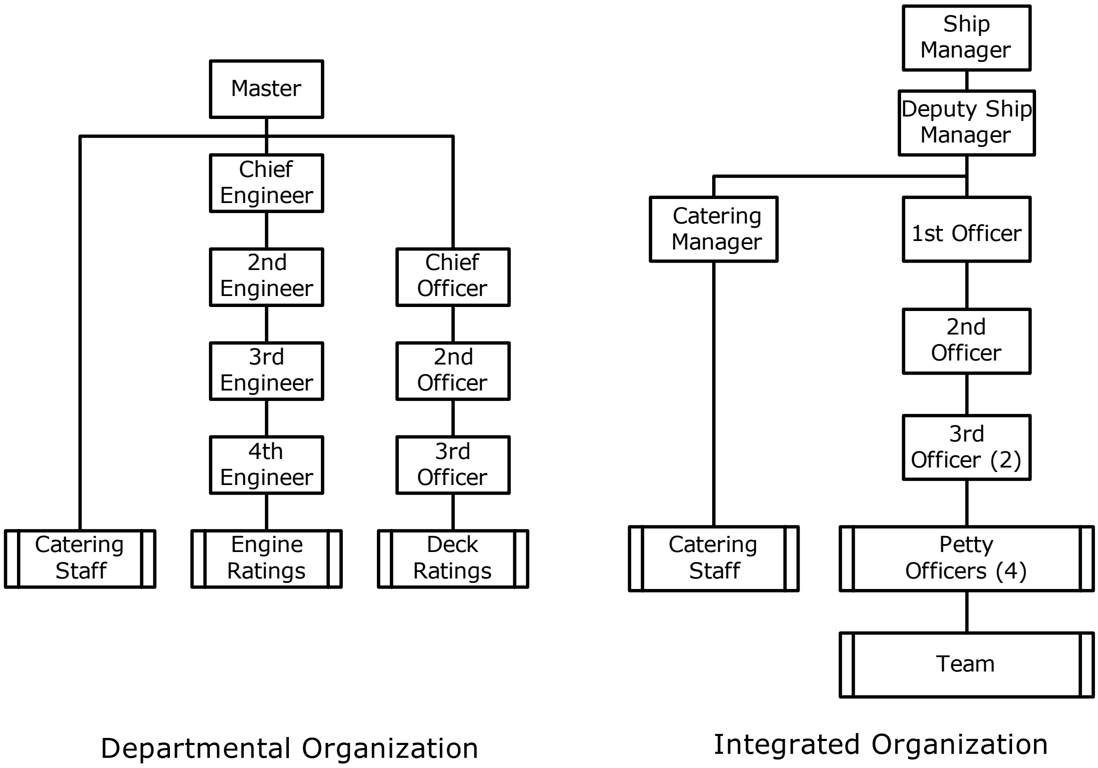

Figure 4 – Shipboard organization
Source: Maersk A/S. (2004). *Future ship organization*. Copenhagen: Author.

Even though the total number of the crew for the integrated organization is smaller than that for the traditional organization, the primary effects of the change in structures are the breakdown of departmentalism and flexibility in operation. Strong departmentalization of the traditional organization has been characterized by separate stores, separate mess rooms, and different administrative systems in one ship. In many cases, the same tools and equipment are kept both in a deck store and an engine store exclusively for the use of the respective departments. What is worse, physically separated onboard circles have created a barrier of ignorance and indifference between the two departments (Branstad & Sandgren, 1990). On the other hand, even though the structure of the integrated organization in Figure 4 looks hierarchical with a line of command, officers qualified in both disciplines and general purpose petty officers make the shipboard organization more flexible and dynamic. All crew members work in a team organization with shared responsibilities and common understanding of the whole ship as a single system.

The future ship organization shown in Figure 4, which is envisaged by a Danish shipping company, consists of a few highly qualified dual purpose officers, skilled general purpose technicians called petty officers, and a team as a general workforce. Management officers, the Ship Manager and Deputy Ship Manager, having the highest competence in both disciplines, are responsible for the overall management of the ship. The four junior officers, First Office, Second Officer, and two Third Officers, share the navigation watch on the bridge and daily services in the engine room. The four petty officers share the bridge watch during voyages, and they are also in charge of various maintenance work both on deck and in the engine room acting as supervisors for the onboard Team. The Team, whose composition varies depending on the type and age of a ship, and the area of operation, is engaged in general maintenance work, such as cleaning, painting, and welding.

The integrated shipboard operation is technologically possible for any automated ship equipped with a monitoring and alarm system. Above all, container ships are most suitable because of their fixed voyage routes and schedules as well as more shore-based planning and handling of cargoes. On the other hand, the integrated operation with reduced crew is not appropriate for some types of ships such as short-sea ships with intensive operational schedules and frequent calls at ports, and passenger ships which might require a considerable number of crew members for emergencies (Cross, 1990b).

Tables 4 and 5 graphically display work hours of each crew members of the future shipboard organization during normal sea service and in confined waters. As can be seen in Table 4, the four junior officers and four petty officers share the bridge watch during normal sea voyages. The Ship Manager and the Deputy Ship Manager do not take part in the navigation watch, but are available on call if deemed necessary. During the daytime, if the ship is sailing in open waters in good weather conditions, the petty officer on duty will be released from the bridge watch to perform normal daily work. In that case, the bridge watch is taken care of by the duty junior officer alone. The four junior officers also take charge of daily inspections in the engine room and become on call during the night time. The on-call duty changes every day between two junior officers.

Table 4 – Work hours schematic at sea

	1 – 3	4 – 6	7 – 9	10 - 12	13 – 15	16 – 18	19 – 21	22 – 24
Ship Manager	On Call	On Call	Work	Work	Work	Work	On Call	On Call
Dep. Ship Manager	On Call	On Call	Work	Work	Work	Work	On Call	On Call
1st Officer	Off Duty	Watch	Work	Work	Off Duty	Watch	On Call	On Call
2nd Officer	Watch	Off Duty	Work	Work	Watch	Off Duty	On Call	On Call
3rd Officer	On Call	On Call	Watch	Off Duty	Work	Work	Watch	Off Duty
3rd Officer	On Call	On Call	Off Duty	Watch	Work	Work	Off Duty	Watch
Petty Officer	Off Duty	Watch	Work	Work	Off Duty	Watch	On Call	On Call
Petty Officer	Watch	Off Duty	Work	Work	Watch	Off Duty	On Call	On Call
Petty Officer	On Call	On Call	Watch	Off Duty	Work	Work	Watch	Off Duty
Petty Officer	On Call	On Call	Off Duty	Watch	Work	Work	Off Duty	Watch
Catering & Team	Off Duty	Off Duty	Work	Work	Work	Work	Off Duty	Off Duty

On Call   Watch   Work   Off Duty

Source: Maersk A/S. (2004). *Future ship organization*. Copenhagen: Author.

In the integrated shipboard operation, the work tasks can be effectively distributed with flexible arrangement of the workforce depending on the total workload. As can be seen in Table 5, in confined waters, and during arrival and departure, the four junior officers share both the bridge and engine room watch duties. The management officers will be on call around the clock. When it is necessary, the Ship Manager takes command on the bridge while the Deputy Ship Manager takes command in the engine room. The four petty officers are assigned to assist the watch duties either on deck or in the engine room. (Maersk A/S, 2004).

Table 5 – Work hours schematic in confined waters

	1 – 3	4 - 6	7 – 9	10 – 12	13 – 15	16 – 18	19 - 21	22 – 24
Ship Manager	On Call	On Call	On Call	On Call	On Call	On Call	On Call	On Call
Dep. Ship Manager	On Call	On Call	On Call	On Call	On Call	On Call	On Call	On Call
1st Officer			Watch (Bridge)	Watch (Bridge)			Watch (Bridge)	Watch (Bridge)
2nd Officer	Watch (Bridge)	Watch (Bridge)			Watch (Bridge)	Watch (Bridge)		
3rd Officer			Watch (Engine)	Watch (Engine)			Watch (Engine)	Watch (Engine)
3rd Officer	Watch (Engine)	Watch (Engine)			Watch (Engine)	Watch (Engine)		
Petty Officer	On Call	Watch/ Work			Watch/ Work	Watch/ Work		
Petty Officer			Watch/ Work	Watch/ Work			On Call	Watch/ Work
Petty Officer	Watch/ Work	On Call			Watch/ Work	Watch/ Work		
Petty Officer			Watch/ Work	Watch/ Work			Watch/ Work	On Call
Catering & Team			Work	Work	Work	Work		

On Call | Watch (Bridge) | Watch (Engine) | Watch/ Work | Work | Off Duty

Source: Maersk A/S. (2004). *Future ship organization*. Copenhagen: Author.

3.4 Effects of the Integrated Shipboard Operation

Since the fully integrated shipboard operation on automated modern ships has been put in place recently, it is premature to evaluate its long term effects. Nevertheless, several advantages and concerns can be examined from experience and expectation from high-tech ships sailing under the integrated operation. Primary advantages are more efficient ship operation, flexibility in staffing on board, better career perspectives, and cost reduction. On the other hand, careful consideration needs to be given to such issues as adverse effects of automation, less hands-on and specialized skills, service continuity, and reallocation of responsibilities.

3.4.1 Advantages

Efficient operation

With the integrated shipboard organization, a modern ship can be operated in a more effective and efficient way. All crew members on board understand the ship as one system, and they can function as a team, which will lead to more effective operations. Dual purpose officers on the integrated bridge know how their actions on the bridge will influence the operation of machinery in the engine room, and know which equipment is currently out of use for maintenance or malfunction and why. Highly qualified crew working in harmony with shared knowledge and experience will enhance efficiency of the shipboard operation and reduce the risk of accidents (Grey, 1993b).

Flexibility

More flexible staffing is an inherent advantage of the integrated operation on board. Crew members with dual competence can be assigned to interdepartmental tasks depending on needs and availability of staffing. As illustrated in Tables 4 and 5, the dual purpose junior officers can take care of both the bridge watch and engine room inspection, or the engine room watch depending on the ship's operating mode.

The flexibility in operation also contributes to even distribution of workloads. Even though the total number of the crew is smaller than that for conventionally operated ships, more workforces are available for a given shipboard task. Major maintenance work in the engine room, which was previously carried out only by the engine department, can be done by any dual-skilled crew member available. Therefore, workloads at peak periods can be evenly spread among crew members to alleviate fatigue of certain individuals (National Research Council, 1990).

Career perspectives

Officers with dual competence are given better career prospects both at sea and on shore owing to their comprehensive understanding of a ship. A greater number of maritime experts with seagoing experience will be required by the shore-based maritime sectors because of an expected shortage of qualified personnel in the shipping industry. Nonetheless, under the conventional departmental system, it is more difficult for deck officers to find shore-based employment than engineers owing mainly to their highly ship-specific knowledge and expertise (Zade, 1999). In contrast, versatility and good management capabilities afforded to the dual purpose officers will make differences in employment. In addition, the better career opportunity together with challenging multifunctional onboard tasks will make a seafaring career more attractive to young people.

Cost reduction

Originally, the economic pressure to reduce operating costs and the technological advancement necessitated the integrated shipboard operation. However, the crew reduction resulting from the new shipboard organization is not drastic due to increasing statutory requirements for maritime safety, security, and hours of work. According to Mr. Vries of P&O Nedlloyd, while conventionally operated ships are manned with approximately 20 crew members, automated ships with the integrated organization are operated by around 17 crew members (Personal communication, April 27, 2004). Moreover, additional costs will be incurred in investing automated ships and training the dual purpose officers. Therefore, the cost reduction would be possible through efficient and high quality ship operation in the long run rather than the crew reduction.

3.4.2 Concerns

Adverse effects of automation

Automation which has been introduced on board ships is designed to reduce the human workload and improve performance, which will result in a decrease in human-error related accidents. However, automation also has negative impacts on shipboard operation. Automation has reduced physical workloads and active operation while it has increased mental work and passive monitoring. Failure in monitoring is a typical problem associated with automation because human operators are inherently poor monitors; they are easily bored and fail to detect an abnormal signal which may occur very infrequently. The passive monitoring tasks will not only create boredom for operators but also affect their whole attitude toward work, leading to a false sense of security and evacuation of creativity and judgment (Scott, 2002). In addition, the IBS, where all vital shipboard information is concentrated, may cause “information overload” to officers on the bridge (Deboo, 2003). When information is given from many different sources, a watch-keeping officer may be distracted from primary navigational tasks, which is particularly dangerous when the ship is sailing in congested waters.

Automation systems should be so designed as to achieve an optimal human-machine interface, which will assist human operators to make well-informed decisions by gathering, processing, and presenting the data needed. To minimize boredom and maintain vigilance, it is essential to design automated equipment so as to provide active as well as passive activities and sufficient variety of tasks for operators (National Research Council, 1990). To avoid the information overload, Deboo (2003) points out that information to be presented should be combined and reduced through “the need-to-know principle filter” (p. 9). Behavior of human operators, who are poor at monitoring and prone to the information overload, should be carefully considered in designing the automation systems to reduce risks of human error-related accidents and to enhance operational performance.

Hands-on and specialized skills

Dual purpose officers engaged in the integrated operation are maritime generalists, who are assigned to deal with diverse shipboard tasks with their dual competence, rather than specialists either in nautical or technical discipline. On the one hand, the modern technology and automation have made each onboard operation easier, but on the other hand, more and more sophisticated high-tech equipment may require specialist knowledge and skills. Specialized skills are particularly crucial when automated equipment malfunctions beyond the basic troubleshooting, requiring emergency manual operation. Since expertise in each discipline can only be accumulated through hands-on experience, it takes dual purpose officers a longer time to gain required specialist skills.

Service continuity

The team concept, which is an essential factor of the integrated shipboard operation, presupposes crew's familiarity with the ship and service continuity (Grey, 1993b). However, this concept may be undermined by one of the advantages which dual purpose officers can enjoy. Dual-trained officers have better career perspectives, but the other side of the coin is that they might leave the sea to seek better shore employment earlier than was the case with mono-trained officers. To maintain longer employment and the service continuity, shipowners are required to take necessary measures to make seafaring more interesting and attractive. Quality of life and work on board should be maintained. Timely training for upgrading knowledge and skills should be given according to a proper career development plan. A wider scope of job opportunity should be offered through rotation of shipboard and shore positions so that the dual competence can be best utilized.

Reallocation of responsibilities

Reallocation of responsibilities between ships and the shore management will determine the functions of the new shipboard organization. Since the communication technology has brought ships into direct contact with the headquarters ashore, management responsibilities can be shifted either from ship to shore or from shore to ship. In the former case, all vital decisions are made ashore, and the crew is mainly responsible for routine operation of the ship. In the latter case, the onboard management team will take certain management functions within overall guidelines set by the main office (National Research Council, 1990). In order to motivate the crew with decision-making responsibilities and autonomy, which will lead to the improvement of operational efficiency, more responsibilities should be transferred to the ship. If most management responsibilities are to be taken aboard the ship, then longer employment, continuity and commitment of the crew are prerequisite for successful onboard management (Grey, 1993a).

3.5 Summary

Integrated shipboard operation could be an effective measure for traditional shipping countries to improve competitiveness of their fleet while maintaining high quality operation by national officers. This concept is backed up by increasing legislative pressure for quality shipping and greater understanding of the long-term benefits of higher standards in shipping.

The flexibility of the new shipboard organization can improve operational efficiency and reduce the peak time workload in spite of having fewer crew members. In addition, dual-trained officers have better career opportunities both on board ships and in shore-based maritime sectors, which makes the seafaring profession more attractive. At the same time, careful consideration is necessary for effective integrated shipboard operation: the optimal human-machine interface of the automation, the service continuity of crews, and the redistribution of management responsibilities between ship and shore.

The technological advancement in all onboard functions enables and necessitates the integrated shipboard operation, which in turn requires highly qualified officers with dual competence. In the next Chapter, maritime education and training for dual purpose officers in three maritime nations, Denmark, the Netherlands, and Japan, will be examined in relation to national shipping policies of each country.

Chapter 4

Dual Purpose Training: Country Analysis

Dual purpose training has been developed by several traditional maritime countries in various forms and names, usually in line with the integrated shipboard operation, which has been introduced seeking cost reduction and flexible manpower utilization. The integrated operation on board merchant ships necessitates training dual purpose officers. In other words, dual purpose training rarely exists without the integrated shipboard operation.

The form of dual purpose training varies from country to country. In terms of the level of integration, it takes place either at only the STCW-defined operational level or up to the management level. With regard to the extent of integration, dual purpose training can be classified into two types: full-integrated and semi-integrated. Full-integration means full education and certification in both nautical and technical disciplines. On the other hand, semi-integration means full education and certification in one discipline, and basic education and limited certification for watch-keeping duties in the other discipline.

In this Chapter, three traditional maritime countries, namely, Denmark, the Netherlands, and Japan, will be compared regarding the MET in general and dual purpose training in particular. In addition to these, major shipping policies and support measures taken by each country will be examined as important factors influencing the MET schemes.

In order to gather necessary information concerning MET systems in Denmark and the Netherlands, questionnaires (Appendix 1) were sent to respondents comprising the maritime administration, shipowners, and MET institutions (Appendix 2). In addition, interviews were carried out with experts of MET (Appendix 2) to acquire information on how course programs are effectively integrated. Therefore, descriptions of course contents are based on those of the MET institutions to which interviewers belong, namely, the Maritiem Instituut Willem Barentsz (MIWB) in the Netherlands and the Svendborg International Maritime Academy (SIMAC) in Denmark. MIWB takes in more than half of the total students of higher level dual purpose MET scheme in the Netherlands, and SIMAC is the only MET institution for dual purpose officer training in Denmark.

In Japan, dual purpose training at MET institutions ended in 1999. Thereafter, nationwide administrative reforms took place in the early 2000s. As a result, governmental bodies as well as MET institutions changed their names and/or status. However, for convenience of explanation, descriptions regarding Japanese MET systems are based on facts in the 1990s when the dual purpose training was mainly implemented.

4.1 Denmark

4.1.1 Danish Shipping Industry

The Danish shipping industry is making a major contribution to the national economy, being the second largest income earner. At the beginning of 2003, Denmark ranked 12th in the world maritime nations based on total tonnage. The merchant fleet comprises some 600 ships with a total tonnage of 16.5 million DWT. The Danish fleet can be characterized by its modern container ships being operated worldwide. The average age of the fleet is approximately 13 years, which is considerably younger than the world average of 17 years. This low average age can be attributable to an ongoing new-building order program equating to 10 percent of the current fleet size, which makes the Danish fleet one of the most modern and technologically advanced one in the world. Some 65 percent of the tonnage is engaged in liner trade, and container ships represent in terms of tonnage more than half of the Danish fleet. More than 95 percent of the tonnage is operated in international cross-trade without calling at Danish ports. This international nature of the Danish shipping involves vulnerability to the competition from open flag registered fleets, which are, in nature, cross-traders (ILO, 2002).

During the 1980s, Denmark, like other traditional maritime nations, experienced a gradual decline in the national fleet and seafarers due to increased international competition. In 1988, Denmark created the Danish International Register of Shipping (DIS) in order to prevent further flagging-out, encouraging shipowners to bring their fleets back under Danish flag, and maintain employment opportunity for Danish seafarers. To restore the international competitiveness of the Danish flag fleet, it was most effective to bridge the crew cost gap between Danish ships and ships operated under FOC. Under the new registry, seafarers are exempted from income tax allowing shipowners to pay net wages. In addition, shipowners are allowed to employ foreign seafarers, except for the master, and to negotiate their wage levels reflecting the difference in costs of living. It is estimated that crew costs could be reduced by 30 to 40 percent as compared with ships under the traditional Danish register (ILO, 2002).

With the crewing cost reduction to an internationally competitive level, the new registry has improved competitiveness of the Danish national fleet contributing to the retention of national flagged ships. As can be seen in Figure 5, the decrease in the national registered ships was reversed after the advent of DIS, and it has been held reasonably steady at around 600 ships. Even though the ordinary registry, Danish Register of Shipping (DRS) still remains, it is almost exclusively used for domestic ferries and fishing vessels. The introduction of DIS has achieved its desired goals of restoring the international competitiveness of the Danish flagged fleet while retaining national regulations and effective administrative control over registered ships.

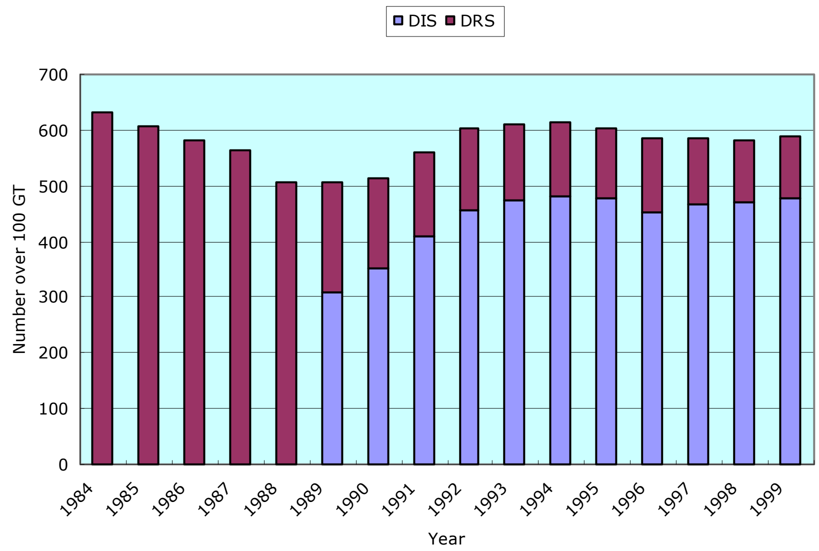

Figure 5 – The number of Danish flagged fleet

DRS: Danish Register of Shipping
DIS: Danish International Register of Shipping
Source: Danish Maritime Authority (as cited in ILO. (2002). *Meeting of experts on working and living conditions of seafarers on board ships in international registers.* Geneva: Author.)

Although Denmark successfully restored their national fleet by introducing the new registry, the employment opportunity for Danish seafarers did not take the same positive track. Figures 6 and 7 indicate the decrease both in officers and ratings employed on Danish flagged ships before the advent of DIS, and the gradual recovery thereafter due to the increase in the national fleet. However, during the decade, the proportion of Danish seafarers had fallen from 98 percent to 93 percent for officers, and from 88 percent to 71 percent for ratings. The increasing use of non-nationals is a reflection of shipowners' consideration to labor costs. Job opportunities for Danish ratings were more affected by the transition to DIS than those for officers. This can be explained by the fact that shipowners have preference for high quality Danish officers on the one hand. On the other hand, there are still a lot of manual jobs on board, which simply require cost-effective hands (Dirks, 1998).

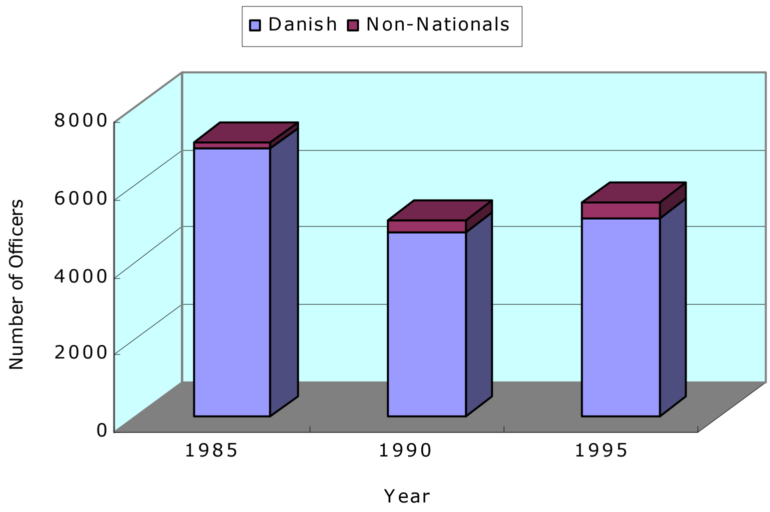

Figure 6 – Danish and non-national officers on Danish flagged fleet
Source: Thematic Network on Maritime Education, Training and Mobility of Seafarers [METNET]. (2000a). *Work package 2: Evaluation of national studies and efforts for meeting the national demand for seafarers by a national supply, final report*. Malmö, Sweden: Author.

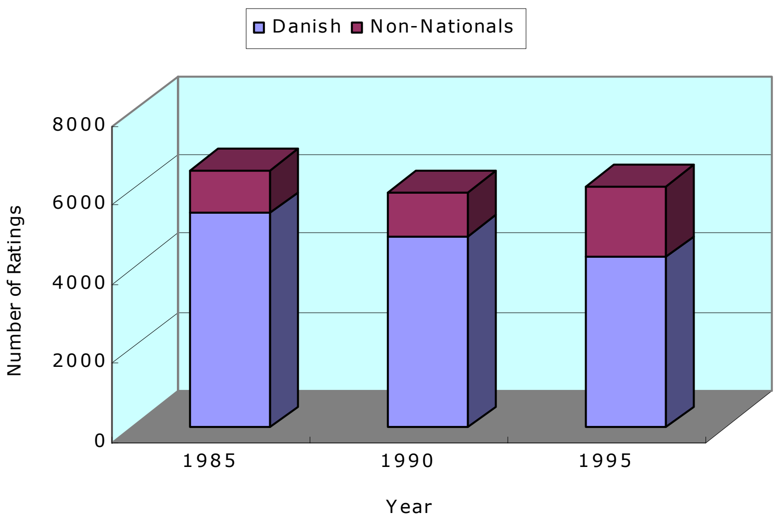

Figure 7 – Danish and non-national ratings on Danish flagged fleet
Source: Thematic Network on Maritime Education, Training and Mobility of Seafarers [METNET]. (2000a). *Work package 2: Evaluation of national studies and efforts for meeting the national demand for seafarers by a national supply, final report*. Malmö, Sweden: Author.

In 2002, as a result of heavy pressure from the shipping industry, Denmark introduced a tonnage tax system for merchant shipping, which is similar to the Dutch system. It is premature to evaluate the effects of the new tax system on Danish shipping. However, if considering successful precedents in the Netherlands and the United Kingdom, it can be expected that Danish shipping will further enhance its competitiveness in world shipping.

4.1.2 Danish MET

In Denmark, MET for officers takes place in 9 specialized schools: one MET center for dual purpose ship's officers and engineering officers, one nautical college for deck officers, one skipper school, and six engineering colleges. MET is under the management and control of the Danish Maritime Authority (DMA), which is a part of the Ministry of Economy, Business and Industry. While the DMA is responsible for regulatory and supervisory functions such as quality control and audit of the MET institutions, greater autonomy and responsibilities are placed on the individual MET institutions for detailed course contents as well as assessment of students.

For admission to MET programs for officers, applicants are required to complete primary and secondary school for 10 years having passed advanced school leaving examinations in mathematics, physics, chemistry and Danish and English languages. In addition, each student has to sign a written agreement with a shipping company approved by the DMA before entering the MET scheme, which will guarantee an onboard training place for the student and ensure qualified training during the seagoing periods provided by the shipping company involved. Since the DMA considers its responsibility as the training for Danish nationals, all MET programs are conducted in Danish (ILO, 2002).

All MET programs in Denmark are free. For schooling, all necessary costs including fees, accommodation and equipment are funded by the government; in addition, students receive about 700 USD per month from the government. For onboard training, all costs are paid by the shipping company, which will be reimbursed by the government. This is the evidence of strong commitment of the government to high quality MET, which will contribute in no small way to the country's economy. The DMA's policy on MET falls in line with the philosophy of Danish shipowners that new ships are to be operated with modern technology and high quality crews (Dirks, 1998).

A current problem of Danish MET is insufficient number of youngsters entering and completing the MET programs, which will lead to a considerable shortage of officers. As far as the dual officer training is concerned, the DMA estimates that the Danish fleet requires about 300 cadets annually, while the current intake to the dual MET scheme is about 200. In addition, around 40 percent of new entrants do not complete the dual officer program. Although this rate is lower than the average drop-out rate of Danish universities, which is around 50 percent, the high rate of drop-outs is significant wastage of the government funding. Possible reasons for the insufficient intake and the high drop-out rate are negative images or misperception of work and life at sea among young Danes, and too high training standards for students. Danish shipping will face serious officer supply problems unless effective measures are taken.

4.1.3 Danish Dual Purpose Training

The training scheme for the dual purpose officer, who is called Ship's Officer, was established in Denmark in 1998. The new scheme was strongly encouraged by Danish shipowners in the light of recent decline in Danish officers on the DIS fleet due to still high manning costs and shortage of supply. In order to maintain both high standards and competitiveness of the Danish fleet, it was considered necessary to man technologically advanced modern ships with highly skilled but fewer officers, who were required to have a high degree of flexibility (Lock, 2002). The dual purpose officer training was commenced in compliance with the demands for crew reduction and flexible manning system on the modern Danish fleet.

The dual purpose MET scheme in Denmark is a "sandwich system", which comprises a junior officer program and a senior officer program. As for the junior program, traditional three year courses for deck and engineering officers were combined into the dual officer program for four-and-a-half years. As illustrated in Figure 8, theoretical study at school and practical training on board merchant vessels alternate during the junior officer program. On successful completion of the junior officer program, graduates are certified with two certificates of competency (COC): one for watch-keeping deck officer, the other for engineering officer. Although no Danish MET program currently leads to an academic degree, introduction of the academic degree is being discussed reflecting increased interests in higher academic qualifications among the young generation.

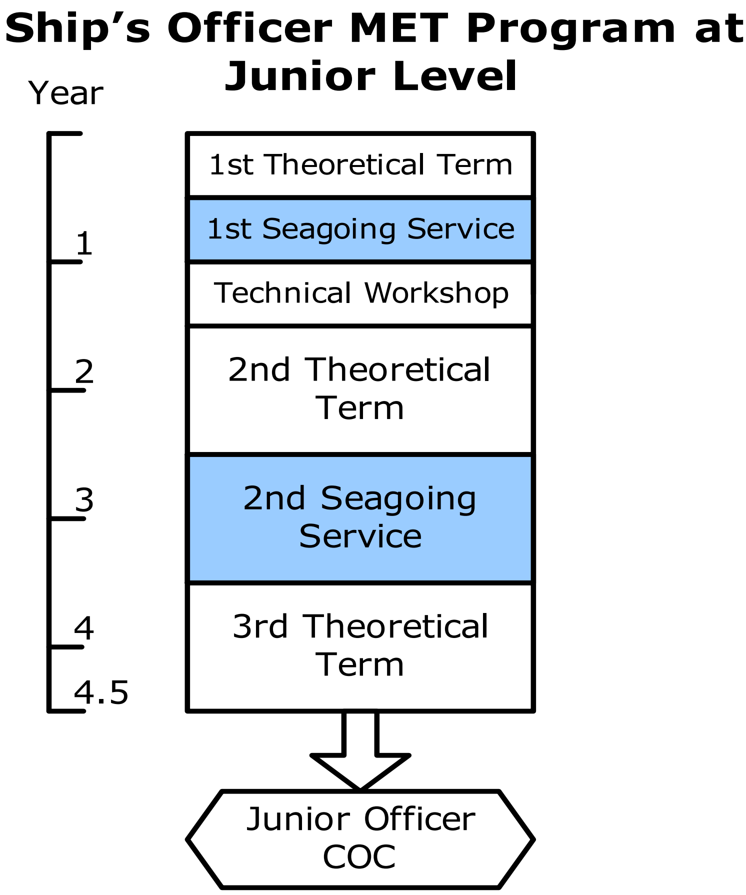

Figure 8 – Danish Ship's Officer training program at junior level
Source: Lock, P.E. (2002). Why dual purpose officers – and how? *International Maritime Lecturers' Association (IMLA) Twelfth Conference Proceedings, 21-25 October 2002, Shanghai, China* (pp. 116-124). Beijing: China Communications Press.

Onboard training for total duration of 18 months is conducted after the first and second theoretical term. During the training period, the cadet training officer of each ship is responsible for proper training in both departments in conformity with the Onboard Training Record Book (TRB) published by the DMA. Changes of training places between the deck and engine rooms usually take place on a monthly basis. Furthermore, cadets are required to submit written work tasks and project work, which are evaluated and approved by the cadet training officer on board. Completion of the training and work assignments with satisfactory results is requisite to proceed to the next theoretical term.

Graduates from the junior officer program are qualified to serve on merchant vessels as Ship's Officer at junior level. Almost all graduates from the junior program have been employed by the same shipping companies which have made contractual agreements with them. A further 12 months of seagoing service is required to enter the theoretical education program for senior officers, in which specialization takes place to become a master, chief engineer, or dual purpose Ship's Manager. This is illustrated in Figure 9. In 2003, the proportion of the first entrants to each specialization was approximately 10, 30, and 60 percent respectively. In theory, the first Ship's Manager will be expected to take command in 2009.

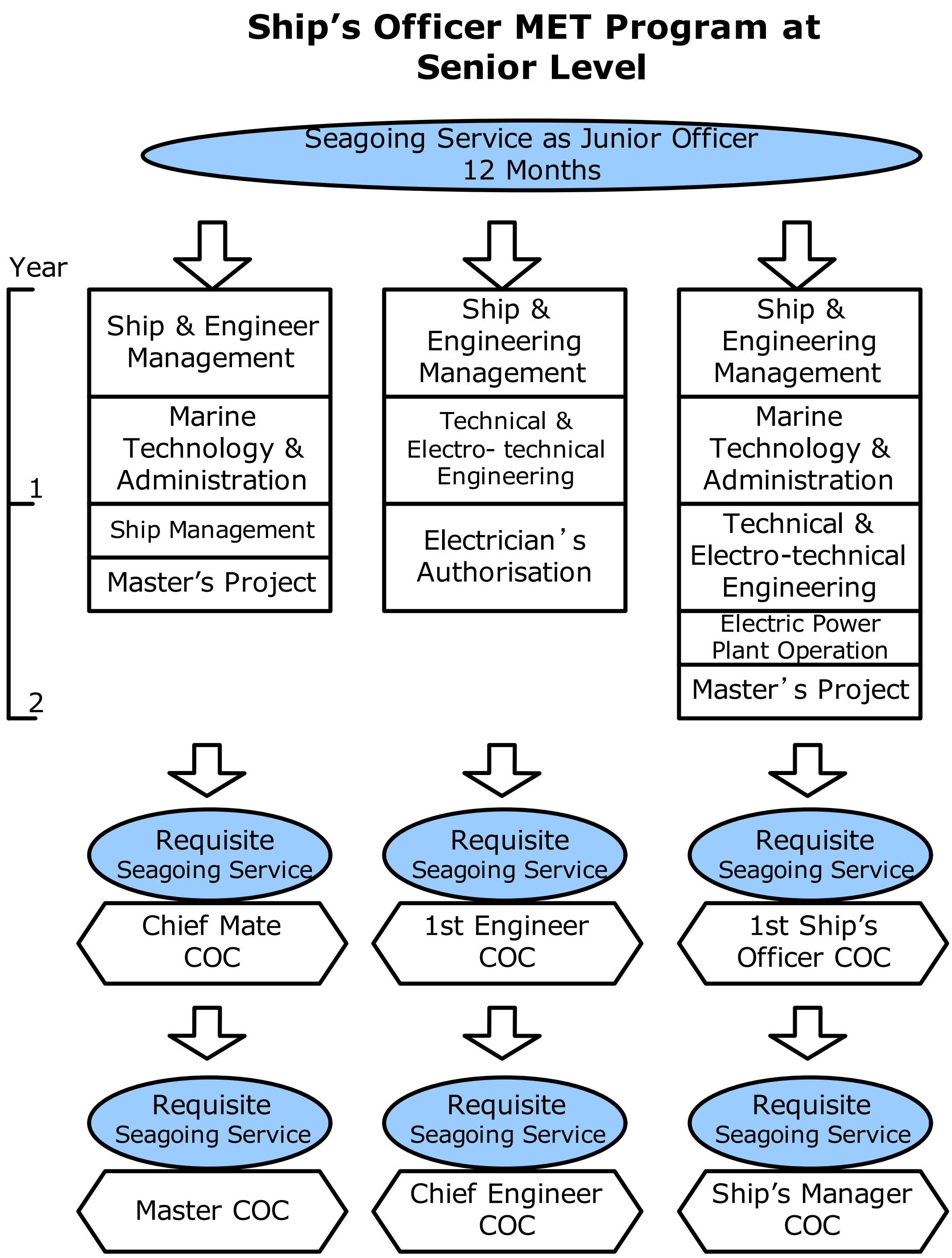

Figure 9 – Danish Ship's Officer training program at senior level

Source: Lock, P.E. (2002). Why dual purpose officers – and how? *International Maritime Lecturers' Association (IMLA) Twelfth Conference Proceedings, 21-25 October 2002, Shanghai, China* (pp. 116-124). Beijing: China Communications Press.

During the dual officer program, students sit for different types of examinations every six month, which will lead to the issue of officer's COC. Those examinations are a combination of written examinations, oral examinations, and presentation and hearing of "projects", which are research studies embracing multiple aspects of ship operation and management.

The MET institutions are responsible for assessment of students' academic performance as well as detailed contents of education and training programs. Examinations are planned, conducted, and evaluated under their respective quality control systems in accordance with rules and regulations stipulated by the DMA. All MET procedures of the institution are defined and included in the quality control system, which is continuously audited by the DMA through DMA's quality standards system.

In order to make the dual officer training program as effective and efficient as practicable, the MET institution maintains close relationships with the maritime administration and relevant organizations in the shipping industry, such as shipowners' association and officers unions. Continuous evaluation and upgrading on the training program are made through discussion and seminars with the relevant organizations. For instance, representatives from shipping companies including masters and chief engineers are invited to take part in the evaluation of examinations in order to ensure relevance and level of standards. Moreover, some subjects, such as management and administration, have been incorporated in the senior officer program in corporation with representatives from the shipping industry. According to Capt. P. E. Lock, in reorganizing the MET program, emphasis should be placed more on "the way to teach" than on "what to teach" in close cooperation with the shipping industry, which is the most important factor for successful dual purpose training (personal communication, May 12, 2004).

4.2 The Netherlands

4.2.1 Dutch Shipping Industry

The Netherlands has been a maritime nation for many centuries. Situated on the geographically strategic location as the gateway to Europe, with Rotterdam as the world's largest port, the Netherlands has promoted a variety of maritime related industries, which form one huge maritime cluster comprising 11 sectors and some 11,800 companies with employment of nearly 200,000 jobs. The shipping industry occupies a relatively minor part of the Dutch maritime cluster since approximately 70 % of the maritime related earnings are made by the land-based sectors (Veenstra & Bergantino, 2000). In fact, at the beginning of 2003, the Netherlands was, in terms of total tonnage of the controlled fleet, 25th in the world maritime nations, consisting of 650 ships with 5.5 million DWT in total. Therefore, the Dutch government and shipping industry share the view that the maritime cluster as a whole should be strengthened while maintaining a strong coherence (MTPW, 2002).

In 1996, the Dutch government introduced a new shipping policy, which was aimed at strengthening the position of Dutch flag while retaining the strong maritime environment. The new policy is a combination of a tonnage tax system, wage tax arrangements, flexible manning requirements, and general stimulation to the maritime sectors. A new fiscal law offers shipowners a choice of either opting for the new tonnage tax regime or remaining with the regular taxation system. Shipping companies would benefit from considerable reduction of their corporate tax by choosing the new tax system. In addition to the corporate tax incentive, another tax concession yields wage tax reduction to shipowners if the seafarers are employed on Dutch flagged ships irrespective of crew's nationality. However, the amount of reduction to which shipowners are entitled for Dutch seafarers is much larger than that for non-nationals. It is estimated that this scheme reduces the crew costs of Dutch seafarers by about 30 percent. Under the new manning requirements, there are no legal requirements concerning the nationality of crew members on Dutch registered vessels, with the exception of the master, who must possess Dutch nationality. In 2004, however, because of the shortage of qualified Dutch masters, the nationality requirement for masters was also abolished.

As a result of the new Dutch shipping policy, the decline in the Dutch fleet during the 1980s has reversed since 1996. As can be seen in Figure 10, the government support measures have a large impact on the national fleet. While a large number of flagged-out vessels have been brought back to the Dutch register, the total Dutch controlled fleet is steadily growing. The latter can be interpreted as an indicator that the national shipping environment has developed to make the Netherlands more attractive in the world shipping (Veenstra & Bergantino, 2000).

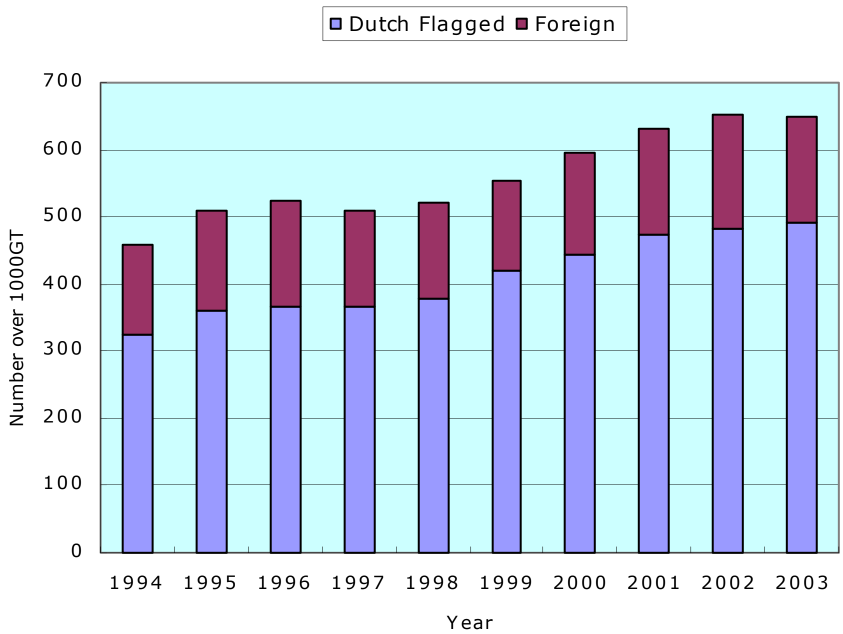

Figure 10 – The number of Dutch controlled fleet
Source: ISL. (1994 - 2003). Shipping statistics yearbook 1994 - 2003. Bremen: Author.

Despite the successful introduction of the new shipping policy, another problem has emerged in the Dutch shipping. Although the new policy caused the increase in the number of Dutch registered vessels leading to more employment for Dutch seafarers, particularly in officer’s ranks, there is not enough supply to meet the demand. The insufficient supply is largely attributable to high initial wastage rate of Dutch officers; few officers sail until retirement, but leave the sea after a relatively short period (Waals & Veenstra, 2002). As the Dutch fleet is steadily growing, the officer shortage is expected to increase unless an effective long-term human resource development strategy is taken.

4.2.2 Dutch MET

Dutch MET leading to officer's COC forms a part of the general education system: four nautical colleges for higher professional education and five nautical schools for senior secondary vocational education. All Dutch MET institutions for officers are aimed at training of dual purpose officers. The four MET institutions at higher level, which are all part of polytechnic universities, award graduates dual purpose COC for all types of ships while the five MET institutions at senior secondary level award graduates dual purpose COC for ships of restricted size and propulsion power. Annual intake for MET institutions is changing according to changes in the shipping market. In 2003, annual intake for the higher level MET institutions was about 120 in total.

MET institutions have to comply with the requirements of two Ministries: the Ministry of Education, Culture and Science (MECS) issuing school diplomas and the Ministry of Transport, Public Works and Water Management (MTPW) issuing officer's COC. The MECS is responsible for the administration and funding of the MET as well as for the overall quality control while the MTPW is responsible for defining course contents and the quality control as far as STCW requirements are concerned.

Candidates for the higher level MET are required to complete senior general secondary education in which mathematics and physics are compulsory subjects, and to pass physical checks. Most of new entrants for the higher MET institutions are 17 years old. Instructions for all MET programs are conducted in Dutch.

In the Netherlands, tuition fees are payable for students over 16 years old, which include MET students both at higher and senior secondary levels. Although students have to pay for their schooling, they are eligible for scholarships from the government for the maximum duration of four years. During the apprenticeship on board, all necessary costs are covered by shipping companies involved.

As a result of the increased employment opportunities on the Dutch fleet and continuous initial wastage from the fleet, there is constant demand for training young Dutch officers. Therefore, it is essential for MET institutions to keep a high graduation figure of students enrolled in the officer training programs. The current drop-out rate at the higher level MET program is approximately 20 to 25 percent, most of which are concentrated on the first year and first seagoing service period. Although the drop-out rate is not alarmingly high, further improvement is necessary to meet the needs from the shipping industry.

4.2.3 Dutch Dual Purpose Training

Dutch dual purpose officer training has been continuously evolving since its creation in 1985. In the late 1970's, the Dutch fleet was losing international competitiveness owing mainly to high crew costs of Dutch officers. In order to improve the competitiveness of the fleet, the shipowners, seafarers unions, and Ministries concerned agreed on streamlining shipboard organizations, which had been proven feasible through experiments carried out by major Dutch shipping companies. The Dutch fleet, which was gradually automated, then needed a smaller number of officers who could perform all tasks necessary to operate ships safely and economically.

In order to meet the demand from the shipping industry, semi-integrated dual purpose officer training was introduced at all higher level MET institutions in 1985. In the semi-integrated scheme, specialization took place in the final fourth year, so that students had to choose one discipline for the highest COC and the other for the lowest COC.

Due to demands from the shipowners for further integration of the dual purpose training, and positive feedback from the continuing review of the semi-integrated scheme, the Dutch dual purpose officer training was fully integrated in 1995. In the full-integrated scheme, two four-year training programs for deck and engineering officers are integrated into one four-year dual officer program, which leads to the highest COC for both disciplines.

The Dutch dual purpose MET program takes a "front-ended system" where all theoretical parts of the training up to the highest level are conducted in one single course of studies at shore-based MET institutions. The training scheme for the full-integrated dual purpose officer, who is called Maritime Officer (Maroff), is illustrated in Figure 11. The Maroff course begins with basic training for two years followed by two six-month seagoing periods and advanced training for one year in between. Upon successful completion of the four year course, graduates are awarded the Bachelor degree and three kinds of COC at operational level: Maritime Officer, watch-keeping deck officer, and watch-keeping engineering officer. The COC in mono-discipline is awarded because many graduates are still employed on traditionally operated ships. In recent years, about 90 percent of graduates find employment at sea, and 20 percent of them work as the Maritime Officer. The COC at management level is issued after, apart from having requisite seagoing service, successful completion of the management course for one month.

Onboard training, which is arranged between the MET institution and Dutch shipping companies, is conducted according to a Training Record Book (TRB) prepared by the school in consultant with the MTPW and MECS, and supervised by the training officer on board. In addition to the tasks required by the TRB, students have to regularly submit written assignments to a mentor at school for comments and guidance. The training on both disciplines is planned to alternate in regular and equal periods for about three weeks.

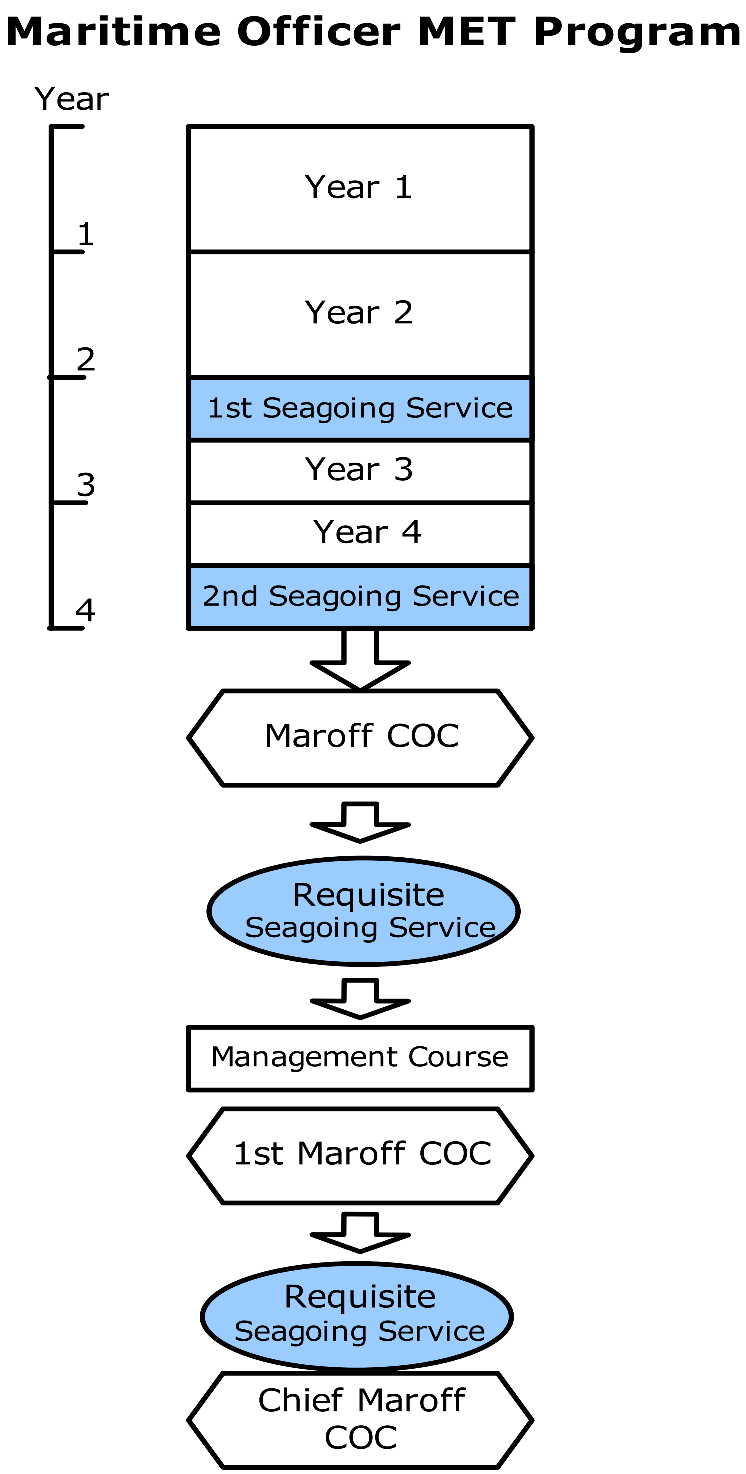

Figure 11 – Dutch Maritime Officer training program

Source: Thematic Network on Maritime Education, Training and Mobility of Seafarers [METNET]. (2001). *Work package 9: Establishment of principles for a common approach to certification, final report*. Malmö, Sweden: Author.

The Dutch dual purpose training, which is a full-integrated front-ended system, imposes a heavy study load on students. In order to satisfy a magic equation, 4 + 4 = 4, while maintaining high standards of training and low drop-out rate of students, several measures have been taken to improve course contents and teaching activities. Firstly, the curriculum was restructured and streamlined. Only necessary subjects were chosen to teach based on the clear training objectives, and traditional obsolete subjects were removed. Secondly, a modular approach is taken, in which each teaching item is not spread out over the year. Continuous review and adjustment have been made to ensure that each module is properly positioned both horizontally and vertically to avoid unnecessary overlap of similar items and sequence group modules from basic to specific (Cross, 1990b) The modular system is structured based on the philosophy that a ship is one system consisting of multiple sub-systems. As Table 6 shows, each teaching module is combined and integrated as the training progresses so that students can obtain an overall view of the entire ship operating system. Project training (PR) and integrated simulation training (SIM) are conducted in the fourth year based on the same philosophy. Thirdly, effective teaching aids were introduced. Visual aids, computer aided learning programs, and simulators are used to accelerate and intensify the teaching and learning process (Cross, 1990b).

Table 6 – Modular system

Year	Technical	Nautical	General & skills
1	ES1, ES2, DS1	SD1, SD2, TC1	OS1, MP1
	PS1, AS1, AS2	VP1, VP2	
2	ES3, ES4	TC2, TC3	OS2, BS
	PS2, PS3	VP3, VP4, VP5	
3	Seagoing service		
	ES+DS, AS+PS	VP+NS	LM, MC
4	Ship (SIM, PR) & specialization		
	Seagoing service		

Legenda:

Technical subjects
ES Electric System
DS Digital System
PS Propulsion System
AS Auxiliary System

Nautical subjects
SD Ship Design
VP Voyage Planning
TC Transport & Cargo Handling
NS Navigation System

General & skills
OS Operational Skills
MP Mathematics & Physics
BS Basic Safety
LM Law & Management
MC Madical Care
SIM Simulator
PR Project

Source: Maritiem Instituut Willem Barentsz. (2004). *Modules in de opleiding*. Retrieved April 20, 2004 from http://141.252.165.13/mainframeset.php?dbase=miwbsite&subcat=MAROF&maintarg=main.php&page=marofmodules&kop=kop.php

All educational processes of the MET program are overseen by the MECS. Students sit for examinations after every 12-month study, which will lead up to the highest level of officer's COC. Although examinations are implemented by the MET institutions, they are subject to random check by the MECS. Quality control system of the MET institutions, including teaching equipment such as simulators, are certified by classification societies, and approved and accredited by quality standards system of the MECS taking the class certificates into account. The MECS may ask the MTPW for assistance for technical aspects of the quality audit where needed.

The dual purpose MET program has been continuously upgraded in close consultation with the shipping industry. The MET institutions, shipowners association, seafarers unions, and the Ministries concerned regularly hold discussions on MET vision, professional profile of the Maroff, and educational profile of the dual purpose training. While the professional profile describes what tasks the Maroff should be able to perform on board, the educational profile states what subjects should be taught at school to satisfy the criteria of the professional profile. Close consultation between the MET institutions and the shipping industry is essential to ensure that land-based education meets the requirements of professional practices (Dirks, 1998).

4.3 Japan

4.3.1 Japanese Shipping Industry

Japan has maintained the second largest merchant fleet for years just after Greece. At the beginning of 2003, the Japanese fleet, comprising 1000 GT and over, stood at approximately 2,800 ships totaling 103.2 million DWT. Since Japan is poor in natural resources and surrounded by seas, international seaborne trade is vital to the Japanese economy as well as people's lives. In fact, in terms of tonnage, the seaborne trade accounts for more than 99% of Japan's trade, and imports and exports together represent about 80 % of the total seaborne trade. Therefore, cross-trade is a minor part of Japanese shipping.

As in many other traditional maritime nations, the Japanese merchant fleet has faced a continuous decline in competitiveness due to high labor costs of Japanese seafarers, resulting in reduction in Japanese flagged ships and Japanese seafarers. As can be seen in Figure 12, the number of Japanese flagged vessels has continued to decrease while the total Japanese controlled fleet has been maintained at around 2,000 ships. In proportion to the continuous decline in the national fleet, as figure 13 indicates, there has been a sharp decline in Japanese seafarers, both officers and ratings, sailing on the Japanese controlled fleet.

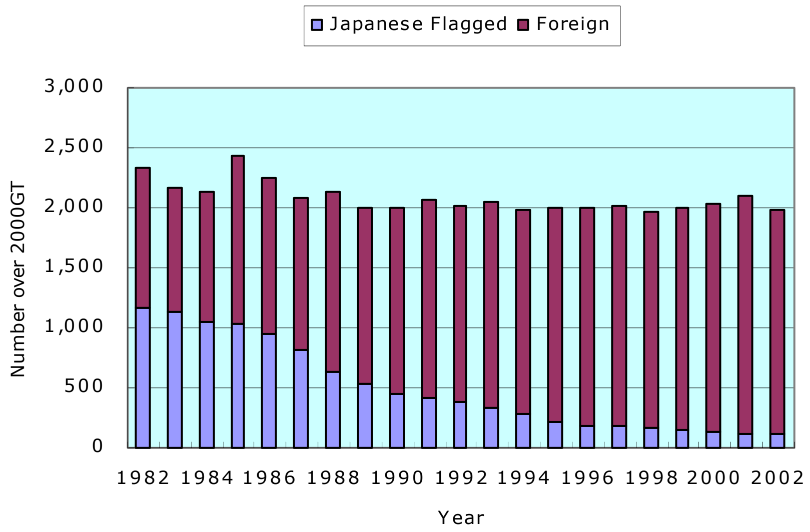

Figure 12 – The number of Japanese controlled fleet

Source: Japanese Shipowners' association. (2002). *The current state of Japanese shipping 2002*. Retrieved April 4, 2004 from http://www.jsanet.or.jp/e/shipping-e/index.html

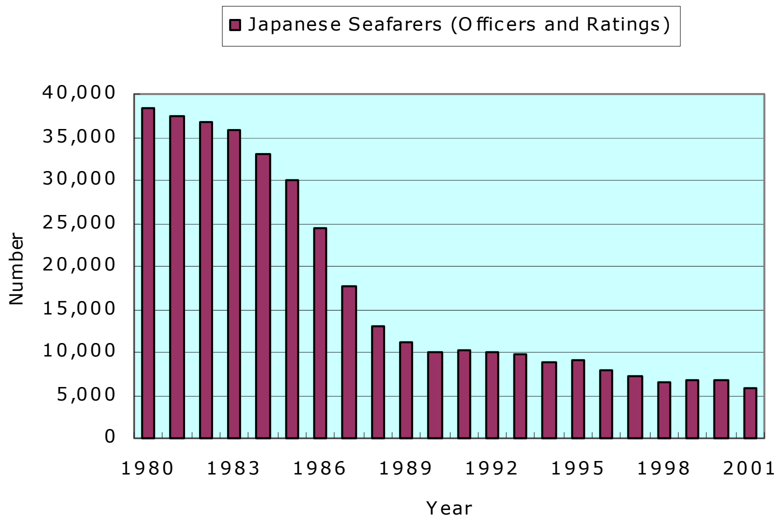

Figure 13 – Japanese seafarers on Japanese controlled fleet

Source: Japanese Shipowners' association. (2003). *Shipping statistics handbook 2003*. Retrieved April 4, 2004 from http://www.jsanet.or.jp/data/index.html

To recover the competitiveness of Japanese flagged ships and to secure the employment of Japanese seafarers, Japan first took technological measures in the late 1970s. With technological advancement, integrated shipboard operation was introduced to automated ships, which were called Modernized Ships, in order to reduce crew size, and then labor costs. A new manning system allowed a dual purpose officer to combine the functions of a deck officer and an engineering officer. The dual purpose officer was termed Watch Officer in Japan because they were required to perform dual functions centering on watch-keeping duties (Wada, 1986). The crew size was gradually decreased to 13 persons, and selected ships with certain types and routes, which were called Pioneer Ships, were operated by only 11 crew members.

However, unexpected rapid appreciation of the yen against the US dollar in the 1980s severely affected the Japanese shipping, of which most freight revenue was dollar-denominated. As a result, it turned out that even the most streamlined Japanese flagged ships were not sufficient to restore competitiveness, which made the government and industry shift their core shipping policy from the reduced manning to mixed manning by allowing Japanese flagged ships to be manned with non-nationals. Figure 14 illustrates the rise and fall of the Modernized Ships. The number of the Modernized Ships started to decrease after reaching a peak in 1988, and then all-Japanese crews were gradually replaced with mixed crews, who usually consisted of eight Japanese and 14 non-nationals.

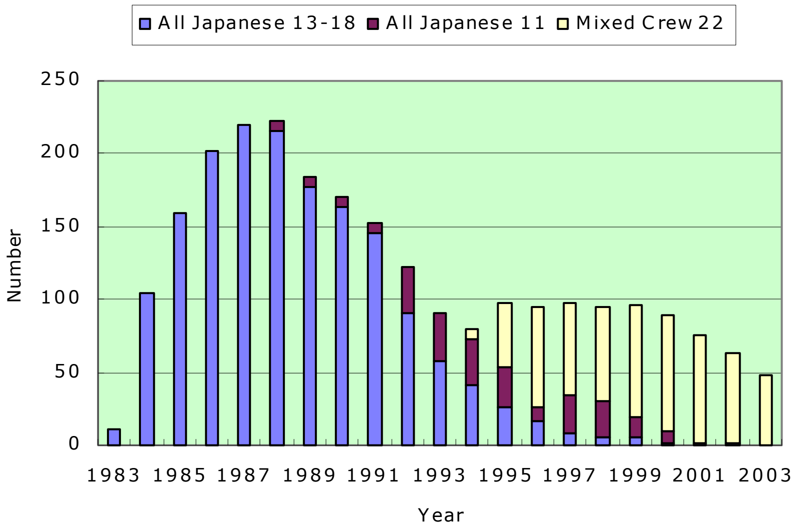

Figure 14 – The number of Modernized Ships
Source: Japanese Shipowners' association. (2003). *Shipping statistics handbook 2003*. Retrieved April 4, 2004 from http://www.jsanet.or.jp/data/index.html

After the unsatisfactory results of the Modernized Ship project, a new measure called International Ship System was introduced in 1999. Unlike the second registry, the International Ship System defines a Japanese ship which is considered vital for stable international transportation as the International Ship under the Japanese register, and grants favorable taxation treatment and relaxed manning requirement except for the master and chief engineer, who must be Japanese nationals (APEC, 2001). Although it is too early to judge the effectiveness of the International Ship System in restoring the competitiveness of the Japanese flagged fleet, the new measure did not produce immediate effect as far as Figure 12 is examined; therefore, introduction of a tonnage tax regime and second registry are also being discussed so that the Japanese flagged fleet can compete on an internationally level playing field.

4.3.2 Japanese MET

Japanese MET for officers takes place at seven MET institutions under the Ministry of Education (MOE): two universities of mercantile marine and five colleges of maritime technology, and at one marine technical college under the Ministry of Transport (MOT). While the universities and colleges are aimed at giving theoretical part of MET to students, the technical college is in charge of upgrade training for seafarers. In addition, the Institute for Sea Training (IST) under the MOT, having six ocean-going training vessels, provides practical onboard training for students from the MET universities and colleges.

For admission to the MET universities, applicants are required to complete high school education and to pass entrance examinations including a physical check. To be admitted to the MET colleges, applicants need to complete junior secondary school education and to pass an entrance examination including a physical check. Most of the new entrants to the universities and colleges are 18 and 15 years old respectively. The language of instruction used in all MET institutions is Japanese.

In Japan, education other than compulsory education for ten years is not free. MET students have to pay their tuition for schooling. However, all necessary costs for the sea training on board the training vessels are funded by the government.

A major problem of Japanese MET is a high wastage rate if the wastage rate is defined as a rate of the number of graduates employed at sea to the number of initial intake. According to the MOT, the wastage rate was roughly 70 to 80 percent for the universities and 60 to 65 percent for the colleges in the 1990s. Since the drop-out rate during the MET program was not high at around 20 to 30 percent, the high wastage rate was mainly caused by insufficient employment opportunity for Japanese seafarers on the Japanese fleet. Japanese shipping will lose a mechanism not only for transferring maritime excellence and expertise to the next generation but also for providing maritime experts with seafaring experience for shore-based maritime sectors unless the Japanese fleet offers more employment for prospective Japanese officers.

4.3.3 Japanese Dual Purpose Training

Japanese dual purpose training was created in response to a demand from the Modernized Ship project. The training scheme for dual purpose officers was introduced to the MET universities and colleges in 1984. The training course of the IST was also modified to suit requirements for the dual officer training. Total duration of the new training scheme remained the same as the former mono-training scheme. In line with the requirement for the Watch Officer, the dual purpose MET scheme was a semi-integrated type and limited to the training for operational level COC. Although there was a plan to fully integrate the dual purpose MET scheme, it was not realized due to the shift in the Japanese shipping policy from the reduced manning to mixed manning.

Figure 15 illustrates a Watch Officer MET program for navigation course students in the universities, and a subsequent pathway to the master. Students choose either navigation or engineering course at their enrollment, and take a full MET program on one discipline and basic program necessary for watch-keeping duties on the other. During the four-year university course, students take six-month onboard training in total, for one month in year one through year three, and for three months in year four. After successful completion of the four-year program, graduates are awarded the Bachelor degree; thereafter, graduates who want to obtain officer's COC will proceed to the sea training course for six months. Although the number of graduates who choose the six-month sea training varies depending on trends of employment opportunity at sea, more than two-thirds of the graduates took the optional onboard training in the 1990s.

Japanese MET is characterized by its unique sea training course on board training vessels. The requisite sea training leading to the operational level COC is provided on different types of training vessels for a total of 12 months, namely, diesel ships, steam turbine ships, and sailing ships. Duration of the training on one ship ranges from one month during the university program to three or six months during the sea training course. All training curricula are structured so that students can obtain practical knowledge and skills both in nautical and technical matters. A well-structured and consistent training program is effective in providing students practical knowledge and basic operational skills. Adding to this, it is widely recognized that life and work on board together with others will equip students with a sense of cooperation and leadership

Candidates for officer’s COC are required to take a national examination prepared by the MOT. The national examination consists of written, oral, and physical examination; however, candidates for the operational level COC who successfully completed the MET program at the universities or colleges, and onboard training for a sufficient period, are exempted from the written examination. Upon passing a physical and oral examination in both disciplines, graduates from the sea training course are awarded an officer’s COC at operational level in one discipline and a limited COC for watch-keeping duties in the other. The management level COC in either discipline is awarded upon passing the national examination after completion of requisite seagoing service.

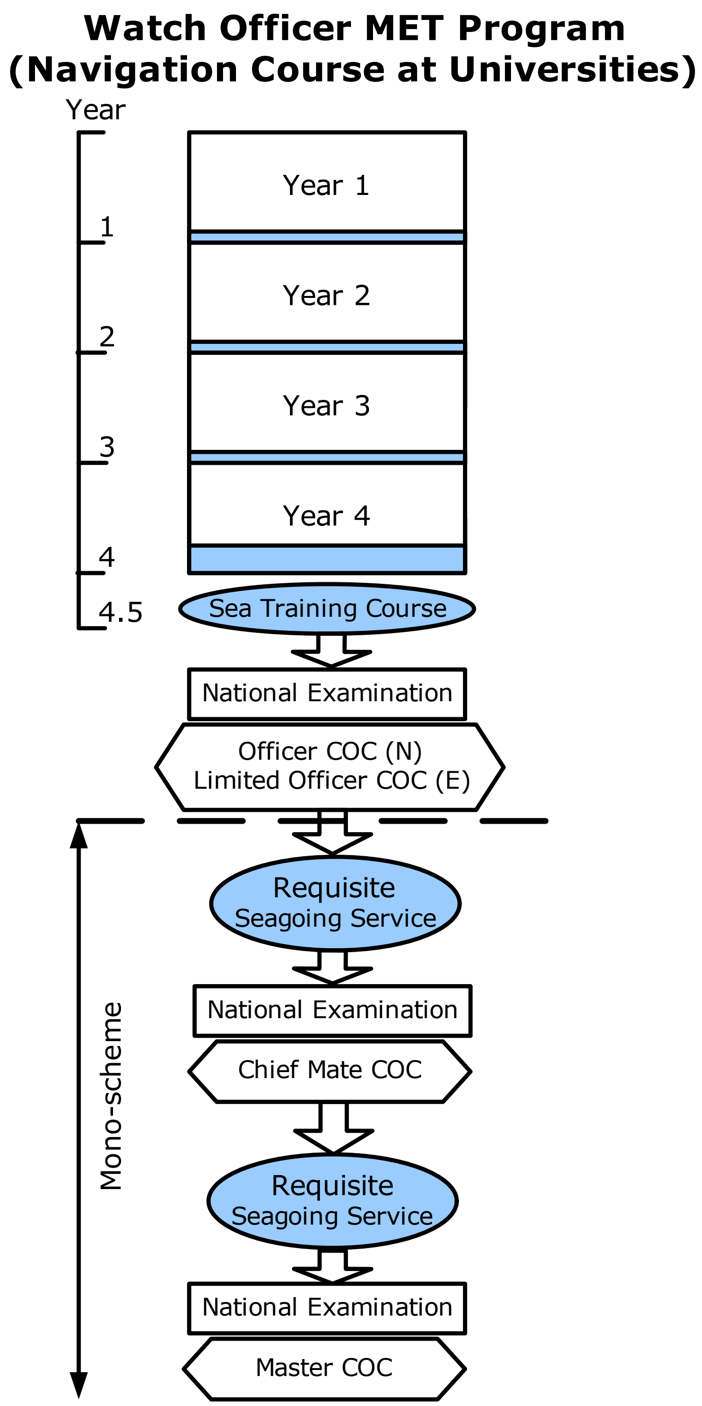

Figure 15 – Japanese Watch Officer training program
Source: The Author

MET programs at the universities and colleges have to comply with requirements of both the MOE and MOT. The MET institutions have to obtain approval for the course curriculum not only from the MOE as higher educational bodies, but also from the MOT to grant students exemption from the written examination for officer’s COC, which makes the MET program less flexible and less responsive to the needs from the shipping industry requiring lengthy administrative procedures. In fact, when the first graduates from the dual purpose MET scheme started their careers at sea as the Watch Officer, the number of the Modernized Ships had already started to decrease.

In the wake of the change in Japanese shipping policy from reduced manning to mixed manning, in other words, from the Modernized Ship to the International Ship, the dual purpose training for the Watch Officer also ended in 1999. Although the government and shipping industry recognized advantages of multi-disciplined competence of the Watch Officer both on board and ashore, the main focus of Japanese MET had shifted from the dual purpose training to mono-disciplined specialization as well as fundamental maritime competence, which are necessary for Japanese officers to play managerial and supervisory role in the multinational environment.

4.4 Comparative Analysis

Denmark, the Netherlands, and Japan have developed dual purpose officer training schemes for different reasons and in different forms. Distinctive features of each scheme are summarized in Table 7, and considerable differences can be observed among the three countries. In order to identify circumstances and effects of those differences, the three schemes will be compared concerning several salient items.

Table 7 – Comparison of dual purpose MET

Country	Denmark	The Netherlands (Higher level)	Japan (University)
Name of dual officer	Ship's Officer	Maritime Officer	Watch Officer
Commencement	1998	1985 (semi) 1995 (full)	1984 (ended in 1999)
Other Shipping policies	1988 DIS 2002 Tonnage tax	1996 Tonnage tax, other tax reduction	1999 International Ship
Type of MET	Sandwich	Front-ended	Front-ended
Extent of integration	Full	Full	Semi
Level of integration	Management	Management	Operational
Entry level	Age 17	Age 16	Age 18
Change in years of education	3 → 4.5	4 → 4	4.5 → 4.5
Onboard training	1.5 years (Merchant vessels)	1 year (Merchant vessels)	1 year (Training vessels)
Examination	Combination of school exam.	Combination of school exam.	National exam.
COC	1 Deck officer 1 Engine officer	1 Maroff 1 Deck officer 1 Engine officer	1 Full COC (D or E) 1 Limited COC (E or D)
Academic degree	-	Bachelor degree	Bachelor degree

Source: The author

Commencement of dual purpose training

Dual purpose training was introduced in the three countries after competition in world shipping became more and more intense. The rationale behind introducing the dual purpose training was that it would enable operating cost reduction through implementing integrated shipboard operation, which was in line with the national shipping policy, namely, improving competitiveness of national flagged fleet with reduced national officers. However, there is a difference among countries in relation to other shipping policies. In Denmark and the Netherlands, other supporting measures such as a tonnage tax regime and second registry were introduced to strengthen national fleets before or during implementing the dual purpose training, while any effective measures were not taken until the dual purpose training ended in Japan. This might prove that crew reduction solely is insufficient to restore fleet competitiveness for most OECD countries, which was also examined with the cost analysis in Chapter 2.

Type of MET

Denmark takes the sandwich system, in which land-based education is split into the junior officer course and senior officer course, and successful completion of each course leads to the issue of COC at each level. In the sandwich system, there is some repetition of teaching subjects in both courses, and it takes longer time until the highest level of COC is obtained. However, students at the senior officer course can benefit from their practical sea experience (METNET, 2000b). On the other hand, the Netherlands and Japan take the front-ended system, where land-based education is conducted in one course of studies, and successful completion of the course leads to the issue of COC at the management level with or without an additional examination. Although the front-ended system is time-efficient, it imposes heavier study load on students with no professional experience.

Extent of integration

The Danish and Dutch schemes are fully integrated leading to the COC of full capacity. On the contrary, the Japanese scheme was semi-integrated leading to the full COC in one discipline and the limited COC in the other. That was because dual purpose officers in Japan were required to perform dual functions on watch-keeping duties. It is true that the full-integrated scheme puts heavy study load on students, but it will enhance flexibility in the manning schedule on board because duality of officers is not limited to watch-keeping duties.

Level of integration

Like the duality of integration, difference in the level of integration results from different shipboard organizations. Higher level of integration enables smaller crews with completely novel structure of organization on board. Since a number of teaching subjects of the operational level can be incorporated in those of the management level, the front-ended system will be more efficient if integration takes place up to the management level.

Change in years of education

Necessary time for teaching and learning in an integrated MET program largely depends on efficiency of curriculum and teaching methods; however, some extension of the total duration seems sensible when increased burden for both teachers and students is considered. Besides consideration of the study load, legal and financial conditions of national MET are also influential. Among the three countries, only Denmark extended the duration of the first land-based program, which was made possible by the government's strong financial support and commitment to high quality MET. In contrast, the total years of the land-based education remained the same in the Netherlands despite the highest level and extent of integration. The reason might be explained by the maximum period of four years for which the scholarship from the government is available for students.

Onboard training

In most countries including Denmark and the Netherlands, onboard training is carried out on merchant vessels, and costly training ships are replaced with other means of practical training. Due to inherent uncertainty of quality of the onboard training which largely relies on planning and supervision by ship training officers, MET institutions may have to check the progress of students. Furthermore, transfer of students' knowledge to practical skills may need to be facilitated during land-based MET as much as feasible through simulator and laboratory training (METNET, 2000b). On the other hand, in Japan, most of practical training of the whole MET scheme is focused on sea training carried out on the training ships. However, at the same time, the reliance on the training ships may have retarded introduction of other effective training tools in the land-based MET program, such as simulations and computer based training, despite the high technological feasibility. Use of simulators, in addition to the onboard training, would have facilitated dual purpose training by giving an overall picture of shipboard operation effectively and efficiently.

Examination

In Denmark and the Netherlands, periodical school examinations will lead to the issue of officer's COC. Particularly, in the Netherlands, both the Bachelor degree and dual officer's COC are awarded on successful completion of the MET program. This is realized as a result of close cooperation between the Education Ministry and Transport Ministry. On the other hand, in Japan, graduates from the MET institutions are not awarded the officer's COC unless they pass the national examination by the Transport Ministry. This may be one of the maladies of administrative sectionalism in Japan.

Academic degree

In order to award an academic degree, the MET institution has to include academic subjects in the curriculum in addition to the STCW essentials. Nevertheless, since a seafaring career nowadays can be considered a combination of sea going experience and subsequent shore-based position in maritime sectors, an academic degree is necessary not only for developing the seafaring career but for improving its attractiveness. In this sense, it stands to reason that introduction of academic award has been discussed in Denmark.

4.5 Summary

Dual purpose training has been developing since the late 20th century in several traditional maritime countries. Although the main objective of the dual purpose training is a provision of dual-competent officers for the integrated shipboard operation, its type and form vary from country to country.

In Denmark, the Ship's Officer training was recently introduced. With strong support from the government and industry, it has been implemented successfully so far, but the final product, the Ship Manager, has yet to be seen. In the Netherlands, the Maritime Officer training has a long history, and is still evolving through continuous review and adjustment. It began as a semi-integrated type, and fully integrated later on. Graduates from the MET institutions are serving not only as Maritime Officers on dual-operated ships but also on traditionally mono-operated ships with flexible manning schedules. In Japan, the Watch Officer training started in line with the Modernized Ship project. However, after it was concluded that even the Modernized Ship is not sufficient to regain competitiveness, the dual purpose training threw its lot with the project.

Major characteristics of each dual purpose training scheme, such as the level and extent of integration, duration of education, and reward of the training scheme, are different from one scheme to the other depending on different backgrounds. Therefore, a successful training scheme in one country is not necessarily applicable to another country. In the next Chapter, strengths and weaknesses of the dual purpose MET schemes of the three countries will be further examined in light of their respective environments in order to identify key factors for successful dual officer training in general.

Chapter 5

Effective Dual Purpose Training

In the previous Chapter, considerable differences in the dual purpose training schemes were observed through the comparative analysis of the three countries, for example the level and extent of integration and COC awarded. Then the main characteristics of each training system were further analyzed to identify circumstances and effects of these major differences. Even though the three training schemes differ in many aspects, the comparative analysis revealed important issues which contribute to strengths and weaknesses of the dual purpose training in general. In this Chapter, strengths and weaknesses of each training scheme as well as its external environment will be analyzed through a SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis model to identify some key factors for successful dual purpose training.

5.1 SWOT Analysis of Dual Purpose Training

In a SWOT analysis of dual purpose training, the internal and external environments of the dual purpose training are analyzed to assist in planning strategies for effective training. The internal environment can be classified as strengths and weaknesses of each training scheme, which determine its capabilities and resources for training competent dual purpose officers. The external environment can be classified as opportunities and threats in national backgrounds and world shipping which are relevant to the dual officer training. Based on the comparative analysis in Chapter 3, important environmental factors of the dual purpose training in Denmark (D), the

Netherlands (N), and Japan (J) can be summarized in the following lists.

Strengths

1. Greater autonomy and responsibility for detailed course contents (D)
2. Close relationship with the shipping industry and the government (D, N)
3. MET program is free. (D)
4. Scholarship by the government (N)
5. Costs of onboard training are covered by shipping companies. (D, N)
6. Onboard training is funded by the government. (J)
7. Bachelor degree is awarded to graduates. (N, J)
8. Highest level of COCs are awarded. (D, N)
9. Integrated simulator training (N)
10. Structured Onboard training with pure training ships (J)

Weaknesses

1. Less flexible MET program (J)
2. Heavy study loads on students (N, J)
3. MET program is not free. (N, J)
4. Scholarship is limited for four years. (N)
5. Insufficient number of new entrants (D)
6. High drop-out rate (D)
7. High wastage rate (J)
8. Academic degree is not awarded. (D)
9. COCs awarded are limited to operational level. (J)
10. Uncertainty of quality of onboard training (D, N)
11. Too much reliance on training ships (J)

Opportunities

1. Shipping is vital to the national economy. (D, N, J)
2. Favorable shipping policy of the government (D, N)
3. Strong commitment of the government to high quality MET (D)

4. Involvement of shipping companies in MET (D)
5. Technological advancement (D, N, J)
6. Gradual increase in the national flag fleet (D, N)
7. Large percentage of container ships (D)
8. High demand of dual purpose officers from the shipping industry (D)

Threats

1. International competition in world shipping (D, N, J)
2. Change in the exchange rate (J)
3. Change in national shipping policies (J)
4. Decline in the national flag fleet (J)
5. Increasing use of foreign officers on the national fleet (D, N, J)
6. Insufficient employment opportunity for national officers (J)
7. Insufficient employment opportunity for dual purpose officers (N)
8. Negative image of seafaring (D, N, J)

5.2 SWOT Matrix of Dual Purpose Training

To develop competitive strategies for effective dual purpose training, a SWOT matrix can be constructed based on the SWOT profile. As shown in Table 8, the SWOT matrix consists of four strategy categories: Strengths/Opportunities (SO) strategies, Weaknesses/Opportunities (WO) strategies, Strengths/Threats (ST) strategies, and Weaknesses/Threats (WT) strategies. The SO strategies use internal strengths to take advantage of external opportunities. The WO strategies aim at improving internal weaknesses by taking advantages of external opportunities. The ST strategies use internal strengths to reduce the impact of external threats. The WT strategies establish defensive plans to prevent internal weaknesses from making it highly susceptible to external threats (SWOT analysis, 1999). The purpose of the SWOT matrix is not to determine the best strategies but to assist in developing feasible alternative strategies depending on respective competitive environments. Since the SWOT profile of the dual purpose training combine the three training schemes with different internal and external environment, the SWOT matrix in Table 8 contains strategies for wider application.

Table 8 – SWOT matrix

	Strengths	*Weaknesses*
Opportunities	SO Strategies 1. Continuous evaluation and upgrading on training programs (Strength 1, 2 & Opportunity 3, 4) 2. Accelerated training with simulators (Strength 9 & Opportunity 5) 3. More training on information handling and enrichment subjects (Strength 1, 2 & Opportunity 5, 8)	WO Strategies 1. Onboard training at earlier stage (Weakness 6 & Opportunity 4) 2. Onboard training supervised by MET institutions (Weakness 10& Opportunity 4, 5) 3. Awarding of academic degree (Weakness 8 & Opportunity 8)
Threats	ST Strategies 1. More training on enrichment subjects (Strength 1, 2 & Threat 6)	WT Strategies 1. Awarding of academic degree (Weakness 8 & Threat 8)

Source: The author

5.3 Key Factors for Effective Dual Purpose Training

The SWOT matrix suggests several strategies to make the dual purpose training more effective. MET institutions should not only implement the SO strategies, by which their strengths can be used to take advantage of available opportunities, but also pursue WO, ST, and WT strategies in order to shift toward situations where SO strategies can be applied. As a result of having formulated four types of strategies, some essential factors are brought into sharp relief: continuous upgrading of training programs in close cooperation with the industry and government (SO strategy 1), efficient training methods with a system approach (SO strategy 2), enrichment subjects leading to an academic degree (SO strategy 3, ST strategy 1, WO strategy 3, and WT strategy 1), and effective onboard training supervised by MET institutions (WO strategy 1, 2). Those factors might be regarded as key factors for successful dual purpose training.

5.3.1 Continuous upgrading of training programs

Since dual purpose training was created in response to a demand from the shipping industry in order to streamline shipboard organizations, training programs should comply with the industry's need for the new type of ship operation. The integrated shipboard operation is still its infancy. In fact, a fully integrated ship commanded by a dual-certified ship manager is yet to be seen either in Denmark or the Netherlands. Therefore, continuous adjustment of training programs is necessary to meet changing requirements from the industry.

Curriculum for dual purpose training should be based on a job analysis, which identifies roles of the new type of officers. Responsibilities of the dual purpose officers should be redefined since the role of each officer is more critical than in a larger crew and harmonization in workplace is essential (Mc Mullen, 1988). After the job analysis, training objectives can be specified according to skills and knowledge required for real onboard duties. It is necessary to consider changes in competence required for dual purpose officers in relation to constant changes in technology on board. Then, essential elements of competence to be trained will be identified.

In order for MET institutions to adapt the training programs to the shipboard operational reality, it is of vital importance that close relationships between MET institutions and the shipping industry cast continuous exchange of information and feedback through discussions and seminars, and this process should involve, not only educational administrators, but also class room lecturers and fleet officers. In addition to the cooperative involvement of the industry, a strong commitment of the government to high quality MET is crucial so that the government enables MET institutions to flexibly respond to foreseeable changes in the professional profile of dual purpose officers. Constant review and adjustment of the training programs through close cooperation among key parties, MET institutions, the shipping industry, and the government, will make the learning experience at school relevant to professional reality on board.

5.3.2 Efficient training methods

As the study load of the dual purpose training is heavier for the compressed course duration, new concepts and methods of teaching are required to make the teaching and learning process more efficient while maintaining the training standards. A system approach should be taken, in which teaching subjects are looked at from an angle of the ship as one operational system, rather than going through each item of subject matters separately (Cross, 1990b; Lock, 2002). Project training is a typical example of the system approach. Having multiple aspects of ship operation and management, the project training will make the learning process more efficient by giving students an overall picture of the ship.

Integrated simulator training is another powerful facilitator for the dual purpose training making the total system more visible and understandable (Cross, 1992). Simulator training can be done in three steps according to the progress of training: Computer Based Training (CBT) for familiarization with a different process of each sub-system, single function simulation training for each sub-system such as navigation, propulsion, and cargo handling, and integrated simulation training for the total system, the ship. The CBT can provide students opportunities for self-paced training. Each single function simulators, such as bridge operation, machinery operation, radio communication, and cargo handling simulator, can be used to train each sub-system separately or to reinforce specific tasks. Each simulator can be integrated as a full mission ship simulator in order to give an overall view of the total shipboard operation by demonstrating how the sub-systems will influence each other and how the total system functions as a whole (Cross, 1992). The integrated simulation training will prove its value in facilitating the system thinking and accelerating the learning process of students.

5.3.3 Enrichment subjects

As the professional profile of dual purpose officers is not a simple combination of those of deck and engineering officers, a training curriculum based on STCW essentials for both disciplines must be reinforced by such subjects as management, logistics, and electronics. First of all, managerial skills such as planning, communication, and leadership are of utmost importance for the dual purpose officers working in the new shipboard organization that puts much emphasis on the team working. Management programs at MET institutions will assist students to learn how to live with, manage, and positively motivate others in the shipboard environment (Mc Mullen, 1988). Logistics is another enrichment subject necessary for the dual purpose training. Shipping has been incorporated into the inter-modal transportation chain. Therefore, once certain management responsibilities are shifted to the ship, onboard management staff is required to have wider understanding of logistics. Lastly, practical knowledge of electronic systems is essential for the dual purpose officers working on automated modern ships. Since most important onboard equipment has high reliability and redundancy, the electronic course should focus on basic principles, system monitoring, and trouble shooting for possible problems.

In addition to the above subjects, holistic training on information management will assume more importance as the role of dual purpose officers shift from handling equipment to handling information. Operators of the integrated ship control system illustrated in Figure 3 are required to possess skills of effectively combining and processing information in order to make a proper and prompt decision. Ability of the information management might be enhanced through the integrated simulation training, which provides the operational environment close to the real IBS on board.

The enrichment subjects are not only essential for dual purpose officers but effective in enhancing the mobility and attractiveness of seafarers. The new curriculum would provide professional mobility from ships to shore where practical shipboard experience with additional knowledge of management and logistics is required. In addition, those subjects are requisite for awarding an academic degree. If the seagoing career is combined with the shore based position, where the enrichment subjects and academic degree make differences, this combined maritime career will attract young people to the sea.

5.3.4 Effective onboard training

In most countries implementing dual purpose training, statutory onboard training is carried out on merchant vessels with cooperation of shipping companies. Therefore, the quality of onboard training is greatly dependent on fleet officers' understanding of and attitude toward the dual purpose training, because the dual purpose training is relatively novel to officers on board and all cadets are not necessarily provided training berths on dual-operated ships. Above all, the ship's training officer plays an important role in coordinating all training programs according to the Training Record Book (TRB) and being a link between the ship and MET institutions.

To make the onboard training a seamless process in the whole dual purpose training program, it is essential for MET institutions to regularly supervise the progress of the training, provided that the ship and the school are connected through satellite communication links. The mentor at school can monitor the progress of cadets through the direct link while cadets can benefit from earlier response and feedback on their progress of training, assignment, or project work. Standardized TRBs and new communication technology will enhance the quality of the guided onboard training program (Muirhead, 1998).

When planning onboard training for dual purpose officers, such issues as to when one-year onboard training takes place in the whole training program and how frequently training duties change between the deck and engine departments should be carefully considered. In order to effectively apply knowledge obtained at school to particular onboard tasks, onboard training should take place after a certain period of school time. On the other hand, there are advantages of having onboard training at an earlier stage. A short sea training period at the beginning of a MET program might help prevent unnecessary drop-outs later in the program. Students would be given opportunities at an earlier stage to assess what the life at sea is like and to make a right decision for their future careers (Dirks, 1998). The interval of alternate training periods should be planned taking into account acquisition and retention of tasks to be learned. Changes between nautical and technical matters should take place in gradually increasing frequency as the training progresses, and ultimately, both duties might alternate in one day, which is the case with the real integrated shipboard operation.

5.4 Summary

Salient characteristics of the three different dual purpose training schemes, which were identified through the comparative analysis in Chapter 4, could be reassessed from such viewpoints as capabilities and resource of the training scheme itself and its external circumstances. The internal environment (Strengths and Weaknesses) and the external environment (Opportunities and Threats) of dual purpose training of the three countries were identified through the SWOT analysis, and several strategies to make the training schemes more effective were presented by formulating the SWOT matrix.

Training programs should be constantly monitored, reviewed, and adjusted to keep training contents for dual purpose officers relevant to the reality of the integrated shipboard operation, which is inherently dynamic and flexible. The whole training program should be based on the system approach, which can accelerate the teaching and learning process by giving an overall view of the integrated shipboard operation. The course contents should consider requirements for dual purpose officers, such as management skills, knowledge of logistics, and ability of information handling. Onboard training should be a continuous part of the whole training program, which can be effected by cooperative involvement of shipping companies and regular supervision of MET institutions. Close relationships among MET institutions, the shipping industry, and the government are indispensable to implement the above strategies which necessitate quick response to changing requirements for a new breed of officers.

Chapter 6

Conclusions

It is clear, from what has been discussed in previous Chapters, that the dual purpose training is not stand-alone but interdependent on the integrated shipboard operation, which is also effected by several necessary conditions: need for cost reduction, need for maintaining quality national shipping and maritime experts, and availability of modern technology. Those conditions mainly apply to industrialized maritime countries, whose shipping industries have been seriously affected by the intense international competition since the 1970's.

After the oil crises in the 1970's, many shipowners in traditional shipping countries flagged out their fleets to open registry countries in order to save operating costs by hiring cheaper labor. Negative consequences were apparently a decrease in the national flag fleet and seafarers, which in turn led to insufficient human resource supply for the national maritime industry as a whole. In order to reverse the negative trend and to revitalize the national shipping industry, support measures such as the international registry and tonnage tax system were initiated by several maritime nations. Those measures are designed to maintain national flagged tonnage and seafarers by improving international competitiveness of the national flag fleet.

In addition to the governmental support measures, integrated shipboard operation was introduced in several traditional maritime countries for a more competitive national flag fleet. Technological advancement on board, such as the UMS, the IBS, and satellite communications made the new shipboard operation with smaller multi-competent crew feasible. Even though short-term cost saving by crew reduction is less effective than by hiring cheaper crew, long-term gains of high quality operation resulting from flexible work distribution and high operational efficiency can be expected. Furthermore, better career perspectives of dual purpose officers can contribute to improving recruitment and retention of qualified maritime experts both on board and ashore. On the other hand, the human-machine interface of automated systems, the service continuity of crews, and the reallocation of managerial responsibilities need careful attention.

The comparative analysis of the dual purpose training schemes, in relation to the national shipping industries, of Denmark, the Netherlands, and Japan has exemplified how MET is influenced by the shipping industry and national shipping policies, and has revealed considerable differences among the three training schemes. The SWOT analysis and SWOT matrix of the three training schemes have assisted in identifying critical factors of effective dual purpose training.

It can be concluded that the system approach to training programs, in which teaching subjects are looked at from a ship's angle, is the most effective in order to facilitate the teaching and learning process of the dual purpose training. The modular approach to curricula, project training, and integrated simulator training will provide an overall picture of the ship as one operating system. Close relationships among MET institutions, the shipping industry, and the government are also essential so as to continuously ensure relevance of the training scheme to needs of the shipping industry. Finally, in addition to those strategic factors, favorable national shipping policies, which will increase competitiveness of the national flag fleet, are vital to make dual purpose training and integrated shipboard operation sustainable.

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APPENDIX 1

Questionnaire on MET and Dual Purpose System

A. General and National Shipping Policy

1. When did the dual purpose officer training start?
2. What is the name of the dual purpose officer?
3. Main purposes of the introduction of the dual purpose officer.
4. What certificate of competency (COC) is awarded to a graduate from the dual purpose training? (one certificate or two certificates)
5. Does the monovalent system still exist?
6. At which level does integration take place on board? (operational level, management level, or Master / Chief Engineer level)
7. To what extent is the integration done? (full-integration or semi-integration)
8. Nationality requirements for national registered vessels (number, level)
9. Government's support for the national registered vessels such as subsidies and preferential tax treatment

B. MET

1. The number of MET institutions leading to officers' COC
2. The number of MET institutions leading to dual purpose COC
3. Language used in MET
4. Admission requirements for MET programs leading to the dual purpose COC
5. Is there any differences in the admission requirements between the dual purpose scheme and past (or existing) monovalent schemes?
6. A flowchart diagram of the national MET system from enrolment to the highest level of COC (school time, sea time, and total time to reach the highest COC) under the dual purpose scheme and the past (or existing) monovalent scheme

7. When and what kind of examinations do candidates take for the dual purpose COC of each level?
8. How is the quality control system implemented?
9. Change in the number of applicants and new students into MET institutions due to the introduction of the dual purpose training
10. Who pays for the schooling and onboard training?
11. Who arranges onboard training places for students?
12. What is the frequency of changes from deck to engine room duties during onboard training?
13. Is the progress of cadets monitored by the school during onboard training?
14. Do cadets have to submit reports or assignment to the school during onboard training?
15. If yes, how do cadets correspond with the school, e-mail or other media?
16. Any obligation of a cadet to the shipping company which has paid for onboard training (e.g. working for the company for a specified period)
17. Academic degree awarded to graduates from the dual purpose scheme
18. Change in curriculum and total credits for each discipline (deck / engine) due to the introduction of the dual purpose training
19. Change in total study years at MET institutions due to the introduction of the dual purpose training
20. Measures taken to make education process more efficient for the dual purpose training (e.g. simulators)
21. Cooperation and close contact with shipping companies (regarding curriculum, onboard training, updating training for lecturers etc.)
22. Change in the drop-out rate or repeating school year(s) due to the introduction of the dual purpose training
23. What percentage of the graduates from the dual purpose program is employed as dual purpose junior officers?
24. Change in employment opportunity at sea due to the introduction of the dual purpose training

D. Shipping Companies

1. Which shipping companies are implementing integrated shipboard operation?
2. What types of ships are suitable for the integrated shipboard operation?
3. Are dual-purpose-trained officers working on traditionally operated ships?
4. Do mono-trained officers have to obtain COC in the opposite discipline to work on dual-operated ships?
5. What are benefits of the integrated operation for shipping companies?
6. Any disadvantages of the integrated shipboard operation for shipping companies
7. Prerequisites for implementing the integrated shipboard operation in terms of ships- design, equipment and manning organization
8. Average manning cost (wages) of national officers at each level
9. How much manning cost can be reduced by the integrated shipboard operation?
10. How much more should be invested to build a modern automated vessel for the integrated shipboard operation?
11. Is it possible to carry out the same level of onboard maintenance work with reduced crew as could be done by traditional deck / engine departments?
12. If not, how much more will cost for maintenance work done by shore maintenance companies?
13. Is there any maintenance-dedicated staff on board the dual-operated ship or ashore for her?
14. A diagram of standard integrated shipboard organization (Number of total crew)
15. A standard watch keeping and shipboard operation system of dual purpose officers in one voyage
16. Change in average duration of employment on board due to the introduction of the integrated shipboard operation

APPENDIX 2

List of Respondents to the Questionnaire and Interviewees

1. List of Respondents to the Questionnaire

1.1 Denmark

Mr. Erik O. Mortensen	Danish Maritime Authority
Mr. Klaus Matthiesen	Danish Shipowners' Association
Capt. Poul-Erik Lock	Svendborg International Maritime Academy

1.2 The Netherlands

Mr. Henk de Vries	P&O Nedlloyd
Capt. S. J. Cross	Maritiem Instituut Willem Barentsz
Mr. Harold van den Oever	Maritiem Instituut Willem Barentsz

2. List of Interviewees

2.1 Denmark

Capt. Poul-Erik Lock	Svendborg International Maritime Academy

2.2 The Netherlands

Capt. S. J. Cross	Maritiem Instituut Willem Barentsz
Mr. Harold van den Oever	Maritiem Instituut Willem Barentsz