An approach to the optimum utilization of training vessels in order to carry out the most suitable practical training

Yutaka Emi
World Maritime University

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AN APPROACH TO THE OPTIMUM
UTILIZATION OF TRAINING VESSELS IN
ORDER TO CARRY OUT THE MOST SUITABLE
PRACTICAL TRAINING

By

YUTAKA EMI
Japan

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

MASTER OF SCIENCE
In
MARITIME AFFAIRS
(MARITIME EDUCATION AND TRAINING)

2007

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DECLARATION

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

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

Signature: Yutaka Emi

Date : 27th August 2007

Supervised by:

Mr. Rajendra Prasad ...........................................
Lecturer
World Maritime University

Assessor:

Mr. Jan Horck .............................................
Lecturer
World Maritime University

Co-assessor:

Mr. Jerzy Listewnik ..............................
Associate Professor
Maritime University Szczecin, Poland
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Abstract

Title of Dissertation

An approach to the optimum utilization of training vessels in order to carry out the most suitable practical training

Degree: MSc

Recently the working conditions of seafarers have become chaotic because of multicultural environment, shorter time in port, enormous paper work for quality management system and sophisticated automation system. In order to prevent the catastrophes, global improvement of education and training is the one of the solutions in the long term.

The dissertation is a study how to utilize training vessels as a practical training method in the field of the Maritime Education and Training (MET). Based upon the STCW Code Table A-II and A-III, the practical training methods in MET are divided into four types: laboratory equipment training, simulation training, ship-in-service and training vessel.

In this study, the training vessels are focused upon engaging navigation and meeting requirements of ship size and engine power in the STCW Convention. Accordingly, training vessels are categorized by the types and purposes of the training vessels.

Using the financial data related to vessel operations from the National Institute for Sea Training (NIST) Japan and the data related to the training vessels from NIST’s 3 types of vessels: sail powered vessel Nippon Maru, motor vessel Seiun Maru, steam

V
turbine vessel *Taisei Maru* and the Thai brand new training vessel (expectation of launching date: February 2008), the following ways the optimum utilization of the training vessels are given in this paper.

- Real remedial procedure training
- Mobility laboratory training centre
- International co-operation as mobility training facilities
- Attraction of young generation to maritime affairs
- The practical places of teaching from senior to junior in order to hone their competency
- Cadet-centred training
- Sandwich placement model for practical training among the simulation the training, the ship-in-service and the training vessel

**KEYWORDS: Practical training, training vessel, onboard training**
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<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>AASTMT</td>
<td>Arab Academy for Science &amp; Technology and Maritime Transport</td>
</tr>
<tr>
<td>ALAM</td>
<td>Akademi Laut Malaysia</td>
</tr>
<tr>
<td>AMSMA</td>
<td>Admiral Makarov State Maritime Academy</td>
</tr>
<tr>
<td>ARPA</td>
<td>Automatic Radar Plotting Aid</td>
</tr>
<tr>
<td>AUSTA</td>
<td>Australian Sail Training Association</td>
</tr>
<tr>
<td>BSAFL</td>
<td>Baltic State Academy of the Fishing Fleet</td>
</tr>
<tr>
<td>CBT</td>
<td>Computer Based Training</td>
</tr>
<tr>
<td>CMA</td>
<td>California Maritime Academy</td>
</tr>
<tr>
<td>CMTI</td>
<td>Compendium of Maritime Training Institute</td>
</tr>
<tr>
<td>DNV</td>
<td>Det Norske Veritas</td>
</tr>
<tr>
<td>DMA</td>
<td>Danish Marine Authority</td>
</tr>
<tr>
<td>DMU</td>
<td>Dalian Maritime University</td>
</tr>
<tr>
<td>EBME</td>
<td>Examination Board for Maritime Education and Training</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>FESMA</td>
<td>Far East State Maritime Academy</td>
</tr>
<tr>
<td>GLMA</td>
<td>Great Lakes Maritime Academy</td>
</tr>
<tr>
<td>GMU</td>
<td>Gdynia Marine University</td>
</tr>
<tr>
<td>ICMES</td>
<td>International Co-operation on Marine Engineering System</td>
</tr>
<tr>
<td>ILO</td>
<td>International Labour Organization</td>
</tr>
<tr>
<td>IMO</td>
<td>International Maritime Organization</td>
</tr>
<tr>
<td>ISM Code</td>
<td>International Safety Management Code</td>
</tr>
<tr>
<td>ISPS Code</td>
<td>International Ship and Port Facility Security Code</td>
</tr>
<tr>
<td>JMU</td>
<td>Jimei Maritime University</td>
</tr>
<tr>
<td>KMTI</td>
<td>Kerch Marine Technological Institute</td>
</tr>
</tbody>
</table>
KMU  Korea Maritime University
LNG  Liquefied Natural Gas
LOA  Length over all
MasMA  Massachusetts Maritime Academy
MMA  Maine Maritime Academy
MARPOL  International Convention for the Prevention of Pollution from Ships
MET  Maritime Education and Training
MMTC  Merchant Marine Training Centre
MNMU  Mokpo National Maritime University
MOL  Mitsui O.S.K. Line
MSTU  Murmansk State Technical University
NIST  National Institute for Sea Training
NTL  National Training Laboratories
NYK  Nippon Yusen Kaisha
ONA  Odessa Navigation Academy
PAL  Precious Associate Limited
SASMEX  Safety at Sea and Marine Equipment Exhibition
ShMU  Shanghai Maritime University
SzMU  Szczecin Maritime University
SOLAS  International Convention for the Safety of Life at Sea
STCW  International Convention on Standards of Training, Certification and
Watchkeeping for Seafarers
STI  Sail Training International
SUNYMC  State University of New York Maritime College
TAMU  Texas A&M university
TEU  Twenty foot Equivalent Unit
TU  Tokai University
UK  United Kingdom
USA  United States of America
WMU  World Maritime University
Chapter 1: INTRODUCTION

What is a qualified seafarer? As far as normal operations are concerned, recent advances in technology make anyone manage ship operations on account of automation. However, in heavy weather conditions, automation functions are sometimes hard to manage. Furthermore, human errors and any unexpected events also interrupt automation functions. Automation gives seafarers easier operation while some deficiencies make it more difficult to remedy automation failure. Therefore, unlike before, seafarers are required to have remedial abilities from any unexpected events as qualified seafarers.

Undoubtedly education and training is an enormous investment for investors. Indeed, phasing out training vessels especially in European countries is evident of giving up investing in Maritime Education and Training (MET). Instead of investing in training vessels, simulation training was introduced because of cost efficiency. However, as Berg and Skotgård (1996) pointed out, in accordance with experience from other high risk industries, investment in human competence improvement is very profitable in the long term. Hence, investment in education and training should take into account continuous improvement in the long term.

Parson proposed (1992) to re-introduce cadet training vessels which was a successful training method although it had fallen out of favour during the 1980s. As he mentioned, even though 15 years passed from his proposal, training vessels should be reviewed as the most suitable practical training method. Moreover, Subramaniam, the general manager of Eurasia Group, highlighted “If you think training is expensive,
try having an accident” to delegates at the recent SASMEX (Safety at Sea and Marine Equipment Exhibition, 2007) in the Training and Education Seminar. His statement could facilitate for people related to the maritime field to provide more appropriate training with crews and candidates.

Concerning practical training, based upon STCW Code Table A-II and A-III, there are 4 types of practical training in MET: laboratory equipment training, simulation training, ship-in-service and training vessel. The term training vessel is used in a vast range. In this paper, training vessel is focused upon engaging navigation and meeting requirements of ship size and engine power in the STCW Convention. Through discussion about the role of each practical training method in MET and the role of training vessels as a tool of method of onboard training, how training vessels should be utilized from an extensive view point are dealt with by mainly using data from the National Institute for Sea Training (NIST). The latest training vessel in Thailand is also used as an example of improving onboard training.

Through discussion about optimum utilization of training vessels, the training vessel should be utilized as follows:

- Real remedial procedure training
- Mobility laboratory training centre
- International co-operation as mobility training facilities
- Attraction young generation to maritime affairs
- The practical places of teaching from senior to junior in order to hone their competency
- Cadet-centred training
- Sandwich placement model for practical training among the simulation the training, the ship-in-service and the training vessel
Chapter 2: METHODS OF MARITIME PRACTICAL TRAINING

According to the OECD project report, the availability and training of seafarers (Precious Associated Limited and Knightsmart Limited, 2003); maritime education roughly consists of safety training, technical training, commercial training and others. Each area is defined as follows:

- **Safety training** relates to the safety aspects of ships and shipping, human resources, operations, cargo and the environment, which are covered by the STCW, SOLAS and MARPOL Conventions and requirements.

- **Technical training** includes also safety issues but not mandatory, ship familiarization and understanding a Safety Management System. It covers highly sophisticated equipment.

- **Commercial training** means cargo handling, cargo care and any other commercially related matters. However, there are no internationally recognized standards of marine commercial training or qualification although many organizations run training seminars and workshops in a multitude of subjects from the ISM Code to safe handling cargo.

- **Others** cover all the areas of treatment with contingency including budget control, resource management, and social and management skills
When above 4 training is categorized according to fundamental training and application training, the safety training can be categorized as a fundamental training. This is because the safety training should be learnt and trained in the earlier stages because of fundamental subjects. And the technical training covered both fundamental and application training because the technical training includes vast range of knowledge and skills. With respect to the management and commercial training is categorized as application training.

<table>
<thead>
<tr>
<th></th>
<th>Safety</th>
<th>Technical</th>
<th>Management</th>
<th>Commercial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fundamental</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>Application</td>
<td></td>
<td></td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

To cultivate competent seafarers, candidates should acquire not only knowledge and skills but also experience. So long as the occupation deals with others’ properties and human life such as the police, medical doctors and seafarers; hands-on practical training is imposed on candidates in order to prevent catastrophes as much as possible. Importance of hands-on training is to accumulate evaluation criteria to tackle confronted difficulties through experiencing real work. Thanks to technology development, the ship operation itself gets easier and easier than ever before as long as every condition is normal.

### 2.1 Laboratory equipment training

Laboratory equipment training is task-based training which is essential for seafarers to learn. Acquiring a particular skill, the laboratory equipment training is utilized in a large number of educational institutions. Examples of facilities for the laboratory training and penetration ratio in the MET institutions which aggregate to 552 including fishery, navy, governmental or private all over the world are given in Table 2.
Table 2: Type of laboratory facilities

<table>
<thead>
<tr>
<th>Type of laboratory</th>
<th>No. of Institutions</th>
<th>Penetration rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer</td>
<td>329</td>
<td>59.6</td>
</tr>
<tr>
<td>Engineering Workshop</td>
<td>304</td>
<td>55.1</td>
</tr>
<tr>
<td>Diesel Power Plant/Workshop</td>
<td>281</td>
<td>50.9</td>
</tr>
<tr>
<td>Survival</td>
<td>276</td>
<td>50.0</td>
</tr>
<tr>
<td>Fire-Fighting</td>
<td>257</td>
<td>46.6</td>
</tr>
<tr>
<td>Electronic</td>
<td>254</td>
<td>46.0</td>
</tr>
<tr>
<td>Communications</td>
<td>246</td>
<td>44.6</td>
</tr>
<tr>
<td>Physics</td>
<td>242</td>
<td>43.8</td>
</tr>
<tr>
<td>Seamanship</td>
<td>241</td>
<td>43.7</td>
</tr>
<tr>
<td>Electronic Navigation</td>
<td>237</td>
<td>42.9</td>
</tr>
<tr>
<td>Language</td>
<td>230</td>
<td>41.7</td>
</tr>
<tr>
<td>Chemistry</td>
<td>228</td>
<td>41.3</td>
</tr>
<tr>
<td>Refrigeration</td>
<td>209</td>
<td>37.9</td>
</tr>
<tr>
<td>Automatic Control</td>
<td>197</td>
<td>35.7</td>
</tr>
<tr>
<td>Meteorological</td>
<td>163</td>
<td>29.5</td>
</tr>
<tr>
<td>Marine Pollution Prevention</td>
<td>129</td>
<td>23.4</td>
</tr>
<tr>
<td>Planetarium</td>
<td>101</td>
<td>18.3</td>
</tr>
<tr>
<td>All above facilities</td>
<td>19</td>
<td>3.4</td>
</tr>
</tbody>
</table>


There is no international uniformity for MET institutions to have a certain kind of training facilities. However, according to the IMO CMTI, with respect to simulators which are mandatory (STCW Code A-I/12, 4 and 5), 46.7 % of the institutes have Radar simulators and 41.3 % have ARPA simulators. By using data of RADAR simulation as a benchmark by means of internationally mandatory training, only 4 items: Computer, Engineering workshop, Diesel power plant/workshop and Survival training are higher in ratio than RADAR simulation and Fire-fighting is almost equal...
in ratio to RADAR simulation. However, Table 2 indicates that the MET institutions regard the above 5 major laboratory training as more important hands-on training than others. The top 3: Computer, Engineering workshop and Diesel power plant/workshop are categorized more as technical skills training and the following 2 items: Survival and Fire-fighting are categorized as safety training. For thorough understanding, those 5 subjects need more practical lesson than classroom lecture.

2.2 Simulation training

In this section, simulation training is focused upon from several points of view; one is configuration, another is learning outcome and the other is way of using it. Taking such subcategories of simulation training into account could optimize the simulation training.

2.2.1 Configuration of simulator training

According to the standard for certification of maritime simulator system of Det Norske Veritas (DNV), a full mission simulator, a multi task simulator, a limited task simulator and a single task simulator (referred to special task by DNV) are defined in Table 3. Sometimes computer-based training is in single task training; however, in this paper, the computer-based training is described as another category.

<table>
<thead>
<tr>
<th>Table 3: Type of Simulation training</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Capable simulating</strong></td>
</tr>
<tr>
<td>Full mission</td>
</tr>
<tr>
<td>Multi task</td>
</tr>
<tr>
<td>Limited task</td>
</tr>
<tr>
<td>Single task</td>
</tr>
</tbody>
</table>

Source: Det Norske Veritas
The configuration of simulation training: full mission task, multi task, limited task, single task and computer-based task, are focused upon in this section.

2.2.1.1 Full mission

The full mission simulation is the most sophisticated type of simulation training with full visual up to 360 degrees, mock-up construction, interconnecting with other types of simulators. By using the full mission type of simulators, cadets can train under more reality situations rather than other types of simulation training. For instance, in case of ship-handle full mission simulator, the mock-up bridge is mounted on a motion platform for special effect. The disadvantages of full mission simulation training are that sufficient space, which is comparatively expensive, is needed.

2.2.1.2 Multi task

Multi task simulation training means composite tasks, simulation training, more advanced training options and flexible configuration. In case of navigational simulation training, unlike limited task simulations, visuals can be included. For instance, bridge crew training can be categorized in the multi task training.

2.2.1.3 Limited task

Limited task simulation training is replica-based hands-on training or limited instrument training. To be familiar with particular task, the limited task training is carried out. For instance, chart work training by using the radar can be categorized limited task training.
2.2.1.4 Single task

Hands-on single instrument training can be combined with other simulated instruments. As an advantage, single task simulation training is not always needed to build facility for its installation. On the other hand, limited training options can be a disadvantage of single task simulation training. Radar simulation or ARPA simulation training is categorized in this task.

2.2.1.5 Computer-based training

The operation of simulation training is done by keyboard, mouse pad or touch screen. Requirements for computer-based training are a set of computers. The advantages of Computer-based training in comparison with other types of simulation training are comparatively small amounts of investment, unnecessary spaces and constraints on training time. In order to maintain or improve crews’ knowledge and skills, computer-based training systems are installed in the vessels. The computer-based training allows learners to carry out self-study whenever they want.

Currently maritime institutions utilize several kinds of simulators because of improvement of educational efficiency. Depending upon students’ level of knowledge and skills as well as financial level, different configurations of simulation trainings are applied to practical training.
2.2.2 Purpose of learning outcome for simulation training

In this section, the category of purpose of learning outcome for simulation training is subdivided into 3 subcategories: teamwork-building, skill-building and knowledge-building.

2.2.2.1 Teamwork-building

Usually ship operation depends upon several crews’ cooperative work. In order to foster competent seafarers, teamwork training is one of the most important objectives because the duty officer has to analyze collected pieces of information and give his/her crew appropriate tools for decision-making. Moreover, each seafarer should understand not only his or her own task but also others’ tasks in order to execute all tasks smoothly. Full mission and multi task training is suitable for the team-building training because of multiple participant training.

2.2.2.2 Skill-building

Skill-building training is treatment of particular equipment. For instance, ARPA simulation training is to be familiar with its functions and to acquire skills to utilize it. Development skills are one of the purposes of hand-on training. By using real or imitation equipment, learners can cultivate particular skills. Single task and limited task simulation training are suitable for skill-building training in this respect.

2.2.2.3 Knowledge-building

One of the main purposes of simulation training is to acquire knowledge, theories and basic skills. Most cases of computer-based simulation training are categorized as knowledge-building simulation training. This is because it is easy for learners to use
computer-based training whenever they want to. Single task simulation training is also covered in this area.

Table 4 shows close relation between types and purpose of simulation training. From this table, taking the purpose of simulation training into account, it is clear that each configuration of simulation training has optimal way of utilization.

<table>
<thead>
<tr>
<th></th>
<th>Teamwork-build</th>
<th>Skill-build</th>
<th>Knowledge-build</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full mission task</td>
<td>○</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>Multi task</td>
<td>○</td>
<td>○</td>
<td></td>
</tr>
<tr>
<td>Limited task</td>
<td></td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Single task</td>
<td>○</td>
<td></td>
<td>○</td>
</tr>
<tr>
<td>Computer-based</td>
<td></td>
<td></td>
<td>○</td>
</tr>
</tbody>
</table>

2.2.3 Way of using simulation training

The history of using simulation training in aviation is longer than in the maritime field. The purpose of using first flight simulation was to learn how to maintain the aeroplane's equilibrium on land before World War I. Then after the War, this purpose changed to learn how automation system behaves (Rolfe & Staples, 1986). In the early years, the flight simulation was substitution training for flight training by using real aircraft. In contrast to this, currently, every training situation can be reproduced in the simulation training thanks to the use of sophisticated equipment. Thus, remedial procedure training, substitution training and maintenance of knowledge and skills can be carried out in any difficult situation by simulators.

2.2.3.1 Remedial procedure training

Thanks to the technology development, an ineligible seafarer can manage to operate his/her task so long as normal operation is maintained. A competent seafarer means
the one who can solve the problem or minimize damage when confronting an unexpected situation. In other words, competent seafarers can deal with an emergency situation. Therefore, to accumulate experience of emergency situations, the remedial procedure training can be essential training.

One of the most characteristic ways of utilizing simulation training could be the remedial procedure training because of the following reasons:

- To create dangerous situation which does not actually exist;
- To repeat the same situation;
- To create any place and any condition in a training environment;
- To change the parameter easily to the condition required;
- To train students economically, both cost and time;
- To study human performance under stress; and
- To study man-machine interrelations.

### 2.2.3.2 Substitution training

Capable of creation of any situation makes simulation training substitute for real training. Instead of using real equipment or a real situation, simulation training is utilized as an alternative training. Therefore, it makes it possible to reduce wastage of time. For instance, to learn the difficulties of manoeuvring a vessel in heavy weather, simulation training can reproduce expected situation. In case of onboard training, learners and instructors should wait for the weather condition and move to the suitable area because such training depends upon the weather and sea condition. As substitution training from the extensive point of view, the Maritime Institute Willem Barentsz in Holland replaces 60-day onboard training out of 360 days with simulation training by using their sophisticated simulators. In this case, simulation training can be substitution training itself for onboard training.
2.2.3.3 Maintenance of knowledge and skills

Capable of repetition: remarkable function of simulation training especially computer-based training makes it possible for learners to acquire knowledge through repetition training. By using distance learning or computer-based simulation, crews or cadets aboard vessels can deal with self-study in order to maintain or improve their knowledge and skills. Re-education or maintenance knowledge for seafarers can be carried out by computer-based training. According to the Force technology, Maersk Line utilizes computer-based training called the SimFlex Navigator On-board system for their cadets. Thanks to the sophisticated communication environment, mentors can supervise learners without being on board a vessel. By using this system, uniformity of crews’ knowledge can be achieved with cost and time effective. This is because shipping companies can reduce the time and cost to invite them to have re-education training. In addition, Mitsui OSK Line (MOL) has developed a sophisticated computer-based training (CBT) system that brings together elements from third party providers and in-house systems. It allows training histories to be filled electronically and performance of seafarers aboard MOL-operated vessels to be reviewed. “The goal of the system is to upgrade the skills of MOL’s seafarers and reinforce operating safety” (“MOL starts CBT,” 2007, p. 14). The new system’s software allows seafarers to take their own training programme with them whether they are on board or on leave.

2.3 Ship in service: apprenticeship

“Traditionally, practical seamanship skill have been handed down on board from senior officer to junior officer, from junior officer to apprentice and likewise passed down from the senior ratings on board”, (Parsons, 1992). As Parsons described, the ship in service traditionally is the most popular way to carry out onboard training
called sometimes apprenticeship or apprentice. According to Webster’s third new international Dictionary, apprentice means that “one who is learning by practical experience under skilled workers a trade, art or calling”. From a historical point of view, the apprentice system has been utilized in the fields where specific skills are required to be a mature worker since more than 2,000 years ago. In the Code of Hammurabi (King, L.W. Trans.) one of the oldest descriptions about apprenticeship can be found as follows:

188. If an artisan has undertaken to rear a child and teaches him his craft, he cannot be demanded back.

189. If he has not taught him his craft, this adopted son may return to his father's house.

With this background, Johns added his explanation to King’s translation;

A craftsman often adopted a son to learn the skill of craft and also he profited by the son's labor. If he failed to teach his son the craft, that son could prosecute him and get the contract annulled. This was a form of apprenticeship, and it is not clear that the apprentice had any filial relation.

As can be seen from the above, more than 2,000 years ago, initial apprenticeship had come into existence as a way of fostering workers. As Miller indicates (1996), in the Middle Ages, formation of guilds was developed in England before the Norman conquest (A.D. 1066). Accordingly Howard III (1996) explained about the history of apprenticeship during training periods for youth apprentices. Education in reading, writing and arithmetic was given by their master craftsmen. This education for the youths was required by law and was also only an alternative way to go to expensive private schools. However, the industrial innovation and the advancement of public education made apprenticeship decline. After 1800, small craft shops were displaced
by large shops and factories. Then public schools gradually took over most of the educational aspects of the apprenticeship system.

In this manner, apprenticeship included not only occupational education and training but also literacy education for youths. Recently the educational scene has replaced apprenticeship with educational institutions in most fields; however, in the field of merchant marine, transferring knowledge and skills has been carried out by apprenticeship. Yet, recently tight navigation schedules, crowded workload and enormous paper work for safety management issues make it difficult for seafarers to deal with apprentices.

The advantages of using ships in service are to save training expenditure and to carry out more practical training in the management or commercial field, such as cargo handling, which is one of the most important tasks. The difficulties of onboard training for ships in service are training dependent upon navigation and/or commercial schedules, the need to embark instructors for assessment and monitor and limitations for instructors’ and cadets’ accommodations.

2.3.1 Types of ship-in-service

As Short (1992) pointed out, the transfer of competency, such as knowledge and skills, was largely done on board vessel through on-the-job training under a competent practitioner. In the long history, the way in which Short described it has been taken place in the vast range. When cadets get on board any types of vessels except the training vessels for their training in order to acquire knowledge, skills and experience, the training is called the ship-in-service training. In the conventional way of the ship-in-service or apprenticeship, seafarers played the role of trainers. Some ship-in-service training has applied the conventional way, without instructors, and others have applied the way of employing instructors.
2.3.1.1 Without instructors

Training without instructors has several disadvantages from an educational point of view. Recently the work load of seafarers has increased more than before. This is because time in port and the number of crews has been decreased while paper work and time for cargo care has been increased. In proportion to technology development, the ship size has also been increased. In case of refrigerated container (reefer container) vessels, the routine work, such as checking the temperature, refrigerant and LO level, is required for reefer containers, engineering staff devote working time to only routine work because of the large number of reefer containers. It makes them interrupt work to deal with other important work. In this connection, training done by ship-in-service has limitation currently. There is no sufficient time for seafarers to supervise, assess and train cadets appropriately.

2.3.1.2 With instructors

To improve the training by ship-in-service, there are two ways of ship-in-service with instructors, one is instructors aboard the vessels and another is instruction from shore by using the internet or intranet system as a way of distance learning. To be aboard the instructors on the vessels need accommodation and this involves extra labour cost. According to the Nippon Yusen Kaisha (NYK) (2006), they ordered new type of training vessels, 1 LNG carrier and 3 container vessels which will furnish the lecture room and accommodation for instructors. This is one of the most ideal types of onboard training because of the mixture of training vessel and ship-in-service when utilized in the optimum way. To avoid from spending too much money, such as labour cost for instructors, cost of reconstruction for accommodation, or to take temporary way of improving ship-in-service until new vessels are launched, the system of monitoring from shore by instructors can be utilized.
Sooner or later, ship-in-service with instructors should be applied rapidly in order to improve the quality of training.

### 2.3.2 Purpose of ship-in-service

As Howard III indicated (1996), there are several features of apprenticeship in a wide sense:

- The opportunity to develop skills
- Increase employability
- Versatility to adapt to technological changes
- Recognition as a skilled worker

Like laboratory equipment training, simulation training or onboard training by training vessel, ship-in-service training provides opportunity to develop their skills. The distinguished advantages of ship-in-service are to provide opportunity to develop skills relating to commercial training and new technology, to increase employability, to cultivate loyalty to companies and to distinguish qualified potential cadets. Indeed, NIST and MOL keep personnel exchange with each other. The benefit of the bilateral agreement for MOL is to find out the high potential cadets beforehand. This could lead to increase the qualified seafarers. By applying the ship-in-service training, consolidation of relation between MET and maritime industries is taken place. This makes MET flexibly respond the demand from industries.

### 2.4 Training vessel

In accordance with Webster’s dictionary, training ship means “a war ship that carries naval-officer candidate on training course” and “a ship used to train men
for the merchant marine”. Thus, training ships are used by several kinds of candidates as well as for several purposes. In a broader application, training ship means a school ship in order to train people for not only becoming seafarers but also achieving character building. In this chapter, classification by the type and purpose of training ships will be given; furthermore, upon completion of this chapter, the training vessel/ship will be defined including all of the following factors;

- To be engaged in navigation;
- To train candidates for merchant marine in practical skill;
- To be satisfied with 500 gross tonnage or more (STCW Convention’s Code A-II/1); and
- To have main propulsion machinery of 750 kW or more. (STCW Convention’s Code A-III/1)

2.4.1 Type of training vessel

According to the Fairplay World Shipping Encyclopaedia, there are 183 training vessels in the world. The list of training vessels categorized by prim motors is shown in Table 5. In this table, if a sail powered vessel has a diesel engine for propulsion, the vessel is categorized as motor vessel. As can be seen in Table 5, motor vessels dominate in the training vessels

<table>
<thead>
<tr>
<th>Motor</th>
<th>165</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbine</td>
<td>8</td>
</tr>
<tr>
<td>Non propelled</td>
<td>4</td>
</tr>
<tr>
<td>Diesel-Electric</td>
<td>4</td>
</tr>
<tr>
<td>Reciprocating Steam</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: Fairplay World Shipping Encyclopaedia
In accordance with Laczyński’s description (2003), training vessels are categorized into 3 groups: sail powered vessels, training vessels and vessels adopted for training purposes. However, some sail powered vessels have a historical background as merchant vessels. So, such sail powered vessels could be categorized as the third one: vessels adopted for training purpose. In this paper, therefore, training vessels are categorized by another point of views. First of all, training vessels are categorized by a propulsion system as shown the following;

1. Sail powered vessel;
2. Motor vessel: prim motor of propulsion is diesel engine; and
3. Steam turbine vessel.

2.4.1.1 Sail powered vessels

The sail powered vessel is a wind-powered vessel although currently almost all sail powered vessels have their own propulsion engine. Formerly sail powered vessels were used as not only commercial merchant ships or battle ships but also training ships whereas currently they are used as primarily training ships except in some cases such as:

1. Cruise ship: *Royal Clipper* that Star clipper company owns in Luxembourg;
2. Hotel & restaurant ship: *Barken Viking* which is commanded by Liseberg Restaurant AB and berthed in Gothenburg, Sweden; and

Incidentally, the *Barken Viking*, the *Dar Pomoroza*, the *Glenlee* and the *Gorch Fock* have a career as training vessel. For instance, the *Barken Viking* carried Swedish cadets from 1954 to 1995 and the *Dar Pomoroza* was engaged as a training vessel from 1910 to 1918 as the *Prinzess Eithel Friedrich* for a German maritime school as well as from 1930 to 1981 for Polish maritime schools; however, during World War
Dar Pomoroza was interned in Sweden without crew. Thus, in most cases sail powered ships have a background as a training ship although currently they have other functions.

The viewpoint from sail powered vessel to sail powered training vessel changed, Table 6 shows that more than 10 countries use it as a training vessel for the navy on the one hand and as can be seen from Table 7, 5 countries use it for merchant purposes with a total amount of 11 training vessels engaged in navigation on the other hand. Historically, only a few sail powered training ships have been used for merchant purposes, for instance, Danmark in Denmark, Dar Molodziezi in Poland, Kaiwo Maru and Nippon Maru in Japan.

<table>
<thead>
<tr>
<th>Name of Sail Training Vessel</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMERIGO VESPUCCI</td>
<td>Italy</td>
</tr>
<tr>
<td>ARA LIBERTAD</td>
<td>Argentine</td>
</tr>
<tr>
<td>ARC GLORIA</td>
<td>Colombia</td>
</tr>
<tr>
<td>ARM CUAUHTEMOC</td>
<td>Mexico</td>
</tr>
<tr>
<td>ESMERALDA</td>
<td>Chile</td>
</tr>
<tr>
<td>GORCH FOCK II</td>
<td>Germany</td>
</tr>
<tr>
<td>INS TARANGINI</td>
<td>India</td>
</tr>
<tr>
<td>JUAN SEBASTIAN DE ELCANO</td>
<td>Spain</td>
</tr>
<tr>
<td>KALIAKLA</td>
<td>Bulgaria</td>
</tr>
<tr>
<td>KRI DEWARUCI</td>
<td>Indonesia</td>
</tr>
<tr>
<td>MIRCEA</td>
<td>Romania</td>
</tr>
<tr>
<td>SAGRES III</td>
<td>Portuguese</td>
</tr>
<tr>
<td>STATSRAAD LEHMKUHL</td>
<td>Norway</td>
</tr>
<tr>
<td>YOUNG ENDEAVOUR</td>
<td>Australia</td>
</tr>
</tbody>
</table>
Table 7: Type of training vessels for merchant purpose

<table>
<thead>
<tr>
<th></th>
<th>Sailing vessel</th>
<th>Motor vessel</th>
<th>Steam vessel</th>
<th>Institute</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>YU FENG</td>
<td></td>
<td></td>
<td>SMU</td>
</tr>
<tr>
<td></td>
<td>YUKUN</td>
<td></td>
<td></td>
<td>DMU</td>
</tr>
<tr>
<td></td>
<td>DA YU SHAN</td>
<td></td>
<td></td>
<td>JMU</td>
</tr>
<tr>
<td></td>
<td>KUN LUN SHAN</td>
<td></td>
<td></td>
<td>JMU</td>
</tr>
<tr>
<td>Denmark</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EGYPT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>DANMARK</td>
<td></td>
<td></td>
<td>DMA</td>
</tr>
<tr>
<td>Japan</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>AIDA IV</td>
<td></td>
<td></td>
<td>AASTMT</td>
</tr>
<tr>
<td></td>
<td>BOUSEIMARU</td>
<td></td>
<td></td>
<td>TU</td>
</tr>
<tr>
<td></td>
<td>GINGAMARU</td>
<td></td>
<td></td>
<td>NIST</td>
</tr>
<tr>
<td></td>
<td>KAIOWMARU</td>
<td></td>
<td></td>
<td>NIST</td>
</tr>
<tr>
<td></td>
<td>NIPPONMARU</td>
<td></td>
<td></td>
<td>NIST</td>
</tr>
<tr>
<td></td>
<td>SEIUNMARU</td>
<td></td>
<td></td>
<td>NIST</td>
</tr>
<tr>
<td></td>
<td>TAISEIMARU</td>
<td></td>
<td></td>
<td>NIST</td>
</tr>
<tr>
<td>Korea</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SAENURI</td>
<td></td>
<td></td>
<td>MNMU</td>
</tr>
<tr>
<td></td>
<td>SAEYUDAL</td>
<td></td>
<td></td>
<td>MNMU</td>
</tr>
<tr>
<td></td>
<td>HANBADA</td>
<td></td>
<td></td>
<td>KMU</td>
</tr>
<tr>
<td></td>
<td>HANNARA</td>
<td></td>
<td></td>
<td>KMU</td>
</tr>
<tr>
<td>Poland</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>DER MLODZIEZI</td>
<td></td>
<td></td>
<td>GMU</td>
</tr>
<tr>
<td></td>
<td>HORYZONT II</td>
<td></td>
<td></td>
<td>GMU</td>
</tr>
<tr>
<td></td>
<td>Navigator XXI</td>
<td></td>
<td></td>
<td>SMU</td>
</tr>
<tr>
<td>Russia</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MIR</td>
<td></td>
<td></td>
<td>AMSMA</td>
</tr>
<tr>
<td></td>
<td>STS SEDOV</td>
<td></td>
<td></td>
<td>MSTU</td>
</tr>
<tr>
<td></td>
<td>KRUZENSHTERN</td>
<td></td>
<td></td>
<td>BSFAFF</td>
</tr>
<tr>
<td></td>
<td>NADEZHDA</td>
<td></td>
<td></td>
<td>FESMA</td>
</tr>
<tr>
<td>Thailand</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ukraine</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>VISUDSAKORN</td>
<td></td>
<td></td>
<td>MMTC</td>
</tr>
<tr>
<td></td>
<td>DRUZHBA</td>
<td></td>
<td></td>
<td>ONA</td>
</tr>
<tr>
<td></td>
<td>KHERSONES</td>
<td></td>
<td></td>
<td>KMTI</td>
</tr>
<tr>
<td>USA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>GOLDEN BEAR</td>
<td></td>
<td></td>
<td>CMA</td>
</tr>
<tr>
<td></td>
<td>STATE OF MAINE</td>
<td></td>
<td></td>
<td>MMA</td>
</tr>
<tr>
<td></td>
<td>ENTERPRISE</td>
<td></td>
<td></td>
<td>MasMA</td>
</tr>
<tr>
<td></td>
<td>TEXAS CLIPPER</td>
<td></td>
<td></td>
<td>TA&amp;MU</td>
</tr>
<tr>
<td></td>
<td>EMPIRE STATE VI</td>
<td></td>
<td></td>
<td>SUNMC</td>
</tr>
<tr>
<td></td>
<td>STATE OF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MICHIGAN</td>
<td></td>
<td></td>
<td>GLMA</td>
</tr>
</tbody>
</table>

Source: IAMU News issue 8, EASTMET report, Universities’ Website, personal communications
Table 8: List of Abbreviations for Institutions in Table 7

<table>
<thead>
<tr>
<th>ShMU</th>
<th>Shanghai Maritime University</th>
<th>MSTU</th>
<th>Murmansk State Technical University</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMU</td>
<td>Dalian Maritime University</td>
<td>BSAFF</td>
<td>Baltic State Academy of the Fishing Fleet</td>
</tr>
<tr>
<td>JMU</td>
<td>Jimei Maritime University</td>
<td>FESMA</td>
<td>Far East State Maritime Academy</td>
</tr>
<tr>
<td>DMA</td>
<td>Danish Marine Authority</td>
<td>MMTC</td>
<td>Merchant Marine Training Center</td>
</tr>
<tr>
<td>AASTMT</td>
<td>Arab Academy for Science &amp; Technology and Maritime Transport</td>
<td>ONA</td>
<td>Odessa Navigation Academy</td>
</tr>
<tr>
<td>TU</td>
<td>Tokai University</td>
<td>KMTI</td>
<td>Kercq Marine Technological Institute</td>
</tr>
<tr>
<td>NIST</td>
<td>National Institute for Sea Training</td>
<td>CMA</td>
<td>California Maritime Academy</td>
</tr>
<tr>
<td>MNMU</td>
<td>Mokpo National Maritime University</td>
<td>MMA</td>
<td>Maine Maritime Academy</td>
</tr>
<tr>
<td>KMU</td>
<td>Korea Maritime University</td>
<td>MasMA</td>
<td>Massachusetts Maritime Academy</td>
</tr>
<tr>
<td>GMU</td>
<td>Gdynia Marine University</td>
<td>TA&amp;MU</td>
<td>Texas A&amp;M University</td>
</tr>
<tr>
<td>SzMU</td>
<td>Szczecin Maritime University</td>
<td>SUNMC</td>
<td>State University of New York Maritime College</td>
</tr>
<tr>
<td>AMSMA</td>
<td>Admiral Makarov State Maritime Academy</td>
<td>GLMA</td>
<td>Great Lakes Maritime Academy</td>
</tr>
</tbody>
</table>

One of the most distinguished educational features of sail training vessels in comparison with other types of training vessels is to develop team work ability. In order to operate the vessel, crew members on sail powered vessels have to cooperate and coordinate their actions with each other to efficiently deal with yard and sail operations. This is necessary for rigging and changing sail by manpowered operation. Therefore, sail training is suitable for acquiring social skills. Training vessel Danmark is used as a tool of pre-sea training which is fundamental training in order for not only students of maritime institutions but also youngsters who have other fields of backgrounds in order to cultivating social skills. According to Nordseth, Director of Danish Maritime Authority and visiting professor at WMU explained (personal communication, February 26, 2007) that social skills means the skills needed to be a crewmember in a merchant ship, such as:

-Ability to cooperate with other persons of various social and cultural backgrounds;
-Ability to solve problems as part of a team;
-Ability to take responsibility; and
-Ability to act as a leader, a troubles shooter and problem-solver.
In addition to Nordseth’s statement, the following description about the purpose of sail training is given in the website of Sail Training International (STI):

“Sail training uses the experience of being at sea principally as a means to help people learn about themselves, discover hidden strengths and talents and understand the value of working as a team.”

(Sail Training International, 2007)

Therefore, considering the utilization of the sail powered vessel as a training facility in many naval institutions, Nordseth and STI indicated that the purpose of using the sail powered vessel can be distinct advantages. In contrast to those advantages, there is a major disadvantage of the sail powered training vessel because the sail operation itself does not have a close link to the majority of practical operations involved in the merchant ship. Having considered this disadvantage of sail operation, the motor vessel has been preferred to the sail powered ship in this respect.

### 2.4.1.2 Motor vessels

Another type of training vessel is motor vessel which merchant vessels usually use. Henceforth, motor vessel means that the prime motor for propulsion system is either diesel engine(s) or electric motor(s). Table 7 shows that 7 countries with an aggregate of 16 vessels use the motor type training ships. Dalian Maritime University in China launched new training vessel, *Yukun* in October 2006, whose purpose is pure training vessel although other Chinese universities use motor training vessels whose function include merchant purposes. Recently, Mitsui OSK Line (MOL) also launched motor training vessel *Spirits of MOL* on 1st July (Press release by MOL), which is the first pure training vessel owned shipping company.
2.4.1.3 Steam turbine vessel

Before the oil crisis, as a propulsion engine, the steam turbine engine dominated the larger vessels in the merchant field because of its huge power. However, after the oil crisis, the number of steam turbine vessels decreased because of the large amount of fuel consumption. Currently, the steam turbine propulsion engines are utilized for naval vessels and Liquefied Natural Gas (LNG) vessels. For this reason, a huge amount of power and reliability of the main engine is required on the naval vessels; furthermore, in case of the LNG vessel, boil off gas i.e. evaporated part of cargo (LNG) used as fuel in boilers, can be utilized for producing steam for propulsion turbines, which makes shipping companies’ operations economical.

A comparison of specific fuel consumption between T.S. *Taisei Maru* (steam turbine vessel) and T.S. *Seiun Maru* (motor vessel) owned by NIST is given in Table 9. According to Table 9, the fuel consumption ratio in ton/day of motor vessel is 86 % of the steam turbine and the fuel consumption ratio in ton/100miles of the motor vessel is 72 %. In addition, the fuel consumption in a year of the steam turbine training vessel is 3 times as much as the motor training vessel. Thus, this is the reason for the decline in the number of steam turbine vessels.

<table>
<thead>
<tr>
<th>Training Vessel</th>
<th>Fuel Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ton/year&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>TAISEI MARU (Steam Turbine)</td>
<td>4683</td>
</tr>
<tr>
<td>SEIUN MARU (Motor)</td>
<td>2926</td>
</tr>
</tbody>
</table>

<sup>1</sup> Average from 2000 to 2006
<sup>2</sup> From fuel consumption record: TAISEI MARU on 4<sup>th</sup> Dec. 2006, SEIUN MARU on 5<sup>th</sup> Feb. 2007
<sup>3</sup> From fuel consumption record: TAISEI MARU on 4<sup>th</sup> Dec. 2006, SEIUN MARU on 5<sup>th</sup> Feb. 2007
As can be described about fuel consumption of turbine vessels, one of the most serious disadvantages of turbine vessels is the high expense for fuel: which is a great portion of the expenditure. Furthermore, another disadvantage is that fostering candidates for engineers, who can deal with steam turbine vessels, is time consuming in comparison with candidates for engineers who tend to be onboard motor vessels. As the main reason, the steam plant is a more complicated system than the diesel plant. On the other hand, one of the advantages of the steam turbine vessel is high reliability. This is because diesel engines need more maintenance whilst the steam turbine requires comparatively less maintenance.

Despite the disadvantages of turbine vessels, some of institutions use turbine training vessels. One example of using the steam turbine training vessel is the USA. To build a training vessel is quite costly because of tailor made vessels such as class room, accommodation spaces for a large number of cadets even if it is a sail powered or motor type training vessel. Had the vessel been handed over from the navy, it would have been possible to save cost for building a training vessel. Those examples can be seen in several maritime institutions in USA. For instance, California Maritime Academy (CMA) possesses Golden Bear or Maine Maritime Academy’s State of Maine. These institutes took over old naval research vessels (turbine vessels) from the US navy.

In conjunction with Japan, for the second example of using the steam turbine training vessel, as Hosoi, N. mentioned that “the practical training on the steam turbine is indispensable for the certification of unlimited third grade engineer, which is one of the reason for the NIST (National Institute for Sea Training) having a steam turbine training ship” (2004). Indeed, according to the Ministry of Land, Infrastructure and Transport Japan Notice 166 Annexed Table 5, engineering cadets are required onboard training by turbine vessel at least for 3 months to obtain unlimited engineering certification.
2.4.2 Purpose of training vessels

In this part, from the viewpoint of purpose, training vessels are described as three categories: laboratories, familiarization and on-the-job training.

2.4.2.1 Laboratories

In some cases training ships are used permanently berthed or anchored as laboratories. For instance, the tanker Ardatovs which is owned by the Latvian Shipping Crewing Agency’s Training Centre is utilized as a training facility for survival at sea and fire fighting. Likewise, as I. Bartuseviciene, Head of international relations and projects office Lithuanian Maritime College, indicates (personal communication, July 4, 2007) that Brigita which was the training ship of Klaipeda University Maritime Institute in Lithuania fulfilled a variety of functions in basic safety training such as:

1. Personal survival module (STCW 78/95 VI, model course Nr. 1.19);
2. Fire prevention and Fire Fighting module (STCW 78/95 VI/1, model course Nr. 1.20);
3. Elementary First Aid module (STCW 78/95 VI/1, model course Nr. 1.13);
4. Personal safety and social responsibility module (STCW 78/95 VI/1, model course Nr. 1.21); and
5. Advanced Fire Fighting module (STCW 78/95 VI/2, model course Nr. 2.03).

However, unfortunately Brigita was sold in 2007. In some cases, training vessels are utilized not as an onboard training facility but as a practical training facility.
2.4.2.2 Familiarization

Onboard training can be divided into two: fundamental training and application training. In addition, there are two cases in using training vessel(s); training vessel can be utilized as onboard training for a whole onboard training period and for part of the onboard training period. To be familiar with life and work environment at sea, training vessels utilized a practical training method. As familiarization training, training vessels are used in navigating, anchoring or berthing. In this respect, MET institutions are opposed to small size vessels as their training vessels. Norway used to a sail powered vessel as pre-sea training; candidates for maritime university, for instance must have 6 months onboard training. As the above described, Denmark utilizes sail powered vessels as pre-sea training; students are aboard training vessels in order to be familiar with the unique environment at sea. As Hallenstvet, Assistant Professor at the Vestfold University College, Norway, explained the sail powered vessel was used as pre-sea training for 6 months before studies at the University, and at the completion of the first year study for students; however, currently the sail powered vessel has never been utilized as onboard training because of the high cost. (Personal communications, Hallenstvet, February 26, 2007)

2.4.2.3 On-the-job training

The on-the-job training is the most suitable way of using onboard training. In order to acquire knowledge, skills and experience, students need to have on-the-job training through onboard training. A large number of maritime institutions utilize the apprentice system as on-the-job training. The first reason is that being cultivated with more practical knowledge and skills is difficult to acquire in the classroom or simulated conditions. The second reason is that educational institution can avoid wasting huge amounts of expenditure by means of operation costs for training vessels.
2.4.3 Intending training ship

As described, training vessels are utilized in order to train people for not only being seafarers but also achieving character building. On the one hand, naval, coast guard, merchant or fishery institutions use vessels that carry out practical training for candidates to acquire the necessary skills and knowledge. However, each institution has different learning objectives to use training ships. Hereafter, the training ship is focused upon merchant purposes. On the other hand, in conjunction with sail powered ships, training on board is provided for particularly youngsters for character building.

For instance, the Australian Sail Training Association (AUSTA) is a voluntary organization which provides young Australians and New Zealanders with sail training to find out their own latent talent and to realize the values of others and of working as one of a team (AUSTA, 2007). In this manner as a member of Sail Training International (STI) which is a non-profit organization and its purpose is “the development and education of young people of all nationalities, cultures, religions and social backgrounds through the sail training experiences”, there are similar organizations in a large number of countries, such as Belgium, Bermuda, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Latvia, the Netherlands, Norway, Poland, Portugal, Russia, Spain, Sweden, the UK and the USA (STI, 2007).

Furthermore, the immobilised ship with berthing, mooring or anchoring is also called training ship when used as a training facility. One example of the training ship with berthing is Akdeniz owned by Istanbul Technical University in Turkey. Akdeniz is used as familiarization training on board berthed in summer season for 1st and 2nd year students (Personal communication, Gurbuz, C. April 26, 2007). However, as Sithambaram mentioned (1998, p.14) “As an ideal training vessel, it is equipped with real working equipment”. Also “On-board training” in STCW Convention’s Code A-
II/1 paragraph 6.1 and A-III/1 paragraph 2.1 described “during the required period of seagoing service the candidate receives systematic practical training and experience in the tasks, duties and responsibilities of an officer”. Therefore, in this paper, the vessel which engages in navigation is categorized as training vessel/ship whilst the vessel which is not engaged in navigation is categorized as laboratory equipment training.

Taking the above into consideration, the training vessel/ship includes all following factors:

- To be engaged in navigation;
- To train candidates for the merchant marine in practical skills;
- To be satisfied with 500 gross tonnage or more (STCW Convention’s Code A-II/1); and
- To have main propulsion machinery of 750 kW or more. (STCW Convention’s Code A-III/1)
Chapter 3: COMPARISON OF PRACTICAL METHODS WITH ONBOARD TRAINING

As Brindle, Director of AIM safety United Kingdom, described (1992), “on board training is not a replacement for the lecture room ashore. It is there to broaden knowledge, to provide the familiarity necessary to achieve efficiency, to add refreshment and piquancy to shipboard knowledge and ability.” More or less so is the laboratory equipment training and the simulation trainings. In this Chapter, through comparing onboard training with laboratory equipment training and the simulation training as well as comparing training by training vessel with ship-in-service, peculiarity of each of practical training will be dealt with.

3.1 Laboratory equipment training and onboard training

The advantages of laboratory equipment training in comparison with onboard training are easier to get or store any resources for teaching materials. The laboratory equipment training is hands-on training; however, as can be seen in Table 2 Type of laboratory facilities in the Chapter 2, most of the training can be replaced by onboard training. Some laboratory equipment training is difficult to be dealt with by onboard training. For instance, the fire fighting carried out on the vessel; nevertheless, the drill can hardly deal with real fire operation. On the other hand, the facilities are utilized in real fire and smoke. In other words, the laboratory equipment training versus the onboard training can be put into on shore training facilities versus floating facilities at sea. In contrast to shore facilities, vessels have physical limitations i.e. no
sufficient space to install facilities. Thus, the laboratory equipment training is more suitable for fire fighting training.

The particular training which required certain treatment after executions, such as fire fighting and oil spill fighting, is suitable for the laboratory equipment training. If situations or condition allows, the other type of laboratory training can be carried out on training vessel.

3.2 Simulator training and onboard training

Historically simulation training was developed in the aviation field in order to substitute real hands-on training and train emergency situations. Accordingly, flight simulation training has recently focused upon utilizing as a tool for emergency training and human resource management training because the emergency training can hardly be carried out without flight simulators. In order to make appropriate decision rapidly under the emergency situation, continuous remedial procedure training is assigned to aviation pilots.

The primary reason for using simulation training in emergency situations is that it is difficult to create a critical situation with using real vehicles without any accidents. In this respect, remedial procedure training by simulation training is also suitable for MET practical training.

In the fields of MET, seeing the historical trend of replacement of training vessels with simulation training especially in European countries, simulation training has been developed as substitute training facilities for training vessels. Thus, E-learning is used as a tool for maintaining the skills and knowledge. Combining onboard training with simulation training is dominated by computer-based training because of lower cost and as a role of assistant aids for knowledge; however, there is a case of using a full mission task simulator on the vessel.
Ginga Maru has a full mission ship-handling simulator on the training bridge which is located beneath the real bridge, and whose equipment is the same as on the real bridge. Usually the training bridge is used for observation space and execution of ship manoeuvring by only cadets. Using the training bridge as an observation space, cadets can observe the real operation with the instructor’s explanation from the objective point of view. On the other hand, the training bridge is used for operation space for cadets when cadet-centred watchkeeping training, when only cadets manoeuvre the vessel without instructors, is carried out. By using the full mission ship-handling simulator on the training bridge, real operation can be reproduced by simulator training on account of using real ship operating data retrieved from onboard-LAN. In this respect, cadets can easily compare the real operation done by the master with simulated operation done by cadets in the simulation training. Therefore, utilization of combining onboard training with simulation training can be effective training for learners.

Taking the above into consideration, simulation training has superior advantages to the other practical training while it is used as remedial procedure training. Moreover, simulation training combined with onboard training makes it possible to improve the practical training effectively.

### 3.3 Ship-in-service and training vessel

Onboard training is divided into two: one is done by the training vessel and the other is ship-in-service. One of the advantages of onboard training done by the training vessel could be the applicable to uniform training to the greatest number of people. And another advantage is to be able to carry out time consuming training because the training schedule is based upon an educational point of view. For instance, anchoring operation training, which is ship manoeuvring training, can be done by the training vessel. This is because there are comparatively neither time constraints nor navigation route constraints. On the other hand, ship-in-service training could be
more practical training especially commercial training: such as cargo care and cargo handling. The schedule of ship-in-service is based on the trade schedule, in addition, recently seafarers’ work load become harder because of greater paper work for quality standard system and less time in port. Therefore, uniformity of standard training with cadets who are on board either other type of cargo vessel or other navigation route vessels, appropriate supervision of cadets’ training and also assessment for cadets’ abilities could be difficult to carry out without on board instructors.

For the combined training vessel with ship-in-service, as Mearsk Line does, Nippon Yusen Kaisha (NYK) has placed an order for four training vessels to Hyundai Heavy Industries Co. Ltd. The training vessels will include one LNG carrier and three container vessels each with the capacity to offer practical onboard training to 20 trainees will be launched soon. All four vessels will be designed specifically for training and include lecture rooms, in addition to accommodations for trainees, private instructors, and stewards. This will be first time in maritime history for new vessels to be introduced that will be capable of providing training of this type to so many potential candidates.

<table>
<thead>
<tr>
<th>Table 10: Eligible training for each practical training method</th>
</tr>
</thead>
<tbody>
<tr>
<td>laboratory</td>
</tr>
<tr>
<td>Difficult to execute training safely and environmental friendly</td>
</tr>
<tr>
<td>Simulation</td>
</tr>
<tr>
<td>Remedial procedure training</td>
</tr>
<tr>
<td>Ship-in-service</td>
</tr>
<tr>
<td>Commercial training</td>
</tr>
<tr>
<td>Training ship</td>
</tr>
<tr>
<td>Time consuming real training</td>
</tr>
</tbody>
</table>

As mentioned above, all practical training methods: laboratory, simulation, ship-in-service and training vessel training, have own remarkable advantages as shown in the Table 10. As regards way of learning and training, repetition is the important way of acquiring knowledge and skill; therefore, classification of eligible training in Table 10 should be covered with other training methods in order to provide better practical training.
Chapter 4: ADVANTAGES AND DISADVANTAGES OF TRAINING VESSEL

In the previous Chapter, a comparison of training vessels with other practical training methods was discussed. In contrast to the previous Chapter, this chapter will focus upon only the training vessel as a method of onboard training as well as the advantages and disadvantages of the training vessel.

4.1 Advantages of the training vessel as a method of onboard training

There are several advantages of the training vessel as a practical training method as follows:

- To deal with real remedial procedure training
- To allow cadets to commit real mistake
- To standardize education and training to many cadets at once

4.1.1 Real remedial procedure training

Currently thanks to advanced technology, it looks like anyone could manage ship operations under the normal conditions. Yet, human errors and any other unexpected events could lead to accidents or problem in the heavy weather. So seafarers are faced with some difficulties in solving the problem. Therefore, as a remedy in any
unexpected events, there needs to be a qualified seafarer. In order to foster competent seafarers, real training and sufficiently long training should be provided to cadets.

4.1.2 Committing real mistakes

As an example of real remedial procedure training is black out drills in training vessels. The black out drill is difficult to deal either by simulation or by ship-in-service. Black out, one of the worst situations on a vessel, means failure of electricity on the vessel. During the black out, emergency electricity will be supplied; nevertheless, only limited equipment: communications equipment and emergency lights can be used. The black out makes seafarers nervous until recovery from the abnormal condition. Such mental constraints can hardly be reproduced by simulators. Moreover, nobody is unwilling to carry out the black out drill in ship-in-service training because black out is not desirable condition for vessels. Generally, in order to avoid black out, there is an automatic remedial system in all ships. When black out happens, both dark and silence will prevail in the engine room although the engine room is the noisiest place in the vessel by means of machinery sounds and vibration.

A number of experiences of the black out makes it possible for seafarers to deal with this problems. The difference between an eligible seafarer or not is how to be able to deal with the problem adequately in an emergency situation even though the unexpected event has never been experienced. To accumulate real experience of remedial procedure could be one of the best ways of training to avoid catastrophes. Training on a training vessel allows cadets to commit real mistakes in comparison with other training method whereby the mistake is allowed or not. The mistake itself is not such a good experience for the person who made the mistake; however, as Baumeister, Bratslavsky, Finkenauer and Vohs (2001, p.323) indicate “the psychological effects of bad ones outweigh those of the good ones”, making mistakes by themselves and/or seeing others’ mistakes teaches cadets how they should behave in such a case. Cadets can learn a great many things from their own or others’ mistakes in particular by comparing with perfect performance.
4.1.3 Standardizing education and training

Afloat training facilities: the training vessel can carry plenty of cadets. Hence, standardization of education and training is easy to carry out by utilizing the training vessel. In the case that cadets come aboard vessel from more than two institutions, students have different knowledge levels; however, the unbalanced knowledge level can be revised through onboard training. Moreover, by utilizing the training vessel in foreign countries, international standardization of MET can be carried out.

As mentioned the above, the advantages of the training vessel are to deal with real remedial procedure and to allow cadets commit some type of mistakes. Moreover, in the case of limited usage, to standardize education and training toward a large number of cadets can be advantages of using training vessel.

4.2 Disadvantages of training vessel as a practical training method

There are some disadvantages of possessing training vessels for operators or owners. These disadvantages make people do away with the training vessel or replace the training vessel with simulation training.

4.2.1 Operating cost

One of the most prominent disadvantages of the training vessel is the vast operational costs. The NIST’s annual expenditure from April 2006 to March 2007 (National Institute for Sea Training, 2007) is shown in Figure 2, which was retrieved from the NIST’s Profit and Loss Statement in the fiscal year 2006 (Currency rate at the 30th March, 2007 is applied: $1=¥117). According to Figure 1, $12-million was spent on vessel operating costs for 5 training vessels. These costs consist of fuel cost, maintenance cost, food cost and others. Accordingly, the vessel operating costs are close to the capital cost of the California Maritime Academy’s brand new simulation
centre, which will house present bridge and radar simulators, two new bridge training facilities with 360-degree views, two small-vessel bridge simulators, gas turbine and liquid cargo simulators and an oil-spill/crisis management training centre.

Furthermore, the details of vessel operating costs are shown Figure 2. Annual fuel cost of the fiscal year 2006 of NIST is $4 million, which is half of the annual expenditure of World Maritime University (World Maritime University, 2006)
As can be seen above, operating costs for the training vessel can be a huge amount of expenditure; besides, the training vessel in most cases can never bring financial profit.

### 4.2.2 Human resources

From an educational point of view, in order to maintain safety conditions for cadets in a risky environment, a great number of onboard staff get on the vessel. In other words, a huge amount of labour cost is required. In case of NIST, to deal with more than 100 cadets, about 20 officers (8 nautical officers including the master, 8 engineering officers, 3 radio officers, and 1 Medical Doctor) and about 38 ratings are aboard on a training vessel although personnel arrangements are different between domestic voyages and international voyages. For instance, the medical doctor is required to be aboard only on international voyages. This is because one nurse is always on board and it is easy to access shore in emergency situations during domestic voyage.

### 4.2.3 Lack of commercial training

All training vessels except a few cases, such as the Shanghai Maritime University or the Jimei Maritime University, do not provide commercial training; nevertheless, commercial training is not internationally recognized standard training. The more quality service is improved in the maritime field, the more cargo care and cargo handling become important. For this reason, the schedule based upon educational point view is quite different from the one based upon a commercial point of view. Most cases of commercial training rely upon ship-in-service onboard training.

As mentioned above, the disadvantages of the training vessel are high operating costs, requiring a large number of staff and lack of commercial training.
Chapter 5: PROPOSAL OF OPTIMUM UTILISATION OF TRAINING VESSELS

Possessing a training vessel needs enormous capital to manage; however, the training vessel has several useful functions. When using the training vessel in an optimizing way, the outcome of utilizing the training vessel will be inestimable. In this section, the most optimum ways of using training vessels are focused upon from two aspects; one is from a physical point of view, i.e. optimum structures of training vessels, and the other is from an educational viewpoint, i.e. optimum arrangement of onboard training.

5.1 Optimum structure of training vessels

As far as an optimum structure of the training vessel is concerned, reducing fuel cost, getting financial support and/or contribution to the public are required as an additional option to training vessels. Taking these into consideration, 5 types of configuration of the training vessel are given in the following section. The first is sail powered vessel, the second is research activity vessel, the third is commercial activity training vessel, the fourth is practical training facilities, and the last is tool for international co-operation.
5.1.1 Sail powered vessels

By using sail powered vessels as a training vessel, saves fuel and gives a positive idea of maritime affairs. Fuel economy is a serious problem for the owner of the training vessel. Further, the diffusion of awareness of maritime affairs is an important issue in order to improve the negative image of the maritime field.

5.1.1.1 Fuel economy

Figure 3 shows that fuel consumption among different types of training vessels owned by NIST: NIPPON MARU (sail powered vessel), SEIUN MARU (motor vessel) and TAISEI MARU (steam turbine vessel). The fuel consumption includes both marine diesel oil and heavy fuel oil. As can be seen in Figure 4, in the year 2000 total fuel consumption of motor vessel is 3 times as much as sail powered vessel and consumption of steam turbine’s is 5 times more. In the year 2006 motor vessel fuel consumption is twice, and that of steam turbine is 4 times as much as that of sail powered vessel. The main reason of decrease fuel consumption for steam turbine and motor vessel in 2006 in comparison with in 2000 is the current steep price of fuel oil bringing about lower fuel consumption in motor and steam turbine vessel. Although steam turbine and motor vessel tried to reduce fuel consumption, sail powered vessel kept its fuel consumption. Hence, sail powered vessel always operates with optimum fuel consumptions.
Figure 3: Fuel consumption among different type of vessels

5.1.1.2 To attract young generation to maritime affairs

Wiping out the negative image of shipping is considered as one of the most important issues to tackle with the present shortage of seafarers. To promote awareness of maritime affairs, the NIST exhibits their training vessel to the public and also invited school children as their field trip or families to have a one day experience onboard. Furthermore, Man the Yard, which is the most respected gratitude done by sail powered vessel or Sail Drills, which is sail operation drill, contributes to attract young generation to maritime affairs.

Comparing exhibition vessels between sail powered vessels and other types of vessels, obviously sail powered vessels fascinate more people. Such exhibition has usually lasted for 6 hours in a day. Cadets have played important roles such as
guardians, announcers and guides, on such open public events. Based on the past data of *Nippon Maru* (sail powered vessel), *Seiun Maru* (motor vessel) and *Taisei Maru* (steam turbine vessel), a noticeable difference in the number of visitors depends upon the different types of training vessels. The maximum of 7,578 visitors had boarded on sail powered vessel while the maximum of 4,951 visitors had been fascinated to visit on motor vessel and so do 3,602 visitors on steam turbine vessel. The number of visitors could depend upon how much advertising has been done by the host port in advance; however, no matter how much sail powered vessel are advertised, they fascinate more than other types of vessels.

Not only does such exhibition fascinate a large number of people by the sail powered vessel but performances called Sail Drill or Man the Yard do as well. The Sail Drills is an extending and securing sail operation which includes climbing up the masts, moving the yards, extending and stowing sails operated by cadets. Only the time when completing the sail extension, the audience can see the most brilliant configuration of the sail powered vessel although ordinarily the vessel comes into port with bending sail.

With respect to the Man the Yard activity which is the most respected gratitude done by the sail powered vessel. Crews or cadets express their gratitude to the sending off or welcoming people with climbing up the mast and standing on the yard (sail beam) or the rope beneath the yard.

Like the above mentioned, only sail powered vessels have attractive performances to improve attraction young generation to maritime affaires. As far as the author’s experience is concerned, some cadets often mentioned that the sail powered vessel events, Sail Drill and/or Man the Yard made them aim at seafarers who are in demand because there is a shortage of seafarers.
From an educational point of view, as already mentioned in Chapter 2, distinct advantages of sail powered vessels, except saving fuel, are to cultivate social skills or seamanship easier; nevertheless, the knowledge and skills of the sail operation itself are not practically linked to the required one as a disadvantage. In this regard, the sail powered vessel is useful for the initial stage of onboard training. However, the saving fuel cost and the above described added value: fascinating events, of sail powered vessels can be recommended to be utilized as training facilities.

5.1.2 Utilization of training vessels for research activities

Some training vessels are utilized only for several months in a year. In case of Thailand, the training vessel Visudsakorn is utilized for 4.5 months per year and is alongside berth in the remaining periods. Vessels on the berth result in wasting operational costs because the following costs need to be paid:

- Charge for using berth
- Labour cost for duty watch
- Fuel cost for electricity when use own electricity system or charge for electricity when receive electricity from shore.

The Japanese training vessel Bousei Maru, the Polish training vessel Horyzont II and the Russian training vessel Nadezhda function as research vessels. Research activities contribute to educational benefits toward not only MET but also other institutes. Indeed, Bousei Maru is utilized as a tool for diffusion of awareness of maritime affairs through inviting children or youngsters to research activities. If vessels have inactive periods, like the above vessels, using vessels for research activities makes owner of vessels bring more benefits.
5.1.3 Commercially operated training vessel

Shanghai Maritime University uses a training vessel which is a commercially operated cargo vessel and Jimei Maritime University uses a container vessel as a training vessel. This arrangement helps in financial matters about operational cost of vessels although the training schedule in such cases depends upon trade schedule. It is an ideal training vessel arrangement because cadets can learn cargo handling and cargo care, which is one of the most important functions for seafarers as specified in the STCW 95 Convention.

Concerning Thailand, the Merchant Marine Training Centre (MMTC) utilizes training vessel *Visudsakorn*; however, with a view to improving quality of onboard training, a new training vessel, at the present not yet given a name (20th August, 2007), is going to be launched from MMTC on February 2008.

![Image of new training vessel in Thailand given by Bhothirungsi, T.](image)

The image of the Thai’s training vessel is given in Figure 4. As can be seen in Figure 4 the new training vessel can carry cargo containers: 24 TEU although the present training vessel cannot carry cargo. By applying carrying cargo training vessel, not only commercial training but also saving operational cost through trade can be improved by the new training vessel.
5.1.4 Practical training facilities

As described the purpose of the training vessel in this Chapter 2, like some institutions, the training vessel have several laboratory training facilities, which can be utilized. In the case of using the training vessels as laboratory equipment training, most cases of such training vessels are not utilized as one which engages in navigation. However, the training vessel which engages in navigation can be utilized as a mobile laboratory equipment training centre. The training vessel can provide more practical training with learners. Taking the launching life boat training as an example, there is difference in launching boat between from shore and from a floating vessel. Once there are waves, even a little, difficulties in launching the boat becomes larger. As a mobile laboratory training facility, training vessels are utilized by moving from one to another during inactive seasons.

5.1.5 The tool for the international co-operation

According to the International Labour Organization (ILO) R117: Vocational Training Recommendation (1962) Chapter 15 of International Co-operation 78, the following are described:

(1) Countries should co-operate in the field of training to the greatest extent possible and, where desired, with the help of international organisations; (2) Such co-operation should extend to such measure as making available training facilities to enable selected personnel from other countries, either on an exchange basis or otherwise, to acquire skill, knowledge and experience not available in their own countries.

Additionally, in accordance with Resolution 11 of STCW conference, 1995 “Promotion of Technical co-operation”, International Maritime Organization (IMO) also enhances technical co-operation among states.
Furthermore, in accordance with the report: OECD Project-the availability and the training of seafarers, “Additional co-operation must be encouraged between marine training establishments, seafarers and industry employers, including ship and equipment builders, to ensure that relevant training is provided for ship’s operation and shore employment and relevant, and up-to-date information, is provided to students”.(2003, p.74)

As a result of the above encouragement of international co-operation, recently a number of MET institutions are willing to accept foreign students as a studying abroad although a limited number of foreign students can get such opportunities because of financial constraints for transfer to foreign countries and limitation capacity for accommodations. However, the training vessel can be utilized as a means of international co-operation. The training vessel can be utilized as a mobile afloat-the training-facility with a view to the training not only cadets but also trainers. In this case, in contrast to studying abroad, all the students in certain MET institution can be placed on the training vessel for practical the training. The main purpose of international co-operation for education and the training is to standardize the level of education and the training in order to reduce the difference between various countries. In this respect, the training vessels can contribute internationally standardized education and the training through providing not only onboard the training but also laboratory the training.

5.2 Optimum arrangement of onboard training

When using a training vessel, taking not only financial points of view but also educational effects into account, training arrangements should be planned. In this section circumstances of renewal of the Thai’s training vessel and arrangements of using different types of training vessels in Japan are compared.
In conjunction with onboard training arrangements in Thailand, the MMTC utilizes the training vessel *Visudsakorn*, which is able to carry maximum 42 cadets, on one voyage with 15 days to the end of the study year from 1st to 3rd year students. Figure 5 shows the rearrangement of onboard training in Thailand. Accordingly, MMTC accepts cadets from other institutions; therefore, the training vessel *Visudsakorn* has been utilized by 540 cadets: about 180 cadets in each year, for 4.5 months with 9 times 15 days voyages per year, which is over capacity. MMTC deals with onboard training for about 180 cadets divided into several groups. Hence, MMTC can provide onboard training only 15 days with each group. With a view to improving onboard training arrangements, a new training vessel is currently under construction.

When using the new training vessel the periods of onboard training can be extended from 15 days to one or two months in a voyage because unlike the present situation, all 180 cadets in each year can be embarked in a voyage. Incidentally, up to this point in August 2007, it has not yet been decided how many months new training vessel will be used. This is because depending upon the operational costs they have, the operation period of the training vessel will be decided. According to Bhothirungsi, it has not been decided yet how to utilize the new training vessel during inactive seasons and how to deal with cargo from a financial point of view (Personal communication, Bhothirungsi, T. July 5, 2007).
Onboard training by present training vessel for 15 days

Onboard training by NEW training vessel

Onboard training by merchant vessel

Figure 5: Rearrangement of onboard training in MMTC,
Developed author from personal communication, Bhothirungsi, T. July 5, 2007
Table 11: Ships particulars of Thai’s Training Vessel

<table>
<thead>
<tr>
<th>Vessel</th>
<th>Present vessel</th>
<th>New vessel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date Start</td>
<td>03 May 1986</td>
<td>14 February 2008</td>
</tr>
<tr>
<td>LOA</td>
<td>61 m</td>
<td>90 m</td>
</tr>
<tr>
<td>Breadth</td>
<td>11 m</td>
<td>16.80 m</td>
</tr>
<tr>
<td>Draft</td>
<td>3.51 m</td>
<td>5.2 m</td>
</tr>
<tr>
<td>Tonnage</td>
<td>1089 GT</td>
<td>4200 GT</td>
</tr>
<tr>
<td>Main Engine</td>
<td>Diesel MAN B&amp;W GL 23/30, 810 KW</td>
<td>Diesel MAN B&amp;W 7L 32/40, 3500 KW</td>
</tr>
<tr>
<td>Max. Crew</td>
<td>26</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(20 instructors)</td>
</tr>
<tr>
<td>Max. Student</td>
<td>42</td>
<td>200</td>
</tr>
<tr>
<td>Max. speed</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>Cargo Capacity</td>
<td>-</td>
<td>24 TEU</td>
</tr>
</tbody>
</table>

Source: Personal communication Bhothirungsi, T. July 5, 2007

The ship particulars of the Thai’s new training vessel are given in Table 11. According to this table, the capacity of cadets in the new training vessel will increase up to 200. This is sufficient capacity for their cadets. To avoid separating groups to have an impartial onboard training could be provided with the same grade as in schools. This helps MMTC to have a uniform training opportunity. In addition, new training vessel can carry cargo. This makes it possible to deal with commercial training and to make profits. Focusing upon capacity for crew, in case of the new training vessel, by embarking instructors both operational and educational crews can concentrate on their own tasks. This improvement leads to safer operation.
Introducing the new training vessel can create the following benefits in MMTC in Thailand MET.

**Educational benefit**
- To carry out real cargo handling and cargo care training
- To extend period of onboard training
- To provide onboard training in a same condition

**Operational benefit**
- To make profit by carrying cargo
- To get safer operation by specializing crews with their tasks

Regarding Japan, NIST supplies onboard training with 5 vessels for 12 months. According to Japanese law for maritime officers, candidates from mercantile marine for nautical operational level certification should be on board sail powered vessels more than 5 months in total. In contrast to Thailand, Japanese cadets have no opportunity to train as an apprentice on board merchant vessels before getting certification. As can be seen in Figure 6, onboard training by sailing vessel is assigned in the end of the onboard training period for nautical cadets. The council for MET proposed that the training by sailing vessel should be moved from one end to the other. This is because the end of the onboard training period is just before joining shipping companies; therefore, the sail powered training vessel, which is the most different type of vessel from the merchant vessels, is not suitable at the final stage of onboard training. The council also proposed to provide an opportunity to learn commercial training with learners.
Figure 6: Onboard training schedule for Nautical University students

Figure 7 shows an example of onboard arrangements in *Nippon Maru* (sail powered vessel), *Seiun Maru* (motor vessel) and *Taisei Maru* (steam turbine vessel). As shown in Figure 7, since only university students have onboard training separately, the number indicates the year of the students in Figure 7. In contrast MMTC, each vessel of NIST is utilized almost the full year.
Figure 7: NIST training vessel arrangement in a year
5.2.1 One of the best ways of learning: Teach others

The learning pyramid which originates from the National Training Laboratories (NTL) in the USA for applied behavioural science is shown in Figure 8. The figure indicates that teaching others is one of the best ways of learning for the learner.

![Average learning retention rate](image)

**Figure 8: The Learning pyramid**

The idea of the “teaching others” can be seen in the fields of Medicine and MET in the USA. As can be seen in Table 12: Similarity between Maritime and Medicine, the education system in medicine has similarities with the maritime field, such as

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4 The learning pyramid originates from the National Training Laboratories (NTL) for Applied Behavioral Science, 300 N. Lee Street, Suite 300, Alexandria, VA 22314, USA. The percentages represent the average "retention rate" of information following teaching or activities by the method indicated. In fact this diagram was originally developed and used by NTL in the early 1960s at NTL's Bethel, Maine, campus, but the organisation no longer has or can find the original research that supports the numbers given. Retrieved from [http://www.bioscience.heacademy.ac.uk/journal/vol3/beej-3-5.htm](http://www.bioscience.heacademy.ac.uk/journal/vol3/beej-3-5.htm)
treatment immense properties or human life, huge knowledge, proficient skills, unacceptable commitment of mistakes, costly, and irregular duty time.

**Table 12: Similarity between Maritime and Medicine**

<table>
<thead>
<tr>
<th></th>
<th>Maritime</th>
<th>Medicine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unacceptable</td>
<td>Lose or damage of vast property, human life or</td>
<td>Lose or damage human life</td>
</tr>
<tr>
<td>commitment of</td>
<td>environment</td>
<td></td>
</tr>
<tr>
<td>mistakes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Necessity for</td>
<td>A huge knowledge and proficient skills</td>
<td>A huge knowledge and proficient skills</td>
</tr>
<tr>
<td>being specialist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluid working time</td>
<td>Leaving and arriving port, navigation in narrow</td>
<td>operation, emergency case</td>
</tr>
<tr>
<td></td>
<td>water, watchkeeping</td>
<td></td>
</tr>
<tr>
<td>Education expenses</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Complicated</td>
<td>Automation equipment</td>
<td>sophisticated Equipment</td>
</tr>
<tr>
<td>equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Practical training</td>
<td>12 month onboard training</td>
<td>Several years Intern or resident</td>
</tr>
</tbody>
</table>

In the case of the education system of Medicine in the USA, the resident system was established in the 1890s by Sir William Osler who has been referred to as the Father of Modern Medicine in the USA. He replaced the conventional teaching system: class room lecture, with bed side training. According to Cushing, Osler’s idea was the following:

> For the junior student in medicine and surgery it is a safe rule to have no teaching without a patient for a text, and the best teaching is that taught by the patient himself” and “We expect too much of the student and we try to teach him too much. Give him good methods and proper point of view, and all other things will be added, as his experience grows. (1946, pp.596-597)
In accordance with Romano (2004), the resident system required medical school graduates to continue their training by working side by side with experienced doctors and to live at the hospital while acquiring their skills. In order to hone their knowledge and skills, the senior residents play the role of supervisor to junior residents in their own training periods.

Just as the US medical system has senior residents supervise junior residents, so do the US maritime onboard training, which was noticed at the California Maritime University (CMA). The 3rd year students and 1st year students are embarked on the training vessel *Golden Bear* from April to July for their onboard training. During their training, senior and junior cadets respectively play their roles of officers and ratings in the training vessel. As a matter of course, instructors to mentor both senior and junior students are indispensable stakeholders in onboard training. The most distinguished feature of onboard training by training vessels allows cadets to commit more real mistakes under the appropriate supervision and/or mentor. Teaching is one of the best ways of learning because it is impossible to teach others without full understanding.

In this way of arrangement there is another advantaging point. Through junior cadets’ playing the role of ratings, they can understand the whole work in the vessel. As Gurbuz indicates (Personal communication, Gurbuz, C. April 26, 2007), some candidates for officers either nautical or engineering learn practical work only from the officer’s point of view through onboard training; nevertheless, officers should comprehend the whole work of seafarers. Therefore the role playing of ratings makes cadets understand the rating’s task.
5.2.2 Cadet-centered training

Conventionally, from a learner’s point of view, lectures or training have been carried out passively. Teachers or instructors lead their lectures or training by their pace. Here, cadet-centered training means not the passive training but the participatory training in which cadets take initiative under instructors’ supervision.

5.2.2.1 Background of the cadet-centered training in Japan

Upon completion of cadets’ study and training as candidates of seagoing officers and also passing the exam for certification, they can get 3rd grade: operational level certification. In the case of Japan, the sea area for navigation is divided into 4 by Japanese law of ship safety. Therefore, every grade certification (from 1st to 6th) gives limitation for not only ship’s size or the range of the main propulsion output but also navigation zone. As far as the area of the seagoing ship is concerned, the classification of navigation zone is divided into 3:

1. Zone 1: Within 20 miles from shore;
2. Zone 2: Surrounded area by East longitude from 094 to 174 and North latitude 63 to South latitude 11 excluding Zone 1, as shown Figure9; and
3. Zone 3: All excluding Zone 1 and 2.
Table 13: Limitations of Japanese certification

<table>
<thead>
<tr>
<th>Ship's Tonnage</th>
<th>Grade</th>
<th>Zone</th>
<th>Grade</th>
<th>Propulsion power (kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>unlimited</td>
<td>Master</td>
<td>1</td>
<td>Chief engineer</td>
<td>Unlimited</td>
</tr>
<tr>
<td>&lt; 5,000</td>
<td>Master</td>
<td>2</td>
<td>Chief engineer</td>
<td>&lt; 6,000</td>
</tr>
<tr>
<td>&gt;5,0000</td>
<td>Chief officer</td>
<td>2</td>
<td>1st engineer</td>
<td>&gt;6,0000</td>
</tr>
<tr>
<td>500&lt;1,600</td>
<td>Chief officer</td>
<td>3</td>
<td>1st engineer</td>
<td>1,500&lt;3,000</td>
</tr>
<tr>
<td>&gt;1,600</td>
<td>2nd Officer</td>
<td>3</td>
<td>2nd engineer</td>
<td>&gt;3,000</td>
</tr>
</tbody>
</table>

Source: Japanese law of maritime officers

Limitations of 3rd grade certification are given in Table 13. As can be seen in the above Figure and Table, depending upon the navigation zone, ship’s size and main propulsion machinery of propulsion power, a 3rd grade certification holder, for instance, can be a master or chief engineer on board any size of ship or output power vessel which is engaged in navigation within 20 miles away from shore such as domestic voyage in accordance with Japanese national law. In addition to the limitation of certification, there is no legislative system to take a re-education or re-training course by means of promotion to higher rank or certifications. Thus, NIST should provide practical training not only at the operational level but also at the management level with cadets.
5.2.2.2 Status quo of cadet-centered training

In NIST, cadet-centered watch keeping is carried out at the end of cadets’ onboard training. Usually cadets spend watchkeeping with officers; however, during the cadet-centered watchkeeping, they have to stand by themselves on the bridge or the engine control room. Duty on watch with officers is like a simulated duty on watchkeeping. Without the first 30 minutes and last 30 minutes, officers and ratings leave cadets alone on the training bridge or the engine control room.

In the engine department, there is maintenance training of 2 cycle long stroke diesel engines or 4 cycle medium speed diesel engines at the end of onboard training. Even this training was recently carried out by cadet-centered training. Ten years ago or more, cadets were able to engage in real work but not so important parts in the same maintenance training. Thus they had to keep away from real operations such as removing or inserting piston(s). However, recently engineer officers delegate not only easier tasks but also important or difficult tasks of maintenance to cadets as much as possible. This is not a standard way of training but most engineering officers in NIST accept cadet-centered maintenance training. In case of maintenance training for 4 cycle middle speed diesel engines, each group is allocated responsibilities for each cylinder. For instance, the work of removing the cylinder head or the piston is done on cadets’ initiative. Cadets can learn the real difficulties of execution, leadership and planning through cadet-centered operations. If this kind of maintenance training is carried out by cadet-centered training, it takes considerable time to complete training as well as to prepare for the work. This is because cadets are not familiar with complicated and dangerous tasks and also confirmation done by engineering officers or ratings sometimes one by one process of maintenance. It is difficult for the ship-in-service training to accept time consuming training under risky conditions.
5.2.3 Sandwich placement model in practical training

Like Thailand’s MET system, when both the training vessel and ship-in-service are utilized as onboard the training methods, the training vessel is always arranged in the initial stage of the onboard training period. This is because on the one hand, the training vessel is the most suitable practical the training method for fundamental training and ship-in-service training is more suitable for commercial training on the other hand. However, as far as cadet-centred training is concerned, the training vessel is on optimum training method and cadet-centred training should be carried out at the final stage. In this connection, optimum arrangement of the training vessel and ship-in-service could be as following:

![Figure 10: ideal onboard the training arrangement](image)

Figure 10 shows ideal onboard training arrangements. The training vessel is put on the initial and the final stages of onboard training, and ship-in-service should be at the point as close to the final stage as possible. In the higher level of education institutions, the sandwich placement model is accepted extensively especially in European or North American countries. As shown in Figure 10, the ideal arrangement of onboard the training seems to be the sandwich placement model. In order to provide autonomy training, the sandwich placement model between training vessel and ship-in-service should be arranged for optimum utilization of the training vessel. In the case of the relation between the simulation training and the training vessel, the sandwich placement model can be adopted. The simulation training is regarded as preview and review training for onboard training. Particularly the
emergency training by the simulation training is suitable for review training as the application training.

Taking this chapter into consideration, the following proposal makes it possible to optimum utilization of training vessels.

- Sail powered vessel
- Research activities
- Commercially operated training vessel
- Mobile laboratory equipment training facilities
- Tool for international co-operation facilities
- Practical training place for teaching to junior cadets
- Cadet-centred training
- Sandwich placement model for onboard training arrangement
Chapter 6: Conclusion

Dutch philosopher Spinoza described (1677) that:

So long as a person imagines that he or she cannot do this or that, so long as he or she is decided not to do it; and as a consequence so long as it is impossible to him or her that he or she should do it.

It seems that using the training vessel may be impossible for most MET institutions because of financial constraints. Indeed, the high operational costs are the serious disadvantages of the training vessels even if it is possible to make profit by carrying cargo, research activities or using the laboratory training facilities to others; however, the benefit of transfer by using the training vessel not only competency from instructors, teachers or senior seafarers to learners but also awareness of maritime affairs from maritime related people to ordinary people, is priceless in the long term.

Investment in the MET is seemingly a vast expenditure; however, the investment saves enormous expenditure. This is because to increase competent seafarers means to be able to minimize catastrophes in the long term. In this connection, the financial loss of the Exxon Valdez was $3.5 billion (Reason, 1997).

\(^5\) The original: So long as a man is affected by the image of anything, he will regard that thing as present, even thoug it be non-existent, he will not conceive it as past or future, except in so far as its image is joined to the image of time past or future. Wherefore the image of a thing, regarded in itself alone, is identical, whether it be referred to time past, time future, or time present; that is, the disposition or emotion of the body is identical, whether the image be of a thing past or future.
Undoubtedly the training vessels are a useful practical method for fostering qualified seafarers on account of the following advantages:

- To deal with real remedial procedure training
- To allow cadets to commit real mistakes

Furthermore, taking the following factors into consideration, optimum utilization of training vessels can be carry out.

- Mobile laboratory training facilities
- International co-operation as mobile training facilities
- Attraction of young generation to maritime affairs
- The practical places of teaching from senior to junior in order to hone their competency
- Cadet-centred training
- Sandwich placement model for practical training among the simulation the training, the ship-in-service and the training vessel
References


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Philip, B. G. & the Merriam-Webster editorial staff. *Webster’s third new international dictionary* (p.106 & 2424)


Reason, J. (1997) Table 10.2 the financial losses incurred by major events in the petrochemical industry: *Managing the risks of organizational accidents.* (p.237) Burlington, Ashgate publishing limited.


http://www.btinternet.com/~glyn Hughes/squashed/spinoza.htm


Appendix A

Pictures of some training vessels which NIST owns
## Appendix B

Technical specifications of NIPPON MARU, TAISEI MARU and SEIUN MARU

<table>
<thead>
<tr>
<th></th>
<th>NIPPON MARU</th>
<th>TAISEI MARU</th>
<th>SEIUN MARU</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of ship</strong></td>
<td>Sail powered vessel</td>
<td>Steam turbine vessel</td>
<td>Motor vessel</td>
</tr>
<tr>
<td><strong>Port registry</strong></td>
<td>Tokyo</td>
<td>Tokyo</td>
<td>Tokyo</td>
</tr>
<tr>
<td><strong>Date of built</strong></td>
<td>September 14, 1984</td>
<td>March 16, 1981</td>
<td>September 25, 1997</td>
</tr>
<tr>
<td><strong>Code of signal</strong></td>
<td>JFMC</td>
<td>JLPY</td>
<td>JLLY</td>
</tr>
<tr>
<td><strong>Loa (m)</strong></td>
<td>110.09</td>
<td>124.84</td>
<td>116.00</td>
</tr>
<tr>
<td><strong>Breadth (m)</strong></td>
<td>13.80</td>
<td>17.00</td>
<td>17.90</td>
</tr>
<tr>
<td><strong>Depth (m)</strong></td>
<td>10.73</td>
<td>10.52</td>
<td>17.90</td>
</tr>
<tr>
<td><strong>Gross Tonnage (ton)</strong></td>
<td>2,570</td>
<td>5,887</td>
<td>5,890</td>
</tr>
<tr>
<td><strong>Main engine</strong></td>
<td>DAIHATSU 4 cycle Diesel engine (2 sets) 2,206 kW (3,000 PS)</td>
<td>KAWASAKI HA - 70 Turbine engine (1 set) 5,148 kW (7,000 PS)</td>
<td>MITSUI - MAN B&amp;W 6L50MC 2 cycle Diesel engine (1 set ) 7,723 kW (10,500 PS)</td>
</tr>
<tr>
<td><strong>Fuel oil (m3)</strong></td>
<td>503</td>
<td>1,966</td>
<td>1,641</td>
</tr>
<tr>
<td><strong>Fresh water (m3)</strong></td>
<td>884</td>
<td>1,219</td>
<td>1,357</td>
</tr>
<tr>
<td><strong>Maximum / Sea speed (knot)</strong></td>
<td>14.33 / 14.20</td>
<td>19.22 / 17.9</td>
<td>21.0 / 19.5</td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>9,800 miles (18,150 km)</td>
<td>12,600 miles (23,335 km)</td>
<td>15,000 miles (27,780 km)</td>
</tr>
<tr>
<td><strong>Max No. Persons</strong></td>
<td>190</td>
<td>214</td>
<td>252</td>
</tr>
<tr>
<td><strong>Crew</strong></td>
<td>70</td>
<td>74</td>
<td>72</td>
</tr>
<tr>
<td><strong>Cadets</strong></td>
<td>120</td>
<td>140</td>
<td>180</td>
</tr>
</tbody>
</table>