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WORLD MARITIME UNIVERSITY

Dalian, China

**ANALYTICAL REVIEW OF MARITIME
EDUCATION AND TRAINING MODEL FOR
CHINESE SEAFARERS**

By

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The People's Republic of China

SD1540

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

MASTER OF SCIENCE

**(MARITIME SAFETY AND ENVIRONMENT
MANAGEMENT)**

2015

DECLARATION

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

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

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ABSTRACT

Title of Dissertation: **Analytical review of maritime education and training model for Chinese seafarers**

Degree: **MSc**

With the development of international shipping market, the international demand for senior seafarers is constantly expanding. Even influenced by economic crisis and continuous depression of shipping market in recent years, demand for senior seafarers is increasing instead of decreasing. Senior seafarers are in short supply despite a large total number of crew members available. China is a large shipping country with a large population and rich human resources. Facing the shortage of senior seafarers, China must study on crew training modes and enhance the international competitiveness to make a shift from a large shipping country to a powerful shipping country.

Beginning with the necessity of studying crew training, this paper reviews the history of maritime education in China, makes research on crew training modes in China and conducts comparative analysis between several crew training modes in developed shipping countries.

This paper concludes supply the and demand of seafarers from both domestic and international viewpoints, predicts labor market, puts forward the main factors influencing crew training, and gives suggestions on crew training mode in China.

Key Words: Seafarers; Training Mode; Demand of Seafarers; Maritime Education

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LIST OF ABBREVIATIONS

C/E	Chief Engineer
C/O	Chief Officer
COC	Certificate Of Competency
CBA	Computer Based Assessment
CBT	Computer Based Training
ECDIS	Electronic Chart Display and Information System
GMDSS	Global Maritime Distress and Safety System
GNP	Gross National Product
ISM	International Safety Management
IMO	International Maritime Organization
IBS	Integrated Bridge System
INS	Integrated Navigational System
LNG	Liquefied Natural Gas
MET	Maritime Education and Training
MSA	Maritime Safety Authority
MEPC	Marine Environment Protection Committee
MARPOL	International Convention for the Prevention of Pollution From. Ships, 1973 as modified by the Protocol of 1978
NGOs	Non-Governmental Organizations
PSC	Port State Control

R & D	Research and Development
STCW	Standard Training and Certification for Watchkeeping
SMS	Safety Management System
TEU	Twenty equivalent unit
UN	United Nations
UMS	Unmanned Machinery Space
VLCC	Very Large Crude Carrier

CHAPTER 1

INTRODUCTION

1.1 Research Background

Sea transportation is of importance for basic industries of national economy in China. Shipping industry has achieved remarkable achievement since the policy of reform and opening up was launched in China. Driven by the “two belts” strategies, China’s capital is trying to change the pattern of global trade and in the process of its promotion, infrastructure also gets huge profit. Ports and shipping enterprises will serve as pioneers in response to the national strategy of developing maritime industry (An, 2015). In the past few years under the influence of economic crisis, a slowdown in demand and excess in capacity has become the new normalcy, but this does not hinder the development of the shipping industry. China is independent to reform the marine transportation management system, to open international and domestic markets, and to implement the strategy of a combination of state-owned policy, collective policy and private policy. As a result, the shipping industry develops fast; the fleet scale is enlarged; the construction of port facilities is accelerated; the technical level is unceasingly enhanced; shipping power and shipping team are strengthened; the shipping policy, laws and regulations, management, and security system are perfected.

At present, China's shipping fleet capacity reaches 142 million tons, which is about 8% of the total capacity of sea fleet in the world. It ranks the fourth in the world and is 610 times as large as that of early days when China was founded. Our shipping system is formed by a large fleet of modern oil tanker, dry bulk carrier, container ship, liquefied gas ship, ro-ro ship and special transport fleet. Ports can provide 31,760 berths that are nearly 200 times more than that in the early days when China was founded. Port cargo throughput has amounted to 11.8 billion tons, which is 870 times as large as that of early days when China was founded. Ever since the reform and opening up, outbound cargo work throughput has increased by 57 times. Container ship throughput has reached 190 million TEU and has been No.1 in the world for 10 years. More than a decade ago, almost all ports in China were left out of the world's top 20. But up to now China has 30 ports with throughput of one hundred million tons, 22 ports with millions of TEU. Ports in China occupy 8 seats in top 10 of the world's port cargo throughput and container throughput respectively (Wang, 2014). China has been consecutively elected as Class A member in IMO for the 13th time. All of this has effectively guaranteed the transport of bulk cargo such as coal, food and building materials, the transport of major strategic resources like oil, ore, coal, steel, and various kinds of processed products and the import and export of all kinds of industrial and agricultural products, in the meantime it helps to increase China's international influence.

Seafarers as the main power of sea transport are the soul of the carriage of goods by sea and the key to preventing vessel pollution to protect the safety of goods. By the end of 2013, there had been more than 570,000 seafarers registered in China, responsible for 90% of foreign trade transportation in China. Shipping education takes on the task of cultivating marine personnel for the development of the shipping world and it has made great progress since the reform and opening up. At the same

time, it provides a large number of capable personnel to the cause of China's maritime transportation and makes a positive contribution. At present, with the development of world regional economic structure and international trade and advanced technology, current shipping education in China seems to be out of date, compared with the urgent need in international economy and the development of shipping industry both at home and abroad. Therefore, when developing strategy of developing the sea transport, there is also a need to accelerate the reform of updating crew training system.

Today's marine technology is quite different from that of decades ago. Nowadays all sorts of advanced technology in the navigation are gradually in common use, such as electronic chart, meteorological navigation, unmanned engine room, GMDSS, etc. But new technology fails to significantly reduce maritime accidents, though the reliability of the advanced technology is beyond doubt. In spite of the improvement of ship design and building, and enhanced security of ship due to advanced materials or technology, accidents at sea still occur. To its reason, human factor plays an important role. Human factor is the root of shipping safety, according to statistics, 80% of shipping accidents are caused by human factors to some degree. Therefore, in shipping business, crew quality is of vital importance for shipping safety and efficiency.

China has a large amount of crew members, which consists a large proportion in the international crew market. But Chinese seafarers are not quite demanded in the global seafarer market, and China is in lack of qualified crew members. In China, before getting to work, crew members should get vocational training to obtain working certificate. However, maritime training institutions, facilities, equipment, teachers and other basic conditions are uneven. The training quality is different, so

the quality of trained crew is also different. Certified maritime education and training institutions are able to cultivate qualified graduates specialized in navigation, who are able to do work at sea with comprehensive understanding of theory and actual exercise. Overall, China is lacking in high-quality personnel in the field of navigation. Construction of a team with sufficient crew members of good quality and reasonable structure can ensure the safety of navigation, prevention of pollution, and it also helps to make a shift from a country with a large number of seafarers to a country with powerful seafarers.

1.2 Objectives of research

In order to meet the need of all kinds of shipping personnel in domestic and international shipping markets and revitalize the shipping industry in China, to further improve the seafarers' training mode is particularly important. By analyzing the crew training mode of domestic maritime universities, namely training organizations, understanding the characteristics of training, learning their merits and shortcomings, this paper provides reference to crew training pattern in China. This research adopts the method of statistics analysis, quantitatively predicts relevant trends based on existing data and formula (Stern, 1988). This paper discusses the crew training mode in China, and finds out the shortcomings of crew training mode in training institutions to improve our training system and strengthen the understanding of crew training mode to ensure crew training quality (Wu et al, 2008).

CHAPTER 2

Current Development of Maritime Education in China

2.1 Development of Maritime Education in Modern China

Modern Chinese maritime education originated in late Qing Dynasty, the end of 19th century. The famous modern industrialist educator Sheng Xuanhuai, upholding the belief “self-strengthening firstly occurs in the reservoir, reservoir only promoted by education”, founded Nanyang public school in 1896. The school was affiliated to Mail Transfer Department in 1906. Because the Qing government was weak, being defeated for many times and signed a series of unequal treaties, China’s maritime rights, all the important trading ports and navigational regime, navigation, the customs and control of pilot-age were under foreign control. In 1909, the department planed to develop maritime trade, so the ship administration specialty was set up. Students should study in school for three years, and get on board for internship for one year. With maritime theories and practice as teaching principles, it has long effect until today. The opening of ship administration department initiated the modern Chinese higher maritime education.

In ship administration department, traditional patterns of the dictating syncretism

were followed, which made important contributions to the history of maritime education in China. In 1910, there were 517 registered ships over 20 tons and the total weight reached 114,815 tons (Cui & Yang, 2009). The development of shipping was in urgent need of a large number of senior officers, but the ship administration department was not able to meet the demand. From 1911, when the first batch of students was recruited, to 1946, China's maritime education experienced an amount of difficulties, such as closed by the government etc., but this did not hinder the development of China's maritime education. Since 1946, the national Wusong Merchant Maritime College was reopened in Shanghai. The college decided the training model that the first three years of study was completed in school, the following two years of internship was on board. After finishing the internship, students should participate in the graduation exam. Qualification of performance and certificate of graduation issued by the port administrative department could be obtained after passing the exam.

Since the 1950s, China begun to learn from the Soviet Union in training mode and the navigational training has been added into a number of basic courses. Training purpose was reset to cultivate shipping engineers and shipping power equipment engineer for at least five years, during which three years' internship was allocated such as on-board practice or workshop practice or cognition practice, production practice and graduation practice. Students in harbor superintendence administration departments should also attend the graduation report or graduation design defense work in addition to be involved in a number of specialized professional examinations. Students with qualified results could obtain graduation certificate as a second officer, second engineer issued by the harbor superintendence administration department (Xu, 2001). In the 1960s educational reform of "fewer but better" was put forward, so courses of navigational colleges were reduced, basic theory weakened and learning

years reduced to 4 years. Since the renovation of the college entrance examination in 1970s, the basic theory in teaching has been increasing. With the development of shipping industry and international trade, English communication skills and vessel operating management knowledge have become the focus of teaching reform. School year was set for four years, including a month of cognitive practice and a semester of graduation practice. Graduation diploma and degree of certificate shall be issued after graduation. After a year of experience at sea, students can get certificates of crew members directly from the harbor superintendence administration departments.

Chinese modern and contemporary maritime education is the extension of modern maritime education greatly and development. The healthy development of maritime education impacts a lot on the development of shipping industry in China. The development of Chinese maritime education stages are defined by different scholars. Professor Zhao-lin Wu in Dalian Maritime University divided maritime education into three stages (Zhang, 2012): the first stage (in the late 1980s and early 1990s), the main research content, which was separated from the general engineering education, was inherent regularity in maritime education itself, it created independent research field for maritime education and laid a solid theoretical foundation; the second stage (the 1990s), the main research content was whether the undergraduate education was education of degree or vocational education. Though there was no distinct result, it has realized various kinds of navigational education; the third stage (in the early 21st century), the main content was whether the maritime education was education of degree or vocational education. Multi-level and multi-type maritime education has gained recognition from experts and scholars. Another division is from the perspective of national development (Wu, 2010), two stages were divided: the first stage (1909 - the founding of new China), the main content was copying foreign navigation mode, but development was slow due to national disasters; the second

phase (after the founding of new China), China has gradually began to specify regulations and paved way for long-term development after the 21st century.

Though analyzed from different angles, different stages of nautical education are developed, but the specific evolution process is still the same. Maritime education in China experienced three times of closing and reopening (Wang & Wang, 2009), however, in early maritime education, great importance to theory and practice ability was attached, and the need of experienced teachers with qualifications had a deep influence on the development of maritime education in China.

2.2 Current Development of the Crew Training Mode in China

2.2.1 Training Objective

Training objective refers to the education purpose in the embodiment of school education agencies at various levels (Bao, 2007). It is decided by needs of a particular society and the specific social hierarchy. In order to meet the requirements of all walks of life, the various people at different ages, all kinds of schools are built. Schools at all levels should formulate their respective training objectives to complete their tasks and cultivate qualified personnel.

Institutions of higher navigation specialized teaching steering committee put forward in 1996 professional training objectives (undergraduate): “training personnel meeting the needs of the socialist modernization construction with the all-round development of morality, intelligence and physique, or providing basic training for engineers, in conformity with 1978 seafarers training, certification and the international conventions on standards on duty, meeting crew competency standards, qualified for modern ship management of the advanced navigation”. Training goal in junior

colleges is slightly lower, which provides preliminary training for engineer officers and other requirements are similar to undergraduates.

Professional training objectives issued by the national ministry of course specialty catalog and introduction in navigation major (undergraduate) are:

Navigation technology: provide professional training to adapt to needs of socialist marketing economic development. Train students with all-round development of morality, intelligence and physique to be equipped with knowledge of maritime navigation, shipping management and other aspects to work in all enterprises related to transportation and institutions engaged in maritime navigation and operation management, in accordance with international and national vessel crew competency standards. So the students can be qualified personnel to adapt to development of modern shipping industry. Length of schooling is 4 years and students are allowed to stay in school for 3-6 years. Students can be awarded bachelor's degree in engineering if complying with the regulations of degree awarding.

Marine engineering: Train students with the all-round development of morality, intelligence and physique to meet the needs of the socialist modernization construction and domestic economic development. Provide students with basic training to meet international and national vessel crew competency standards and train students to be equipped with knowledge and skills in marine engineering to work in all enterprises related to transportation and institutions engaged in maritime navigation and operation management. Length of schooling is 4 years and students are allowed to stay in school for 3-6 years. Students can be conferred bachelor's degree in engineering if complying with the regulations of degree awarding.

2.2.2 Education System and Current Management

Since the first navigational college was established, maritime education in China has developed unceasingly, and now a complicated educational system of vocational and technical education, specialized subject and undergraduate courses, master education and doctor education, etc is set up (Wen, 2012). By 2012, there were 107 national maritime education and training institutions, including 14 (14%) specialized navigational colleges, 25 (23%) vocational colleges, 28(26%) secondary vocational and secondary technical schools, 40 (37%) other crew training institutions which had contribute to the diversified development of maritime education and training institutions. With the development of the shipping market, scale of nautical education enrollment is expanding, though the economic crisis in 2008 has made negative influence on the size of seafarers education, on the whole, current growth trend is increasing.

Quantity of seafarers and scale of fleet in China rank highly in the world and play an irreplaceable role in the global shipping transportation which carries 85% - 85% of the external transportation and 4.8% of the total turnover of goods. Economic crisis in 2008 had big impact on the development of shipping market and the shipping market has been stagnant since. As a result, quantity of shipping order has decreased and the ship recycling market made profits. But now, national economy develops well and the shipping market is still prosperous as the international market gradually restores and constant regulation of macro policy in China enters into effect. After the reform and opening up policy, marketing economic system was established, national economy got great development and the shipping industry has played a more and more important role in promoting economic development. Rising of state-owned enterprises and fast development of small and medium-sized enterprises have

brought the shipping market with new change of structure. So the demand of crew quality goes higher and higher, especially with the development of world economic integration and China is more and more eager to get into international market. Therefore the traditional pattern of crew training is gradually not suitable to new rules.

With the improvement of shipping modernization and automation, the requirement of seafarers is higher and higher. Shortage of senior crew will affect the development of economy. Under the new economic situation, looking for new crew training mode is imperative. Due to the continued effects of the financial crisis, the world market is facing the difficulty that the number of ordinary crew and senior officers cannot adapt to the economic situation and the shortage is obvious, especially in the top-four management level. Crew competency is decreasing and the western developed countries are reducing the number of crew. So crew members in developing countries gradually account for most of the international crew output. Competition in domestic market is intense, the number of crew in low-level overpopulates and leads to confusion in the labor market. Some crew members reduce their wages in order to gain experiences at sea, which accelerates vicious competition (Zhou, 2013). But wages of chief officer show a trend of growth, therefore, reasonable construction of crew training mode, taking account of the labor market to cultivate qualified crew, is a pressing problem.

2.3 Main Crew Training Mode in Current China

2.3.1 Depending on Navigational Colleges

Initiate education and training to crew members before getting to work. Graduates from maritime colleges and universities account for the larger proportion of seafarers

in shipping enterprises in the labor market. Most navigational colleges are run by the government in a traditional way (Li & Qu, 2014). The government provides a large amount of money to guarantee teaching facilities in maritime colleges, such as simulator, practice and onboard teaching, etc.. Maritime colleges provide comprehensive knowledge, school learning activities as the basic theory and offer enough knowledge for the development of future work. In the process of learning at universities, the syllabus also includes practice which also lays a good foundation for the understanding of future work.

2.3.2 Training onboard

Onboard working pays special attention to time, and training onboard is the application of theoretical knowledge and transition from theory to practice. Training onboard is the inspection of competency and an inevitable part of an intern on the way to be a qualified seaman. Simulating in training school or training institutions still cannot effectively replace experience on board (Liu, 2004). International training attaches great importance to seafarers' training onboard, and it is recorded on the internship program and internship logbook, and there are specialists who are responsible for supervision and evaluation.

Maritime colleges and universities generally set a month of cognitive practice and graduation practice, completing the basic content of onboard training. Some training institutions and shipping companies cooperate on the training onboard. Due to the large number of students in college, training institutions lack specialized training facilities, so maritime colleges such as Dalian Maritime University and Shanghai Maritime University who have the economic strength to provide specialized teaching ships for students to complete training courses onboard. The effect of onboard

training is not desirable, firstly because of the lack of professional teaching content and syllable and the lack of effective teachers or professional senior crew responsible for students' learning.

According to teaching plans, students need to submit the internship report in accordance with the requirements. Some content of internship needs to be completed by shipping equipment, but due to the particularity of equipment, students should be under the supervision of teachers or specialized training personnel to use instruments, which greatly reduces the enthusiasm of students about operation onboard. On the other hand, training onboard lacks effective and objective evaluation, so training evaluation system onboard should be strengthened. The same problem also happens to training on ships provided by companies rather than the college itself. Shipping companies and schools cooperate to provide ship learning opportunities for students for free, but in fact some companies are not truly responsible. What even worse is that they regard students as cheap labor to do some work that has nothing to do with the navigation for its own profit. The lack of perfect supervision system provides opportunities for irresponsible company.

2.3.3 On-the-job Training on Land

Many large shipping companies take into account their needs in business development and take advantage of production in practice to invite professors from maritime colleges to provide special training to crew members, aiming at training seafarers for LNG, VLCC, chemical tanker, and special ships, etc. Enterprises can use its own training model to determine the scope and content of training, so specific training has more freedom. Shipping companies regulate the implementation of crew training through safety management system, and consider the implementation as an

important part of quality system audit. STCW 78/95 convention supplementary provisions article 1 and article 14 (the responsibility of the enterprise) regulate that the enterprise is responsible for crew training mechanism, and clearly require companies to ensure that each crew member is familiar with specific duties and responsibilities for related facilities and equipment. Training of crew members in-service of shipping company in China mainly concerns performance and promotion together with safety education before training. A few companies also provide training on ISM English and port state control and other relevant content.

2.3.4 Training on Crew for working on multi-nation ships

Crew manning has a narrow definition and also a broad definition. Crew manning in narrow sense refers to domestic shipping companies sending free crew to foreign companies in special regions, providing ship manipulation, control, management and various services in maritime transport (Filipowicz, 2004). In this paper crew manning refers to a narrow definition. China's crew manning market is controlled by two big enterprise camps: the first are member companies which are approved by the State Ministry of Commerce with labor management permits, such as COSCO, China shipping, Huayang Maritime and international companies around the world. The second are private, personal and foreign crew dispatching companies. Many departments in China participate in the management of dispatching seafarers, and labor service export is controlled by the Ministry of Commerce together with its subordinate coordination agencies. Coordination agencies are approved by the Ministry of Commerce and they are professional branches led by China International Contractors Association. They are voluntary, nonprofit and self-disciplined organizations approved by the government with right to manage labor services of seafarers in accordance with the law. According to the regulation of our government,

companies assigning seafarers should have a government approval of assigning sailors and join the coordination agencies to comply with the unified coordination and management.

In order to develop all kinds of maritime personnel to enhance competitive power in international shipping labor market, Ministry of Transport began to regulate and standardize management of crew assigned abroad in 1992. This method has its unique advantages in training crew of high quality and high ability. But its disadvantage is also obvious. Crew assigned abroad should comply with international convention and standards. Demand of seafarers who receive training is higher in the beginning, which limits the large-scale development of training.

CHAPTER 3

Current Development of the Crew Training Mode abroad

3.1 School Patterns

There are two patterns:

1. Run independently: the school recruits students and provides training to them, After graduation, students are free to choose jobs in the future or recommended by schools, which is similar to the domestic “two-way choose” in job seeking market.
2. Run by enterprises: shipping companies and maritime colleges and universities cooperate to run schools and jointly recruit students. Enterprises can also set up their own schools. Upon graduation; students should work for the company, which is similar to directional training in many parts of the country.

3.2 Management Model

Management system: navigational colleges are different from general institutions of higher education, which is mainly due to the particularity of sailing career. So the navigational colleges are generally established by a government agency because of their high educational costs, strict international standards and low return. Very few navigational colleges are private or in the folk. There are three main types of foreign management modes, namely, directly controlled by national transportation

departments, management of main and subsidiary and directly controlled by national Ministry of Education.

3.2.1 Directly Controlled by National Transportation Departments

Maritime colleges and universities in developed countries, such as Australia, the Philippines, Norway, Denmark, France, Russia and the United States, are directly controlled or mainly controlled by national transportation departments (Mu, 2013). Due to the particularity, history and special ties with shipping companies of maritime industry and special investments, some old and famous maritime colleges and universities in the developed world are directly controlled or mainly controlled by national transportation departments, such as Australian Maritime College, Russian Far East Maritime Institute and the United States Federal Maritime Institute, etc. maritime colleges and universities directly controlled by national transportation departments are for two reasons: on one hand seafarers and maritime transport are in a special environment of globalization; international conventions restrict maritime transport, marine pollution prevention, training and certification for crew on duty, etc. STCW convention set by IMO is mandatory. Seafarers not recognized by IMO can neither work on domestic vessels nor on international vessels. Because it is Departments of Transportation in IMO members that attend the meeting to discuss, it is reasonable for Departments of Transportation to fulfill the responsibility of national education and training for seafarers. On the other hand, it is expensive and time-consuming to cultivate qualified seafarers. In addition, seaman profession has the characteristics of liquidity, so the general institutions cannot meet the requirement of training funds and standard of international convention.

3.2.2 Management of Main and Subsidiary

National Ministry of Education regulates maritime colleges and universities according to standards of secondary or higher education. The state Department of Transportation makes standards for seafarers, education quality supervision in the form of investment in equipment of large-scale training. As the constant revision of international conventions, management of main and subsidiary appears to be slow in response and affects the development of shipping industry. A few countries use such management mode to establish state-owned, vocational education combined with degree education institutions, or set navigational departments within universities of science and technology, such as Kobe University of Mercantile Marine and Tokyo University of Mercantile Marine in Japan, Navigational Department in University of Science and Technology in German, Danny Academy of Mercantile Marine in Poland. In general, national departments of education are in main charge of management and the state department of transportation assists the departments of education. In recent years, national departments implementing this mode begin to seek new changes to overcome slow response to international conventions and establish vocational marine technology schools directly controlled by the departments of transportation. The most typical examples are Japanese Institute of Technology and Hamburg Maritime College in German, etc.

3.2.3 Directly Controlled by Chinese Ministry of Education

In some countries where shipping is not significant, there are no specialized navigational colleges. Instead they rely on polytechnic colleges and universities to train professional seafarers, which are controlled by ministry of education.

At present, the world maritime education and training education is divided into single

function, dual function and multi-intelligence type, as shown in table 3-1. Single function refers to training on senior officers with single function, namely deck crew or engine crew. Dual function refers to officers who can both work on the deck and in engine department. Multi-intelligence type refers to officers who can both work on the deck and in engine department, and also who can be engaged in the work of master or chief engineer.

Table 3-1 Foreign Maritime Education and Training System

Type of System	Country
Single function	Denmark Portugal Australia, Japan
Dual function	Holland
Multi-intelligence type	France

Source: (Chen, 2001)

3.3 Training Mode

World maritime colleges and universities are quite different in training mode due to different training target and method. On the whole it is divided into three patterns: consistent mode of training, sectional training mode and comprehensive training mode of navigation.

3.3.1 Consistent Mode of Training

Most modern countries generally adopt this kind of traditional education mode, such as the United States, Japan and Russia. Compared with other training modes, the advantage is the combination of degree education and vocational training, which is also known as double certificate education. After graduating from high school, students enter navigational colleges to study for three years to five years and a half.

During the period of learning, students should participate in internship onboard. The specific time of onboard training is different according to requirements of different countries. After graduation, students should participate in national competency test of senior officers or attend courses recognized by test authorities in school. Students can obtain graduation certificate and qualification certificate of senior crew members after passing the exams. After internship for a full year or a year and a half in shipping company, and meeting requirements of regulations, students can obtain competency certificates of duty officer or engineer. This kind of education mode, which is adopted by navigational colleges, is in line with national access mechanism of employment and suitable for standards of professional behavior in modern shipping enterprises.

3.3.2 Sectional Training Mode

Sectional training mode divides learning into three parts, namely, theoretical study - practice onboard - theoretical practice, which is a combination of theory and practice. Compared with consistent training mode, sectional training mode pays more attention to ability of practice. Typical representatives are the United Kingdom, Norway and Australia. After graduation from high school, students enter maritime colleges and universities to study professional knowledge for more than a year. Firstly they come to the comprehensive study of a sailor and engineman, and then it moves to professional knowledge about navigation and marine engineering, and participation in the internship onboard. There is a minimum time for internship regulated by the state, but students can decide their own learning time according to the actual situation. After about a year of training onboard, students can obtain qualifications at sea. After these two steps, students can go back to school to complete the studies for vocational qualification certificate of senior officers.

3.3.3 Comprehensive Training Mode of Navigation

Comprehensive training mode of navigation belongs to advanced maritime education in modern time which puts higher requirements of hardware and software facilities for maritime colleges and universities or training organizations. It is time-consuming and expensive to train a qualified seafarer. Today only a few developed countries adopt this training mode, such as the Netherlands, and few maritime colleges and universities in France, the United States, Japan and Germany. The distinctive feature of this model is that students trained can meet the requirements of a deck officer and also be qualified for engine department, which demonstrates the full combination of marine navigation and marine engineering. So it is difficult to practice in reality, as it takes at least four years to finish one stage of internship in France, and it needs more time in the Netherlands. The aim is to cultivate practical personnel who understand both navigation technology and marine engineering. So such graduates have strong adaptability, and are particularly suitable for requirements of development of shipping automation.

These three models are in common based on the fact that the work of seafarers requires solid professional knowledge. So maritime education regards practice training as an important teaching content to ensure that students have enough ability to be competent in this area. On the other hand, with the development of science and technology in recent years, importance is given to marine simulator, so maritime colleges and universities are paying attention to the introduction and use of marine simulator. Simulator training as an important teaching method can make up for deficiency in practice training, because it costs less, has good effect and students can gain solid practical experience. Simulator teaching is widely used as one of the important means of competency assessment. Some developed countries have already

considered using simulator for substitute of part of internship onboard, which demonstrates popularity of simulator in teaching.

Table 3-2 Comparison between Training Modes

	Education of Degree		
	Consistent Mode of Training	Sectional Training Mode	Comprehensive Training Mode of Navigation
China	☆☆☆		
America	☆☆☆		
Japan	☆☆☆		
Philippines	☆☆	☆☆	
India	☆☆	☆☆	
France			☆☆☆
England		☆☆☆	
Netherlands			☆☆☆
German	☆☆		☆☆
Denmark		☆☆☆	
Egypt	☆☆☆		
Poland	☆☆☆	☆	
Australia		☆☆☆	
Russia	☆☆☆		
Malaysia	☆	☆☆☆	

☆☆☆☆= high ☆☆☆=moderate ☆=few

Source: (Gao & Xu,1999).

3.4 Training Modes in Foreign Countries

(1) Philippine crew training mode

The Philippines takes the leading position in international market of crew export. Statistics from senior, general and non-technical output of seafarers demonstrate

that senior crew in the Philippines saw a sharp growth; non-technical crew showed a slightly upward trend, while ordinary seafarers fell slightly. This suggests that the Philippine crew training mode can adapt to international crew training mode, and the changing trend of crew number is in accordance with the increasing demand for senior seafarers of international market.

To improve the quality of training and reach international standard, Council for Higher Education in the Philippines exercises the power of government agencies to establish national maritime education system. In addition, the council improves and adds text books including basic safety courses which are set up for the first time (fire prevention and fire extinguishing, basic first aid, personal survival skills, personal security and social responsibility). Moreover, the council also requires training institutions to increase basic equipment and facilities for the courses. In terms of field training, training institutions without proper facilities can ask the training center to sign an operating agreement to ensure normal practice. The council uses GMDSS and RADAR simulators to train deck officers and use boiler and turbine simulators to train marine engineers.

Representative training mode in the Philippines is the mode in Asia-Pacific Maritime College, which is supervised and managed by Philippine Crew Guild. Asia-Pacific Maritime College is for under graduates with four years of schooling. Students in their junior year should get onboard for internship on the ship owned by the college. The normal training mode is directional cultivation to provide crew for cooperative enterprises. After graduation, students go to work in relevant enterprises for 5 years and then they are free to choose to stay in the company or not. The company can also decide whether the students can stay or not in this two-way selection mechanism.

(2) Indian crew training mode

India is also a large country in seafaring output with good training quality. Compared with China, India has the advantage of English, so Indian seafarers are welcomed in the international market. To promote the development of crew education, merchant education and research center was established since 1992, which consists of three branches: Indian National Shipowners Association on behalf of Indian shipowner; Association of Shipowners and Ship Agencies on behalf of the foreign shipowners and ship agencies; Foreign Association of Shipowners and Ship Agencies on behalf of the foreign shipowners and ship agencies. Indian Department of Transportation (Ground) issued India Liberalization Guide in 1997 to encourage private training department. Liberalization and open policy require crew training for private schools, which is the same as public schools, but the examination and certification shall be conducted by the governmental department in charge of shipping.

Indian maritime education and training system consist of three parts, namely degree education in navigation, vocational education and on-the-job training. All students receive three stages of maritime education and training: education and training before getting onboard, training onboard, training and education after getting onboard.

(3) Japanese crew training

Japan lacks natural resources and in need of importing a large amount of energy and materials, etc. Japan is also one of the 11 countries heavily relying on shipping country (Wang, 2009), so it also attaches great importance to the development of domestic shipping, especially crew training, as the main principal shipping. Now Japanese maritime education and training institutions are roughly consist of:

seafarers' schools, merchant college, university of merchant ship, navigational training institutions and other maritime colleges (university of fisheries, private university, etc.). Seafarers' schools are similar to secondary technical schools in China; merchant colleges are similar to technical schools in China; university of merchant ship are similar to maritime universities in China; universities of fisheries to cultivate deck officers and engineers on fishing boat are similar to universities of fisheries in China. Some private universities have similar navigational majors, but students are relatively less.

Japanese higher maritime education system is mainly composed of merchant universities and merchant colleges. Students in merchant university (college) are recruited by passing exams after graduating from high school (middle school). After 4 years and 6 months in school (5 years and 6 months), students can graduate when their results are qualified, but they do not have a certificate of crew at this time. Crew competency certificate can be obtained after mandatory training for 12 months organized by maritime education institutions and passing national examination to obtain corresponding certificates. Certificates are issued for the second mate, third mate, the third engineer and the fourth engineer. Certificate of Master or chief engineer can be further obtained by passing additional national examinations, but the training is not mandatory.

Training in Kawasaki, a Japanese company, includes three parts. The first is the security rights system. Manager in shipping department should conduct training on the master and chief engineer according to the safety management manual "crew training program"; crew affairs department should introduce the vessel to new senior crew members onboard; the captain should conduct training on new crew members about safety management system and keep records. Then it is about

education onboard, arrange three months of on-board training plan for new officers, including watch-keeping and actual operation. Finally it is about education on land, conduct training on the new captain at company headquarters for two days, including basic knowledge of the master, accident prevention, etc., and conduct training on other senior crew members for two days including navigation control, goods management, accident prevention and insurance claims, etc.

(4) South Korean crew training

Maritime education and crew training institutions in South Korea are divided into two kinds: one kind is about aquaculture, including Busan Fisheries University, Jeju National University, Lishui Fisheries University, Kunsan Fisheries University, Posco Aquatic Institutions of Higher Education, etc.; another kind is merchant universities, mainly South Korea Ocean University and Mokpo National Maritime University. Compared with similar foreign colleges, crew training institutions in South Korea has been developing rapidly and they used to export a large number of seafarers to developed countries. With the development of economy of South Korean, a number of people consider crew work to be hard and the income gap between work onboard and on land is narrowing, so seaman profession is losing its attraction. Even so, South Korea still has a wealth of experience in training high quality crew members, and training institutions have better teaching facilities, training textbooks and teachers. South Korea is strict with certification system, quality system, and training evaluation system, etc. South Korea makes its own regulation according to the requirements of ISO 9000 and STCW convention concerning the training of seafarers as a general rule, and then training institutions can set its own corresponding provisions according to national rules to get approval of government.

Training institutions in South Korea cannot issue a certificate of competency directly to the seafarer; they only undertake the training and provide assessment results to governmental departments. Government departments shall issue certificate of competency to seafarers after reviewing the assessment results submitted by training institutions. The work of governmental departments mainly concerns monitoring training institution to complete training in accordance with the procedures under quality guarantee system.

(5) crew training in Singapore

Singapore is in the junction of Indian Ocean and the Pacific, at the entrance of the Strait of Malacca; it is also a key hub of sea transportation. After years of development, Singapore has become the world's second-largest shipping center. Maritime education in Singapore mainly concerns vocational education (Zhao, 2009), focuses on actual operation, and adopts the mode of university-enterprise cooperation. Bachelor Degree is not given to students majoring in navigation, but a diploma of graduation. There is no fixed recruiting plan for Singapore maritime college. It depends on the number of students taking the entrance examinations, which is mainly because few young people in Singapore choose navigation major. So, navigational colleges cooperate with major shipping companies to maintain stable students in a sponsored mode. Famous companies such as Maersk Line and Neptune Orient Lines recruit some interns each year and then send them to study in Singapore Polytechnic. Some areas in China also have this kind of training mode where the company sponsors schools for orientation training. For instance, Dalian Maritime University in China once cooperated with Maersk Line and Singapore Polytechnic to cultivate a batch of high quality crew.

Navigation technology in Singapore, for example, divides its courses into three

years and three stages. In the first year, students get basic training before getting onboard and professional introduction. In the second year, students should work onboard for 12 months for internship. Internship time should meet requirements of Maritime Safety Administration of Singapore not only to meet requirements of tests of Maritime Safety Administration but to ensure the ability of actual operation of students. It allows students to be qualified in age to attend the test, so that students can immediately work onboard after graduation. For students sponsored by companies, internship is directly arranged by the company on its own fleet; for students without sponsorship, they should contact the company for internship opportunities under the help of colleges. The third stage is to strengthen professional theory with more courses that are more difficult. At this stage, professors will have further discussion with students who have internship experience combined with their own working experience in the ship. Teaching emphasizes on actual operation and involves international conventions and regulations. The teaching process also uses marine simulator to conduct simulation, which is an important item in the evaluation of Maritime Safety Administration, the purpose is to improve students' ability of practice.

After the courses, students should attend the exam and assessment. Qualified students can obtain certificate of diploma. Because competency certificate of Maritime Safety Administration requires more than certificate of diploma, Maritime Safety Administration makes arrangements in daily teaching.

Marine engineering is also divided into three stages with the second phase of internship onboard for one year. Courses of marine engineering are designed to focus on practice, so many workshops and simulators of main engines and auxiliary engines are added into Singapore Maritime College besides regular teaching

facilities. Most courses of marine engineering are completed in workshops and laboratories, which pay more attention to the improvement of operational ability.

(6) Sri Lanka (Wang, 2009)

Sri Lanka has strength in crew training with advanced training equipment. There are two modern training organizations dedicated to improving quality of crew training, namely, Colombo International Institute of Marine Engineering and crew training institutions, which are able to complete all kinds of required training. Colombo International Institute of Marine Engineering is the largest maritime education and training institution approved by the government in Sri Lanka to provide good and short-term training. All courses set by this institute are in line with international standards of STCW 78/95 convention. This training institution has most of the supporting facilities for internship, such as plants and laboratories. Factories for internship are equipped with lathes, milling machines, shaping machines, drilling machines and other related devices to achieve comprehensive training. This institute accepts a number of foreign students every year, which demonstrates its educational power. Courses such as basic survival at sea, proficiency in lifeboat and rescue boat are instructed by the captain and experienced professors. All courses of fire extinguishing at sea are delivered by the captain, marine engineers and qualified teachers in airport and airline fire services department. In addition, fire fighting training simulators is also equipped. Trainees use separate respirator in a moving, closed and dark room, which is full of smoke to complete simulated training. Crew training institution is a representative of private training institutions in Sri Lanka, which is committed to training for shipping enterprise including training on land and practical training at sea.

(7) Norway

Norway has a wealth of experience in terms of crew training and it has a mature training system. Training system includes training before getting onboard: crew members should pass the assessment test, training plan after assessment, Refresher Course relevant to company policies and special shipping procedures, including safety management system. And then it is about training onboard: crew members should be familiar with the training. Training begins while working in a CBT (Computer -based Training) way. Keep training records and the instructor should give feedback. Finally it is training after getting onboard: the company assesses the program, makes proposal about promotion and provides training courses needed next time before getting onboard (simulator, bridge resource management, manufacturer's training courses).

Here are two ways of maritime education in Norway (delegation of maritime education from Department of Transport, 2002). The first kind is 10 years' elementary education, followed by 3 years' study in navigational high schools, and then further followed by education in navigational college (a total of four colleges) for three years. After graduation, students go to work at sea and obtain certificate of competency when meeting requirements of practice. After 3 years' college study, students can also go to universities for further study. The second way is that after 10 years' elementary education, students go to study in the secondary vocational school for four years, and then enter a navigational institute of technology. There are 17 such navigational institutes altogether, with learning time for two years. Certificate of operation can be obtained by service at sea for one year after graduation. Shipowners Association is responsible for practice at sea in Norway with special method of practice training system. For students receiving secondary vocational education, a 2 + 2 + 2 "sandwich" teaching system is adopted, with theory teaching for two years and training onboard for 2 years, then students should return on land to

have a 2 years' study in one of the 17 maritime vocational colleges to obtain qualification of a senior crew member.

(8) American crew training mode

The US government attaches great importance to training of shipping personnel. The position of nautical education is guaranteed by legislation in the United States. In addition, the government provides financial support to infrastructure in maritime schools. Navigational major has a smaller scale, mainly concerning nautical science, marine engineering, shipping logistics, and ship management. The US adopts a policy of the combination of degree education and vocational education, which greatly increases employment opportunity for graduates when they are back to shore. In terms of curriculum reform, importance is attached to management. Vocational education, cutting-edge technology education and leadership management education are combined. Because nautical education pays attention to practice, the U.S. maritime education moderately stresses the importance of the practice, as a result, experimental courses and practice take a large proportion of school hours. Courses attach great importance to laboratory study and practical operation and they also combine theory teaching with practice teaching. At the same time, small vessels are equipped for internship to ensure that students majoring in navigation can get internship onboard, so as to guarantee the quality of learning to the greatest extent.

American Merchant College affiliated to the US government is a typical example, which has cultivated a large number of high-quality personnel in the field of navigation and national defense, so as to greatly increase the American power at sea and in national defense. This college has also been confirmed as permanent college, and students can obtain a bachelor's degree after graduation. Courses are set on the basis of practice education. So much learning time is assigned to internship at sea.

Practice internship lasts for 18 weeks, theoretical study for 38 weeks, internships on land for 2-6 weeks. Theoretical study is similar to that of China, mainly including navigation, seamanship, cargo work, electronic navigation, ship structure and stability, and maritime laws. All of these courses have enhanced the understanding of work onboard so that students can have a clear understanding of their future job.

(9) Canadian crew training mode

Take College of Fisheries and Oceans in Saint Johns for an example. This college undertakes certificate training on undergraduates, graduates, senior crew members, technicians, mechanics and other kinds of training. School year is 4 years for navigational major, graduation internship for 15 months and cognitive internship for two months which demonstrates that practice internship takes a large proportion in the teaching plan. The course plan is flexible and teachers pay more attention to students' daily performance that accounts for half of the final assessment. Flexible courses give full play to the teachers so that teachers can have a better communication with students about their knowledge and work experience at sea. In this way, thought patterns are developed in students, and students are trained to cope with emergency situations that would occur in the future. Teachers have a wealth of experience in the college and elementary courses are delivered by captains and chief engineers with rich experience.

(10) Australian crew education (Liu, 2013)

There are mainly three colleges engaged in maritime education in Australia, while Australian Maritime College represents the highest level of education and it is also the only public school engaged in maritime education and training. Courses in Australian Maritime College are similar to that of China, which are based on the requirements of Manila Amendments of STCW Convention. Courses are divided

into two stages. Taking courses of duty officer as an example, the first stage is about basic training before getting onboard, including proficiency in emergency rescue, fire fighting, and lifeboat, etc. Training at this stage is the same as training for four certificates in China. After training at the first stage, students should get onboard for internship for 18 months. The second stage is mainly about theoretical study.

3.5 Comparative Analysis and Model Analysis of Crew Training Modes at Home and abroad

Maritime education has made great progress in China after years of development. Compared with developed countries, China has both advantages and disadvantages. At present, most countries in the world adopt consistent mode and sectional mode of training, but developed countries such as France and the Netherlands are building and developing comprehensive training mode of navigation. With the development of science and technology and intellectualization and modernization of navigation, comprehensive training mode of navigation will be a necessary trend of development. Of course, comprehensive training mode of navigation involves many aspects of reform, for instance, the teaching plan and syllabus, etc. need to be reformulated and adjusted; the training time may also need corresponding change, which conflicts with the current teaching system. Teaching facilities need to be updated according to new syllabus. Attention should be paid to the development and utilization of marine simulators, international standards on the simulator and future employment after graduation, etc. (IMO, 1997).

Comprehensive training mode of navigation will raise the cost of maritime education, which puts forward the higher request for the existing system. In order to guarantee the development of maritime education in China and keep up with the trend of world, relevant departments should ask port and shipping enterprises to participate in the

changes of crew training mode besides providing support in policy to contribute to the development of shipping industry in China. We can introduce experience of developed countries to establish a mode of cooperation in running schools, involving the government, schools, and enterprises, to share the responsibility of crew training, reduce the risk of reform and overcome difficulties in shortage of fund, limitation of teaching faculties and hardship in job-hunting.

Table 3-3 Comparison between Maritime Education at Home and Abroad (Liu, 2004)

Country	School year	Issue of certificate of competency
Germany	4 years, including training onboard for 12 months(6 months in the first and third year)	Graduates do not need to attend test to get certificate of competency on duty.
Holland	4 years, including training onboard for 12 months(the third year)	Certificate of competency can be obtained after 3 years at school; certificate of Master can be obtained after the fourth year (no test is required)
Sweden	4 years, including training onboard for 16 months(4 months each year)	Graduates do not need to attend test to get certificate of competency on duty.
United Kingdom	4 years, including training onboard for 12 months(the third year)	Certificate of competency on duty can be obtained after oral tests
India	3 years, including training onboard for 3 months(the	Students with degree should receive training for 12 months and attend a oral

	second year)	test to get certificate of competency on duty
China	4 years, including training onboard for 6 months(the fourth year)	Certificate of competency on duty can be obtained after attending operational assessment and theoretical tests when graduate

Source: (Hu & Xia, 2010)

Foreign crew training system, especially the crew training system of shipping enterprises, reflects the human oriented concept of crew training, highly concerns human factors, and regards crew training as part of culture in shipping enterprises. Many training institutions also focus on innovative ability, strain capacity, management ability, competency ability, language communication ability and application of new technology in the process of crew training, in addition to basic vocational skills. Foreign training is flexible and rich in content which meets the requirements of international shipowners on transformation of new technology, strain ability and innovative ability, all of these factors increase competitiveness of crew members in international labor market. Furthermore, foreign training also emphasizes on safety training according to requirements of conventions, rules, and industrial norms, which also shows the human-oriented management concept of shipping companies. Foreign crew training is not only confined to teaching activities, continuous training and update also occur in daily work, which greatly promotes the study and experience accumulation of crew members. Foreign comprehensive training with multi-level and multi-channel characteristics, together with its incorporated human oriented concept, provides reference for current crew training in China. Chinese crew members have great potential in international labor market. Foreign shipowners have shown a trend to turn to Chinese market to cultivate senior officers meeting their requirements, with the help of advantageous resources in China. Therefore, China should also take this opportunity to expand the international market of crew members and explore innovative crew education and training mode.

CHAPTER 4

Demand Forecast of Senior Officers in China

4.1 Supply and Demand for World seafarers

The number of senior officers has seen a gradual decline in developed countries due to various factors, so shipping companies have to recruit crew members from developing countries, especially some Asian countries (Silos et al, 2012). According to human resources report of international crew released by BIMCO/ISF in 2000, although OECD countries (North America, Western Europe, Japan and etc.) are still the main sources of senior officers, the number of primary deck officers and engineers has fallen by 4% compared with that in 1995-2000 (Shipping Statistics Year Book 2000, 2001). The number of senior officers in the far east is closely after that of OECD countries, followed by some countries in eastern Europe. It shows that the center of crew supply is gradually moving from traditional crew suppliers (Europe, Japan and North America) to Asia, which brings opportunity for crew export in China.

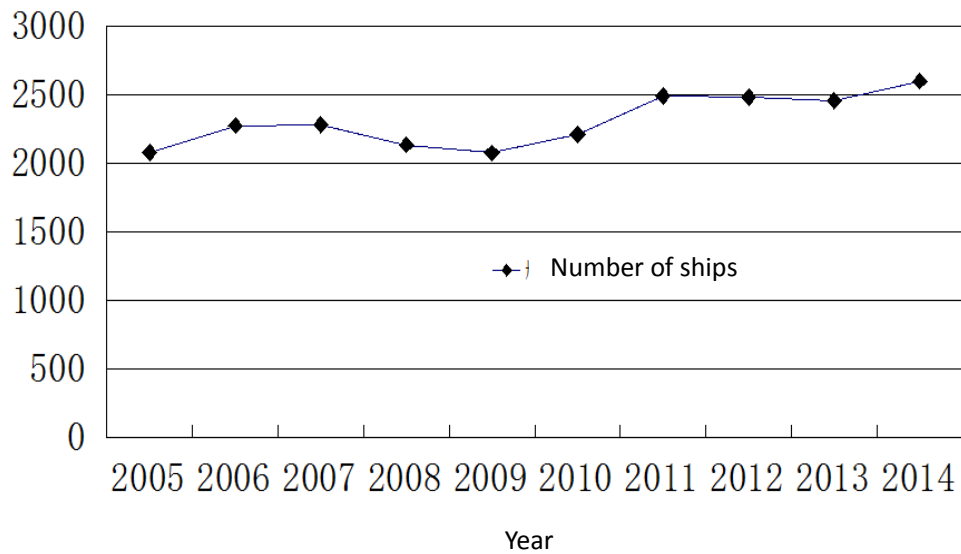
Almost all the statistics from authorities of labor exporting countries show that members in Organization for Economic Cooperation and Development (OECD) are the main countries in demand of senior officers, but countries in the far east have also increased their demand of seafarers and the latter are main countries in need of ordinary crew. Under full consideration of the scale, tonnage and changes of vessel types of merchant fleet for transport in the world and under reassessment of the

proportion of seafarers who can be competent in different countries, it shows that senior officers in merchant fleet are still in short supply and ordinary crew still has a large number of surplus, though how many people in this large fleet can be qualified for international labor export is not sure (Brewer, 2001).

Accompanied by increasing job-hopping of senior crew, the enrollment of senior crew students is expanding. At the same time, the growth rate of ship ownership in the world is only 1%. According to requirement, old vessels equipped with senior officers are gradually being abandoned, so additional demand for senior crew is not as large as predicted in previous years. In fact, differences in culture and language, lack of experience of assignment abroad and some restriction of the flag state become barriers for seafarers to go abroad for supplement. So some countries have surplus of seafarers. Taking these obstacles into consideration, the estimated number of shortage of senior crew will be far larger than the original number (Ruggunan, 2011).

4.2 Developing Trend of Merchant Fleet in China

The development of merchant ships (300 gross ton and above) of recent 10 years in China is shown in the graph. There is a rise in general but there are also slight fluctuations. 2009 saw the sharpest decline which had something to do with the downturn of international shipping market. But it has kept slow growth in recent years (Li & Lian, 2012).



Source: Development statistics of road and water transportation in China

Figure 4-1 Development of Merchant Fleet in China

4.3 Prediction of Development of Merchant Fleet in China

Over the past decade, the development of Chinese fleet has seen a smooth trend in general, so exponent smoothness method is used to make prediction, the formula is:

$$F_{t+m} = at + bt \quad m$$

$$A_t = 2 S_t' - S_t''$$

$$b_t = (S_t' - S_t'')$$

$$S_t' = \alpha X_t + (1-\alpha) S_{t-1}'$$

$$S_t'' = \alpha S_t' + (1-\alpha) S_{t-1}''$$

In the formula: F_{t+m} is m forecast in advance;

X_t is observation value at t stage;

S_t' is the first exponential smoothing value at t stage;

S_t'' is the second exponential smoothing value at t stage.

$S_0' - S_0'' =$ as a result $S_0' = S_0'' = 2215$

Table 4-1 Data of Merchant Fleet in China for 10 years

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Amount	2082	2278	2284	2137	2079	2213	2494	2486	2457	2603

According to table 4-1, there is a rise in general but there are also slight fluctuations, so $\alpha=0.8$, computation sheet is made by prediction formula:

Table 4-2 Computation of the secondary exponential smoothing method

Year	t	X_t	$S t'$	$S t''$	a	b	F_{t+m}
2005	1	2082	2019	2130	2088	-84	
2006	2	2278	2244	2221	2267	92	2004
2007	3	2284	2276	2265	2287	44	2359
2008	4	2137	2165	2185	2145	-80	2331
2009	5	2079	2096	2114	2078	-72	2065
2010	6	2213	2190	2175	2205	60	2006
2011	7	2494	2433	2381	2485	208	2265
2012	8	2486	2475	2456	2494	76	2693
2013	9	2457	2461	2460	2462	4	2570
2014	10	2603	2575	2552	2598	92	2466

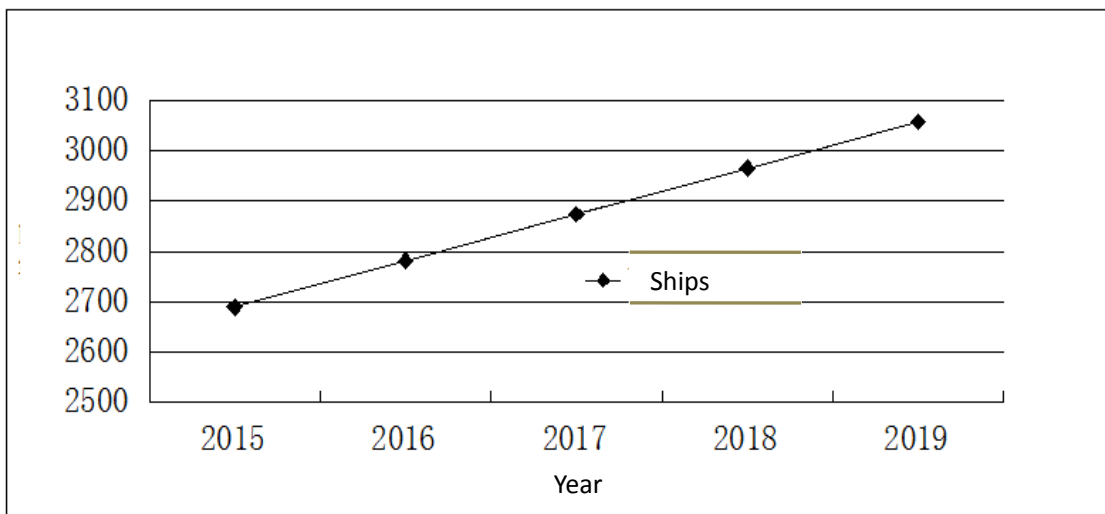
Prediction formula can be obtained according to the computation above:

$$F=2598+92m$$

Development of merchant fleet in the coming 5 years can be concluded, as shown in table 4-3, figure 4-2.

Table 4-3 Development of Merchant Fleet in China for the next 5 years

Year	Forecast/ship	Year	Forecast/ship
2015 (m=1)	2690	2018 (m=4)	2966
2016 (m=2)	2782	2019 (m=5)	3058
2017 (m=3)	2874		



Source: Development statistics of road and water transportation in China

Figure 4-2 developing trend of the amount of merchant fleet (300 tonnage and above) in China

4.4 Demand Forecast for Senior Officers in Chinese Merchant Fleet

The demand for crew members has direct connection with the number of ships in a country, the fixed number of senior officers in navigation technology, the using specification of senior officers in navigation technology, quantity and turnover of goods transportation in department of water transport, and economic indicators such as gross national product (GNP) (Kasilingam, 1998).

(1) Senior officers manning

With the development of shipping technology and higher degree of modernization, ship manning standard also changes significantly. Maritime Safety Administration in China specifies 11 rules on single ship manning during the performance of Manila Amendments of STCW Convention, namely the deck department: captain, chief officer, second officer, third officer; engine department: chief engineer, second engineer, third engineer, fourth engineer, as well as the new ship operator, so there are nine senior officers onboard, as shown in table 4.

Table 4-4 Fixed number of senior officers

Position	Deck department			Engine department			Total	
	Master	C/O	2/O & 3/O	C/E	2/E	3/E & 4/E	E/E	
Number	1	1	2	1	1	2	1	9

Source: New edition of <Code of exams and certifications for Chinese seafarers>

According to the nature of work, crew members have no weekends or holidays, but a centralized holiday system. Because the ship is still on work, other seafarers should be sent onboard for substitute. So the actual need of staff is greater than the specified one, and the ratio is called coefficient of manning and represented by Fm . The main factors affecting Fm is V , natural attrition D , job transformation C , emergency preparedness E , etc, its computation formula is as followed:

In recent years, holidays for senior officers are longer than the past, considering factors such as natural attrition and job transformation, Fm is 1.85 in this paper.

Prediction formula of senior crew members in China:

$$Q = St + C + Fm$$

In the formula:

St is estimated number of vessels in the target year;

C is fixed number of senior officers;

Fm is coefficient of manning

Put the estimated number into the formula, so the estimated number of senior officers in ocean fleet in China is available, as shown in table 4-5.

Figure 4-5 Prediction of Demand of Senior Offices of Merchant Fleet in China

Year	Predicted Number	Number of Senior Officers
2015	2690	44789
2016	2782	46320
2017	2874	47852
2018	2966	49384
2019	3058	50916

CHAPTER 5

Analysis of Main Factors influencing Crew Training and Education

The reason why crew members need education and training is the gap between their own knowledge and requirements of jobs. These gaps are the main reasons for the change of the shipping regulations, such as higher requirements for work: the inspection of foreign ships conducted by port state countries has been tightened to ensure maritime security and prevent marine pollution; and with the development of new technologies, new navigation equipment is created, operating methods are changed. All of these factors affect education and training for crew members.

5.1 Requirements of Shipping Regulation

5.1.1 Requirements of Manila amendment of the STCW Convention

As the integration of global economic, vessels are moving toward giganticism, rapidness, specialization and modernization. Global protection of the marine environment is tighter, application of new technology including information technology is wider and deeper, and standard of crew training and watch-keeping is higher and higher. At the same time as pirates are increasing, so the shipping security is a serious challenge and new requirements on crew training are put forward. Based on the above factors, comprehensive review and correction of STCW78/95 should be conducted (IMO, 2001). On June 21, 2010 revision of International Convention on

Standards of Training, Certification and Watch-keeping for Seafarers 1978 was adopted in Manila at the diplomatic conference of International Maritime Organization STCW convention (Manila Amendments of STCW Convention (Zheng, 2012). It is the most fundamental international laws and regulations on crew education and training. Not only maritime colleges and universities in their member states should train students according to the requirements, but shipping companies should also be in accordance with the requirements for its crew recruitment and training, otherwise, they will be hard to work in international shipping industry. STCW convention makes its requirements clearly that when assigning seafarers to work onboard, the competent authorities of the contracting states need to ensure the following:

- (1) Each seafarer should hold the corresponding certificate.
- (2) Ship manning should satisfy the requirement of safe manning of competent authorities.
- (3) Relevant documents and maintenance data related to seafarers on board should be kept well and be ensured to be available at any time, such as data about experience, training, health and competency.
- (4) All seafarers are familiar with the vessel and their responsibilities.
- (5) All seafarers perform their duties effectively and coordinate their activities in emergency.

Manila Amendments of STCW Convention puts forward higher standard on the basis of crew training and certification in STCW78/95, according to current development and demand of shipping industry. New requirements and standards among various rules and regulations on competency standard in the convention will have significant influence on maritime education and training in countries around the world. China is

a big country in crew education and training. Currently there are more than one hundred maritime colleges and training institutions approved by Maritime Safety Administration of People's Republic of China. In the year and a half since the new convention was adopted and taken into effect, authorities, relevant institutions and training centers should focus on studying and implementing teaching plans, professional training program for crew members, training plan of duty performance and knowledge updating, they should also pay attention to increasing training equipment according to the requirements of new convention, and improving knowledge and ability of training faculties.

5.1.2 Requirement of ISM Code

From the perspective of management, International Safety Management Rules (hereinafter referred to as: "the ISM Code") (IMO, 1994) in SOLAS Convention has made the most changes in recent years. Since 1998 rules on some types of vessels were taken into effect, ISM Code has objectively played an important role to ensure the safety of shipping. ISM Code as international management rules provides standards on shipping safety operation and pollution prevention management. The goal is to ensure safety at sea, prevent casualties, avoid harm to the marine environment and damage to property.

Management is always inseparable from human resources, and human resources are closely related to personnel training. For example, ISM Code requires "personnel onboard and off-shore should continuously improve their safety management skills, including emergency preparedness related to safety and environmental protection." Here "continuously improve their safety management skills", means that personnel

training in shipping companies will continue to improve with the development of shipping industry; otherwise it is unable to adapt to new changes.

Part 6 of ISM Code have seven aspects relative to resources and personnel, and the following four points are the most relevant to crew training:

(1) Shipping companies should be based on domestic and international requirements to ensure that each ship is manned with qualified crew with certificates of competency and certificates of physical health.

(2) Shipping companies should establish procedures to ensure that new employees and transferred personnel are familiar with their duties.

(3) Shipping companies should ensure that all personnel related to SMS of the company fully understand the related regulations and guidelines.

(4) Shipping companies should ensure that personnel performing duties related to SMS can communicate effectively.

The implementation of ISM Code is the measure taken by International Maritime Organization (IMO) in this respect. Article 6 of ISM Code makes specific requirements and regulations on crew manning and quality of crew and competency. In this way, it provides clear standards in qualified crew manning (Wang, 2002). Specifically, Article 6 of ISM Code requires those who are entrusted with shipping companies for ship management and operation should be assessed according to domestic and international standards; crew members should be certificated and healthy; new and transferred personnel should be familiar with normal operation and duties in emergency in accordance with SMS. Instructions should be delivered to seafarers before the voyage, and provide relevant information to make sure that crew members have clear understanding about related regulations, rules and safety

management system, in addition, continuous training is also in need. Ensure that each crew member on its employment is qualified according to regulations. In the past, language barrier existed between crew members and the captain, so seafarers did not have full understanding about the new job and were not fully clear about relevant regulations, rules and guidelines, and their operational ability was also poor, but after the implementation of ISM, it is likely that the crew members are not qualified, which puts forward higher requirements for crew members.

The ISM Code made special provisions about rights and capacity of the captain. Article 5 of ISM Code requires that the captain should not only be able to drive correctly, but be fully familiar with safety management system and good at safety management. According to this requirement, the captain should have corresponding training, hold international certificates and be qualified to make command on the ship. To help the captain to make decisions about safety and pollution prevention, article 5 also establishes absolute rights and responsibilities of the captain. In the past, the captain always listened to off-shore departments, but now the captain has absolute rights to make decisions about safety and pollution prevention in accordance with the code. So in sea accidents, interference or depriving of the captain's right to make decisions from the shipping companies is not allowed. If the captain is late in the exercise of discretion, which leads to failure in accidents prevention or loss reduction, it will be considered to be not proper manning and not seaworthy vessel.

5.2.3 Requirements of 11Regulation of MSA

For overall performance of Manila Amendment of STCW Convention, Ministry of Transport has issued a new version of law of the People's Republic of China on crew

competency examination and certification (Xiao, 2014). “New test rules” have made changes in many ways: firstly it cancels limitation of degree in accordance with requirements of PRC; secondly it simplifies applicable area and production of certificate, canceling educational requirements of promotion and make requirements of crew promotion in a scientific and reasonable way; thirdly it attaches great importance to training content, training process and training results; fourthly it strengthens the responsibilities of companies and organizations to make them pay attention to crew training.

Competency examinations for different positions under “11 rules” are shown in the table. Test requirements for the captain and deck crew are shown in table 5-1. “11 rules” makes it clear that students who have received maritime education and competency training can apply for competency examinations, and test requirements for the captain and deck crew are shown in table 5-2.

Table 5-1 Requirements of Tests of Master and Deck Crew

Applied Position	Crew on duty	Senior officers on duty	Third mate	Second mate	Chief mate	Master
Competency Test	Competency test for seafarers on duty	Competency test for senior officers on duty	Competency test for the third mate and the fourth engineer	Test exemption	Competency test for the first mate	Competency test for the master

Table 5-2: Competency test for all kinds of maritime students to apply for captain and deck crew

Maritime students	Training time	Training time of position competency	Applied navigating zone	Applied position	Notes
full time undergraduate	4 years	12 months	no limitation	Third mate	
			no limitation	Second mate	Maritime colleges of better quality
Full-time higher vocational colleges	3 years	12 months	no limitation	Third mate	
Non-maritime graduates	18 months	18 months	no limitation	Third mate	
Full-time secondary vocational/technical secondary school	2 years	12 months	no limitation	Third mate	Experience at sea for 12 months
		12 months	no limitation	Third mate	
Students with	2 years	2 years	no	Third	Experience at

maritime education for 2 years			limitation	mate	sea for 12 months
		2 年 2 years	Coastal navigating zone	Third mate	
Seafarer on duty or senior officers on duty for 18 months	12 months	12 months	no limitation	Third mate	
Seafarer on duty for 18 months	2 months	2 months	Coastal navigating zone	Senior seafarer on duty in corresponding navigating zone	
Students meeting basic requirements as crew members	4 months	4 months	No limitation/ Coastal navigating zone	Senior seafarer on duty in corresponding navigating zone	
Third mate for	exemption	exemption	No	Second	

18 months			limitation/ Coastal navigating zone	mate in correspo nding navigati ng zone	
Second mate for 12 months	3 months	3 months	No limitation/ Coastal navigating zone	First mate in correspo nding navigati ng zone	
First mate for 18 months	3 months	3 months	No limitation/ Coastal navigating zone	in correspo nding navigati ng zone	

Notes: time of educational training and competency training for maritime students working on vessels less than 500 gross tonnage has been relatively reduced.

Source: New edition of <Code of exams and certifications for Chinese seafarers>

These new changes have brought new opportunities for the development of Chinese crew members (Rao & Xing, 2014).

There are specific provisions: seafarers assigned to the ship by the company shall ensure that:

(1) Seafarers assigned to the ship by the company should hold appropriate certificates of competency according to provisions of the rules and requirements on safe manning of competent authority.

(2) Seafarers assigned to the ship should be familiar with specific duties and ship arrangement, devices, equipment, procedures, features and limitations in relation to their daily duties or emergency duties.

(3) Seafarers in-service can effectively coordinate their activities when performing duties to ensure safety or prevent pollution in case of an emergency.

5.2 Restriction of PSC

Port state control (PSC) means that the country in charge of the port should inspect foreign ships stopping in the port, through checking on the vessel and detaining the ship when necessary. PSC plays an active role in recognition and understanding in offsetting ships of low standard.

5.2.1 Global Network of PSC

Port state control (PCS) as an efficient way to ensure maritime safety, and a vast network has been established in the whole world. Nowadays there are 9 regional organizations of port state control around the world, as shown in table 5-3.

Table 5-3 Regions of PSC in the world

Name	Established time	Area	Remarks
Paris MOU	1982	Western Europe and north Atlantic waters	19 countries

Latin American MOU	1992	Latin American waters	12 countries
Tokyo MOU	1993	Asian-Pacific region	18 countries
Caribbean MOU	1996	Caribbean region	20 countries
Mediterranean MOU	1997	Mediterranean waters	10 countries
Indian Ocean MOU	1998	Indian Ocean	15 countries
Abuja MOU	1999	Central and Western African waters	16 countries
Black Sea MOU	2000	Black Sea coast	6 countries
(USCG)	1994	American Port	independent

5.2.2 Expansion of Scope of PSC Inspection

PSC inspection is mainly for requirements of merchant vessels in international convention, including technology condition, crew competency and safety operation requirements, etc (Hetherington, 2006). It mainly concerns conventions set by International Maritime Organization, associated with other convention (such as International Labor Organization, etc.). With the modification of convention, the content is increasing and the inspection is refined. Crew members are required to operate equipment or exercise on site, these conventions are:

- (1) International Load Line Convention of the Ship
- (2) International Convention on Safety of Life at Sea (SOLAS) and its protocol
- (3) Maritime Agreement Regarding Oil Pollution (MARPOL)
- (4) International Convention on Standards of Training, Certification and Watch keeping for Seafarers (STCW)
- (5) International Regulations for Preventing Collisions at Sea (COLREG)
- (6) International Convention on TONNAGE Measurement (TONNAGE)
- (7) ILO147 convention, etc.

5.3 Application of New Science and Technology in Navigation

With the development of science and technology, information technology exists everywhere in our society. Shipping industry is of no exception. All aspects from ship design to ship maneuvering reflect the advanced information technology and it makes vessels become giant, fast and automatic. Basic features of modern ships are:

- (1) A new integral bridge design
- (2) Equipped with advanced navigational equipment
- (3) Innovative organization on the ship
- (4) Specially trained personnel

5.3.1 Improvement of Ship Automation

In recent years, the level of marine automation has increased unceasingly. As representatives of ship maneuvering technology, integrated bridge system (IBS) and integrated navigation system (INS) provide reliable guarantee for safe navigation. The navigation system can not only automatically keep track of direction, speed,

position and time, it can also use electronic chart system (ECDIS), radar and ARPA for collision avoidance and sailing, at the same time it can also automatically check the depth, carry out automatic navigation (AUTO PILOT), control the track of navigation, etc. In addition, application of artificial intelligence to the ship collision is also in research.

5.3.2 Development of Communication Skills at Sea

Internationally, satellite communication system mainly concerns Inmarsat. Inmarsat is an organization with a long history providing maritime satellite communication services. Now it is using the latest Inmarsat satellites of the third generation to provide customers with global coverage except polar area. Each satellite can also provide a large amount of communication to a specific area, and roaming users can directly contact each other by satellite. Now equipment station C and F on board have already been in use of this system.

With continuous development of digital communication technology, ITU in related resolutions requires shipping agencies in all countries to consider and use new digital communication technology, and make research on corresponding technical standards, procedures, rules, terms and other relevant issues and problems in transitional period to expect a new era of radio communication at sea (Wang, 2012). The VSAT satellite communication system, iridium satellite communication system, high-frequency electronic mail technology and C email Fax communication system are digital communication that can be used in new technology at sea, which fully meet the requirements of rapid development of communication in shipping industry.

CHAPTER 6

Establishment of Crew Training Mode in China

6.1 Training Goal Based on Necessities for Seafarers

6.1.1 Basic Qualities of Seafarers

(1) Basic knowledge mainly refers to basic knowledge and competency, such as foreign language (communication), computer operation, word expression, accurate access to information, etc. In the era of knowledge economy, cultivation of innovative thinking, creativity and sustainable learning is one of the main content of higher maritime education. It is also the exact quality that seafarers should possess.

(2) Professional knowledge mainly refers to special knowledge and ability to work in navigational positions which are equivalent to requirements of STCW Convention in functional sections, such as navigation, seamanship, goods, transport, maritime law, ship management practice, ISM code, etc., Seafarers should have the basic ability of handling, navigating, communicating, (such as GMDSS operation, etc), and cargo operation, etc.

(3) Special ability refers to special ability related to occupational safety. Such as “advanced firefighting”, “essential safety”, “proficiency in first aid”, “master of

lifeboat and rescue boat”, etc. Tankers and roll-on ships still need “tanker operation”, “personnel management” and so on.

6.1.2 Professional Competence of Senior Officers

Maritime education and training system in China still adopt functional model for a period of time. Each major (navigation technology, marine engineering) has the same basic knowledge and skills, but the difference is knowledge and professional ability about special types of vessels, such as oil tanker, chemical tanker, liquefied steamboat, and etc. required by bulk liquid goods. Senior officers working on such ships must receive professional training and get corresponding certificates of quality, such as certificate of oil tanker safety operation, certificate of COW, etc. Therefore, there should be seafarers holding such certificates among the crew to meet the needs of ship operating and assignments. Due to the fast growth of special ships carrying liquid cargo, the number of senior crew will increase accordingly. As a result, great importance should be attached to crew training in this aspect.

6.1.3 Other Competence required by other Professional Characteristics

Seafarers work in special work environment, so team spirit is essential. They should work together with other sailors, which is particularly important. Team spirit is regarded more important than technical skills and working ability abroad, at the same time, it draws attention in domestic, then the “bridge resource management” (BRM) courses and training are initiated. In addition, strain capacity, social communication ability, organizing and management ability and psychology ability to bear burdens highlight the professional nature of seafarers.

6.2 Main Factors Influencing Training

6.2.1 Internal Factors

(1) Strategic objectives and organizational structure

Strategic goal refers to the attention paid by decision-makers in shipping company to crew training, which determines the direction, size and objectives of development in shipping company. Organizational structure refers to internal division of labor and organizational form in shipping company which has a great influence on crew training. An effective training model depends on whether there is a clear and tacit cooperative structure.

(2) Internal requirement of the crew

Crew members have different background and experience, so each training model should meet the actual needs of different groups. For example, for new crew graduating from maritime institutions and on-the-job crew, different emphasis on training requirements and plans should be made.

(3) Fleet status

Crew training should meet requirements of technical condition of the fleet. Therefore, in the development of training plan, factors such as age, type of ship need to be considered to make training effective and indeed solve practical problems in production.

(4) Training needs and resources

The basis of making specific training plan is that the organizers of training know the needs of crew training. For crew members in China, English fluency and computer operation ability must be strengthened. Training resources mainly refer to training faculties, training equipment and facilities, training materials, training environment

and so on.

6.2.2 External Factors

(1) Social environment

Manila Amendments to STCW Convention, ISM Code and 11 rules of MSA in China all make basic requirements on recruitment and usage of crew members in shipping companies. Shipping companies are under high pressure due to increased competition in the international shipping industry. In addition, protection of marine environment, prevention of pollution also increase the responsibility of shipping companies which force shipping companies to establish a standard and take measures to guarantee the quality.

(2) Level of science and technology

The application of information technology in shipping industry, such as design of modern ship (integrated bridge IBS, UMS), advanced equipment (INS integrated navigation system, GMDSS, AIS, ECDIS, etc.), satellite communication systems, distant learning network, INTERNET and etc. brings challenges to crew members, which also brings great impact on the training system in shipping company. The most effective mode of training and methods to keep up with the development of advanced navigation equipment needs to be thought carefully, with update of technical knowledge and other issues taken into account.

(2) Level of science and technology

The application of information technology in shipping industry, such as design of modern ship (integrated bridge IBS, UMS), advanced equipment (INS integrated navigation system, GMDSS, AIS, ECDIS, etc.), satellite communication systems,

distant learning network, INTERNET and etc. brings challenges to crew members, which also brings great impact on the training system in shipping company. The most effective mode of training and methods to keep up with the development of advanced navigation equipment need to be thought carefully, update of technical knowledge and other issues should also be concerned (Dong, 2007).

6.3 Training Content

It is the main content of education and training to meet the requirements of international conventions and educational courses. Requirements of maritime colleges and universities cannot fully meet the needs of shipping companies. Graduates need necessary vocational training to become senior seafarers in the ship company. Mr En-hong Li put forward valuable views about Chinese professional training on crew members. He thinks that crew training must be targeted, and both parts of training and trainees should put forward clear goals and objectives, and economic measures are also necessary. Content of training mainly concerns English (English) ISM Code and safety and pollution prevention, etc.

From the perspective of shipping companies, education and crew training should be planned according to different crew groups and the developing strategy of the company. Training should be able to reflect the needs of the future and the progress of the industry, characterized by technology and management. Training should adapt to needs of human development. According to training requirements, it can be divided into two ways: on land training and on board training, basic training contents are as follows:

6.3.1 Training on shore

(1) Review before getting on board: crew members who do not work on board for a long time, should review and focus on training and simulators.

(2) Update of knowledge and skills: such as new type of ship and its characteristics, new equipment and its usage (ECDIS and VDR, etc.), marine computer, etc.

(3) Professional development: learning knowledge and skills about shipping safety and pollution prevention

(4) Company plans and ISM Code: understand the company's developing strategy, safety management regulations, basic knowledge about ISM system, program files and manuals, etc.

(5) Promotion and certification: crew training aiming at promotion can be completed by cooperation between maritime colleges and shipping companies.

(6) Requirements of special skills of MSA: such as special training on ship safety operation.

(7) Computer skills: common application software (word, excel, power point, email, etc.), special software on board (communications, information management, etc.).

(8) Knowledge and skills in English language communication skills, ability of reading professional English (such as the ISM Code, regulations, charter, pollution prevention knowledge), commonly used style of writing.

(9) Corporate culture of modern enterprise has its own tradition and style, both old employees and new crew members subject to the cultural background; especially the multinational crew members should work together.

(10) Management mode of foreign shipowners

Of course, the content above can be finished both onboard and onland, which depends on the overall arrangement of the company.

6.3.2 Training onboard

(1) Being familiar with living and working environment: including shipping equipment, working environment (and emergency routes), operating procedures and special arrangement of each ship.

(2) Resource management: part B of the STCW convention refers to bridge resource management (BRM), its purpose is to ensure that the captain on duty and officers can use the resources of bridge effectively (actually including bridge human resources).

(3) Working procedures: shipping company should formulate corresponding Bridge Procedures Guide and encourage the use of the checklist (Check list), according to characteristics and requirements of their fleets, consulting Bridge Procedures Guide issued by international shipping trade unions.

(4) Exercises on ships: the purpose is that exercises on board can help to ensure life and property in emergency situations and prevent marine pollution. According to requirements of SOLAS and other international conventions, the ship should exercise drills on a regular basis, and record it in significant navigational logs.

(5) Professional knowledge and skills: using modern computer tools, relevant vocational training (CBT), such as professional knowledge and skills.

6.4 Establishment of Training Modes

Bill Gates once said that keep learning is the only chance to keep up with changes within any organization. The process of learning is to learn advantages from others. For shipping companies, it is to take the initiative to keep learning to adapt to

changes. To the smooth development of the enterprise, human resources should be exploited. However, crew training is the important part of human resources development.

6.4.1 Principles of Establishing Training Modes

- (1) Make development plan of personnel based on developing strategy in the enterprise.
- (2) Attach great importance to human resource development, and establish human-oriented concept.
- (3) Make full use of advanced information technology, and set up the concept of high quality training.
- (4) Improve safety management system and perfect the organization.
- (5) Create a good environment for training to motivate enthusiasm.
- (6) Achieve safe and efficient training purpose.

6.4.2 Responsibilities of Training Institutes

In light of the structure of shipping company in China, it is essential that the personnel department should understand the basic information about crew members. Evaluation should be conducted before working on board, for example, which type of ship to work on and whether seafarers can adapt to the situation. But actual performance onboard should be assessed by personnel aboard (such as the captain, chief officer or designated staff) and the owner of the cargo and the shipowner. If accident occurs, safety supervision departments should give comment. These evaluation or feedback shows that the actual working ability of crew members, at the same time, it will determine the training needs of the crew. Related training organizations and their responsibilities are shown in the figure below:

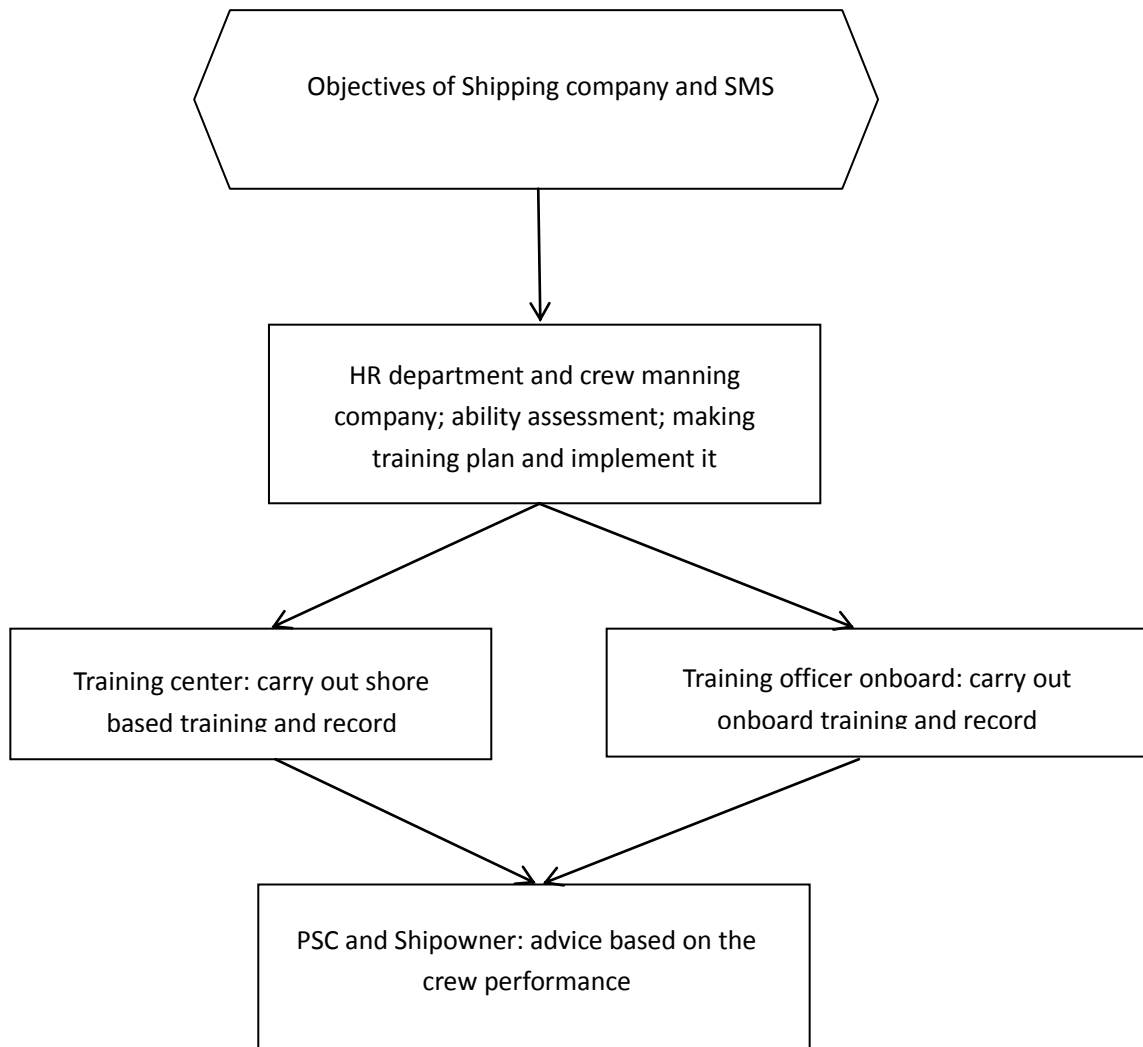


Figure 6-1 Organization and Duties of Training

To emphasize that the on-board training is very important, how to organize training onboard should be highlighted by shipping enterprises. At present, some enterprises have sent training faculties onboard to provide training guidance to the crew at work, which is worth promoting. It not only saves the cost, but also makes the training effective and satisfying. But there is still a long way to go, and it is also very important to look for guiders among senior officers.

6.4.3 Good Organizational Procedures

A perfect training mode of operation cannot exist without a well organized program. It starts with analysis of positions of crew members or deciding the needs (by evaluating method). The basic chart of organization is showed as below:

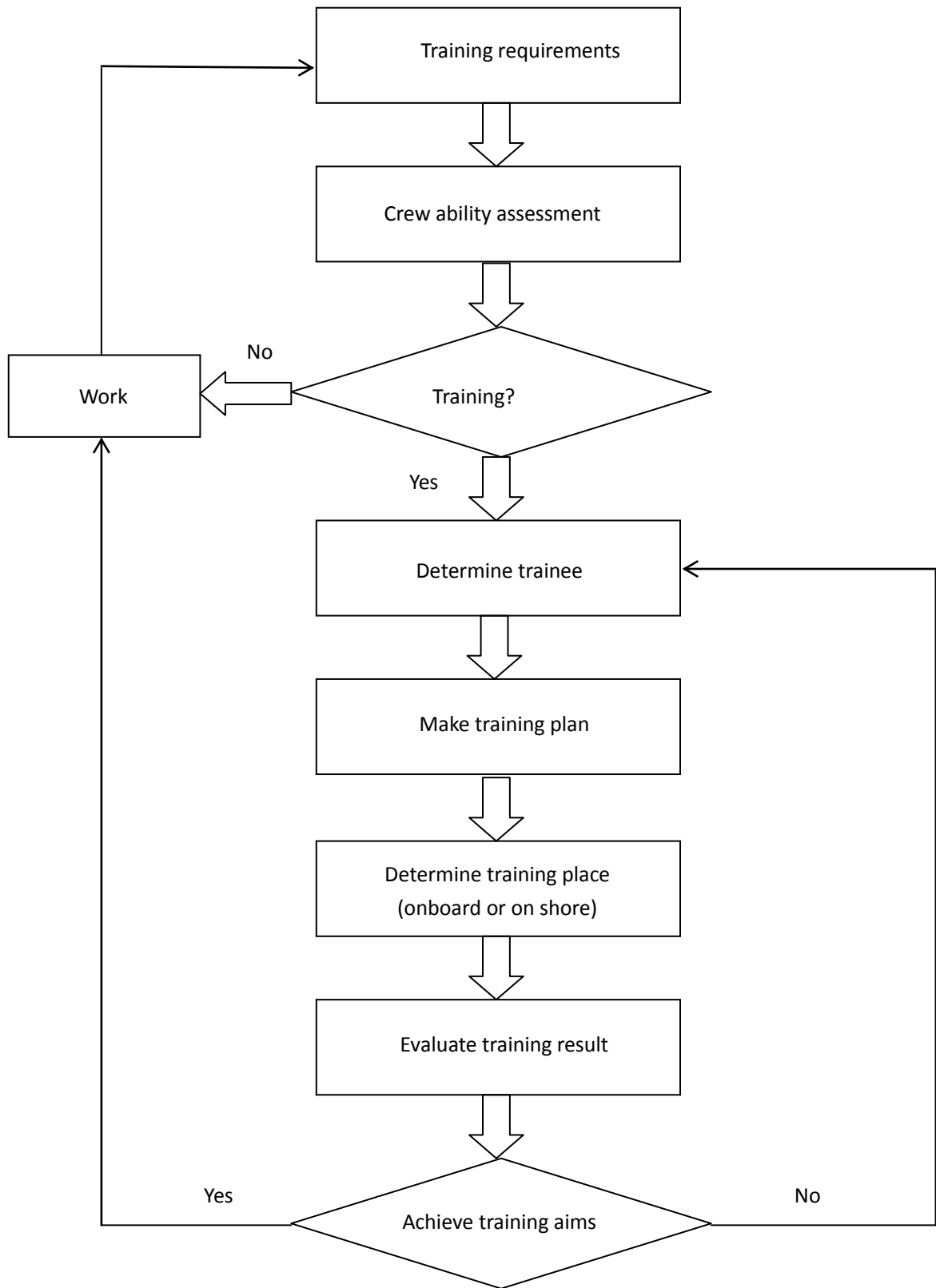


Figure 6-2 Procedure of Training

6.5 Implementation of Training Plans

6.5.1 Training Resources

Training resources mainly concern human resources and material resources. Human resources refer to teachers, guidance personnel and supervisors. Three basic conditions of human resources are: enough knowledge, corresponding qualifications at sea and teaching skills (or guidance). According to the requirements, training personnel can be chosen among crew members and they should be offered corresponding positions and remuneration; training personnel can also be selected among personnel in companies, or among other departments from the shipping industry. Material resources refer to training facilities, equipment, computer software, books and materials, etc. Among them, computer based training (CBT) is popular at home and abroad. Appropriate computer training software is the key resources to CBT training. Comprehensive mode of dialogue between man and machine, combined with animation image and caption instructions and etc., can vividly provide basic knowledge and skills to staff training. It is both suitable for single personnel training and group training.

6.5.2 Assessment Methods

The final evaluation of training results is critical in the whole training process (Liu, 2001). Reasonable and appropriate evaluation methods are required to decide whether the training has reached the expected purpose and trainees has learned knowledge and skills in need.

Common ways of assessment are:

- The CBA (computer - based assessment) assessment, such as SETS,

CES3000 etc.

- Operation at workplace;
- The interview;
- Written examination and interview;
- Comprehensive test.

According to specific training objects, one method or more could be adopted. When making choices, 6 points must be taken into consideration: repetitiveness, authenticity, reliability and practicability, effectiveness, and adequacy. Assessment should start with determining objectives and measurement, preparing evaluation scheme, implementation of the evaluation and making plans for improvement.

After the assessment, assessors should write an assessment report. If it fails to achieve goals, measures should be taken to make improvement. This report should be in accordance with the requirement of the quality system (or SMS) and be kept in archives.

CHAPTER 7

Conclusion and Outlook

7.1 Conclusion of the paper work

By analysis of current situation of maritime education and training and comparing with international standard, this paper concludes the deficiencies in maritime education and training in China, especially in professional training, professional English and gaps between ideas, etc; compared with patterns of foreign maritime education and training, it comes to a conclusion that defects exist in crew education and training in China, especially shorter time of practice (internship), and it puts forward corresponding countermeasures. This paper makes predictions about demand for officers in China, which is beneficial to analyzing demand and supply of crew labor market. There are many factors influencing crew education and training, which mainly concern: conventions and regulations related to shipping industry, port state control and development of navigational science and technology, etc. So shipping enterprises in China have to establish complete crew training system, attach great importance to training and evaluation, strengthen cooperation with maritime colleges and universities to ensure that Chinese seafarers are in line with domestic and international convention, and they can meet the needs of shipping companies.

7.2 Limitation

Training personnel for shipping enterprises is characterized by internationality with

high cost, and it specifically targets at certain positions. It is very extensive, especially in international shipping. Nowadays with changes in professional training system and policies, personnel training need more research and exploration. In comparison, this paper just provides macro research results of a certain period. Therefore, in this sense, this paper just starts the research and exploration in this area. Due to research time, research materials and ability of the author, this paper does not make a more in-depth and detailed discussion on this subject and many problems are still left for more comprehensive, thoughtful and meticulous research. In addition, this paper does not fully understand maritime education in developing countries, so no sufficient evidence has been provided.

7.3 Envision and Outlook for Further Research

Maritime education and training research still has a long way to go, and this paper only discusses some improvements in the field of maritime education and training practice audit focuses on shipowners' attitude to take measures. Since the implementation of ISM Code, it has put more stress on shipowners or ship managers about crew training, which promotes the training work, such as implementation of the training plan onboard, implementation of the training plan on land, and evaluation of the ability of seafarers, etc.

In order to meet new challenges, foreign shipowners have set up training centers in China. We have to aim at international standard to improve ideas and methods to carry out crew education and training to strengthen shipping power, etc. With the development of science and technology, a full range of simulators are going to appear in training institutions. Unattended engine room of modern ship is bound to bring personnel reorganization onboard, namely comprehensive training mode of

navigation, which emphasizes the work of senior officers. On the other hand, with the improvement of automation and advanced communication technology, ship operation has become easier. Professional knowledge and the target of crew education behind ship operation will be gradually clear in the near future.

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