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WORLD MARITIME UNIVERSITY

Dalian, China

**RESEARCH ON THE TRAINING AND
CERTIFICATION OF DUAL-PURPOSE
SEAFARERS IN CHINA**

By

LIU BIN

THE PEOPLE'S REPUBLIC OF CHINA

A research paper 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 ENVIRONMENTAL MANAGEMENT)

2015

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DECLARATION

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

The content of this dissertation only reflects my own personal opinions, and is not necessarily endorsed by the University.

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ABSTRACT

Title: Research on the Training and Certification of Dual-purpose Seafarers in China

Degree: M.Sc

Many people believe that the shipping industry stands on the threshold of a new era in which highly capable ships can be made more cost-effective through the introduction of automation and the technologies that enable significantly reduced manning. With the ships getting bigger and smarter, a lot of work has been done by the machines themselves and a reduction of the need for a large quantity of seafarers is inevitable.

Keeping a steady, sufficient and competent team of seafarers working on board the ship is necessary for the safety of ship, pollution prevention and other purposes, while the manning level has been considerably decreased, the development of breadth (multi-function and multi-purpose) and depth (quality) of competence of seafarers has then become the right guideline for the future seafarer training.

Dual-purpose seafarers can greatly enlarge the breadth of competence as the functions described in their certificates which show the competent performance on designated duties get considerably expanded. Meanwhile, the work ability in different departments and in the face of different emergencies will contribute to the high quality of them.

The author will have a particular analysis on the application prospect of dual-purpose

seafarers in China and draw the conclusion that it is necessary to develop this kind of seafarers with a variety of sound reasons, after which the qualification requirements and certification issues for seafarers will be discussed in this dissertation.

Key words: seafarer, dual-purpose, training, qualification, certification

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LIST OF ABBREVIATIONS

STCW—Standards of training, certification and watchkeeping for seafarers

ECDIS—Electronic Chart Display and Information System
GMDSS—Global Maritime Distress and Safety System
UMS—Unmanned Machinery Space
MLC—Maritime Labour Convention (2006)
JMC—Joint Maritime Commission
IMO—International Maritime Organization
ILO—International Labour Organization
MSA—Maritime Safety Administration
BIMCO—the Baltic and International Maritime Council
ISF—the International Shipping Federation
DMU—Dalian Maritime University
EMSA—European Maritime Safety Agency
ITF—International Transport Workers’ Federation
CoC—the certificate of competence
CoP—the certificate of proficiency
MET—Maritime Education and Training
MOT—Ministry of Transport (China)
MOE—Ministry of Education (China)
FOC—Flag of Convenience
UNCTAD—United Nations Conference on Trade and Development

CHAPTER 1 GENERAL INTRODUCTION AND BACKGROUND INFORMATION

After being invented for thousands of years which could be found in the evidence from Egyptian rock drawings dating from 6000 BC(Bellis, 2015), the ship, a kind of floating vessel with huge capacities, has become one of the most significant tools for transportation which helps seaborne trade to play a vitally important role in the global economy development.

The operators of ships, here mainly refers to marine officers and engineers, are classified according to the department they work in. For quite a long time, such seafarers focus on the single type of knowledge and skill, namely either navigation or engineering without thinking about the possibility of merging them together. However, some people had a try on dual-purpose training under which seafarers were trained to be capable of working successfully in both deck and engine department, and received good effects.

Dual-purpose seafarers, which was first introduced in France in the 1960s, refer to officers attending dual-purpose training and holding alternative certificates authorized by national competent authorities. They can work for deck department or engine department as required, which stands for the meaning of dual-purpose. But at that time as the shipbuilding technology, equipment and management needs for dual-purpose were not high, dual-purpose seafarers did not get much attention from the international maritime community.

In the following years, high-salary system for seafarers gradually increased the running costs of the ship. At the same time modern computer and automation

technology widely used on merchant ships, for instance, the Electronic Chart Display and Information System (ECDIS) replaced the paper chart, on which nautical officers carried out the route planning, also allows for proper manning reduction to some extent. Similar example can be found in Unmanned Machinery Space (UMS), which enables the engine room department to be operated with just a few seafarers. In order to guarantee the safety of ship after the reduction on manning, control operating costs and simplify the personnel arrangements, some of the big shipping companies gradually recognized, accepted and even gave the priority to employee dual-purpose seafarers. And dual-purpose seafarers, after many years' application, are proved to be useful especially for the improvement of safety of the ship.

1.1 Introduction to dual-purpose education/training

The continuous development in shipping industry brought some impact on the seafarers training objectives and corresponding teaching methods for the maritime education institutions. And it influenced seafarers themselves as well. Western European countries began to use dual-purpose training mode in Maritime Institutions to develop future new seafarers. By attending training courses, many seafarers also successfully got another kind of competence other than the ones illustrated in the certificates they held.

The present status of maritime education shows that course settings don't have to be abundant and should fit for the actual needs and requirements. Being different from China's current "Single-purpose training" system (separating marine navigation from marine engineering), some other countries have introduced dual-purpose education/training and succeeded in maritime education by cultivating many excellent seafarers. These countries include the United States, France, the Netherlands, Germany and Japan. Maritime colleges and universities of these

countries, having implemented the dual-purpose education mode, bring us a sense of urgency for adopting dual-purpose training mode in China and developing more Chinese dual-purpose seafarers.

1.2 Introduction to dual/multiple purpose seafarers in STCW Convention

In 1995, the 1978 STCW Convention was significantly amended with technical details associated with provisions of the Convention. From then on, the certificates of seafarers have been classified according to functions and levels of responsibility. STCW Convention specifies the standards of competence are grouped, as appropriate, under the following seven functions according to STCW Convention:

- ✓ Navigation
- ✓ Cargo handling and stowage
- ✓ Controlling the operation of the ship and care for persons on board
- ✓ Marine engineering
- ✓ Electrical, electronic and control engineering
- ✓ Maintenance and repair
- ✓ Radio communications

And the responsibilities of seafarers are specified into three levels:

- ✓ Management level
- ✓ Operational level

✓ Support level

According to this specification, a seafarer, after being consistent with the required standards of competence, is able to do the work in accordance with corresponding level and functions. And if he/she gets the qualification of multi-levels and functions relevant to such levels, he/she can apply for a multi-levels and multi-functions certificate, regardless of the classification of department.

Chapter VII of the Annex to the STCW 95 Convention deals with alternative certification, which provides that the seafarers can be granted with alternative certificates as long as they have completed relevant education and training and meet the standards of competence described in the Convention. In another word, STCW 95 Convention enabled the reorganization of traditional work division system on board and introduced certification system in accordance with the functions.

The alternative certificate refers to STCW certificates issued to enable the holder to perform different functions that are not necessarily within the same department, which means the holder of alternative certificate have the competence for work, for example in deck department and in engine department, hereinafter refers to dual-purpose. Being not detailed in the Convention, the certificate awarded will specify the functions and the level of responsibility by their domestic authorized organization. A candidate for alternative certification will need to qualify in all these functions at a determined level of responsibility in one department (deck or engine) before being able to qualify for other functions (at the same level of responsibility) in a different department.

1.3 The development from traditional training mode to dual-purpose training mode

Considering the characteristics of ship construction and management, seafarers have been divided in either deck or engine department for decades. They are trained, evaluated, certified and managed accordingly with a single purpose just as specified in STCW Convention. This mode has been popularly adopted by many countries. However, nowadays the development of shipping technology and new shipping market has changed enormously and these great changes are now challenging this single purpose mode.

As the quantity of seafarers working on board a ship is getting much smaller than before, the quality of them should be enhanced to have a better control over the modern ships. In order to adapt to the international shipping industry and the demand of the continuous development of the shipbuilding technology, the knowledge and skills needed for the seafarers should also be constantly updated, reformed and developed. When looking for methods to fit the new situations, some people come to the hyporesearch paper: Is it possible to train a seafarer who can do both deck and engine room work?

The answer is YES. Dual-purpose seafarers were not only developed in France but also in some Western European countries in the twentieth century. With the positive practical responses from ship owners which prove the benefits in employing them, dual-purpose seafarers were gradually adopted by many shipping institutions and companies. Some countries have even made it fully adopted in recent years.

1.4 The real situation of dual-purpose seafarers and the training mode in China

Unfortunately, China has not yet developed any dual-purpose seafarers up to now, apart from some company's unilateral attempt. Since Chinese workforce has been famous for relatively low costs and the established single purpose seafarer training mode seemed to be enough to meet the requirements of the shipping industry, no one was interested in cultivating dual-purpose seafarers or the establishment of dual-purpose training system. This situation needs to be improved now because most shipping companies in China are now facing new problems in running the ships. Many companies decide to reduce the number of crew working on their ships, some of which can only meet the minimum manning requirements set by China MSA. The decrease of crew on board may lead to potential risk in running the ships under the previous working system; therefore it becomes vitally important to improve the quality of the seafarers on board and let them successfully run the ship even with fewer quantities.

In the 1995 STCW Convention, The training standards of competence for the crew were specified into mainly seven functions and three levels of responsibility, which have been implemented in China from then on. At the same time, two important departments on board the ship, namely deck and engine department were defined in Chapter II & Chapter III, and almost all of the Chinese seafarers are trained, educated, certified according to this classification. Along with the implementation of the STCW Convention Manila amendment, Chinese maritime education and training institutions have been performing a variety of work to meet the new requirements set by the convention, especially on the requirements of the crew training.

Anyway, Chinese maritime education and training institutions have always been

working hard at training high-quality seafarers no matter for the supply of domestic coastal ships or for the increase of seafarers dispatched aboard. But deep into the existing administrative system, they are found to be passive on the training system or training mode reforms, and none of them tried to carry out dual-purpose training mode, except the investigations conducted by only a few scholars.

1.5 Brief Summary

Apparently, dual-purpose training mode has been established for almost half a hundred years and developed in many countries. It has been proved to be mature and effective and the seafarers trained under this mode are recognized and welcomed by many of the biggest ship owners. From the practical effects of seafarers developed under dual-purpose training system, it is clear that the safety of the ship generally gets sounder protection than the effect of normal seafarers trained under the traditional mode on the same position. The effectiveness is also confirmed by 1995 STCW Convention, the Chapter VII of which makes provisions on alternative certification. However, it is alternative for the contracting states of the convention and only a minority of them has adopted dual-purpose training. It is also not popular in China for some reasons but need to be developed further.

CHAPTER 2 MARKET DEMAND ANALYSIS

Dual-purpose seafarers have a competent performance no matter in the deck department or in the engine department; therefore they can be considered as a new form of seafarers with higher ability compared with single-purpose seafarers. Since the shipping industry is getting more and more urgent on the demand for high quality seafarers, those seafarers who are capable of doing comprehensive work will win the favorite from the shipping companies and seafarers market.

2.1 Shipping industry: The demand for smaller quantity but higher quality seafarers

“Although the economic outlook for shipping may, in the prevailing circumstances, be uncertain, the march of technology seems inexorable, as the industry seeks constantly to improve its efficiency and improve performance – both from the commercial and environmental viewpoints.”

---- Efthimios E. Mitropoulos

Arising from the new shipping development of large-scale and automation, especially the wide application of computer technology, for instance integrated systems (including ECDIS and electronic navigational charts) have become the norm, while the concept of e-navigation seems set to open doors to enhanced berth-to-berth navigation, the ship becomes more and more integrated and efficient (Maritime Knowledge Center, 2012), and can be successfully run with small quantity of seafarers, which indicates a decrease demand on a large number of crew.

There is solid evidence that the ship manning has reduced gradually from more than fifty in the nineteenth century to about twenty people or even less on an ultra-large ship nowadays. For instance, Maersk Mc-Kinney Moller, the first Triple-E ship of Maersk and also the biggest operating ship in the world which has room for 18,000 TEU containers (20-foot equivalent units), can accommodate 34, and in principle run with as few as 13 seafarers, but in regular service approximately 22 persons will make out the crew (Kendall, 2013) . And it was reported that a modernized ship could run with 11 Japanese crew including one captain, one chief engineer, four watch officers, four dual-purpose crews and one rating.

Under the premise to ensure enough rest time for the seafarers and safety guarantee for the ship, the shipping companies will of course choose to employ fewer seafarer to work on their ships. But people should have a clear understanding that the reduction of expense on this issue is not an ideal way for the ship because it has negative effects as well. Some potential risks may emerge, such as lack of maintenance, overwork, distress, lack of watchkeeping and communication and so on. These risks can be really dangerous for running the ship and may result in hazardous environmental accidents or great loss to the ship itself.

And ship owners increased the number of ships sailing under a so called “Flag of Convenience” (FOC), some people also call it the phenomenon of “flag out”, to operate under the flag of a nation that as minimum regulations and almost no taxation rather than the flag of a nation with a costly and complex regulatory framework. Foreign flag such as Liberia, Panama, Malta, the Bahamas, and Cyprus have been responsible for much of the flagging out that has occurred over these years (Psaraftis, 2014). In this case, they would like to hire high-quality and multi-purpose seafarers to keep the ship running with relatively low wage spent on the desire of

reducing costs.

From the prospective of protecting vessels and personnel safety, as well as environmental protection, the convention and rules focus on establishing constraints over the parties involved, including provisions which provide the ship owners with a bigger challenge. Even though they renewed their equipments to solve the problem, there is still a great need for seafarers with more comprehensive abilities to maneuver the floating behemoth and carry out the rules.

Dual-purpose seafarers give a better option for the shipping industry which enables less crew working on board the ship on one hand and enhance safety level of the ship on the other hand. From the shipping companies' perspective, they would also like to give a priority to those seafarers with dual-purpose certificates after purchasing a number of vessels with a high degree of automation technology in order to further reduce their running costs, facilitate the company's personnel arrangements for the seafarers and have a better guarantee on safety.

With broader applicability, dual-purpose seafarers can play the role in different types of work on the ships and therefore look very attractive to the ship owners, even though they can not carry out different tasks at the same time. The attraction is also present in China. For promoting the national economic construction, Chinese government has been committed to building the energy-saving and environmental friendly shipping industry for a long term, which is a great opportunity for the application of dual-purpose seafarers in China.

2.2 Ship owners: An optimized choice considering sustained high costs and safety management

The continuous increasing wage cost of seafarers draws more attention on ship manning, leading to the situation that ships are run by less and less crew. From a research funded by Commission of the European Communities, we can find out that over a broad sample of ships, ship types, and flags (all EU flags included), an ATOMOS type ship manned by a crew of 10 is likely to realize significant lifetime cost savings over its equivalent conventional parent ship (Psaraftis, 2014)

If fuel cost is excluded, the payment for seafarers, although depending greatly on the size of the ship, the category of the ship and the nationalities of seafarers hired on board the ship, is generally the biggest kind of operating cost for the shipping companies all over the world. Actually, the payment for seafarers can be as high as 30% of the total running costs in some western countries. The percentage in China is smaller but still can be one of the most important factors for running the ship. A research given by the Natural Environment Research Council (NERC) proved that crew pay costs continue to be the main cost component of operating the vessels as shown in Figure 2.1.

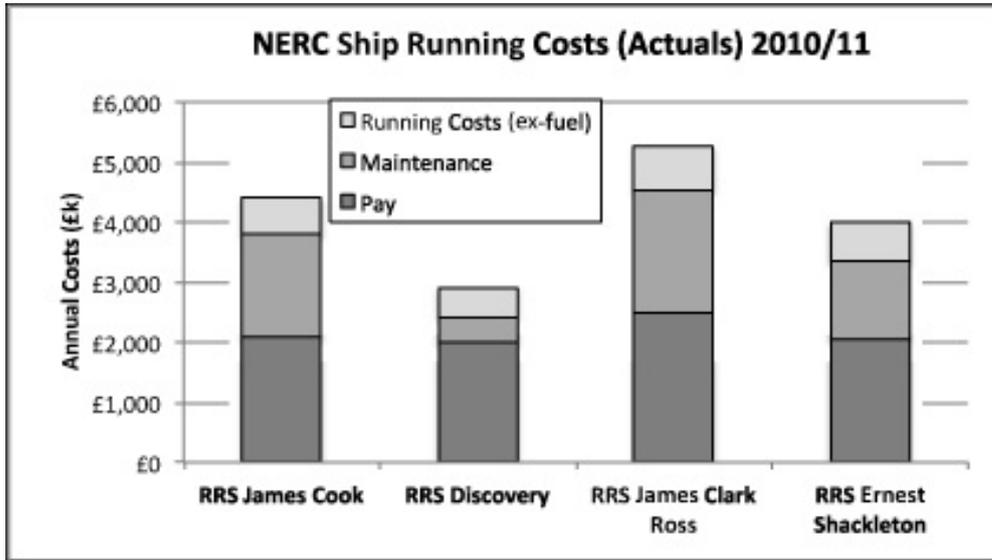


Figure 2.1 Ship Running Costs analysis

(Source: Parliament, 2012)

According to a new survey by international accountant and shipping consultant Moore Stephens, ships operating costs are expected to rise by almost three per cent in both 2014 and 2015, with crew wages likely to increase most significantly by 2.4 per cent in 2014 and by 2.6 per cent in 2015 respectively. An increasing trend of crew costs can also be revealed from a research given by Richard Greiner as shown in figure 2.2.

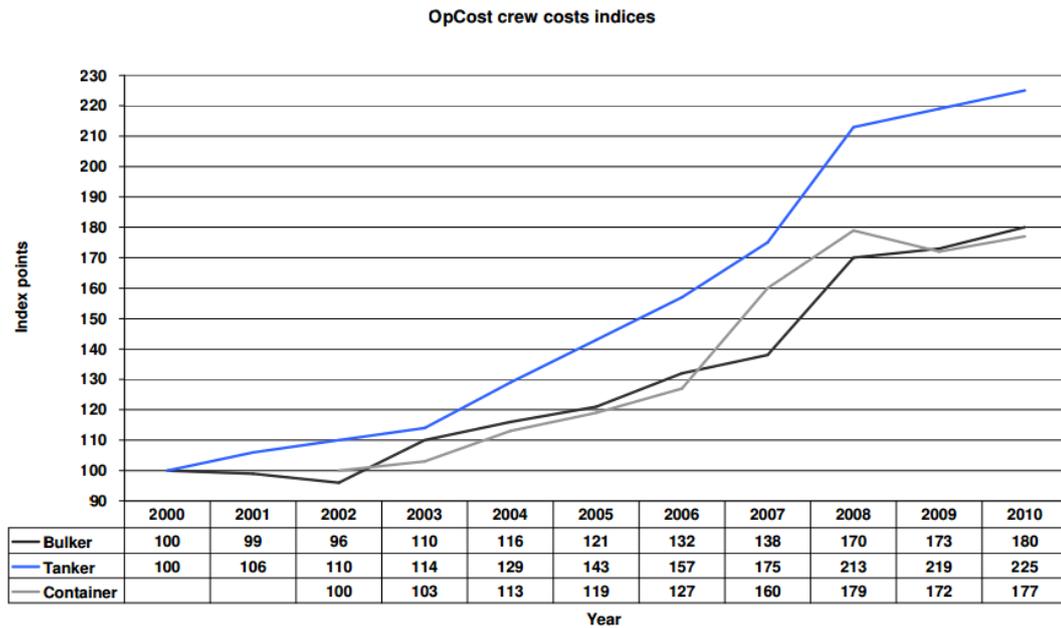


Figure 2.2 Crew Costs Indices—a distinct growth trend

(Source: Greiner, 2011)

And faced with the crew getting away from the recognition by the society, the international communities generally agree to comprehensively safeguard the interests of the crew and improve their remuneration. The minimum monthly basic wage figure for able seafarers has most recently been included in MLC (2006). A continuous increasing trend of the basic wage for able seaman, from 500\$ in 2006 to 592\$ in 2015, can be found from the Recommendation on Seafarers’ Wages, Hours of Work and the Manning of Ships, which was given and updated by a subcommittee of the Joint Maritime Commission of ILO:

Table 2.1 Recommended basic wages of able seafarers

(US \$)

2006	2007	2008	2009	2012	2013	2014	2015	2016
500	515	530	545	555	568	585	592	614

(Source: JMC, 2014)

But the ship owners will probably not be very pleased to pay high wages without any reservations. People usually think that if I pay you more money, of course you should do more work or better work. The payment cost is steadily increasing while the work has not been changed too much, the ship owners will have to find new ways for the corresponding value equal to what they pay. In this case, ship owners will choose the most competent and able seafarers to replace the normal ones without special skills. Employing dual-purpose seafarers will not simply reduce wage costs, actually their payment should be higher than normal seafarers as they have better knowledge and skills, but they can make sure the ships are maintained and managed in good order, which will save maintenance costs and repairing costs.

China used to be well known for the relatively low labour cost. There is no denying that Chinese seafarers, especially those who work on the ships engaged in Chinese near-coastal waters and inland waters are paid relatively at a low level. However, the wages for seafarers (near-coastal waters) have been increased in the new century on the whole, while the seafarers working on ships sailing in inland waters still stay nearly unchanged at the same time. Some people believe that it is the oversupply of

seafarers that leads to the low wage standards, while some other people have different opinions that the low barriers to entry and no technical content are the root causes of the redundant state of seafarers. Under the condition that the seafarers are over supplied, the competition between them will be intensive. In fact in recent years, the crew certified to work on ships engaged in near-coastal waters will have to wait for boarding for a much longer time than before. In this case, the first requirement for the seafarers is to improve their own abilities and skills.

It is inevitable that the wage of seafarers is going to increase in the future and apparently the crew payment cost has been one of the biggest considerations for running the ships. The application of dual-purpose seafarers will make improvement for their abilities, help them to get the owner's approval, and win the competition in the future.

2.3 Education and training institutions: Training system reform need for cultivating crew with high quality and comprehensive capacities

With the development of economy, the demand for seafarers in China saw an explosive growth in the last decade. Chinese traditional four maritime education and training institutions (Dalian Maritime University, Shanghai Maritime University, Wuhan University of Technology and Jimei University) could not meet the market demand for the crew, thus a number of non-Maritime professional Training institutions began to teach students for becoming seafarers.

Table 2.2 1996-2012 Annual Statistics of Maritime Colleges Enrollment in China

Level Year	Universi ties	College s	Seconda ry school	Two-ye ar maritim e educatio n	Non-Ma ritime Graduat es Training	Corresp ondence course	Total
1996	1325	1211	1910				4446
1997	1521	1353	1544				4418
1998	1560	1563	1590				4713
1999	1912	1933	1381				5226
2000	2067	2813	1373				6253
2001	2637	2225	1051				5913
2002	2855	3453	1387				7695
2003	2955	5280	1468				9703

2004	2869	6401	1153				10423
2005	3271	7959	1462				12692
2006	3702	7973	4155	1951	285	4719	22785
2007	4094	9290	7864	4470	883	5311	31912
2008	4604	9182	15472	7876	1524	5652	44310
2009	4589	11026	18318	5240	1417	5588	46291
2010	4475	12829	23324	5017	1353	6971	53996
2011	5723	13050	15767	4804	1025	3544	43913
2012	5271	9683	7349	2799	485	2573	28160

(Source: China MSA, 2013)

The number of enrollment peaked at 53,996 in 2010, which was more than twelve times of the quantity in 1997, with the explosive growth of non-maritime professional training institutions from 66 in late 1990s to 121 in 2014 (Sun & Yao, 2013). Some institutions focus more on the quantity of graduated students than the quality, and actually their main purpose for setting marine courses is to fill the market vacancy. They have not enough resources and equipment as required by

STCW Convention and can hardly guarantee the quality of the output. Actually, only Dalian Maritime University and Shanghai Maritime University have one dedicated ship separately for the use of teaching and practical training(Bao & Wang, 2012) Although the quantity of enrollment used to increase rapidly and stood at a high level, this kind of ill growth can not be enduring. The quantity jumped dramatically in recent years, one big reason of which is the quality can not meet the requirements of ship owners. Some of the graduates are found to be incompetent or not competent enough for the actual work on board the ship. This situation arouse people's big concern on the quality of seafarers because employing such low-quality or sub-standard seafarers may lead to great loss for ships and goods of great value.

The ability of the seafarers differs mainly due to the different quality of teaching which is related to the factors in the training system including experienced teachers, practice instruments and equipments, teaching methods, authentic training environment and other factors. This difference of quality was not significant when the economic situation is good as the market demand for the crew is high and urgent. However, the current international and domestic economic situation is uncertain and not optimistic anymore, and the ability of the seafarers, which can become the first priority standards for employment, stands on a new level.

Then how to comprehensively enhance the quality of the seafarers? The answer exists in the training system. One important issue is to ensure that the crew training carried out in those marine institutions complies with both the Conventions and the domestic regulations. More importantly, the training should fit for the development of the shipping industry. With the accelerating update of technology, marine equipment becomes more and more advanced, integrated and complex. We must attach great importance to the continuous change of equipment and knowledge,

ensuring that the seafarers' abilities can adapt to the development and avoiding potential technical risk resulting from human factors. The new requirements of the STCW convention call for training in the use of modern ship equipment. Even though some of the standards incorporated in the Convention were set many years ago and ship technology is even more advanced nowadays, there is still a large gap between the real practical ability of the seafarers we have and the high quality seafarers we need.

The training system should not only be rectified by continuous updating knowledge and skills which are found to be expensive and time-consuming for seafarers, but the system itself should also get reformed for the better and further development, and also for the survival in the competition. As the deck/engine department division has not changed and the crew number has been reduced, the seafarers are assumed to take more responsibility and become more independent when solving problems. Under such a situation, the training mode which is set to train seafarers to work for deck or engine department respectively, needs to be reformed to some extent for more effective and concrete control of safety over the ship. By developing multiple purpose seafarers or dual-purpose seafarers, the quality of seafarers can be greatly enhanced, and the quality rather than quantity is the obligation for maritime education and training institutions.

2.4 Seafarers: The motivation from seafarers' own career development

Arising from the reduced crew size on new ships that are designed and built with advanced technology, it has become necessary to enhance the seafarers' abilities to meet higher requirements under the new situations. General purpose ratings and dual-purpose (deck and engine) officers with additional skills will replace those with fewer skills (Brook, 1989).

On one hand, it is foreseeable that the competition will be more intense for the seafarers. It was estimated that at least 40,000 Chinese seafarers holding unrestricted certificates worked on ships engaged in Chinese near-coastal waters rather than foreign ships overseas in 2013 (China MSA, 2014). Even though they wanted to find work on foreign ships which would bring a much higher salary, their abilities might not afford them to do so and only those who acquire more knowledge and skills can come to the fore talents. Compared with seafarers holding single purpose certificates, dual-purpose seafarers are more competitive when working on land and can play a great role to provide more assistance to colleagues because of their comprehensive knowledge and ability. So, joining in the training courses and become a dual-purpose seafarers will be a good choice for their own benefits. And for the graduates from the training institutions, they will have a wider range of choice when they work on board the ship and will easily get recognition by the colleagues on board, making their career started smoothly.

On the other hand, developing dual-purpose seafarers will help them to get jobs onshore. Maritime professionals have always had a tendency to look for good job opportunities on shore for longing for a more settled life with their families after sailing for certain years (Singh, 2013). In former times most seafarers spent their whole life in the profession at sea and only illness or an emergency forced them to get a shore-based job. But today it is very different than before; they end the seafarer's career mostly after a few years of working at sea (Peters & Neumann, 2014). And the reasons are various, such as health problems, care of family, desire of further career development, lack of respect and other reasons.

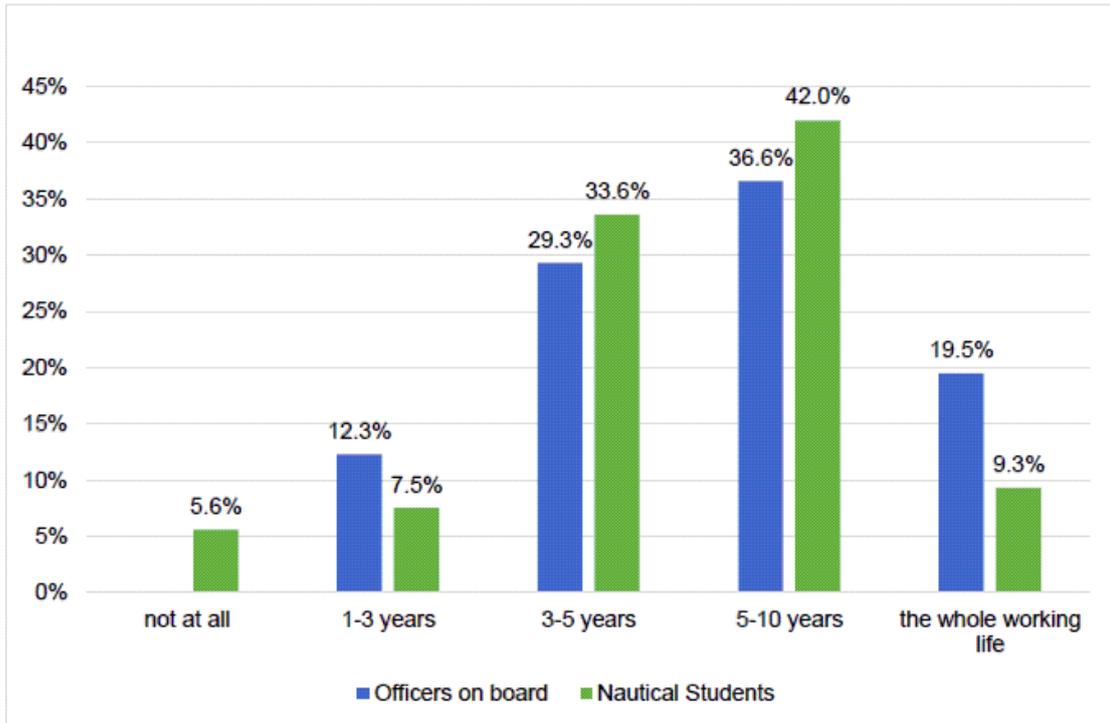


Figure 2.3 Expected stay in the profession of a seaman of nautical students and officers onboard

(Source: Peters & Neumann, 2014)

Although companies that run merchant ships require trained people who can operate and maintain the ships, the seafarer holding an officer certificate may realize that it is very difficult to find jobs onshore since the vacant posts are not so many while the special profession as a seafarer brings a large restriction for working in the places far away from the ship. Same situation may occur for seafarers working in engine department but the difficulty level is much lower. This is because the engineering department of the shipping company, being busy with all kinds of issues like handling the applications for spare parts, oil, materials, labour supplies, etc, supervising the repairing and maintenance of ships, developing and supervising the operation plans for the ship, etc, usually has a bigger demand for high-experienced

seafarers of management level than deck department. The onshore career path for deck officers, on the contrary, is much narrower because most of the work related to deck department, which is key for the safety of the ship and no one dares to delay, has already been properly handled on board the ship. Besides, the captains who are promoted from deck officers and authorized with unique powers will deal with most of the management and communication issues on board the ship, leaving the onshore department with respect to their professions less work to do.

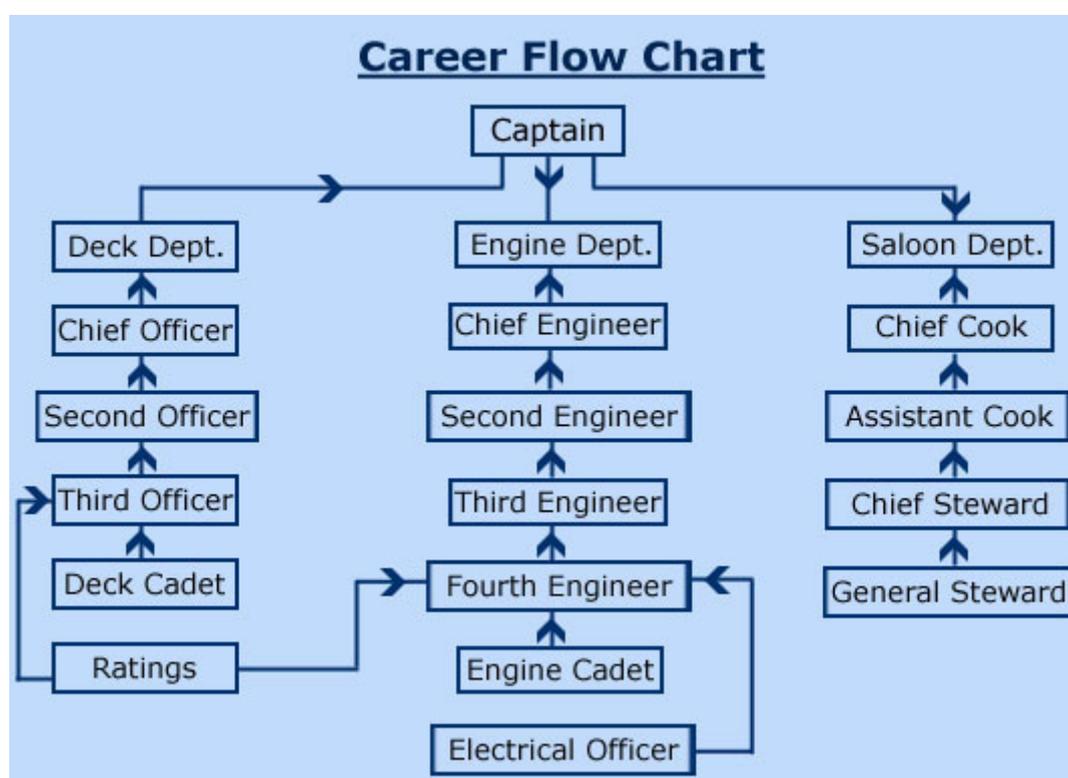


Figure 2.4 Normal career flow for seafarers in “Merchant Navy” company

(Source: STM-academy, 2015)

Benefiting from dual-purpose and the experience in different departments, they will have a wide range of choice for the next occupation after the career of working at sea.

And the shipping companies will absolutely be very glad to employ those who are familiar with both deck department and engine department because of the comprehensive experience which is widely considered as a key asset as a seafarer.

2.5 Country: National interests and dispatch strategies

In 2013, China dispatched 119,316 seafarers aboard, among which the biggest three proportions of the positions are “the other seafarers” (i.e. waiters, kitchen workers) with 37,258 persons, “able seaman” 20,885 persons and “able oiler” 14,367 persons as shown in figure 5, leaving officer assignment fewer than 50,000 persons (China MSA, 2014). Considering that Chinese seafarers market is so huge with nearly 420,000 seafarers able to work for international trading ships, the proportion is just approximately 11% of the total seafarers. And from another viewpoint, we can obviously figure it out that the majority of dispatched seafarers belong to support level or people with low-technology requirement.

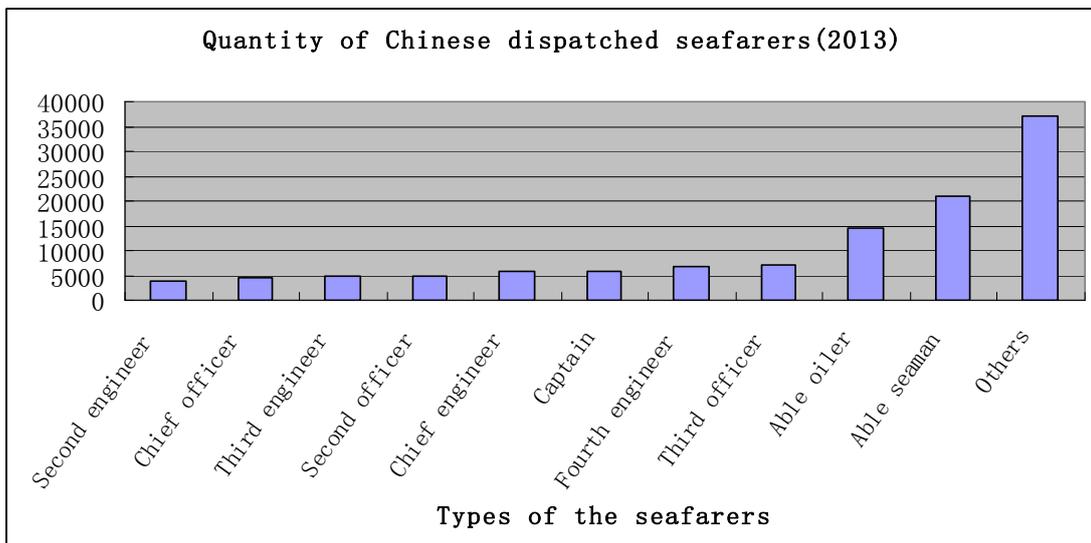


Figure 2.5 The quantity of Chinese dispatched seafarers in 2013

(Source: China MSA, 2014)

And from more detailed analysis, we can find out that the majority of the dispatched seafarers are sent to ships flying Hong Kong, Singapore and Panama flags usually with a team of entire Chinese seafarers operating the ship.

Of course there is a big gap for improvement with regard to the dispatch of seafarers of operational level and management level because officers are generally found to be in a shortage condition on a global scale. The Baltic International Maritime Council (BIMCO) working together with the International Shipping Federation (ISF) has been conducting research studies on marine labour market since 1990 and releases an update every five years. Earlier in the BIMCO/ISF 2005 report, the issue of seafaring shortage was identified as a global issue, while the most recent report still highlighted that crewing would be likely a future challenge as the market with a continuing tight condition would lead to recurrent shortages for some officers (BIMCO/ISF, 2010). In an increasing competitive global market, skilled manpower is becoming a rare commodity, and it is not surprising now that the maritime sector is feeling the heat as well (Fang, 2007).

Chinese seafarers are likely to get a booming increase on dispatch of high quality seafarers. One reason is that the global demand for officers forms a stable driven force for seafarers output, and the situation that shipping companies get more and more interested in flying convenient flags also contributes to dispatch development. As more and more ships choose to fly convenient flags which have no restrictions on the manning of seafarers from other states, seafarers from some countries, China for instance, will have certain advantages as they have been famous for relatively low wages. The attitude of Chinese government on the seafarers dispatch is also encouraging for the prospects, which is another reason. Dispatch has a lot of benefits like increasing foreign exchange earnings, reducing domestic employment pressure,

enhancing influence on ship owners and so on. China has always been trying to expand the scale of crew dispatch, which makes great profit on one hand and reduce the domestic employment pressure on the other hand. But the present dispatch situation is embarrassing with the majority of the seafarers dispatched aboard belong to support level.

Table 2.3 Status of the top 10 seafarers dispatch countries

	Management level		Operational level		Support level	
	Country	Proportion(%)	Country	Proportion(%)	Country	Proportion(%)
1	Philippines	20.8	Philippines	37.6	Philippines	50.6
2	Ukraine	10.5	India	8.6	Ukraine	6.2
3	Poland	8.3	Ukraine	8.4	India	5.2
4	Russia	8.3	Russia	6.2	China	4.8
5	India	7.2	China	5.7	Indonesia	4.1
6	Croatia	5.0	Poland	4.5	Poland	3.9
7	South Korea	4.6	Indonesia	3.9	Burma	3.4
8	China	4.2	Burma	3.3	Russia	3.2
9	Indonesia	3.7	Romania	3.0	Latvia	1.9
10	Romania	2.8	Croatia	2.6	Romania	1.9
Sum		75.4		83.8		85.2

(Source: Gu, 2006)

In fact, the wages for seafarers of Chinese coastal waters keep on increasing in the last decades, although the salary for cadets and officers of operational level saw a significant decrease a few years ago. As the average salary of Chinese crew keep increasing, the traditional advantage of low wage level is not very significant

compared with seafarers from other Asian countries like Burma, the Philippines, etc. People have to find new ways in winning the competition in the global seafarer labour service market and how to improve the dispatch situation of Chinese seafarers also becomes a big issue for the government. By developing dual-purpose seafarers, Chinese seafarers are more likely to be recognized by the foreign ship owners, who have a great power on the decision of employment. Once recognized by the foreign ship owners, the education/training for dual-purpose seafarers will be stimulated and get more supports, and the seafarers will get further development.

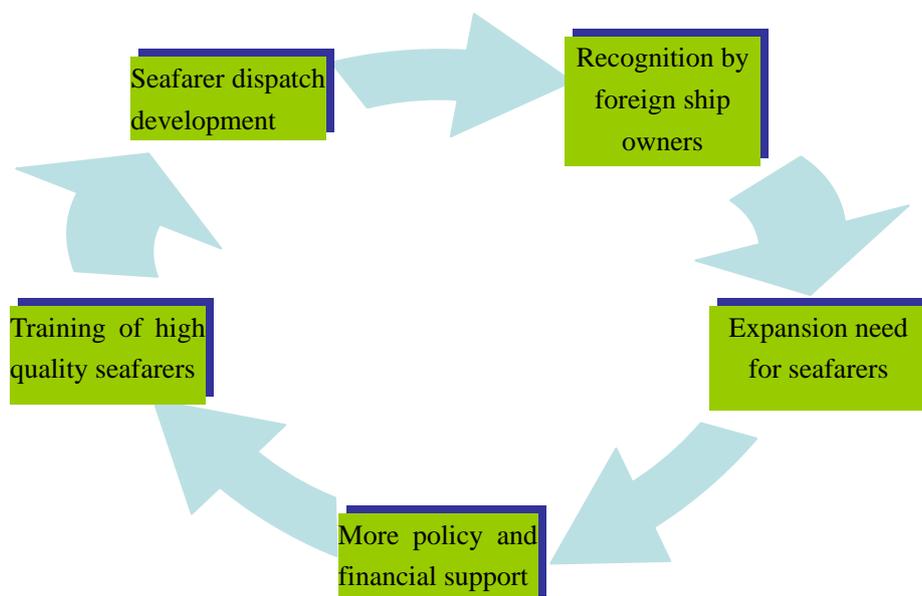


Figure 2.6 A virtuous cycle in the training of high quality seafarers

(Source: author)

Dual-purpose seafarers, with the capability of working in both deck and engine departments, represent a kind of high quality seafarers who are designated to occupy the main position of the seafarers market in the future. And as Figure 6 shows, the high quality of seafarers will lead to larger quantity output because of better

competitiveness (apart from the influence factors such as domestic need, special situation, salary difference and so on). And recognition and influence will get developed to support the further improvement of the seafarer quality.

2.6 Brief Summary

With the development of shipbuilding technology and advanced automation degree, ship manning number reduces gradually, while the demand for high-quality and multi-functions crew is still on the rise. Facing the fierce competition with colleagues from no matter the same country or other countries, dual-purpose seafarers can be seemed as a prospective sort of seafarers conforming to the development in the shipping industry and labour supply-demand market. In fact, the so called shortage of seafarers is very much related to officers or seafarers of management level and operational level as classified in the STCW Convention (Wu, 2011). Not only the ship owners are clear of it, but also the institutions and the governments are trying to enhance the quality of seafarers and develop seafarers dispatch strategy.

The application of dual-purpose seafarers can improve seafarers' own qualities and competitiveness which is welcomed by ship owners as well as shipping companies. Seafarers' career paths will also get broadened because of the acquaintance of comprehensive knowledge consisting of different departments. Equally importantly, China is a country with abundant human resources, which encourages the application of dual-purpose seafarers to become preemptive in the international seafarers service market. All of these benefits lead to a same signal: China needs to develop dual-purpose seafarers.

CHAPTER 3 DIFFICULTIES, FEASIBILITY AND INTENTION IN DEVELOPING DUAL-PURPOSE SEAFARERS

Although dual-purpose seafarers have been proved to be useful and effective for the work on the ship and the global shipping industry has a strong demand for such high quality seafarers, there is still some resistance coming from the existing system or deviation from the designed purpose which will prevent dual-purpose seafarers from becoming popular and widely adopted.

3.1 The difficulties and resistance when developing dual-purpose seafarers in China

Well developed in many countries such as France, the Netherlands, America and so on, dual-purpose seafarers can be considered as a good and future choice for the shipping market. Among Asian countries, Japan is another good example to have adopted dual-purpose training. However, their experience and training mode can not be so simply copied into China because every country has its own features. Developing dual-purpose seafarers in China is a huge project which needs the cooperation from many related bodies. Some difficulties when developing them will need to be highlighted here. The whole training system, manning regulations, crew personnel arrangement will need be upgraded with the cooperation from government, shipping companies, training institutions and seafarers. And the main difficulties in developing dual-purpose seafarers can be summarized as following:

- ✓ Lack of cooperation from some shipping companies

- ✓ The training system upgrade for new training tasks
- ✓ The re-edit of teaching materials
- ✓ The coexist of traditional seafarers and dual-purpose seafarers on the ship
- ✓ The management for dual-purpose seafarers in shipping companies
- ✓ The legal issues related to the adoption of dual-purpose seafarers
- ✓ The conversion between traditional seafarers and dual-purpose seafarers

Anyway, profit is naturally the most significant driving force for any reform in the market economy, and the choice for shipping companies to hire dual-purpose seafarers or not to hire them depends largely on which kind of strategy will bring them with more profit. Some ship owners may remain reluctant in developing dual-purpose seafarers because that will lead to an increase of training cost which will be probably paid by them finally. And it is undeniable that insurance for the ship and cargo stimulates them to look for more profit regardless of the potential risk resulting from employing low quality seafarers.

We should overcome the shortsightedness as focusing on short-term profit or sticking to old ways. It is foreseeable the manning level will be compressed further with the development of electronic and auto level in ship's running and only those men of many-sided abilities can win the favor of the future seafarer service market.

3.2 Feasibility analysis of dual-purpose seafarers in China

Obviously there are some difficulties in the application of dual-purpose seafarers and more importantly they are new to China so many people will have questions: Are

they really needed for Chinese shipping industry? Isn't it a waste to employ such seafarers as part of the skill of the crew is not needed under the present division of work mode? Who will take the responsibility of possible chaos in the practice? These are aspects that we must consider and think over, and we can still see positive prospects in developing them.

Firstly, the training system for dual-purpose seafarers, which already exists in many countries, is significant as a reference for the Chinese domestic seafarers educating and training system. The key factor in the application of dual-purpose seafarers is how to effectively carry out the training for seafarers. Since we can learn it from other countries, there will be less resistance in the adoption of dual-purpose seafarers.

Secondly, China had similar experience as to the marine courses adjustment. In early 1990s, four marine courses at that time in China, namely marine navigation, marine engineering, electrical management and communication navigation emerged, leaving the former two existing until now. The processes for implementation, which is comprehensively related to the maritime administrations, maritime universities & training institutions, shipping companies and seafarers, were found very smooth and effective. Besides, Integrate Sea-River Competency Certificates of Seafarer, which allow the seafarers to successfully work on the ship sailing via sea to Yangzi River, vice versa, are keenly discussed nowadays. Under this programme, seafarers can get three certificates after a single kind of education/training: degree certificates, CoCs of inland water seafarers and marine seafarers' CoCs. These efforts are very important reference or experience, which will help carry out dual-purpose education, training and certification.

Thirdly, the hardware and software for the application of dual-purpose seafarers are

already prepared. On the one hand, as the quantity of candidates studying marine courses is getting smaller in recent years while the equipments and professional teachers are maintained properly as required by the maritime administrations, the training equipments and teachers of the maritime training institutions in China can no doubt meet the training requirements for dual-purpose seafarers. On the other hand, the maritime administrations in China, managing more than a million seafarers in China, have a very sound experience in terms of seafarer management and will not be clumsy when dealing with such issues.

In a word, the related organizations have the ability to carry out training, certification, management for dual-purpose seafarers and other aspects in developing dual-purpose seafarers in China. The only work is to make it happen.

3.3 Aim of developing dual-purpose seafarers in China

Although we have the ability to prepare and develop dual-purpose seafarers in China, the situations may change inconsistently as expected. This policy may be used deriving from the original purpose or even misused for other reasons, the most common of which are to reduce the crew on board the ship and to make improper arrangement of watchkeeping. For instance, it is provided by Ministry of Transport (MOT) of China that the captain and chief mate, the chief engineer and second engineer shall not disembark at the same time on seagoing ships of 500 gross tonnage and above (or 750 kilowatts and above), and on ships of 600 gross tonnage and above (or 441 kilowatts and above) sailing in inland waters (The ministry of transport of PRC, 2004). In this case, a seafarer holding a dual-purpose certificate, for instance, for competence of both a captain and a second engineer, can not represent the role of captain and second engineer at the same time.

The purpose of developing dual-purpose seafarers is to allow the shipboard organization to be in line with modern technological developments and to open up a new career path for seafarers (Guide, 2012). And according to Regulation VII/3 of STCW Convention--Principles governing the issue of alternative certificates, it shall not be used to reduce the number of seafarers on board, nor to lower the integrity of the profession or “de-skill” seafarers. Besides, it should not impair the existing social system as to justify the assignment of the combined duties of the engine and deck watchkeeping officers to a single certificate holder during any particular watch.

But it is not strange to see a seafarer work as an officer on duty of bridge in a narrow waterway and change into an engineer when the ship is berthed and do some routine maintenance work or repairing in the engine room. This is the fascination of dual-purpose seafarers indeed: occupying little resource and figuring out much work.

CHAPTER 4 THE IMPLEMENTATION OF DUAL-PURPOSE EDUCATION/TRAINING

It has already been described above that the application of dual-purpose seafarers is a good and future choice fit for the development trend of maritime shipping and seafarer service market, and we are confident to see it come true in the future. To take it further, once dual-purpose education/training is adopted by Chinese government, a key issue is how to properly implement this mode for the cultivation of high quality seafarers. This is essential for ensuring the quality and effect of products of the institutions. Of course the cooperation with education/training institutions is necessary and moreover, we should try to find the most optimized method in implementation to make a smooth change from traditional seafarers to dual-purpose seafarers.

4.1 An example of present Maritime Education and Training in China

With the development of marine technology, the two inter-related courses, namely marine ship maneuvering and communications & navigation of marine ships were integrated, same as the integration of management of marine engineering and marine electrical management. STCW Convention also cancelled the positions of electrical engineer and radio operator, which are formed in accordance with the marine electrical management and communications & navigation of marine ships courses respectively. In 1993, the National Education Commission of China carried out a new round of specialty directory revision work, after which marine ship navigation and marine engineering management were specialized in ship navigation and

electrical management in DMU.

From then on, DMU began to arrange 120 weeks of theory courses and 33 weeks of practical training for marine navigation students, and 110 weeks of theory courses and one year of practical training for marine engineering students, according to the 4-year education programme and target (Hong, 2014). Both of the two specialties put more emphasis on English education and practical training for better familiarity with the real working environment and more competent performance of the duty work. The courses set in DMU can be found in Table 4 and Table 5 as following.

Table 4.1 The main marine navigation courses set in DMU

Categories	Name of courses
Public courses	English, Morals and Ethics, Military theory, etc.
Basic theory courses	Advanced mathematics
	University Physics
	Physical experiments
Basic technical courses	Computer Fundamentals
	Axiomatic basis for computer programming

	Electrical engineering
	Machine drawing
	Navigation Mechanics
	Navigation specialized mathematics
	Radio technology
Major courses	Principle of naval architecture
	Introduction to marine engineering
	Nautical conversation and assessment
	Nautical English reading
	Seamanship training
	Flag signal & VHF COMM
	Marine navigation 1
	Marine navigation 2

	Marine navigation 3
	Navigational Meteorology and Oceanography
	Vessel Watch-keeping & Collision prevention
	The carriage of goods by sea
	ECDIS
	Safety management of the ship
	Nautical instrument
	Navigation Radar & ARPA
	GMDSS Equipment & Communication
	Ocean shipping business and Maritime Law
Practical courses	Passage planning
	Cognition Practice
	Graduation field work & project

	Basic safety and competence certificates training
	Stowage and securing of goods
	GMDSS equipment operation
	Radar observation and plotting/ARPA

(Source: Hong, 2014)

Students are required to have a good understanding and practice on "navigation", "cargo handling and stowage", "controlling the operation of the ship and care for persons on board " and "radio communications" functions of operational level and some knowledge of management level as described in STCW Convention.

Same as marine navigation major students, the students of marine engineering major are cultivated to engage in marine engineering operation, maintenance and supervision, and supervision and building work in marine transportation enterprises with the knowledge of mechanical principle and marine engineering system in accordance with “marine engineering”, “electrical, electronic and control engineering” and “maintenance and repair” functions. There are still some limited optional courses like basis of hydraulic device, principle of naval architecture, inspection to the ship& offshore facilities, etc, which will help the students to form a complete understanding of the work on the ship.

Table 4.2 The main marine engineering courses set in DMU

Categories	Name of courses
Public courses	English, Morals and Ethics, Military theory, etc.
Basic theory courses	Advanced mathematics
	Linear Algebra
	University Physics
	Physical experiments
Basic technical courses	Computer Fundamentals
	Axiomatic basis for computer programming
	Modern monitoring technology of the engine
	Descriptive geometry & machine drawing
	Basis of Mechanical Designing
	Electrical engineering
	Engineering Mechanics

	Engineering fluid mechanics
	Engineering material
	Engineering thermodynamics
Major courses	Marine engine
	Marine auxiliary engine
	Marine automatic
	Technical management for marine power plant
	Marine electrical equipment & system
	Maintenance and repairs of marine engine
	Marine English readings
	Pollution prevention technique of marine ships
	comprehensive knowledge of marine engineering(1)
	comprehensive knowledge of marine engineering(2)

	comprehensive knowledge of marine engineering(3)
Practical courses	engineering curriculum design
	Cognition Practice
	Graduation field work &project
	Basic safety and competence certificates training
	Marine engineering comprehensive experiment
	Dismounting practice
	Marine engine simulator training

(Source: Hong, 2014)

4.2 Implementation of dual-purpose education/training

Simply speaking, dual-purpose seafarers have one more kind of competency related to a department other than the one they are already engaged in. Generally, we can find two ways in implementing dual-purpose education/training: the separate education/training which allows teaching marine navigation courses and marine engineering courses respectively, and the integrated one which merges the two courses together. The former one means that the candidates have to learn marine

navigation courses and marine engineering courses one by one and should be competent for both deck and engine department before the issue of dual-purpose certificates. And the latter one, as the name implies, the candidates will learn an integrated course which concludes marine navigation and marine engineering knowledge as described and required according to STCW Convention.

It should be put with more emphasis that both of these two ways need to meet the qualification requirements, such as minimum age, health condition, approved seagoing service etc. before applying for the dual-purpose certificates.

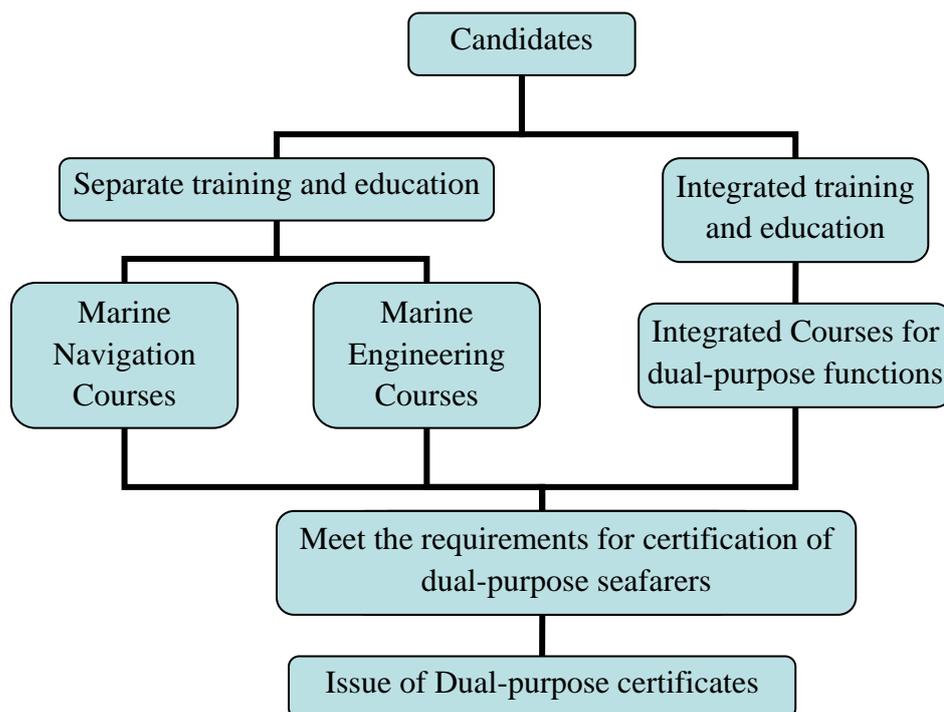


Figure 4.1 Graphic expression of dual-purpose education/training

(Source: author)

The separate education/training is based on the existing MET system; therefore it does not require much change to the whole training/education, examination and certification procedure. The institutions will just need to do what they are doing now and the seafarer, after attending the approved courses, passing the examinations and meeting other qualification requirements, can apply for another function of certificate other than what he/she holds. This mode is simple and easy to be carried out, but the shortcoming is obvious: it nearly doubles the courses and will take a quite long time for seafarers in certification and promotion, and therefore it will probably not be welcomed by either the seafarers or the ship owners. However, as this mode is closely linked with the existing system and existing certificates, it can be used for adding the functions described on the existing certificates for seafarers.

The integrated education/training mode combines marine navigation courses and marine engineering courses together. Actually, these two courses have some overlaps since crossover operation and cooperation are often required for the two professions when finishing certain tasks. So it is an optimized way for dual-purpose education carried out in maritime universities and colleges. By implementing in this way, the overlap courses will be integrated and the length of maritime education will be shortened, thus it is more adaptive to China's maritime education reality.

4.3 Module structure of dual-purpose Maritime Education/Training

To clarify the linkage between the alternative certification provisions of chapter VII and the certification provisions of chapters II, III and IV, STCW Convention specifies the standards of competence into seven functions and the responsibilities into three levels as mentioned in 1.2. This specification plays an important role in the curriculum arrangement.

Obviously, the present marine navigation courses are set in accordance with four functions as specified in STCW Convention and marine engineering courses are set to cover the rest three functions. In other words, the courses are set under the basis of the specification of seven functions. Therefore, in principle, we can have the option of training people qualified in seven functions as a whole; this can be seen as the original thought on dual-purpose training. More encouragingly, it won't last for twice the time as required for every traditional seafarer, because as shown in Table 4 & Table 5, most of the public courses and basic theory courses for both marine navigation and marine engineering are under an overlapping condition and even some of the major courses and practical course can be found with some similarities. This is favorable for the adjustment of dual-purpose education/training.

The overlapping courses will be reserved and independent courses will be merged into a more reasonable and sounder programme, which can be adjusted and split up into modules with a syllabus attached to each module as shown below.

Table 4.3 Module structure for dual-purpose education/training

Module	Main courses included	Aim of the courses	Length of the courses
Naval architecture & ship nautical/power equipment	Naval architecture Introduction to marine engineering Engineering Mechanics	Help students to establish comprehensive understanding of the ship and	1 semester

	<p>Fluid mechanics</p> <p>Engineering material</p> <p>Engineering thermodynamics</p> <p>Navigational Meteorology and Oceanography</p>	<p>equipments and acquire basic skills for ship's operation</p>	
Deck & engine management	<p>Modern monitoring technology of the engine</p> <p>Maintenance and repairs of marine engine</p> <p>Resource Management</p> <p>Seamanship training</p>	<p>Help students to undertake operational/managerial tasks regarding the day-to-day operations on board a ship</p>	1 semester
Advanced technical & electro-technical engineering	<p>Electrical engineering</p> <p>Marine automatic</p> <p>Marine engine</p> <p>Marine auxiliary engine</p> <p>Machine drawing</p>	<p>Help students to obtain the knowledge of major technical plants in relation to the safety, operation, economic, environment and</p>	1 semester

		maintenance	
Ship's operations, technical & administration	<p>Navigation Mechanics</p> <p>Navigation specialized mathematics</p> <p>Mechanical Designing</p> <p>The carriage of goods by sea</p> <p>Navigation Radar &ARPA</p> <p>Vessel Watch-keeping & Collision prevention</p>	Help students to acquire the skills in operation and management for the safety of life, goods and the ship	1 semester
Communication & navigation	<p>Marine English readings</p> <p>Nautical conversation and assessment</p> <p>Radio technology</p> <p>Flag signal &VHF COMM</p> <p>GMDSS Equipment & Communication</p>	Make sure the students acquire the skills required in oral and written communication in English in order to attend to his/her duties	0.5 semester
Electrician's	Marine electrical equipment &	Help students to	0.5

authorization & Electric power plant operation	system Technical management for marine power plant	be capable of commissioning and maintaining electric installations and power plants	semester
Ship management	Safety management of the ship Ocean shipping business and Maritime Law Pollution prevention technique of marine ships	Help students to acquire the skills required for taking charge of managerial tasks	0.5 semester

(Source: author)

Table 6 indicates the main major courses required for dual-purpose education/training, which account for 5.5 semesters in total, and the practical education/training will also take 0.5 - 1 semester to finish according to practical needs. As Chinese best marine education/training recourses exist in limited few universities and institutions which are also coupled with the degree of education with teaching basic theory knowledge and public courses required by the Ministry of Education in China, it should be mentioned here that the total length of the major will take approximately 4 years.

Although specified in a different view, the module of dual-purpose training together with the courses as shown in Table 6 are still closely related to the seven functions.

To put it into practice, we can use the modules to carry out dual-purpose education/training. For example, the requirements for passing the junior officer examination as dual-purpose seafarers are to complete the education/training of:

- ✓ Naval architecture & ship nautical/power equipment
- ✓ Deck & engine management
- ✓ Ship's operations, technical & administration
- ✓ Communication & navigation

Similarly, advanced technical & electro-technical engineering, electrician's authorization & electric power plant operation training should be completed before passing engineer examination in accordance with the specifications.

For the education/training of seafarers of management level, more management courses, especially on ship management, should be added.

CHAPTER 5 QUALIFICATION REQUIRED FOR DUAL-PURPOSE SEAFARERS

Same as seafarers holding single purpose certificates, the dual-purpose seafarer should be capable of taking charge of all required operations on board a ship and performing the tasks in consideration of existing rules and standards for marine safety, environmental protection and occupational safety. In addition, dual-purpose seafarers should be competent no matter in deck or engine department and therefore they are required to satisfy more requirements.

STCW Convention provides that the contracting states have the option to issue or authorize the issuance of certificates which are different from those mentioned in Chapter II & Chapter III. But it should be pointed out that the issue of such certificates shall ensure that the associated functions and levels of responsibility to be stated on the certificates and in the endorsements are consistent with the provisions of Chapter II & Chapter III. As prescribed in the STCW Code, the candidates applying for this new kind of certificates shall complete approved education and training, and meet the requirements for standards of competence for the functions and levels in the certificates. Besides, these candidates shall complete approved seagoing service appropriate to the performance of the functions and levels that are to be stated on the certificate.

Competency examination is a mandatory requirement before applying for the certificate of competence (CoC) and the certificates of proficiency (CoP). The examinations are set to check the candidate's ability of understanding the nautical

knowledge and practical ability respectively (MOT of PRC, 2011).

5.1 Basic training

For emergency, occupational safety, security, medical care and survival functions, basic safety training, comprehensive professional training and security training are required for all seafarers or officer in particular provided in STCW convention. Just like any other seafarers working on the ship, dual-purpose seafarers should complete such training courses for guaranteeing the competence of the real work on board the ship. Candidates are required to finish certain training courses and pass designated courses set by the Maritime Administration before being issued related certificates of competence, or certificates of proficiency when necessary.

5.1.1 Basic onboard training

All of the seafarers working on the ship are required to complete STCW 95 basic onboard safety training courses, covering personal survival techniques, fire prevention and fire fighting, elementary first aid and personal safety and social responsibilities, and hold the basic safety training certificate.

Table 5.1 Comparison of basic security training courses between IMO and China

Item	Length of IMO Model Course (Hours)	Length of courses set in China(Hours)		
		Theory	Practice	Sum

Personal survival techniques	13.25	16	8	24
Fire prevention and fire fighting	15	16	8	24
Elementary first aid	15	14	7	21
Personal safety and social responsibilities	14	24	6	30
Total	57.25	70	29	99

(Source: IMO & China MSA, 2015)

It should be highlighted here that according to the Seafarers' training management rule of PRC, the total course will take at least 17 days in completing the above courses (including training and examination) on the basis of the maximum training hours (everyday at most 6 hours of theory course or 8 hours of practice course) required by China MSA (Gong & Qi, 2014) And the time consumed is approximately 73% more than it spent in the IMO Model Course. However, many of the candidates are university or college graduates who have a very good understanding of knowledge with sound marine background information, and they should not have to spend so much time in learning the basic security training courses. In the author's opinion, this situation needs to be rectified as to reduce practice time in "personal safety and social responsibilities" course and reduce theory teaching time in other

three courses.

As Manila amendment to STCW convention added some new content like "Marine environmental protection basic knowledge", "effective communication on board", "team work", "understanding and measures to control fatigue", etc. into the minimum competency standards, the "personal security and social responsibility" course is mandatory to get refreshed for those seafarers already hold the basic security training certificate issued according to former edition of STCW convention.

5.1.2 Comprehensive professional training

Before taking charge of the officer position, the seafarers are required to complete advanced training referring to Medical First Aid and Medical Care, Advanced Fire Fighting, CPSC & RB (Proficiency in Survival Craft and Rescue Boats) and Designated Security Duties training programme.

Certificates will be issued to the seafarers after finishing these training courses. If the trainings are not included in the qualifications for the certificates to be issued, certificates of proficiency shall be issued indicating that the holder has attended such courses of training.

5.1.3 Ship security training

All seafarers including dual-purpose seafarers shall receive security-related familiarization and security-awareness training or instruction in accordance with the STCW Code and meet the appropriate standard of competence described in the convention. And seafarers with designated security duties are required further related training.

For the dual-purpose seafarers who are going to work as ship security officers, they are required to complete ship security officer training and hold the certificate of proficiency for ship security officers.

5.1.4 Training for dual-purpose seafarers

From the training requirements described in 5.1.1-5.1.3, it is clear that all seafarers will need to complete basic security training and security-related familiarization and security-awareness training or instruction. As dual-purpose seafarers will take the position of officers or engineers, they are required to complete Medical First Aid, Advanced Fire Fighting, CPSC & RB (Proficiency in Survival Craft and Rescue Boats) and Designated Security Duties training programme as required in addition. Besides, if they are in charge of the bridge watchkeeping duties, they should complete GMDSS (Global Maritime Distress Safety System) training and get related endorsement on their certificates.

5.2 Approved course of study

The course study plays a major role in maritime safety and in the protection of the maritime environment. In China, such courses are usually carried out in maritime universities or other colleges which are authorized to teach marine navigation and marine engineering courses.

Such maritime education generally couples with the degree of education, which means many basic theoretical courses are introduced except professional/major courses. Normally, people are required to complete four years of full-time study in the universities or three years in the colleges. After graduation, the graduates should pass the competence examinations for confirming they have acquired the

professional knowledge as required.

Obviously, the students should learn two kinds of knowledge including marine navigation and marine engineering which explain the meaning of dual-purpose. Some people are wondering if the length of study will be doubled since the courses are doubled. But according to the characteristics of Chinese academic education, students will probably not be asked to spend more time in learning after the application of dual-purpose seafarers as the marine navigation and marine engineering courses will be compressed. Actually some courses between the two subjects are already set with an overlap condition. For instance, the marine navigation students should learn Basic Engineering course while the marine engineering students should learn Ship Theory course. Adjustment of the courses will be made on the basis of the existing maritime education/training system.

After learning theoretical knowledge with respect to marine navigation and marine engineering, another important issue is practical training after the implementation of dual-purpose education. Much more emphasis on the practical operation was given ever since STCW 95 Convention as people are more convinced that the experience is one of the most important factors in seafarers' abilities. For the proficiency of the ship and learning efficiency, the length of practical training for dual-purpose seafarers should be extended to a proper period. And a training ship is recommended for education/training institutions.

The students should also complete an approved course of study for the appropriate level of qualification and pass a written examination as well as a real ship or simulator assessment to prove that they are capable of all tasks involved in performing his/her duties as a ship's officer/engineer at an operating or management level, including the performance of safety and environment operations. During the

education/training process, all training, assessment of competence certificate issue and the definition of a system of quality standards giving details of objectives and scope is continuously monitored to make sure that the quality is strictly guaranteed.

To avoid waste of money and blind expansion of marine education, it is necessary to start dual-purpose education/training using pilot mode. Once we have confirmed the effects of dual-purpose training, it is time for a wide range of popularization.

5.3 Seagoing service qualification requirements

Before applying for the certificates of the operational level, the candidates should have approved seagoing service of not less than one year 12 months as part of an approved training programme which includes 6 months of onboard watchkeeping under the supervision of qualified watchkeeping officer(s), and their on-board training programme should be carried out thoroughly which meets the requirements of section A-II/1 of the STCW Code and is documented in an approved training record book in accordance with the provisions of STCW (2010).

Similar to applying for the certificates of the operational level, the candidates shall have approved seagoing service before applying for the certificates of management level but the length of seagoing services will be extended and the watchkeeping duties shall be clarified. Usually, the candidates applying certificates with the function of chief officer or second engineer shall have 12 months of seagoing service performing duties at the operational level. If the function of navigation at the management level is required, 12 months of bridge watchkeeping duties shall be satisfied. For candidates applying certificates with the function of captain or chief engineer, the period of seagoing service will need to be extended to 48 months with equally service time in deck and engine department.

China MSA has developed and approved Training Record Books (TRB) for cadets and Practice Record Books (PRB) for management level officers. These record books should be filled in onboard the ship to prove that the seafarers have got the approved experience before certification.

5.4 Physical and psychological condition

Seafarer is a stressful occupation, with long hours working and fatigue often posing problems for them (ITF seafarers, 2015). When you are working at sea, you want to be fit and healthy physically and psychologically. A lack of facilities for exercise, poor nutrition, isolation, smoking and drinking can also be harmful for on-board health which is a basic condition confronting the heavy work on the ship.

Seafarer is also a dangerous occupation which is going to face many potential risks. Apart from accidents, seafarers are prone to certain serious diseases and health hazards due to the nature of onboard work, hazardous/toxic cargo carried, long working hours, epidemic and endemic diseases etc.

5.4.1 Physical condition

Considering the working intensity, a relatively high physical standard is required for the seafarers working on the ship, so the crew should always keep a good physical condition. The followings are some main requirements in the standards of seafarers' physical condition:

- ✓ Age: No less than 18 years old, which means that the seafarer is physically well developed.

- ✓ Vision: Seafarers should meet the standards of distance vision, near vision,

- ✓ Hearing: Hearing capacity for seafarers is essential and identified with standards.
- ✓ Disease: Not having heart/ vascular disease, severe chronic disease, communicable disease and other diseases which will influence themselves or others to perform work.
- ✓ Physical capacity: Clinical assessment of strength, mobility, coordination, etc (International Labour Office, 2013)

5.4.2 Psychological condition

The physical strain of work onboard has shifted to a growing psychological strain because of reduction in manning level which results from the cost control consideration under the support of new technologies. For dual-purpose seafarers the situation can be even worse because they can be set at different positions as necessary and if there is a shortage for seafarers of one department, the companies will probably treat dual-purpose seafarers as alternative backup rather than sending additional seafarers on board as normal.

And the majority of the shipping companies employ multinational crew, which brings along its own set of problems such as language barrier, group formation etc (Kantharia, 2012). These will definitely contribute to psychological problems for seafarers working on board like fatigue and loneliness. Besides, the seafarers could encounter personal or family problems, homesickness, unfriendly working environment, dissatisfaction with people or policies, etc.

On one hand, continuous psychological stress is harmful for the health of seafarers as

it can lead to variety of mental illnesses. On the other hand, it can also lead to reduced work efficiency, reclusive behavior/neglecting interaction with crew members/withdrawal symptoms, negligence towards duties and certain kind of mistakes, which is detrimental to the safety of ships and environment protection and therefore unfavorable for ship owners.

5.4.3 Medical certificate

To ensure that all seafarers are medically fit to perform their duties at sea, dual-purpose should be physically and psychologically fit for their jobs as demonstrated in 5.4.1-5.4.2. For checking and confirming seafarers' physical and psychological condition, medical certificate is introduced in Regulation I/9 and section A-I/9 of the STCW Code.

The crew should implement safety and health policy and programme as delegated to them, fully support shipboard safety and do everything in their power to maintain their own health and safety as well as the health and safety of other people on board (ILO, MLC and ITF Guidance on Health and Safety, 2014).

Working on ships is difficult but not impossible. Through there are some factors leading to physical and psychological stress, seafarers working on ships must take the right attitude to break monotony and improve interpersonal relationships on ships in order to keep their mind and body fit (Kaushik, 2010).

5.5 Operation ability and skills

Beside the preparation such as knowledge, health, professional attitudes, dual-purpose seafarers are required to master much more skills than others. If a candidate wants to add functions of junior officer in his/her dual-purpose certificate,

it is necessary to have professional training objectives to achieve the accurate operation, navigation positioning, ship collision avoidance, the basic skills of ship maneuvering, emergency rescue and ship management and organization of the preliminary ability, and get the route design, stowage operation capability training and integrated navigation, etc.

Besides, they are required to master the use of modern Marine communications and navigation equipment professional knowledge as well as the global maritime distress and safety system the basic knowledge and skills.

Similarly, if he/she wants to add functions of engineers in his/her dual-purpose certificate, he/she should be capable of on duty work in the engine room of modern ships. They should have the basic skills of using testing means to supervise, adjust and maintain the operation condition of the ship's mechanical and electrical equipments. And the preliminary ability of operating marine automation system is also essential as the automation level of modern ships has been improved impressively.

Moreover, they are required to have the basic skills on ship electrical and mechanical equipment maintenance, repairing and schedule maintenance work. Some operations like pliers, welding and machining are often carried out on board the ship thus should be mastered, and some other skills like reading, mapping and calculating mechanical parts, using computer to carry out technical management work are also essential for work in the engine department, which is mandatory to be mastered (Hong, 2014).

It should be pointed out that it is essential to master profession skills for the officers of the competence of work on board the ship, but such skills are not enough for becoming high-quality officers. On the basis of mastering the necessary theoretical

knowledge, seafarers should have a good practical ability, which is widely considered as a more important issue for the competence of work than theoretical knowledge, because the seafarer is a profession of practical operation in essence. What's more, the application skill of English is particularly important in the international seafarer service market, where English is used as the common language for work and communication. Seafarers also have to work hard with pragmatic innovation spirit, law-abiding discipline and solidarity work quality along with certain social and human sciences knowledge, good cultural qualities and healthy psychological quality.

CHAPTER 6 CERTIFICATION SYSTEM

The certification mode for dual-purpose seafarers includes initial issue, renewal, revalidation and endorsement. Every kind of certification mode should meet the requirements for confirming the competence of the candidates and making the whole certification system under control to prevent the appearance of fake certificates or sub-standard certificates.

Generally, the seafarers' certificates are mainly issued by Chinese Regional MSAs and their branches which are authorized by China MSA. In the implementation process, seafarers' file information get recorded, maintained and shared by MSA officers through a wide local area network covering all the authorized certification bodies.

6.1 The administrative structure for certification of dual-purpose seafarers

MOT of China, being responsible for developing and implementing policies, regulations, and standards for water, is the head of the maritime administration system, under which China MSA takes charge of the implementation and administration of the shipping policy, and developing regulations and standards for the training, examination, assessment and certification of seafarers and the manning of ships as well (EMSA, 2013). Meanwhile, 14 Regional MSAs perform those operative tasks including those related to seafarers' education, training and certification.

6.2 Issuance of dual-purpose certificates to new candidates

After confirming the following requirements have been met, the candidates can apply for the initial issuance of dual-purpose seafarers to regional MSA which are authorized of such issuance (MOT of PRC, 2011).

- ✓ Approved education/training;
- ✓ Approved seagoing service with appropriate records;
- ✓ Medical certificate;
- ✓ Examination and assessment get passed;

The difference between the certification of dual-purpose seafarers and of traditional seafarers in deck or engine department exists on the education/training courses and seagoing service, with many similar requirements like medical certificate, basic and comprehensive professional training, etc. They can be treated in the same way as the other kind of candidates on these aspects.

6.3 Issuance of dual-purpose certificates to seafarers with CoCs

If a seafarer has already got his/her certificate of competence as an officer (including captain, deck officers, engineer) and wants to add functions in his/her certificate to enable him/her to work in the department other than the one he/she is now engaged in, he/she should meet the qualification requirements and be issued with a dual-purpose certificate.

In principle, the period of validity will need to be calculated accordingly. However,

the present format of certificate of competency for seafarers of China which has been put into practice ever since July 1st, 2012, does not specify date of expiry according to every function but treats all the functions as a whole (shown in Figure 5)



Figure 6.1 The first page of seafarers' CoC at present

(Source: China MSA, 2012)

Although this trouble can be easily settled by changing the format of the certificate, the difference in date of expiry will also lead to difficulty in certificate renewal and revalidation. Therefore such kind of seafarers, when applying for the dual-purpose

certificates, will encounter with new problems which China MSA should solve in advance with measures for the implementation.

CHAPTER 7 CONCLUSIONS

From the perspective of the trajectory of shipping technology development we can clearly find out a generally dwindling trend on the manning level. The modern ships need to be run by much fewer seafarers than before. With the help of rapid technological progress on automation and electronic control, it is foreseeable that the manning level of the ship will continue to decrease and the ship may furthermore be operated with, in some people's opinion, no crew in the future.

People then pay more and more attention to the quality of existing seafarers who operate the valuable floating assets. It is undoubted that dual-purpose education/training can enhance the quality of seafarer and promote a safe and steady development for shipping companies as well as the whole shipping industry. From the real application effect, dual-purpose seafarers are found to be very useful from the response of ship owners.

Apparently, the barriers to developing them in China can also be overcome. By properly adjusting the courses and controlling the time period of the courses, dual-purpose training may probably come true without totally changing the MET system or largely extending time period for education/training. And China has also got similar experience which will help the application of dual-purpose training, education and certification.

Developing dual-purpose seafarers is generally promising in China. With the cooperation of related parties including China MSA, education/training institutions, ship owners, shipping companies, etc, we can imagine a good future for the real adoption and wide recognition of dual-purpose seafarers in China.

REFERENCES

Bao, J. Z. & Wang, Y.H. (2012). *Examination and Promotion of Chinese Seafarer Education and Training*. Dalian Maritime University. Dalian: Author

Bellis, M. (2015). *Sailing and Nautical Innovations*. Retrieved June 11, 2015 from the World Wide Web: <http://inventors.about.com/od/nstartinventions/a/nautical.htm>

BIMCO/ISF. (2010). *BIMCO/ISF manpower 2010 update: the worldwide demand for and supply of seafarers*. Author: London

Brook, M.R. (December 1989). Seafarers in the Asean Region. *ASEAN Economic Research Unit*, Institute of Southeast Asian Studies in collaboration with Institute of Asian Studies, Chulalongkorn University and Oceans Institute of Canada. p.133

China MSA, (2014). *Chinese seafarers Information Notice (original in Chinese)*. China Maritime Safety Administration. Beijing: Author

EMSA. (2013). *Report on the inspection of the Maritime Education, Training & Certification System in the People's Republic of China in accordance with the STCW Convention*. EU: Author

Fang, N. (2007). Labour shortage could hit booming maritime sector. *Straits Times*. September,8.

Gong, Y.G. & Qi, F.Y. (2014). Comparison of basic security training between China and Foreign countries (original in Chinese). *Navigation Teaching Research*.

Greiner, R. (2011). *Ship operating costs: Current and future trends*. Retrieved June

15, 2015 from the World Wide Web: www.propellerclub.gr/files/Greiner.pdf

Gu, J. W. (2006). Global labor market & Chinese seafarers manning aboard. *World Shipping*. Vol.29, No.1

Hong, S.Z. (2014). The compilation of teaching plan of marine major in Dalian Maritime University (1909 – 2009, original in Chinese). *Marine Education Research* (2014) 04-0092-25

<http://www.itfseafarers.org/ITI-health.cfm>

ILO, MLC and ITF Guidance on Health and Safety. (2014). *ILO, MLC and ITF Guidance about the Health and Safety on board ships*. Retrieved June 10, 2015 from the World Wide Web:

<http://brainserver.net/uploads/dromon/Circulars/2014/C14034 - ILO MLC and ITF Guidance on Health and Safety.pdf>

International Labour Office. (2013) *Guidelines on the medical examinations of seafarers*. International Maritime Organization. Author: Geneva

ITF seafarers. (2015). *Life at sea: Seafarers' health*. Retrieve June 1, 2015 from the World Wide Web: http://www.itfseafarers.org/life_at_sea.cfm

JMC, (2014). *Updating of the minimum monthly basic pay or wage figure for able seafarers: Seafarers' Wages, Hours of Work and the Manning of Ships Recommendation*. Retrieved June 1, 2015 from the World Wide Web: http://www.ilo.org/global/about-the-ilo/media-centre/press-releases/WCMS_236644/lang--en/index.htm

Kantharia, R. (2012). Reasons and Symptoms of Physical and Psychological Stress On board Ships. *Marine Insight*. Retrieved June 10, 2015 from the World Wide Web: <http://www.marineinsight.com/marine/life-at-sea/reasons-and-symptoms-of-physical-and-psychological-stress-on-board-ships/>

Kaushik, M. (2010). Challenges of a Shipping Job. *Marine Insight*. Retrieved June 1, 2015 from the World Wide Web: <http://www.marineinsight.com/marine/life-at-sea/challenges-of-a-job-at-sea-difficulties-of-a-shipping-job/>

Kendall, P. (2013) *The biggest ship in the world*. Retrieved June 1, 2015 from the World Wide Web: <http://www.telegraph.co.uk/finance/newsbysector/industry/10203784/The-biggest-ship-in-the-world.html>

Maritime Knowledge Center. (2012). *International Shipping Facts and Figures –Information Resources on Trade, Safety, Security, Environment*. IMO. London: Author

Maritime Labour Convention (MLC) 2006, ILO, (2006)

MOT of PRC. (2011). *The regulations of marine seafarers' competency examination and certification in PRC*. The Ministry of Transport. Beijing: Author

MOT of PRC. (2004). *The ship's minimum safety manning regulations of PRC*. The Ministry of Transport. Beijing: Author

Parliament. (2012) *NERC National Oceanography Centre Research Vessel Statistics*. Author: London. Retrieved May 31, 2015 from the World Wide

Web:<http://www.publications.parliament.uk/pa/cm201213/cmselect/cmsctech/727/727we09.htm>

Peters, C. & Neumann, S. (2014). Changes in the average length of stay in a mariner's onboard profession and consequences for Maritime Education Universities and shipping companies. *AMET Maritime Journal*

Psaraftis, H.N. (2014). *Reduced manning to increase fleet competitiveness*. *Research Gate*. Retrieved June 15, 2015 from the World Wide Web: http://www.researchgate.net/publication/237720544_REDUCED_MANNING_TO_INCREASE_FLEET_COMPETITIVENESS1

Singh, B. (2013). Can Seafarers Stay Motivated When Planning to Quit Sailing? In: *Marine Insight*. Retrieved May 23, 2015 from the World Wide Web : <http://www.marineinsight.com/careers-2/can-seafarers-stay-motivated-when-planning-to-quit-sailing/>

STCW. (2010). *The Manila Amendments to the annex to the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1978*. IMO. London: author

STM-academy. (2015). *Career Path of Merchant Navy*. Retrieved May 31, 2015 from the World Wide Web: <http://stm-academy.weebly.com/career-path.html>

Sun, P.T. & Yao, W.B. (2013). China's maritime education environment change and development countermeasures (original in Chinese). *Maritime Education Research*. 2013(1)

Wu, Z.L. (2011). The essence of the shortage of officers and the response of our

country (original in Chinese). *Maritime Education Research*. 2011(1) :1—4.

BIOLOGY

Glen, D. (2008). What do we know about the labour market for seafarers? A view from the UK. *Marine Policy* 32 (2008) 845–855

ITF. (2013). *STCW: A guide for seafarers (Taking into account the 2010 Manila amendments)*. London: Author

Liu, X.J. & Zhu, Y.Z. (2004). Fuzzy comprehensive evaluation of the seafarers' competency after certification (original in Chinese). *Journal of Dalian Maritime University*. Vol.30, No.4

Pettit, S.J., Gardner, B.M., Marlow, P.B., Naim, M.M. & Nair, R. (2005). Ex-seafarers shore-based employment: the current UK situation. *Marine Policy* 29 (2005) 521–531

Rao, G.J. (2011). The Strategy for perfecting the seafarer certification system in China. *Workshop on Maritime Control*.

UNCTAD. (2013). *Review of Maritime Transport 2013*. New York: Author

Zanne, M. (2010). *Costs and revenues from running a ship*. Unpublished handout.