8-30-2023

Study on Quality Evaluation and Training Approach of Chinese Seafarers Based on Safety at Sea

Xiaogang Kang

WORLD MARITIME UNIVERSITY

STUDY ON QUALITY EVALUATION AND TRAINING APPROACH OF CHINESE SEAFARERS BASED ON SAFETY AT SEA

ID No. W1012870

A dissertation submitted to the World Maritime University in partial fulfillment
of the requirements for the award of the degree of Master of Science in Maritime
Affairs
2023

2023

8-point capitals, left aligned

DECLARATION

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

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

Signature: …….Kang Xiaogang….……

Date: ……2023.5.29…..……...…….

Supervised by: ……Wang Huanxin…….

Supervisor's affiliation: ……Dalian Maritime University……

ACKNOWLEDGMENT

Writing a Master of Science dissertation is not an easy task, especially for someone who has begun his academic journey. For the completion of this dissertation, I would like to express my deep gratitude to many people who have guided and supported me in many ways.

First of all, I would like to thank Bohai University for allowing me to participate in the MSEM Program. I gained a lot of new knowledge and friendship in the days when I studied at Dalian Maritime University.

Hereby, I also would like to express my utmost gratitude to my dissertation supervisor Wang Huanxin, who kindly guided my writing process and provided me with valuable suggestions, and resources for the completion of my dissertation. Most importantly, Professor Wang assisted me in establishing systematic academic thinking.

I would like to thank Ms. Zhao, the English lecturer at Dalian Maritime University. She gave me many good suggestions for language improvement for the dissertation and improved the quality of the paper to a certain extent.

Finally, I would like to express my special thanks to Ms. Zhao Lu and Professor Zhao Jian of the MSEM Program for their support and help in my study and life in Dalian.

ABSTRACT

Title of Dissertation: **Study on Quality Evaluation and Training Approach of Chinese Seafarers Based on Safety at Sea**

Degree: **Master of Science**

This paper innovatively summarizes the quality evaluation system for seafarers. Based on the perspective of navigation safety, this paper evaluates the quality of seafarers and constructs a scientific and complete comprehensive quality evaluation system for seafarers. At the same time, this paper analyses the connotations of evaluation indicators and proposes a quality training path for seafarers, taking into account advanced experiences at home and abroad. The research in this paper provides a reference basis for theoretical lectures and practical teaching in maritime colleges and seafarer training institutions.

Based on international and domestic rules such as the STCW Convention, the STCW 2010 Manila Amendments, and Code 11, this paper has compiled statistics on ten major maritime traffic accidents. This paper provides statistical illustrations of the missing qualities of seafarers in accidents and visualizes the relationship between seafarer quality and water transport safety in the form of a graph. Through the analysis of the current situation of the quality of Chinese seafarers, this paper presents the deficiencies in the quality of Chinese seafarers. Finally, given the existing deficiencies, the paper proposes countermeasures to cultivate the quality of seafarers in light of the actual situation.

Research has shown that improving the quality of Chinese seafarers should start at the grassroots level. Specifically, the education system in maritime academies should be reformed to focus on vocational skills, psychological, moral and physical qualities. This will lead to a fundamental reduction in the human factor negligence of seafarers in maritime accidents.

KEY WORDS: Water Transport, Maritime Safety, Seafarers' Quality, Countermeasures

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

GMDSS	Global Maritime Distress and Safety System
CCDR	China Crew Development Report
MET	Maritime Education and Training
ISM	The International Management Code for the Safe Operation of Ships and for Pollution Prevention
EIs	Evaluation Indicators
MLC	Maritime Labor Convention
FS	Final Score
QES	Quality Evaluation System
IMO	International Maritime Organization
REACS	the Rules for Examination, Assessment and Certification of Seafarers
MSC	Maritime Safety Committee
STCW	Standards of Training, Certification, and Watch-keeping
Phy	Physiological
SOLAS	Safety of Life at Sea
MQ	Moral Quality
OSQ	Occupational Skill Quality

CHAPTER 1 INTRODUCTION

1.1 Background

1.1.1 The need for the safety of ship navigation

With the rapid development of the crew business, China has formed a relatively complete system of crew regulations. The education and training system for seafarers is also becoming more and more perfect. The number of crew continues to develop and grow basically meeting the needs of the development of China's shipping industry.

According to the China Crew Development Report (CCDR) 2020 published by the Ministry of Transport, as of 31 December 2020, there were 377,638 seafarers with sea service qualifications, accounting for 46.7% of the total number of seafarers(Press Office of the Ministry of Transport of the People's Republic of China, 2021). In 2020, there were fluctuations in crew development figures compared to the past due to the impact of the covid-19 pandemic. By the end of 2020, an increase of 3.0% year-on-year from 2016 to 2020 is shown in table 1.

Table 1-Registration of seafarers on international voyages 2016-2020 (in persons)

TYPE	2016	2017	2018	2019	2020
Seafarers on international voyages	497192	524498	545877	575823	592998

Source: Author based on CCDR 2020

The number of international seafarers accounts for more than 1/3 of the total number of seafarers in the world(Zhang & Cui, 2022). China sends out more than 130,000 seafarers every year, and the number of seafarers sent out is among the highest in the world(Mao & Jin, 2021). China has become one of the important exporters of seafarer labor in the world. The total number of seafarers ranks first in the world and

is among the ranks of the major maritime countries. The elimination of barriers to trade and lowering of transportation costs has widely boosted globalization and seaborne trade(Baumler et al., 2021). More than 90% of China annual import and export trade goods are realized through maritime channels.

With a global labor market of seafarers developing, maritime safety issues are increasingly attracting more attention. The International Maritime Organization (IMO) has continuously developed and implemented a series of conventions and rules. These rules aim to improve the safety at sea and reduce the incidence of accidents. However, the results have been unsatisfactory. Marine safety accidents occur from time to time resulting in huge economic losses and loss of life. Human factors have been the object of study so as to improve the effectiveness and efficiency of maritime transport(Moreno et al., 2023).

For example, on 16 July 2022, the Antigua multipurpose vessel F, while sailing from Tianjin to India, collided with the Liberian container vessel H in the Old Iron Mountain waterway alignment system in position 38°32′N/120°57′E. The collision occurred with the Liberian container vessel caused a partial depression and damage above the waterline on the bow of vessel F. And vessel H suffered a large area of damage above the waterline on the starboard side of the stern. The human factors contributing to the accident were the negligent lookout of the crew of both vessels, their failure to detect the danger of collision in time and to take early action by all effective means appropriate to the circumstances and situation. At the same time, the second officer on duty of vessel F left his post before the incident, leaving the bridge unmanned.

Figure 1-Posture of the two vessels at the time of the incident

Source: WWW.BING.COM

1.1.2 Requirements of the relevant regulations

On 7 July 1978, at a meeting of the International Maritime Organization (IMO), delegates from various countries voted unanimously and finally formulated the International Convention on Standards of Training, Certification, and Watch-keeping for Seafarers (STCW Convention)(Shen, 2019). In 1984, the STCW Convention came into force in China. By 1999, the number of States Parties to the STCW Convention had reached over one hundred. The 1991 amendment was on the Global Maritime Distress and Safety System (GMDSS) and single manning of the bridge(Deng & Wang, 2019). The 1994 amendment was on special training for seafarers of liquid cargo ships. In 1993, the IMO began a comprehensive revision of the Convention. And in 1995, the IMO adopted amendment STCW 78/95 which entered into force in 1997.

At the 41st meeting of the Human factors, Training, and Watch-keeping (HTW) in early 2010, the Draft Amendments to the STCW Convention 2010 were finally

adopted after much discussion among the participants. The Manila Amendment to the STCW Convention is an important guideline for seafarers' education and training. The 42nd meeting of the HTW committee included a new topic on the development of an e-Sailing Strategy Implementation Plan. The HTW committee has realized that it should not only consider the strategic aspects of navigation, but also focus on new technological developments, including information technology. With the advent of the cyber age, navigational strategies are being brought to the forefront of history, and major changes and advances in maritime technology are on the horizon.

To meet the requirements of international regulations for seafarers and to improve the comprehensive quality of domestic seafarers, China promulgated Rule 04 in 2004, Rule 11 in 2011, and Rule 20 in 2020, namely the Rules for the Examination, Assessment and Certification of Seafarers (REACS) of the People's Republic of China. On 1 March 2012, under the STCW Manila Amendment, China made preparations for compliance and amended the REACS of the People's Republic of China. China ratified the Maritime Labor Convention 2006, to promote international compliance, exchange and cooperation.

The International Safety Management (ISM) Code is under Chapter IX of the International Convention for the Safety of Life at Sea (SOLAS) and aims to provide an international standard for the safe management and operation of ships at sea(Uflaz et al., 2022).

1.2 Research objectives

This paper examines the maritime education models of developed countries in the foreign shipping industry, such as Boston University and Massachusetts Maritime Academy in the USA, and Tokyo Merchant Marine University in Japan. By comparing their education models with the maritime education models of domestic maritime colleges, the study finds areas for improvement in China's maritime education model. By collecting and collating data on various aspects of seafarers'

quality, the study obtains information on the shortcomings of the current situation of Chinese seafarers' vocational skill ability, physical condition and mental state, and then makes targeted improvements.

This paper provides an innovative summary of the seafarer quality evaluation system and updates the evaluation criteria for seafarer quality in the future. The paper also provides a reference for theoretical and practical teaching in maritime colleges and seafarer training institutions.

1.3 Research methods

1.3.1 Literature research method

This paper reviews international and domestic rules such as the STCW Convention, the STCW 2010 Manila Amendment, and Rule 11 of China. At the same time, this paper refers to dozens of core journals and combines the literature analysis method to analyze each evaluation indicator and carry out the calculation of evaluation indicator weights.

1.3.2 Case study method

This paper focuses on a graphical analysis of ten typical maritime accidents taken from the literature and analyses the human factors that have harmed water transport safety. These cases are characterized by a high number of deaths and injuries, large amounts of property damage, and other features that harm social development. Based on the perspective of navigation safety, this paper evaluates the quality of seafarers and constructs a scientific and complete comprehensive quality evaluation system for seafarers.

1.3.3 Comparative research method

This paper compares the maritime education models of developed countries in the foreign shipping industry with those of domestic maritime colleges and universities, thereby identifying areas for improvement in China's maritime education. By analyzing the connotations of the evaluation indicators and combining advanced

experiences at home and abroad, this paper proposes innovative ways for the quality training of seafarers.

1.4 Structure of the dissertation

The study for this paper is as follows:

In Chapter 1, Introduction to the background, objectives, and methodology of the study are presented.

Chapter 2 provides connotations on the seafarer qualities which include occupational skills quality (OSQ), moral quality (MQ), psychological (Psy) quality and physiological (Phy) quality. This chapter collects data on typical maritime accidents and the impacts on seafarer qualities. And this chapter compares Chinese and foreign studies and presents the shortcomings of qualities of Chinese seafarers.

Chapter 3 focuses on structuring a quality evaluation system for seafarers. And the calculation of evaluation indicators is presented in detail. The meaning of evaluation indicators is analyzed in this chapter.

Chapter 4 explores the solutions to the shortcomings in the quality of seafarers respectively. The full reference is made to the international advanced seafaring teaching experience to improve the level of seafaring education in China.

Chapter 5 includes conclusions and outlook. This chapter summarizes the research results and main conclusions while providing an outlook on the next steps of the research.

CHAPTER 2 OVERVIEW OF QUALITY EVALUATION AND TRAINING APPROACH OF SEAFARERS

2.1 Connotation of seafarer quality

The comprehensive quality of seafarers refers to the overall abilities that seafarers demonstrate in sailing a ship including moral, psychological, occupational skills, and physiological abilities. Among them, it is unavoidable to include the physiological characteristics such as the nervous system, digestive system, ways of thinking, sensory organs, and limb movement that seafarers have as human beings themselves. The causes of catastrophic accidents at sea, excluding objective factors that are insurmountable by human beings, are mainly human errors such as errors in judgment and improper manoevuring by seafarers. From an academic point of view, improving the qualities of seafarer means helping them to make up for or overcome certain weaknesses and defects inherent in themselves that are detrimental to navigation safety. These deficiencies are manifested in their behavior, character, physique, thinking, emotions, skills, and morals. The quality of seafarers therefore comprises four basic elements: mental, physical, occupational skills, and moral. The study of seafarers qualities must also begin with their psychological, physiological, occupational skills, and moral aspects.

2.1.1 Occupational skills quality

The quality of occupational skills is a combination of competencies that a person engaged in a professional activity possesses and applies in the course of that activity. It is also the subjective and objective perception of such a practitioner by external parties. The quality of a seafarer's professional skills is the quality of his or her occupational skills. The safety and security of ships at sea highly depend on the occupational skills and professionalism of seafarers(Danacı & Yıldırım, 2023)**.** It requires seafarers to keep up to date with their basic knowledge of shipping, develop their ability to operate ships, and continuously improve their English. The safe

navigation of ships is dependent on the high level of responsibility of seafarers, and also on their skillful work. To process complex situation very rapidly, elegantly and efficiently, taking past experience into account and anticipating the future(Li, 2021).

At present, the shipping market is growing too fast and there is a shortage of senior seafarers. So seafarers are promoted too quickly to their positions. The performance of seafarers on board reflects a decline in their work skills, which is not in line with the skills and experience required for the position. Especially, in the era of global shipping integration, the training of maritime English should be given special attention. The maritime cadets require achieving competence in using ME because efficiency in English is a prerequisite for the Standards for Training, Certification and Watch keeping (STCW) 1995 code, the 2010 Manila Amendments and SOLAS regulations(John et al., 2017). In the three main sectors of OSQ, the basic knowledge of navigation serves as the foundation; the ability to operate ships is a strong guarantee; and Maritime English is an indispensable and important part of the shipping world. The English used at sea for communication is termed as Maritime English (ME) which is a 'restricted language' and different from general English in terms of simplified sentence structures and specific vocabulary(Fan et al., 2017).

2.1.2 Moral quality

MQ is both a reflection of one's ideology and moral character in concrete behavior and a comprehensive reflection of moral cognition and moral behavior. It also includes moral cultivation and moral sentiment, representing the moral style of the individual. The specific embodiment of the excellent MQ of seafarers is the correct values, good self-control, a high degree of commitment, and a sense of responsibility. Seafarers have an awareness of environmental protection, safety, obedience, and an enterprising spirit in the course of their sailing operations.

Seafarers work and live in a monotonous and narrow environment and have less contact with the outside world, so the interpersonal relationship of seafarers is single

and the professional characteristics are very significant. As the soul of the comprehensive quality, the MQ of seafarers requires seafarers to have a spirit of dedication to self and a high sense of responsibility for their work. The moral and ethical qualities of seafarers determine the values of seafarers. Values are the core feelings and preferences that are carried within individuals and are considerably more stable and less affected by external elements(Chan & Li, 2022)**.** During the voyage, seafarers with good MQ will inevitably put the lives and safety of their passengers first. The enterprising spirit of seafarers can improve their mental outlook of seafarers; the engagement can make seafarers treat their work with excellence. Engaged seafarers are emotionally attached, fond of their work and committed to their organization. Engaged seafarers put in discretionary effort to meet organizational goals, can become a catalyst for organizational development (Rameshkumar, 2020). As a result, the probability of accidents on board ships will naturally be greatly reduced. Conversely, if seafarers are unethical and negligent in their duties, they are more likely to lay the groundwork for a disaster to occur. For example, in the sinking of the SEWOL in 2014, It was a serious overload. This is a sign that there is a problem with both moral and occupational quality. This kind of profit-oriented behavior has laid a serious risk to the safety of the ship. In addition, the captain and seamen of the SEWOL were the first to escape after the accident, abandoning the passengers. This reflects a serious lack of professional ethics on the part of the seafarers on board the ship. It can be said that their sense of responsibility and professionalism were extremely problematic. It was their MQ that directly or indirectly led to the death of more than 200 passengers.

2.1.3 Psychological quality

Psychological quality is a localized academic concept. In psychological terms, psychological qualities include emotions, confidence, and willpower. Psychological quality is also a combination of physical ability, mental activity, and social response.

It is perfected through congenital inheritance and acquired development. Based on physical qualities and mediated by practical activities, psychological quality is a combination of inner thinking and behavioral expression. It includes a person's cognitive ability, emotional and affective qualities, quality of will, temperament, and character, and many other aspects.

The psychological quality of a seafarer can influence the daily work and potential of the seafarer. In turn, it can affect the entire shipping process and the achievement of team goals. Under the influence of a certain working environment, seafarers are prone to a certain degree of psychological tension. It is a personal and subjective experience for seafarers. This part of the psychological experience is the result of the interaction between human nature and the objective environment, also known as psychological stress. In the covid-19 years, due to protective measures imposed to control the spread of infection, the repatriation of seafarers has faced unprecedented challenges, leaving many seafarers unable to travel to and from their ship (Luqman & Zhang, 2022)**.**

Poor psychological quality tends to cause psychological tension. When feeling overly nervous and in other undesirable psychological conditions, seafarers can make errors in perception, judgment, and operational errors in response to external stimuli. In recent years, the covid-19 has created a psychological challenge for seafarers. It is clear from this that psychological quality has its specificity compared to other qualities. When faced with an unforeseen situation, those who are not m0entally competent are not able to face it calmly and apply their theoretical knowledge of navigation. In such cases, the seafarer's practical skills are not fully utilized, and irregularities may occur. The error rate of seafarers increases, as does the likelihood of accidents. Seafarers are subjected to more occupational illnesses and psychological stress than other professionals, which directly affects their psychological well-being.

2.1.4 Physiological quality

The physiological qualities of seafarers, also known as physical qualities, are the material basis for all other qualities. Physiological qualities are the first barrier to becoming a seafarer. Therefore, seafarers are required to meet the requirements of the maritime authorities in terms of their physiological qualities. Fatigue is the most difficult physiological quality for seafarers to overcome. A state of physical or mental impairment due to lack of sleep, and physical, mental or emotional exertion that impairs alertness and the ability to safely operate the vessel or perform safety-related duties(IMO, 2019). Working in a fatigued state can lead to dysautonomia, impaired coordination, reduced efficiency, and neurological disorders. A good level of physical fitness and energy is therefore the basis for overcoming fatigue.

In 2012, China's maritime authorities formally implemented the Manila Amendment to the STCW Convention. In the same year, China implemented the REACS 11. These conventions and rules set out the requirements for the health of seafarers in different positions. The specific requirements of the newly introduced medical examination standards for seafarers include height, blood pressure, eyesight, visual field, heart rate, hearing, and spinal extremities. The medical standards for seafarers clearly state that people with respiratory, cardiovascular, neurological, and psychiatric diseases are not suitable for obtaining a health certificate, which means they cannot become seafarers.

2.2 Impacts of seafarers qualities on water transport safety

2.2.1 Statistics and analysis of accident cases

This section collects data on ten typical maritime accidents. These accidents were drawn from seven research papers. The human factors that led to the accidents in the cases and the types of qualities they belong to are collected to analyze the impact of each quality on water transport safety. Ten typical marine accidents summary is

shown in the table 2.

Table 2-Ten typical marine accidents summary

Accident No.	Brief history of the accident	Causes of accidents	Types of defective qualities
1	On 2 February 2006, the Egyptian ship “Salam 98” sank, leaving more than 1,000 people dead or missing(Zhu, 2006).	Vessel was too old; overloaded	Moral Quality
2	On 21 June 2008, the Philippine ferry “Gunstar Princess” capsized, leaving just over 50 people alive and over 800 dead and missing(Inspection, 2008).	Mishandling by the captain; poor decision-making.	Occupational Skills Quality
3	On 4 March 2009, the tanker “Hai Guan Shan 117” was refuelling at the port of Tianjin when fuel oil from the cargo hold flowed into the Hai River(Li, 2009).	The seafarers were not familiar with the ship's safety procedures and operated in violation of them; the seafarers on duty were paralysed and did not strictly enforce the procedures.	Occupational Skills Quality, psychological quality
4	On 10 July 2011, the	Operating without a	Moral Quality

	Russian ship “Burga” sank in the Volga River. There were 208 people on board, and the story ended with nearly 130 casualties(Xu, 2012).	licence and heavily overloaded.	
5	On 13 January 2012, the “Costa Concordia” ran aground and tipped over on its side. At least 32 people died, including four passengers and one seafarer. The captain of the ship survived(Nuan, 2014).	The captain and first officer abandoned the passengers and escaped alone; the sailor failed to carry out the captain's instructions in time.	Moral Quality, Occupational Skills Quality
6	On 9 November 2010, the “Minamikawa Diamond” sank in Japanese waters.Three people were rescued and 22 were killed or missing(Zhang, 2014).	Negligent emergency training of seafarers: inadequate measures after the ship tilted; inadequate management of cargo transport; failure to ensure smooth handover of seafarers; failure to assess risks effectively.	Occupational Skills Quality
7	On 23 June 2012, “Shunlian 128” sank in the west of	The seaman did not effectively tie down the	Occupational Skills Quality

	North Harbour, six seamen were rescued and one was missing(Zhang, 2014).	steel carried and the cargo was not secured.	
8	On 1 October 2012, the "Hong Kong Lamma IV" sank rapidly after being struck. The speed of the sinking caused the death of 38 people(Zhang, 2014).	No waterproof doors at entrances and exits; unstable cabin chairs.	Occupational Skills Quality
9	On 16 August 2013, the MV Santo Tomas Aquinas sank in Talisay City, Philippines. 52 people were killed and 68 were missing(Zhang, 2014).	Human error in operation.	Occupational Skills Quality
10	On 16 April 2014, the South Korean ferry SEWOL suffered a submerged accident and sank. Five people were killed, 174 were rescued, and 284 were still missing(Lin, 2015).	Seriously overloaded; cargo not secured; third officer on sole watch, master not at the bridge when in distress; master abandoned passengers and led the crew to escape.	Moral Quality, Occupational Skills Quality

Source: Author based on ten typical maritime accidents from seven research papers

Seafarer fault summary in ten typical accidents is shown in table 3 and seafarer fault summary is shown in figure 2.

Table 3-Seafarer fault summary

Quality Type	Behavior Type	Number of Occurrences
Occupational Skills Quality	Improper Operation	6
Occupational Skills Quality	Captain Dereliction	1
Occupational Skills Quality	Improper Loading of Cargo	3
Occupational Skills Quality	Poor Enforcement of Safety Rules	2
Occupational Skills Quality	Decision-making Mistakes	2
Moral Quality	Overloading	3
Moral Quality	Failure to evacuate passengers in time or abandoning them and escaping alone	3
Moral Quality	Vessel too old	1
Psychological Quality	Negligence at work	2

Source: Author

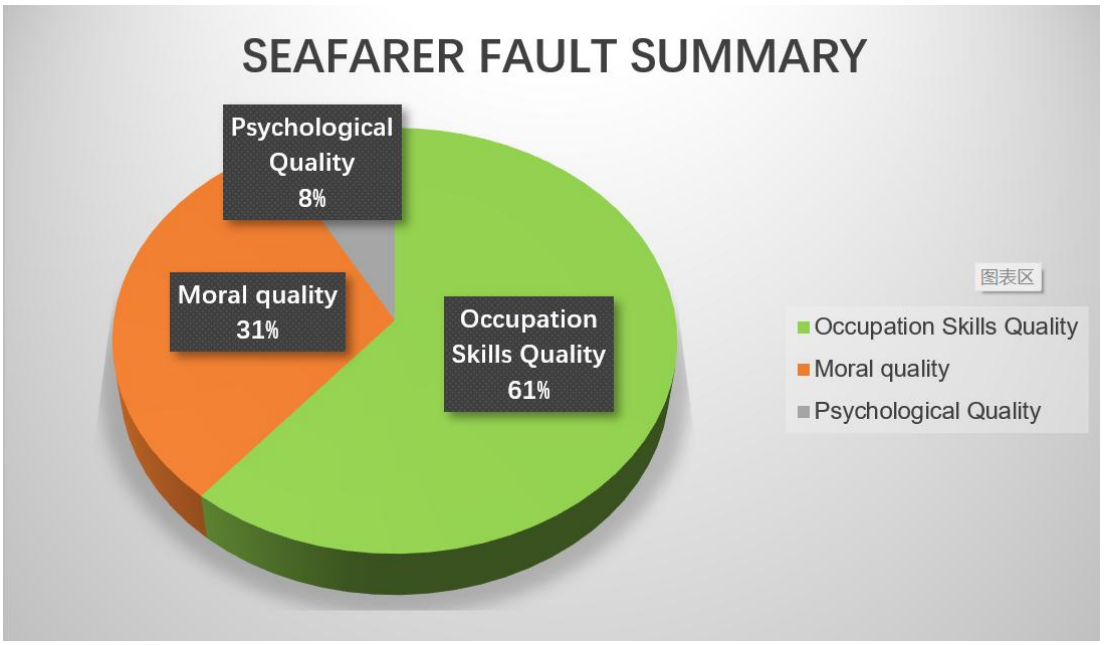

Figure 2-Seafarer fault summary

Source: Author

As is shown in figure 2, OSQ accounted for 61% of the above accident cases; MQ accounted for 31% and psychological quality accounted for 8%. Of course, the impact of the physiological quality of seafarers on maritime accidents is non-significant. Therefore, the lack of OSQ is the main cause of maritime accidents. In descending order are MQ and psychological quality. Physiological quality is a non-significant factor. Although physiological qualities are not shown in the table, they are the material basis for the other qualities and cannot be ignored. In addition, when summarizing the causes of accidents, the types of defective qualities chosen for this paper all come from human faults that are a dominant factor or act as a trigger in the causes of accidents. Therefore, the two different types of qualities that appear in the same accident case should be adopted together.

2.2.2 Impacts of OSQ on shipping safety

Seafarers who operate ships need to know the specifics of the vessel, including safety

hazards, maintenance of equipment, and the carriage of dangerous goods. During the transportation process, they should strengthen the supervision of the cargo and the management of the surrounding staff to prevent any violation of the safety operation rules. In the incident involving the tanker Hai Guan Shan 117, the seafarers on duty did not strictly implement the key operational procedures of the ship's safety management system(Størkersen & Thorvaldsen, 2021). The seaman did not conduct a detailed inspection of the piping and valve ports before loading, resulting in fuel oil from the cargo hold flowing into the sea and river during the loading process. The investigation team reported that the seafarers on board the vessel were not proficient in both ship and safety operating procedures. This shows that poor enforcement of safety rules can cause casualties and property damage to the shipping community, as well as serious ecological damage to the natural environment.

The STCW Convention has clear provisions that the master of every ship must ensure that the watch system is established to meet the standards of safe navigation. As the supreme commander of the ship during the voyage, the master's responsibilities include setting a suitable course of navigation and identifying potential hazards. In exceptional circumstances, the master must take personal command of the voyage. In the case of the sinking of the SEWOL, the master acted in contravention of the Convention regulations. The master arranged for the crew member who was sailing the ship for the first time to complete the navigational watch alone. At the time of the incident, the master did not take command of the ship himself. Also, after deciding to abandon the ship, the master abandoned the passengers and took the lead in escaping, in total contravention of the relevant requirements of the Convention. As seafarers and masters of ships burdened with the task of navigation, they should first and foremost consider the lives of their passengers. During the voyage, they should be aware of the ship and the weather conditions and always be on the alert. If any problems are identified, the crew should

take immediate action to deal with them.

The Code of Safe Practice for Cargo Stowage and Securing requires that the material used to tie down cargo should be made up of metallic ropes, chains, or materials of equivalent toughness and stretchability. However, many ships involved in accidents do not comply with this rule. For example, on board the SEWOL, the containers on board were tied down with ordinary ropes, rather than the metal ropes or chains specifically required by the Code. After the accident, the displacement of the ship's cargo increased the tilt of the ship and caused it to sink faster. The passengers' chances of escape were greatly reduced.

2.2.3 Impacts of MQ on shipping safety

As can be seen from the accident statistics table, the specific manifestations of unsafe shipping caused by a lack of ethics among seafarers are overloading, abandoning passengers to escape alone, poorly maintained ships, or ships that are too old. As actors in shipping, crew members should always put the safety of navigation first and should eliminate any factors that may pose a threat to it in the first instance. However, driven by financial gain, seafarers disregard the potential risks posed by the overloaded operation of ships and they continue to overload cargo or overload passengers. This irregularity leads to repeated accidents and increases the number of casualties. The sinking of the Russian ship BURGA on the Volga, for example, is a typical example of a maritime accident caused by overloading. If the crew had been able to limit the number of passengers, at least the casualties would not have been so severe.

The 1989 International Convention on Salvage provides that the master of a ship is obliged to go to the assistance of persons in distress at sea, provided that there is no threat to the persons or the ship on board(PANG, 2017). At the same time, it is an international humanitarian practice that when the master abandons the ship, he should first organize the escape of the passengers, followed by the departure of the

seafarers and finally the master. However, it is not uncommon for masters and seafarers to be the first to abandon their passengers in the event of a maritime accident. When the COSTA CONCORDIA ran aground, some of the seafarers boarded the lifeboat ahead of the women and children, abandoning their duty of care to the vulnerable and their professional ethics. Poorly maintained and old ships are the result of the inappropriate behavior of shipping companies that put profit before the safety of life and property. Ships are only as good as their economic interests and safety in navigation. Neglecting ship safety for the sake of profit often leads to tragic shipwrecks and loss of life. The leadership of shipping companies must be aware of the importance of safety in navigation. At the same time, seafarers must be true to their profession and not be tempted by immediate profit.

2.2.4 Impacts of psychological and physiological qualities on the safety of shipping

Poor psychological quality of seafarers will cause unsafe shipping. Among the non-technical skills, psychological factors are critical to cooperative behaviors and appropriate competencies that impact maritime safety(Fan et al., 2023). In maritime accidents, seafarers who are not mentally qualified are often negligent in their work. Poorly qualified seafarers are prone to misperceptions, errors in judgment, emotional instability, and poor communication with their partners when in distress. The psychological quality of seafarers is the dominant factor in the seafaring process, because seafarers' use of theoretical knowledge and practical skills is based on psychological quality. When the psychological quality of the seafarer becomes the shortcoming of the comprehensive quality of the seafarer, the seafarer is not able to use the theoretical knowledge or the practical skills correctly, so they are prone to irregularities and increase the error rate. In the case of ESTONIA, there was negligence on the part of the officer of the watch. During the voyage, a large amount of water entered the ship when the bowsprit hatch came off, but the crew did not

notice. In addition, when the ship was tilted sideways, the crew did not try to identify the cause and blindly steered, leading to the disaster.

The impact of physiological qualities on the safety of shipping is non-obvious. This non-obviousness does not mean that there is no impact. The physiological qualities of seafarers are the basis for other qualities. Due to the special nature of the working and living environment on ships, seafarers are often exposed to many contingencies. This places greater demands on the physical fitness and adaptability of seafarers. This specificity requires seafarers to be physically fit, have good physiological systems, and have a certain level of adaptability. Physiological qualities include physical fitness, physiological systems, and adaptability. Physical fitness includes height, weight and athleticism. It is the material basis for the seafarer's life at sea. The physiological system includes the digestive system and the nervous system. The Chinese National Standard for Medical Examination of Seafarers specifies that people with respiratory and cardiovascular diseases are not allowed to become seafarers. Adaptability means that seafarers need to adapt to the environment, diet and work and the enormous psychological pressure. Therefore, seafarers should develop good habits and exercise habits in general. They should normally exercise to build up good self-regulation.

2.3 Comparison of domestic and international research

2.3.1 Current status of research in China

Domestic research on the evaluation of the quality of seafarers and their training ways has focused on the components of quality and the various factors that have an impact on the quality of seafarers.

Lin Daihua suggests reforming the maritime education model to emphasize the comprehensive quality of students(Lin, 2018). Students should strengthen both physical exercises to improve physical and cultural atmosphere to develop psychological quality. Gong Yuguang et al. suggest that theoretical teaching in

domestic seafarers' safety training is overwhelming and the training time is too long(Fang, 2018). The meaning of the concepts in domestic teaching is different from those in foreign seafarer training courses. Domestic teaching needs to be reinforced with practical exercises and adjusted concerning IMO model courses. At the same time, the difficulty of the theory examination should be reduced. Lin Lianping analyses the applied knowledge of our seafarers as too narrow and their foreign language communication skills are generally low(Lin, 2015). The students' ability to use computers and their knowledge of information networks need to be strengthened. In addition, seafarers lack professionalism and service consciousness. Yu Yefang studied the interrelationship between human factors of seafarers and maritime traffic accidents, and the quality of seafarers required to improve maritime traffic safety(Yu, 2015). Jiang Yonglei et al. collect the training mode of shipping education in universities at home and abroad(Jiang et al., 2016). Combining with the national situation, he analyzed the successful experiences abroad and put forward suggestions for the training mode of shipping talents.

2.3.2 Current status of research abroad

In the process of assessing the comprehensive competence of personnel in the US Coast Guard, the assessment covers the ability to coordinate and respond, self-development, adaptability to new environments, and work attitude.

In 2004, Fillipowicz's research identified crew error as the main cause of maritime safety accidents(Filipowicz, 2004). In 2003, Pedersen discussed the current approaches to seafarers' assessment based on the STCW Convention(Pedersen, 2003). They concluded that most of the existing methods do not meet the appropriate standards, leading to a recommendation to use authenticity assessments.

Koh et al. suggest that stressors affecting the psychological quality of seafarers can be divided into shift factors, social factors, job requirement factors, and management factors. Among these, shift factors include long working days, irregular working

hours, and lack of sleep(Koh et al., 2023). Social factors include family separation, loneliness, and lack of recreation. Work demands factors include monotony, lack of freedom, and stressful workloads. Management factors apply to senior seafarers and include inadequate management qualifications for ordinary seafarers, responsibility for the work of other seafarers, and conflicts between safety and economic requirements. Oldenburg, M. suggests that seafarers work on board for long periods and are subject to extreme climatic conditions. The atmosphere and environmental factors they are exposed to are more complex, so seafarers' psychological qualities are easily weakened, leading to psychological problems(Oldenburg, 2009). Maslach C et al. propose that seafarer will include self-awareness, self-control, decisiveness, and resilience(Maslach, et al., 2001). The quality of a seafarer's will is very important for seafarers to eliminate disturbances and deal with unexpected situations and potential dangers in a timely manner during navigation.

2.3.3 Comparison of the current status of domestic and foreign research

Domestic researchers usually divide the comprehensive qualities of seafarers into OSQ, MQ, psychological quality and physiological quality. Most of the research literature published so far is of a review nature, and the data tables are of low quality. Although a more systematic system for evaluating the quality of seafarers has become increasingly mature, domestic research lacks statistical data on maritime accidents as a basis. There is a lack of statistical material that combines the human factors of maritime accidents. Domestic seafarer training courses are not in line with international standards, and there is a single study of maritime education models. A comparison with the quality training pathways of foreign maritime academies is immediately apparent. Therefore, a reasonable and feasible quality training way for seafarers suitable for China's national conditions needs to be proposed.

Foreign researchers focus on putting theory into practice and on the effects of seafarer training. Foreign seafarer training systems are complete and training

methods and approaches are adjusted in response to feedback. Researchers have suggested that the stress factors affecting seafarers' psychological quality are shift factors, social factors, job demands, and management factors. At the same time, they emphasize that long hours of intense work can easily lead to various physical and mental illnesses. Foreign studies have taken a more humane approach. Researchers have not only analyzed the work stress of senior seafarers thoroughly, but have also focused on the physical and mental health of ordinary seafarers. In contrast to the domestic review literature, most overseas shipping research institutes have looked at ways to improve the effectiveness of seafarer training to reduce the impact of human factors in maritime accidents. Foreign research has been more critical of the will power of seafarers, especially senior seafarers. The self-control and self-awareness of senior seafarers had been the subject of study by researchers.

2.4 Shortcomings in comprehensive quality of Chinese seafarers

The number of seafarers sent out of China each year is among the highest in the world. The working and living conditions of seafarers sent abroad are extremely special. Firstly, the different cultural backgrounds lead to different management philosophies. Seafarers sent abroad must learn to obey unconditionally. For Chinese seafarers, who are used to working on ships with an eastern cultural heritage, this adaptation is difficult. When seafarers are sent out individually, they work alongside expatriate seafarers from different countries and speak different languages. This means that they have different cultural backgrounds, so it is difficult for them to communicate with each other. A lack of sufficient understanding of different cultures may inevitably lead to communication barriers(Mallory et al., 2022). This makes seafarers particularly vulnerable to an atmosphere of loneliness, frustration, anxiety, and even hostility towards each other. In addition, the psychological health of seafarer is not included in the health inspection according to Chinese regulation. As such, the psychological health of seafarers has been neglected for a long time(Tang

et al., 2022).

In a market economy, seafarers' careers are less attractive than in other industries, so seafarers are prone to impatience and the management of senior seafarers is becoming more difficult. As a result, demand for seafarers continues to rise as supply outstrips demand in the seafaring market. If seafarers do not face the temptation correctly, their psychological expectations will become increasingly high or even deviate from reality. As a result, the mobility of seafarers will increase, leading to many unnecessary problems. As the personal freedom of Chinese seafarers is limited by the contractual system, they lack choice and are poorly paid. As a result, this has led to a gradual decline in the attractiveness of the seafaring profession.

Seafarers have limited reserve resources and do not occupy a corresponding share of the world seafarer market in terms of output. The current "disruption" problem in the overall dispatching echelon of the Chinese crew would have a negative impact on the sustainable development of the shipping industry and the stability of the global supply chain(Liu et al., 2021). The overall level of physical health of Chinese seafarers is poor. The physical fitness of seafarers shows a tendency to decline with age. Researches pointed that a number of sea accidents were associated with the mental quality of Chinese seafarers. The most famous incidents recorded in 2011, in which 22 fellow crew members were killed by 11 Chinese seafarers near the Chilean coast(Song et al., 2021). This is not in line with the status quo of a major shipping nation. Compared to international standards, the maritime technical personnel trained by maritime academies have a narrower application-oriented knowledge. Moreover, their foreign language communication skills are generally low. Lack of onboard training, and over-reliance on theoretical teaching are among the key factors affecting maritime English teaching(Ungureanu, 2014). Graduates lack professional skills and practical experience. The ability to use computers and knowledge of information networks needs to be improved. Moreover, the personnel awareness of

environmental protection, professionalism, and service are relatively weak. It is essential to create a campus culture full of ‘marine elements’ to develop students’ recognition and interest in the major(Li, 2021). The management and training areas for seafarers after they have been certified are yet to be improved. There is a gap between the overall quality level of Chinese seafarers and the standards of the international shipping market.

CHAPTER 3 ESTABLISHMENT OF QUALITY EVALUATION SYSTEM FOR SEAFARERS

3.1 Comprehensive evaluation system for seafarers

There are different levels of seafarers' competence for duty. To accurately and reasonably evaluate the comprehensive quality of seafarers, this paper adheres to the principles of purpose, uniformity, feasibility and practicality, timeliness, comparability, and the combination of qualitative and quantitative principles when selecting evaluation indicators.

The indicators selected for this paper all reflect only the immediate purpose of seafarer suitability. The range of evaluation indicators (EIs) included in this paper is broad and scientifically systematic. The evaluation system developed in this paper is both operational and practical, and takes into account the rapidity of the data statistics. The EIs are not only applicable to changes in the security of the system over a certain period, but they are also time-sensitive. In other words, it can be applied even if the indicators change. The indicators are selected in such a way that they are highly comparable with each other. The comprehensive seafarer evaluation system is shown in figure 3.

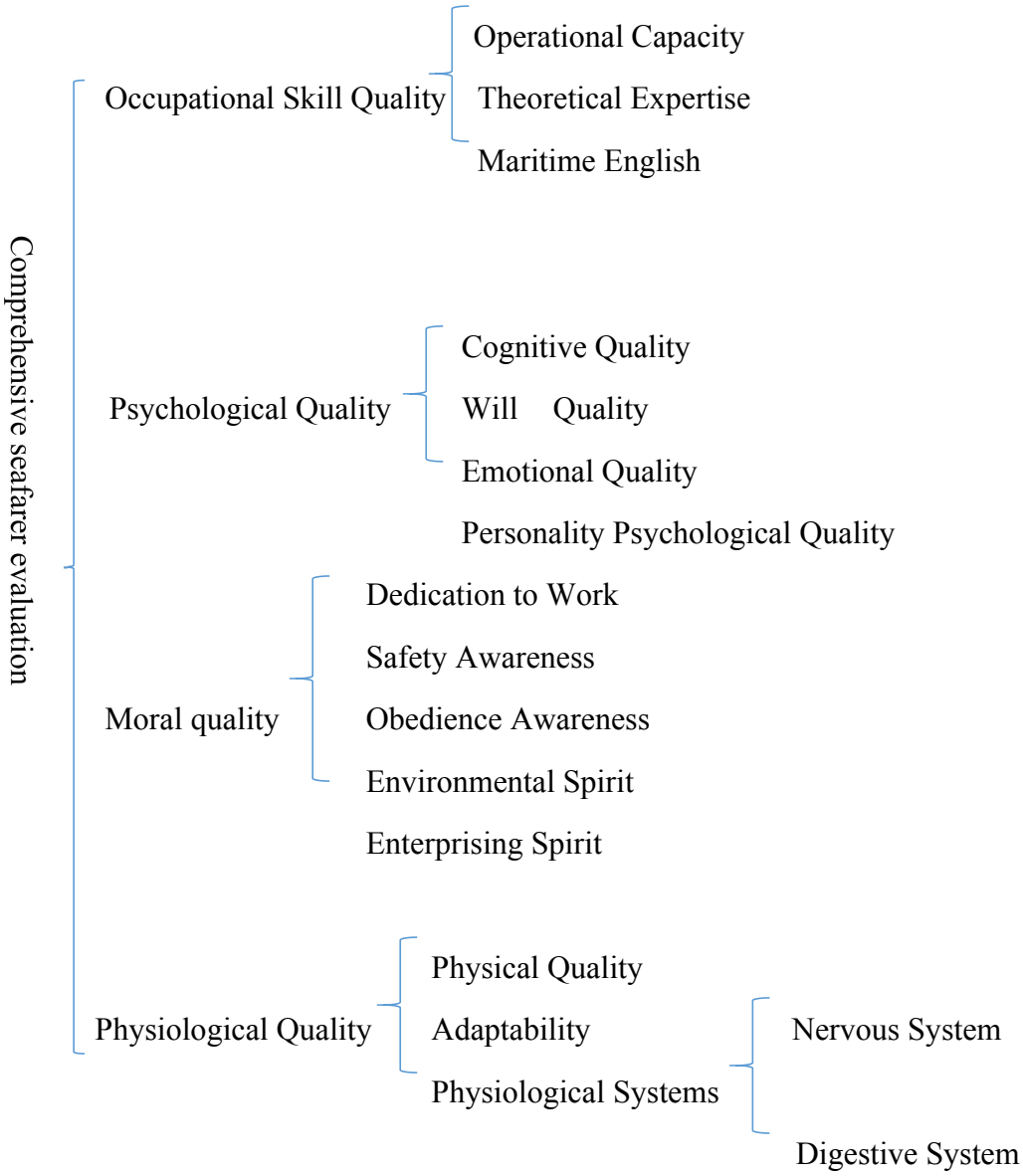

Figure 3-Comprehensive seafarer evaluation

Source: Author

3.2 Calculation of the EIs

Firstly, the summary table of human errors shows that the main causes of the ten typical maritime accidents include OSQ, psychological quality, and MQ. And physiological quality is a prerequisite and necessary condition for a seafarer to live and work smoothly during the voyage. So, physiological quality is an indispensable

EI. Therefore, the evaluation system outlined in Figure 3 is complete and the factors involved are comprehensive. This system is capable of fulfilling the task of adequately evaluating the strengths and weaknesses of a seafarer.

As can be seen from the human error summary figure 2, the psychological quality factors account for 8%, the MQ factors account for 31%, and the OSQ factors account for a whopping 61% of the causes of the maritime accidents selected for this paper. It is sufficient to see that, based on the analysis of the seafarers' quality perspective, the quality deficiencies that induce maritime accidents are, in descending order of importance, OSQ, MQ and psychological quality. In addition, the concept of weights is introduced in this paper to more clearly mark the importance of each of the three types of qualities. At the same time, according to the proportion of the number of accidents caused by each quality defect in Figure 2, this paper assigns weights λ_1, λ_2, and λ_3 to each of these three types of qualities.

Equation 1 can be obtained: $\lambda_1 : \lambda_2 : \lambda_3 = 8 : 31 : 61$

λ_1 is psychological quality weighting; λ_2 is MQ weighting; λ_3 is OSQ weighting

As can be seen from Table 3 and Figure 2, in the quality causes of maritime accidents, the number of the occupational skill quality causes is the first; the moral quality cause is the second; finally, it is the psychological quality cause. In other words, if one of the selected typical maritime accidents is randomly selected, the quality-related accident causes are ranked in descending order of likelihood as occupational qualities causes, moral qualities causes, and psychological qualities causes. It is clear that the greater the proportion of quality causes in Figure 2, the greater the likelihood of an accident occurring. In other words, there is a positive correlation between the two.

Assuming that the typicality of accidents in the article is reliable, it is reasonable to believe that the likelihood of a random maritime accident being caused by one of the

quality-related aspects of the accident (OSQ, MQ, psychological quality) is positively correlated with its proportion in Figure 2. Of course, the most simplified linear positive correlation is chosen here as the link between them. Therefore, the weighting weights in equation 1 are justified.

Assuming that each quality evaluation is calculated on a percentage scale, the total score (evaluation result 1) can be obtained from equation 2 below:

$$S_1 = \left(O_1 \times 8 + O_2 \times 31 + O_3 \times 61\right) / 100$$

S_1 refers to the total score, O_1 refers to the psychological evaluation score, O_2 refers to the MQ evaluation score and O_3 refers to the OSQ evaluation score

As a prerequisite and necessary condition for a seafarer to be able to work and live smoothly during the voyage, physiological qualities profoundly influence psychological, moral, and professional qualities as well as all behavioral actions during the voyage in the actual operation process. It can be argued that physiological qualities limit the output environment of the rest of the qualities when the corresponding psychological, moral, and professional qualities are determined. When the physiological qualities fully meet the requirements, the actual state of the mental, moral, and professional qualities can be fully expressed; when the physiological qualities are close to the minimum standards, regardless of the real situation, the external comprehensive performance of the mental, moral, and professional qualities must be poor; and when the physiological qualities are below the minimum standards, that is, the seafarers do not meet the standards on board, then their mental, moral and occupational qualities cannot be talked about. Furthermore, the way in which physiological qualities affect other qualities is both subtle and subdued. There is no quadratic, cubic, or other function in which the variable peaks at a particular value of the independent variable, of course except at the two endpoints. Therefore, it can be assumed that the final evaluation score is positively linearly related to the

physiological quality evaluation score H based on S_1.

The Final Score (FS) of the evaluation is given by equation 3 below:

$$S_2 = S_1 \times H / 100$$

S_2 is the FS of evaluation, H refers to the physiological quality evaluation score (on a percentage scale)

Taking the sinking of the SEWOL as an example, we can deduce from the causes of the accident that the MQ and OSQ of the seafarers on board were lacking. Under an objective and comprehensive scoring system, the scores for MQ and OSQ must be relatively low. If the corresponding scores for the psychological quality, moral quality, and occupational skills quality of seafarer are 90, 60 and 60 respectively. And the physiological quality score is 85, then:

$$S_1 = (O_1 \times 8 + O_2 \times 31 + O_3 \times 61)/100 = (90 \times 8 + 60 \times 31 + 60 \times 61/100 = 62.4$$

$$S_2 = S_1 \times H/100 = 62.4 \times 85/100 = 53.04$$

This means that the FS for the seafarer in this case is 53.04. If one of the scores is changed, the corresponding change in the total score and the final score are shown in Tables 4 below. The final score S_2 calculated for each of the above represents the final rating of a random seafarer strengths and weaknesses in this evaluation system. High values represent excellent; low values represent poor.

Table 4-The influence of each quality change on the total score and final score

Psychological Quality(score)	MQ(score)	OSQ (score)	Physiological Quality(score)	Total Score S_1(score)	Final Score S_2(score)
60	60	60	85	60	51
90	60	60	85	62.4	53.04
90	90	60	85	71.7	60.945
90	90	90	85	90	76.5

90	90	90	100	90	90
90	90	90	50	90	45
90	90	90	0	90	0

Source: Author based on the equation 1, 2, and 3.

3.3 Meaning of EIs

3.3.1 Indicators for evaluating OSQ

The indicators for assessing the quality of occupational skills include three basic components: practical skills, theoretical knowledge, and maritime English.

Practical skills are the foundation of a career as a seafarer. Whether a seafarer is a graduate of a maritime academy or has undergone post-systematic training, it is important for them to keep up to date with their practical skills. Other factors come into play in the shipping process, but practical skills are the foundation of everything. Materiality determines consciousness, which means that a failure in occupational skills is mostly a failure in practical skills.

Consciousness guides matter. Seafarers need to acquire a certain level of theoretical knowledge before they can master practical skills more easily and quickly. While the practical skills are being updated, seafarers must also focus on updating their theoretical knowledge. It is only through constant and regular training that seafarers can improve their knowledge.

Shipping is becoming an increasingly international and global business. As the largest shipping nation in terms of the number of seafarers, communication between China and the outside world is inevitable and the number of seafarers sent overseas is increasing day by day. It is not uncommon for seafarers from different countries to be unable to speak the same language on the same ship. If they do not have a good command of the English language they need, they will not be able to communicate with their foreign partners on the same ship, nor will they be able to coordinate their cooperation.

3.3.2 Indicators for evaluating physiological quality

The physiological quality assessment indicators include physical fitness, adaptability, and physiological system. Of these, the physiological system is divided into the nervous system and the digestive system. Physiological qualities are the material basis for other qualities. And it is a non-obvious factor in maritime accidents, but its importance is undeniable. A person cannot be a seafarer without having good physiological qualities.

Work at sea requires an exceptional level of physical fitness, while the harsh living conditions also place tough physical demands on seafarers. People with poor physical fitness, such as seasickness, are not suitable for seafarers as they will encounter more dangers than others during their seafaring career. Seafarers are expected to start a physical exercise routine from their student days to develop good habits and physical fitness.

Due to the harshness of life at sea and the variety of food available on board, seafarers are often deprived of fresh fruit and vegetables. Micronutrient imbalances in seafarers' bodies occur frequently, making it impossible for people without better-than-normal adaptability to adapt to the seafaring environment. In addition, seafarers are often away from home for months without contact with their families, and they often experience emotional outbursts and poor moods. Without adaptability, a seafarer's poor physical condition will inevitably affect his or her ability to do his or her job, and may even lead to operational errors and shipwrecks.

The physiological system is subdivided into the nervous system and the digestive system. The Rules 11 contain clear requirements on the nervous system, history of illness, and height of seafarers.

3.3.3 Indicators for evaluating the psychological quality

Psychological quality EIs include cognitive quality, quality of will, emotional and affective quality, and psychological quality of personality.

Cognitive quality refers to the seafarer's intuition to anticipate the potential dangers ahead. A seafarer with good cognitive quality can determine the presence of danger based on his or her situation and make decisions to avoid potential risks.

The quality of will include self-awareness, decisiveness, and self-control. These abilities are essential for seafarers to deal decisively with unexpected and complex situations. Self-awareness is the ability to lead by example; decisiveness is the ability to deal with problems boldly and decisively and to eliminate dangerous situations; self-control is the ability to resist bad temptations such as alcoholism and other bad habits, thus eliminating potential dangers. To make the right decision, seafarers, especially senior seafarers, need to have good self-control and be able to control their emotions when confused and disturbed by various complex factors.

The special working environment of seafarers requires them to maintain a positive and healthy psychology at all times and to be in a good mood to face the tedious life at sea. The safe navigation of a ship also requires seafarers to be in a happy mood when communicating with others on a daily basis, thus creating good teamwork. If communication between seafarers is flawed and there is disharmony in the coordination process, operational errors are likely to occur, which can create instability in navigation.

Personality psychological qualities are the stable components of seafarers' abilities, temperament, and character that they display during their sailing activities. Interpersonal relationships on board are tense and hierarchical. Seafarers are often under a degree of psychological stress due to shift factors, social factors, job requirement factors, and management factors. Therefore, they need good personality psychological qualities to achieve timely psychological guidance and self-regulation.

3.3.4 Indicators for evaluating the MQ

Moral quality EIs broadly include professionalism, safety awareness, obedience awareness, environmental protection spirit, and enterprising spirit. The dedication

includes a sense of responsibility. Seafarers with a good sense of responsibility take their work seriously, think proactively, and solve problems in their work to avoid mistakes in their work. They are usually able to identify and eliminate safety hazards in a timely manner and do their utmost to ensure that the ship is safe.

Safety awareness includes a sense of compliance with the rules of safe operation, i.e. legal awareness. The professional requirements for seafarers include the requirement for seafarers to comply with the code of ethics and for seafarers to receive regular training in safety management knowledge. Once seafarers are certified, training institutions and maritime academies should employ senior seafarers to provide training on seafarer safety management knowledge through case studies and other means to enhance seafarer safety awareness.

Ships are governed by a hierarchical system, so seafarers are expected to follow the captain's instructions to the letter. A sense of obedience is also a basic measure of the quality of seafarers. A good sense of obedience is conducive to the realization of ship and seafarer management, as well as to the safety of maritime traffic.

Environmental awareness requires seafarers to protect the marine environment to the maximum extent possible in their professional roles. If seafarers have a strong awareness of environmental protection, marine resources and ecological balance will be actively and effectively maintained. The damage to the marine environment caused by ship pollution is often catastrophic and seafarer training institutions should increase their efforts to educate seafarers about pollution prevention. Training institutions can raise seafarers' awareness of the marine environment by offering relevant ship pollution prevention courses. Strengthening seafarers' awareness of marine environmental protection will go a long way to reducing the number of marine pollution incidents.

The spirit of enterprise and motivation is the spiritual source for seafarers to develop their careers. The spirit of enterprise is a guarantee that seafarers will continue to

improve their professional ability, technical level, and the spiritual dimension of self-improvement. In the face of the weather, rough seas, hiding various dangers, seafarers need to have the spirit of innovation and enterprise.

CHAPTER 4 RECOMMENDATIONS FOR CHINSESE SEAFARERS QUALITY DEVELOPMENT

4.1. Recommendations for psychological quality development

As seafarers live in a closed environment for long periods, having a healthy mindset is a prerequisite for safe ship navigation. Seafarers should be accustomed to dealing with different people and be actively integrated into the community, which is an indispensable way to develop their psychological qualities. Otherwise, not being able to deal well with strangers and being in an isolated environment, seafarers can easily develop an autistic mentality. Seafarers need to develop cognitive acuity and positive emotions to be in the best possible state of mind for life at sea.

4.1.1 Manage seafarers humanely

Seafarers need to be managed humanely and their interests should be well protected. The maritime sector should adopt a place-based approach and pay attention to fostering a good professional atmosphere to enhance seafarers' sense of belonging and security. Making seafarers proud of their profession is one of the most effective measures to stimulate their career potential to contribute to the shipping industry(Kothari, 2021). Shipping companies should ensure that seafarers' living space, rest time, and food conditions meet international standards. All parties involved should pay attention to the psychological problems of seafarers so that problems can be identified early. Early prevention is an important way to reduce the number of unsafe factors on board.

Overseas surveys have shown that the role of social support in seafarers' mental health is significant. Research suggests that both mutual support among group members and support from outside the group are vital for coping with negative events and experiences. In terms of shipping, it considers both onboard peer support and external support(Pauksztat et al., 2022). It can help alleviate or regulate psychological symptoms caused by work stress and improve seafarers' resilience.

Social support can also help individual seafarers to be less affected by anxiety and depression. For example, the use of social support in the form of community-wide celebrations on World Seafarers' Day can help seafarers to feel part of a family and increase their self-esteem. A questionnaire survey shows that seafarers generally report that the time spent on board is too long. Except the ocean-going crew, most felt that a contract period of three to four months was preferable. However, the reality is that some seafarers either have too many periods of rest ashore or too many periods on board. Research by psychologists has shown that it is not the work itself that causes the greatest psychological stress feelings among seafarers, but rather a lack of periodic relaxation from work.

4.1.2 Regulating the psychological situation of seafarers and helping to overcome psychological barriers

Firstly, an independent psychological profile of seafarers needs to be established. Psychological problems such as depression and demoralization should be addressed from a different psychological perspective and with a targeted approach. Secondly, seafarers should learn the relevant expertise in psychology. Personnel with systematic knowledge of psychology should be trained to act as psychological advisors to seafarers on board. Mental health education programs should be incorporated into the maritime education model so that students of maritime courses have a systematic training base. Again, the focus is on interpersonal harmony. In the design of the ship's equipment and machinery, designers should choose materials and colors that positively suggest the human senses of sight, hearing and touch, in order to cater for human comfort and sensory perception. Finally, the paradigm shift. Because seafarers' lives are so static and isolated, they are prone to rigid thinking, which can lead to psychological problems. It is therefore important that seafarers' leisure time is expanded. The hobbies and interests of seafarers can help to promote a soothing environment on board.

Maritime colleges should take the lead in focusing on the psychological development of maritime personnel. The construction of class groups should be centred on exercising the students' ability to live collectively and integrate into the group. Recreational activities should be organized more frequently to cultivate a wide range of hobbies and interests. Recreational activities provide a platform for human interaction. This approach strengthens self-confidence and also compensates for the trainees' self-absorbed or complacent character flaws. In addition, the school needs to report on outstanding personalities and give talks on psychological knowledge, thus achieving the goal of promoting the mental health of seafaring students.

4.1.3 Psychological intervention on board

Psychological intervention on board conditions is a form of psychological development. As an emergency measure, it is indispensable. For example, an ocean-going company suffered damage in an accident when the pilot operated the ship improperly and collided with a buoy. The economic loss from the accident was upwards of $1 million. After the accident, the seafarers were depressed, and some of them were psychologically abnormal. The researchers provided them with timely psychological interventions. First, starting with cognitive qualities, the researchers encouraged seafarers to relieve their psychological stress by talking to each other. Moreover, the researchers talked to seafarers who were depressed and helped them to resolve their unhappy emotions by providing encouragement and comfort. In addition, the researchers looked for the stressors of bad moods and engaged in communication with them, thus changing the irrational parts of the cognitive profile. Secondly, music was used to regulate. During free time, light pop or soothing classical music is played on board, or the seafarers' favorite music. While enjoying the music, the seafarers discuss it as a group. Again, emotional support is promoted. The benefits of emotional support among seafarers included increased solidarity and camaraderie, as well as working together as a team. The researchers encouraged

other seafarers to initiate conversations with the intervention group and to participate in activities together. This allowed them to feel a sense of community. Finally, relaxation exercises were combined. Physiological activity and psychological responses are inextricably linked, so the intervention group can be assisted with psychological relaxation training using myoelectric skin temperature biofeedback device.

4.2 Recommendations for physiological quality development

Physiological quality includes the ability to think and remember, to perceive, and to be physically fit.

Physiological quality is directly linked to the seafarer's ability to operate. It focuses on the action of the human nervous system in response to external stimuli, i.e. the reaction. The average human reaction time is roughly 0.5-1.0 seconds. If the mental processes occur between sensory and psychological effects, the reaction time will be significantly longer. In ship manoevuring, pilot reaction time is linked to many factors, including endurance, mental state, adaptability, social relationships, age, and professional experience. Endurance, or physical fitness, is the most critical factor in the physiological quality of seafarers. Physical fitness development aims to counteract fatigue. The sensory response of the body's internal mechanism system to the various changes in the body can be seen as the first sign of fatigue. Fatigue is a physiological response to all movements. It can cause a temporary reduction in the body's capacity to work, which can be manifested by a dulling of the mind and a loosening of the will. Fatigue can even make a person emotionally irritable and unstable, as evidenced by a person dozing off when fatigue sets in, while being indifferent to potential danger. Fatigue is divided into physical, intellectual, and emotional, often occurring in conjunction with each other. For seafaring students, the core of physical exercise is the development of reflexes and endurance. The special nature of the seafaring profession means that the physical education curriculum

should be different from that of students in other professions. At present, domestic maritime institutions often neglect the physical training of their students, so that their physical education courses are arranged in a way that is no different from those of other professions. This approach is not conducive to the physical training of maritime colleges and universities students. The following three points need to be done to develop the physical fitness of maritime colleges and universities students.

4.2.1 Physiological training is integrated throughout the learning process

At present, maritime colleges in China only offer physical education courses in the lower grades and for a rather low percentage of credits. This is a direct result of the fact that physical education is not valued by students. Maritime students also generally do not value physical education. Therefore, schools need to increase the variety of physical education courses, course time, and credits. The content of physical education classes should increase the exercise of endurance and reflexes. The teachers responsible for the physical education courses should arrange the courses in varied ways and be strict in their attendance and assessment systems. For example, swimming lessons should be a basic course for students in maritime academies; long-distance running can enhance students' endurance qualities; badminton can enhance students' reflexes. Without affecting other educational programs, schools should try to arrange physical education courses throughout the four years of university. During the four years of university, schools should grasp the special nature of physical exercise for maritime students and make full use of school time to exercise students' physical qualities. Good physical fitness lays a solid foundation for students to grow into excellent seafarers.

4.2.2 Semi-military management system in place

At present, the semi-military management system is widely used in the training process of maritime colleges and universities students in the majority of domestic maritime institutions. For example, Dalian Maritime University builds an effective

semi-military management culture system. The consolidation of a paramilitary management system in maritime institutions is an important way for the university to create a distinctive education and cultivate quality talent. The semi-military management system can improve students' spirit of hard work and endurance, as well as sharpen their willpower. It should be made compulsory in schools and should be implemented in practice. In the course of military training, the reflexes and stamina of seafaring students are improved, while the basic physiological qualities for a seafaring career are developed. Therefore, based on the existing semi-military management system, a new way of semi-military management and cultural education for the cultivation of highly qualified and complex shipping talents should be opened up and realized to add to the innovation of the maritime education model.

4.2.3 Establishment of sports associations

The maritime academy should regularly conduct various competitive sports competitions and encourage students to actively participate in them. Sporting incentives should be introduced, meaning that sporting winners should be rewarded both morally and materially. The establishment of a sports association would both increase students' motivation to play sports and promote the harmonious development of their bodies and minds. Students will place more and more emphasis on the development of their physical qualities. The establishment of a sports association will also help to develop the good habit of regular physical exercise among seafaring students after they have become seafarers. Their good physical qualities will be consolidated and their physical and mental health will be well maintained. In addition, the establishment of a sports association will also enable students to improve their personal adaptability and coordination skills. In this way, the sports association will serve as a bridge between the students and the school authorities, thus contributing to the improvement of the sports training system.

4.3 Recommendations for MQ development

The professional ethics of seafarers is not only related to the safety of ships and the safety of seafarers, but also to the safety of passengers' lives and the healthy development of the maritime industry. The cultivation of seafarers MQ requires the efforts of shipping enterprises and maritime departments, as well as the attention of the whole society. In recent years, there have been many maritime accidents around the world, which are closely related to the deteriorating MQ of seafarers.

4.3.1 Improving the attractiveness of the seafaring profession and linking professional ethics to personal benefits

The decline in the ethical quality of Chinese seafarers is partly due to the overall social climate and partly due to the declining attractiveness of the seafaring profession. The key challenge is to improve the attractiveness of the seafaring profession. As a major shipping nation, China has the advantage of abundant labor resources, but the number of seafarers in its pool is not commensurate with the country's share of the global shipping market. This is therefore in urgent need of policy support from the Chinese government. For example, the hard work and irreplaceable role of seafarers during the COVID-19 epidemic should be made known to the general public through the Internet and the media. so that a positive image of seafarers could be established to enhance their social status and recognition(Li et al., 2022). The Chinese government should introduce policies to support the development of maritime education, such as subsidizing tuition fees to assist students to complete their studies; on the other hand, the Chinese government should support the export of labor and open up policies to serve seafarers on deployments; most importantly, China should strive to stabilize the seafarer workforce, which could be an important way to improve the social status of seafarers. Seafarers are important maintainers of the global supply chain, so their role and status should be further improved so that seafarers can be recognized and respected

by more people both in and outside of the shipping industry(Kongsvik et al., 2020). A country can only realize its dream of becoming a maritime power if it develops its seafaring career. It is recommended that the government and competent authorities increase the promotion of seafarers' occupation(Yildirim et al., 2022).

The maritime sector and shipping companies can link the personal interests of seafarers directly to the quality of their ethics. This can make seafarers feel the urgency of having moral qualities linked to their interests. The link between ethics and financial interests means that financial penalties will be applied in the event of a breach of ethics. Seafarers can reflect on themselves after suffering financial losses and achieve a conscious commitment to ethics. The link between ethics and personal accolades means that if a seafarer is guilty of unethical behavior, he or she loses the right to be selected for various awards. This way, seafarers are warned and taught to develop a sense of honor and shame. The link between ethics and personal career means that ethics are used as a criterion for assessment by the authorities when seafarers are promoted and are strictly controlled. This has a positive effect. Seafarers with good ethics will be able to do well, while those with poor ethics will gradually lose their competitiveness in the seafaring market. Correcting the culture of the seafarer profession in this way will help to foster a positive ethical climate among the seafarer community.

4.3.2 Establishing incentive mechanisms to play a leading role in safety culture

With the rapid development of the global economy, the reshaping of professional ethics for seafarers requires the state to guide young seafarers to establish a correct world view, values, and outlook on life. For example, by using television, newspapers, and internet platforms as a vehicle to select moral role models for seafarers and award them with awards while reporting on their advanced deeds, the aim is to promote a positive influence. Such an incentive mechanism will undoubtedly go some way to improving the mainstream moral values of seafarers. In

such a context, the moral quality of seafarers will be improved to a certain extent. In addition, Managers should not just be concerned with building trust among team members to maximize group potential(Dekker, 2014). Furthermore, in relation to sociology, the function of trust in social systems is of greater interest than the psychological orientations of individuals engaged in trusting/distrusting(Sampson et al., 2019).

Professional ethics is an important part of the safety culture in shipping. A good safety culture is a good vehicle for professional ethics. For example, in 2019, COSCO Group systematically elaborated on the safety culture of enterprises. "Behavioral Identification System", the code of conduct is set out and the sense of honor and responsibility of employees is required. COSCO Group has formulated a comprehensive system of professional ethical standards. The system is fully scientific and comprehensive, and needs to be put to good use in practice. Safety culture education in maritime companies can therefore directly improve the moral quality of seafarers and urge them to strictly adhere to the company's code of conduct.

4.3.3 Enhancing awareness of environmental protection, safety awareness, and obedience training among seafarers

The MARPOL 73/78 developed by the IMO in 1973 sets out the requirements for seafarers to be aware of environmental protection. Marine environmental protection has become a global concern. The environmental awareness of training institutions and school teachers should be raised. Training of teachers could include basic knowledge of the ecosystem, the importance of environmental qualities. Shipping companies should be made aware of the need and the benefits of the international safety codes. In response to the needs of shipping companies, maritime academies should improve communication with shipping companies and adapt the curriculum for their students. Anti-pollution courses for ships must be introduced in maritime

schools. In China, such courses are rarely offered to students, and marine engineering students are only offered as elective courses. It is also recommended that maritime authorities add marine pollution to the seafarers' examinations to increase the attention of seafarers themselves. In addition, environmental awareness education for seafarers should be combined with a training quality system. When establishing the quality system, the maritime academy can refer to the requirements of the latest environmental management system and organically integrate the requirements with the seafarers' education and training quality system.

safety awareness is essential in maritime field. In particular, the seafaring profession, due to the somewhat isolated nature of the voyage, cannot be rescued in time if something goes wrong with the ship. Safety awareness among seafarers is therefore particularly important. There is a clear hierarchy on board. The captain is the supreme commanding officer on board and all other personnel are subject to the captain's orders. Work on board, therefore, requires a good sense of obedience from seafarers. If a seafarer lacks a sense of obedience, he or she will not be able to do his or her job in the command process. Therefore, the safe operation of the ship is not guaranteed. Therefore, seafarers' training institutions must pay extra attention to the cultivation of safety and obedience awareness in their training. To sum up, the quality of seafarers' professional ethics is closely related to the development of the maritime industry, which needs to be given high priority. At the same time, seafarers' professional ethics are closely related to the general social environment and national policies, which need to be developed in an integrated manner. To this end, flag states should continue to improve the social status and economic benefits of seafarers while attaching importance to the seafarer profession. On occasions like Chinese Maritime Day and World Seafarers' Day, crew-themed activities open to the society could be organized to publicize crew careers and contributions to continuously improve crew social recognition and reputation(Wan et al., 2023). This

is a good basis for seafarers to consciously observe professional ethics.

4.4 Recommendations for OSQ development

The quality of occupational skills is the most important aspect of the comprehensive quality of seafarers. As a core quality, the OSQ relates to the safety of navigation on board ships. It accounts for up to 61% of the typical maritime accidents investigated in this paper. Work on board ships is divided and closely structured. Seamanship is, therefore, a highly specialized and technology-intensive occupation.

If the quality of seafarers' occupational skills is at risk, it can lead to a major sinking and loss of life. The OSQ is therefore both the most basic of the comprehensive qualities and the most demanding for seafarers. The knowledge required of a student of maritime technology includes route design, ship manoeuvring and avoidance, marine meteorology, port and waterway engineering, and English for navigation. Maritime technology has evolved through the use of modern technology. As a result, the officers on board need to master a wider range of skills. For example, an officer's maritime English is not good enough and the slightest error in avoiding a collision could easily result in a collision. One more example, an officer who cannot read weather maps may not be able to avoid a known typhoon vortex. It follows that excellent occupational skills are an essential quality for seafarers.

4.4.1 Enhancing seafarers' knowledge level

With the development of technology, the shipping industry has seen a digital transformation. The main concern of Industry 4.0 is about automation, Industry 5.0 will position humans back into industrial framework with the focus on human/machine co-operation(Shahbakhsh et al., 2021). Therefore, theoretical learning for seafarers is a natural trend. The evolution of industrial technology is shown in figure

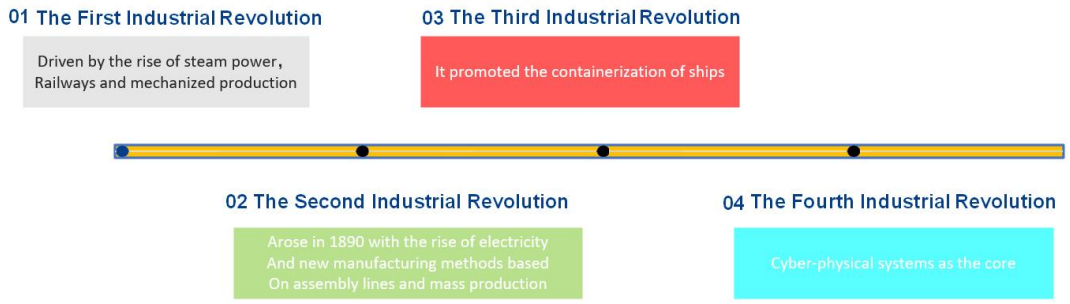

Figure 4-The evolution of industrial technology

Source: Shahbakhsh, M., Emad, G. R., & Cahoon, S. (2021).

Seafarers' theoretical knowledge of navigation is a guarantee of the quality of their occupational skills. Seafarer training is an important form of upgrading seafarers' theoretical knowledge. Training to update seafarers' knowledge is a convenient way for seafarers to master new technology and new knowledge. It is a fact that Chinese seafarers are under-educated. Therefore, this deficiency should be remedied in other ways. For example, there are various ways of furthering knowledge and skills, including mentorship, further education, e-learning for seafarers, and so on. Training institutions play an important role in this process. Seafarer training providers need to be accredited by the maritime authorities. After a seafarer has been certified, the training institution should continue to collect information on the updating of seafarers' knowledge and skills and report these new knowledge and skills to the maritime authority. The competent maritime authorities should organize maritime experts to review the relevant content reported by the training providers and delineate the basic framework. Furthermore, following the requirements of the relevant international conventions, the maritime authorities should scientifically develop and define the training cycle. Through training, it is ensured that the practical skills and knowledge of seafarers are effectively strengthened. It should not be overlooked that educational and research institutions should conduct regular

studies on the effectiveness of seafarers' training after they have been certified so that quality control can be done. Seafarers themselves must also take the initiative to improve their qualifications and continue to further their education in the maritime field. The era of the so-called shift to 'Industry 4.0' and digitalization, seafarers are increasingly expected to adapt and develop their skills to be more digitally inclined, transforming the structure and nature of their skills(Baum-talmor & Kitada, 2022).

4.4.2 The reform of maritime English education

The STCW convention is the fundamental basis for seafarers' training in all countries of the world. The STCW Convention monitors the quality of seafarers in each contracting state to ensure the safety of navigation and personnel. At the same time, the STCW Convention protects the marine environment and effectively controls the human factor in maritime accidents. Since July 2012, the Manila amendments to the STCW Convention have been in force. The implementation of these amendments has contributed significantly to the further development of the shipping industry in line with maritime technology. China as a maritime nation will continue to provide an increasing number of qualified maritime graduates in the global maritime labor market(Ying, 2020). Of course, Along with other standardized criteria of Maritime Education and Training (MET), the cadets need expertise in ME(Yashnikova, 2022). The Manila amendments redefine the standard of English for seafarers. The Convention requires seafarers to be proficient in the use of nautical English to converse with others as necessary. At a minimum, seafarers must be able to communicate at a level where there is no barrier to communication and both parties must communicate clearly and without ambiguity. Lack of proficiency in English leads to miscommunication, which often results in marine accidents, and endangers the safety of life and security at sea. Miscommunication is a kind of human errors and one of the major factors of shipping accidents(Sellberg et al., 2022).

In addition, the amendment also suggests that, given the unlimited potential of information technology development, the training methods for seafarers should be appropriately transformed, for example, by distance e-learning. Then, the teaching philosophy and teaching methods should also be changed accordingly. For example, with the convenience of Internet, an online English learning platform needs to be established so that crew members can make use of their spare time to continuously improve their English skills and lay a solid foundation for promotion(Guo, 2023). China has not yet established a maritime English learning platform that is open to the public and serves seafarers. An international English learning platform for seafarers would not only bring seafarers' English education closer to international standards but also meet their own practical needs and promote access to education. For school students, the learning platform makes up for the lack of English classroom hours and increases the opportunities for students to learn English on their own. For seafarers, the learning platform compensates for the limitations of the learning location and provides seafarers with the possibility to learn English anytime and anywhere. The maritime English learning platform has practical implications for improving the English language skills of Chinese seafarers. Among the English language skills, speaking needs the highest attention as the recruiting agencies mostly test speaking skills in the job interviews(Ahmmed et al., 2020). Basic English for maritime is shown in figure 5, and professional English for maritime is shown in figure 6.

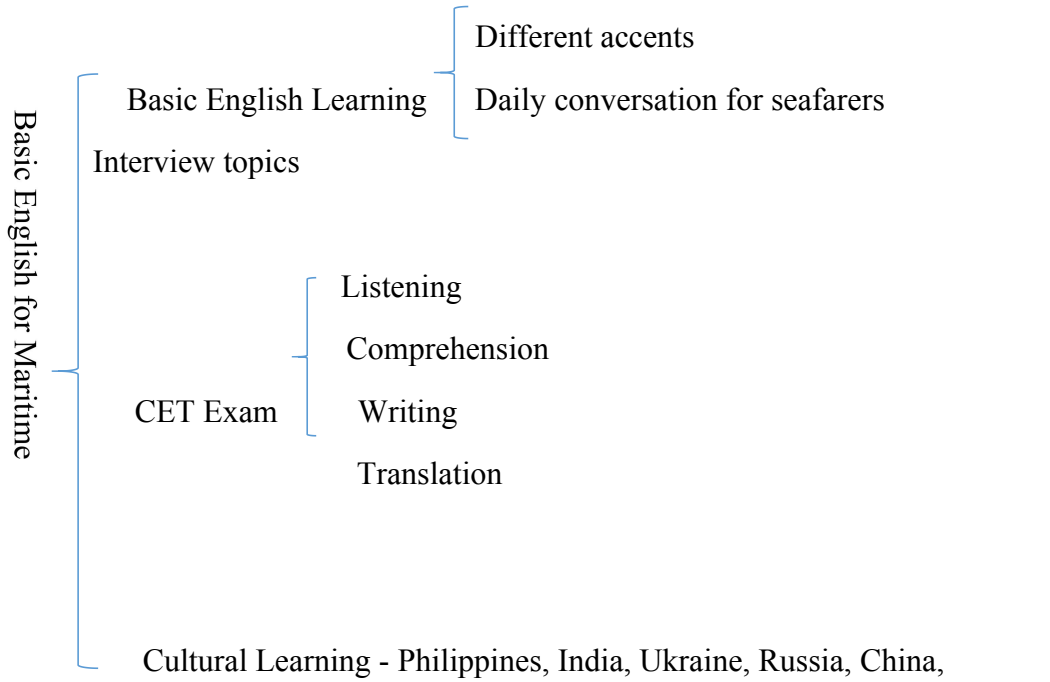

Figure 5-Maritime Basic English System

Source: (Shahnaz et al., 2020).

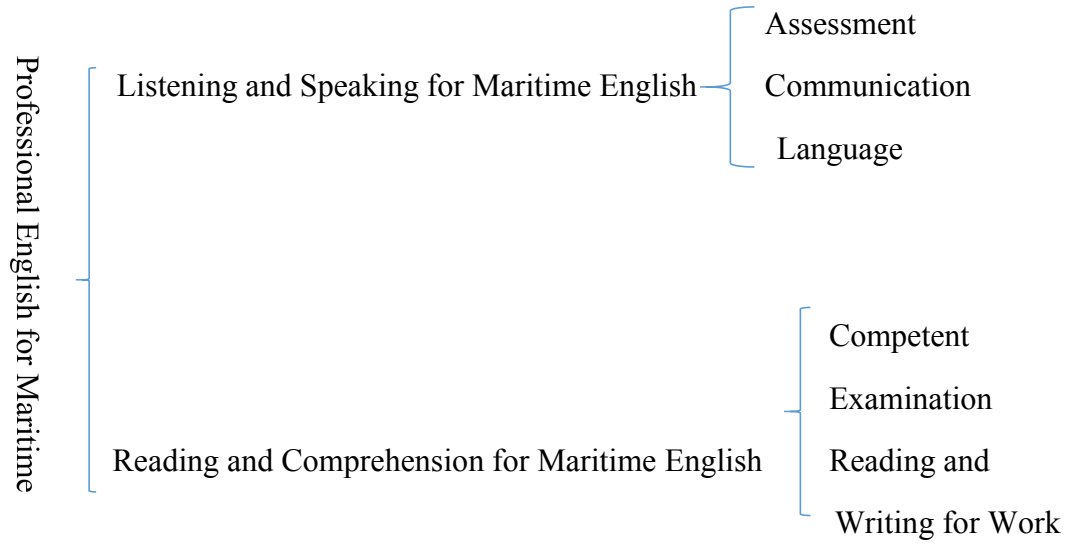

Figure 6-Professional English for maritime

Source: (Ahmmed et al., 2020).

4.4.3 Enhance practical skills training

Maritime colleges and training institutions should employ highly qualified and certified shipmasters and engine masters as instructors. Teachers from maritime academies need to be on board regularly to improve the quality of practical skills training courses. At the same time, post-certification training institutions need to invest in simulators and other supporting equipment. Hands-on simulator training is fully implemented in practical teaching. Training providers need to enrich their experience with trainees and strengthen their assessment standards. In addition, the communication and collaboration skills of trainees need to be effectively strengthened. Teamwork has always been the dominant form of operation in the shipping world. Simulator training has been widely utilized among maritime education and training. It integrates tasks and application context to achieve knowledge transfer. Given this practice, seafarers acquire competencies in the required maritime operations, and assessors/examiners evaluate human performance in the simulation for training purposes(Fan & Yang, 2023). In teaching practice, trainees can be assigned into small groups. Group activities are organized to promote the development of cadets' cooperation skills. It should not be overlooked that seafarers may encounter a variety of unexpected situations during their voyage, so practical simulations should be added to the training to enhance seafarers' resilience.

CHAPTER 5 CONCLUSION AND OUTLOOK

Through the analysis of the connotation of seafarer quality in Chapter 2, the impact of seafarer quality on water transport safety in Chapter 3, the analysis of the current situation of seafarer quality in China in Chapter 4, and the study of the cultivation way of seafarer quality in Chapter 5, this paper finally obtains the conclusion of this chapter. Through the analysis of the methods and graphical data used in this paper, this paper makes the outlook.

5.1 Conclusion

Although shipbuilding technology and the management of shipping enterprises are constantly improving, the most fundamental factor in ensuring the safety of navigation at sea is still the quality of seafarers themselves. Apart from the continuous learning of seafarers themselves, the most common and most important form of improving the quality of seafarers is the continuous training of seafarers. Improving the quality of training is of great importance in improving the quality of seafarers.

This paper has found that some of the training does not fully meet the needs of the actual ship. In other words, some of the courses have some problems that have to be improved. Therefore, based on the factors of seafarers, this paper proposes more effective training programs. And make recommendations to address the shortcomings based on the effectiveness to improve the seafarer education and training work. These lay the foundation for the following work and provide the reader with a reference basis for understanding seafarer training in China from a macro perspective.

Chinese seafarer education and training system, the number of registered seafarers, and sent abroad seafarers is introduced and analyzed. This paper asserts that quality education for seafarers should start at the grassroots level and maritime education system in china need reforming. The quality training of seafarers should take OSQ,

psychological quality, MQ, and physiological quality as the core of training to achieve a fundamental reduction in the human fault of seafarers in maritime accidents.

5.2 Outlook

This paper only collects ten typical maritime accidents at home and abroad from the research literature. It is not comprehensive enough to explain the impact of seafarers' qualities on the safety of shipping. Therefore, the correlation between seafarer quality and safety of navigation can be explored in more depth in the future when the conditions are sufficient and data are available. In the future, when conditions and data are available, the correlation between seafarers' quality and safety of navigation can be explored in more depth, and data on specific navigation areas and periods can be collected more fully for calculation.

The comprehensive quality of Chinese seafarers will continue to change as a result of the rapid development of maritime technology and the advancement of moral values within society. As a result, specific research data will be updated and research will need to be carried out on an ongoing basis. In this way, new paths in the development of seafarer quality can be opened up.

Although this paper gives a comprehensive evaluation system for seafarer quality, it needs to be integrated with reality when evaluating seafarer quality in practice. In other words, specific analysis should be done for specific issues. Factors that have not been considered in this paper should also be accepted, provided they are sufficiently scientific and reasonable.

REFERENCE

Ahmmed, R., Shahnaz, B., Khan, R., & Mazharul, D. (2020). A needs analysis of maritime English language skills for Bangladeshi seafarers to work on-board ships. *Marine Policy*, *119*(May), 104041. https://doi.org/10.1016/j.marpol.2020.104041

Baum-talmor, P., & Kitada, M. (2022). Transportation Research Interdisciplinary Perspectives Industry 4 . 0 in shipping : Implications to seafarers ' skills and training. *Transportation Research Interdisciplinary Perspectives*, *13*(December 2021), 100542. https://doi.org/10.1016/j.trip.2022.100542

Baumler, R., Bhatia, B. S., & Kitada, M. (2021). Ship first: Seafarers' adjustment of records on work and rest hours. *Marine Policy*, *130*(xxxx), 104186. https://doi.org/10.1016/j.marpol.2020.104186

Chan, W. T. K., & Li, W. C. (2022). Investigating professional values among pilots, cabin crew, ground staff, and managers to develop aviation safety management systems. *International Journal of Industrial Ergonomics*, *92*(September), 103370. https://doi.org/10.1016/j.ergon.2022.103370

Danacı, M., & Yıldırım, U. (2023). Comprehensive analysis of lifeboat accidents using the Fuzzy Delphi method. *Ocean Engineering*, *278*(March), 114371. https://doi.org/10.1016/j.oceaneng.2023.114371

Dekker, S. W. A. (2014). The bureaucratization of safety. *Safety Science*, *70*, 348–357. https://doi.org/10.1016/j.ssci.2014.07.015

Deng, X. K. & Wang, H. J. (2019). Study on the strategy of aligning the quality management system of crew education and training with ISO9001:2015 under the framework of STCW Convention. *China Water Transport (2nd Half Month)*, *05*, 48–49.

Fan, L., Fei, J., Schriever, U., & Fan, S. (2017). The communicative competence of Chinese seafarers and their employability in the international maritime labour market. *Marine Policy*, *83*(June), 137–145. https://doi.org/10.1016/j.marpol.2017.05.035

Fan, S., Blanco-Davis, E., Fairclough, S., Zhang, J., Yan, X., Wang, J., & Yang, Z. (2023). Incorporation of seafarer psychological factors into maritime safety assessment. *Ocean and Coastal Management*, *237*(February), 106515. https://doi.org/10.1016/j.ocecoaman.2023.106515

Fan, S., & Yang, Z. (2023). Towards objective human performance measurement for maritime safety: A new psychophysiological data-driven machine learning method. *Reliability Engineering and System Safety*, *233*(September 2022), 109103. https://doi.org/10.1016/j.ress.2023.109103

Fang, M. S. (2018). A few thoughts on improving the quality of basic safety training for crew members. *Knowledge Library*, *24*, 258.

Filipowicz, W. (2004). Vessel Traffic Control Problems. *Journal of Navigation*, *57*(01), 15–24.

Guo, X. R. (2023). A study on the construction of online and offline integration teaching model of maritime English empowered by virtual reality technology. *Journal of Foreign Languages*, *01*, 97–104. https://doi.org/10.16263/j.cnki.23-1071/h.2023.01.013

IMO. (2019). *Guidance on fatigue mitigation and management I:\CIRC\MSC\01\MSC.1-Circ.1598.docx*. *44*(June 2001).

Inspection, C. S. (2008). Who is to blame for the disaster of the "Gunstar Princess." *China Ship Inspection*, *07*, 32–36.

Jiang, Y. L., Dong, Z. H., Li, J. & Zhong, M. (2016). A comparative study on the training mode of Chinese and foreign shipping management talents. *Research on Maritime Education*, *03*, 45–50.

John, P., Brooks, B., & Schriever, U. (2017). Profiling maritime communication by non-native speakers: A quantitative comparison between the baseline and standard marine communication phraseology. *English for Specific Purposes*, *47*, 1–14. https://doi.org/10.1016/j.esp.2017.03.002

Koh, L. Y., Ng, C., Wang, X., & Yuen, K. F. (2023). Social media engagement in the maritime industry during the pandemic. *Technological Forecasting and Social Change*, *192*(March), 122553. https://doi.org/10.1016/j.techfore.2023.122553

Kongsvik, T., Haavik, T., Bye, R., & Almklov, P. (2020). Re-boxing seamanship: From individual to systemic capabilities. *Safety Science*, *130*(August 2019), 104871. https://doi.org/10.1016/j.ssci.2020.104871

Kothari, U. (2021). Seafarers, the mission and the archive: Affective, embodied and sensory traces of sea-mobilities in Melbourne, Australia. *Journal of Historical Geography*, *72*, 73–84. https://doi.org/10.1016/j.jhg.2021.05.003

Li, J. (2009). The causes of operational pollution of ships and the supervision of the "Hai Guan Shan 117" accident. *Tianjin Navigation*, *03*, 66–68.

Li Quan, S. Z. (2021). Research on the quality standard system of seafarers' education and training based on STCW Convention[J]. *Maritime Education Research*, *01*, 20–24.

Li, X. X. (2021). Research on the path of cultivating university students' maritime awareness in the context of a strong ocean state. *Southern Journal*, *04*, 103-104+107.

Li, X., Zhou, Y., & Yuen, K. F. (2022). A systematic review on seafarer health: Conditions, antecedents and interventions. *Transport Policy*, *122*(April), 11–25. https://doi.org/10.1016/j.tranpol.2022.04.010

Lin, D. H. (2018). Research on the path of comprehensive quality training for maritime technicians. *Literature and Science Navigation (Mid)*, *07*, 98.

Lin, J. X. (2015). How to reduce the ethical risk of passenger ship crew from the accident of SEWOL. *China Maritime*, *12*, 51–53.

Lin, L. P. (2015). Reflections on improving the quality of China's maritime technical personnel. *Statistics and Management*, *08*, 140–141.

Liu, J., Ge, Y., & Zhang, Y. (2021). Empirical analysis of brain drain of Chinese seafarers : Reasons and countermeasures. *Maritime Transport Research*, *2*, 100035. https://doi.org/10.1016/j.martra.2021.100035

Luqman, A., & Zhang, Q. (2022). Explore the mechanism for seafarers to reconnect with work after post-pandemic psychological distress (PAPIST19): The moderating role of health-supporting climate. *Ocean and Coastal Management*, *223*(March), 106153. https://doi.org/10.1016/j.ocecoaman.2022.106153

Mallory, T. G., Chubb, A., & Lau, S. (2022). China's ocean culture and consciousness: Constructing a maritime great power narrative. *Marine Policy*, *144*(July), 105229. https://doi.org/10.1016/j.marpol.2022.105229

Mao, H. X. & Jin, L. (2021). Oral stories of a century of seafarers (VII): the development of seafarers' workforce after the founding of New China. *China Maritime*, *09*, 78. https://doi.org/10.16831/j.cnki.issn1673-2278.2021.09.026

Maslach, C., Wilmar B.& Michael, P. (2001). JOB BURNOUT. *Annual Review of Psychology*, *1*. https://doi.org/10.1146/annurev.psych.52.1.397

Moreno, F. C., Gonzalez, J. R., Muro, J. S., & Maza, J. A. G. (2023). Relationship between human factors and a safe performance of vessel traffic service operators : A systematic qualitative-based review in maritime safety. *Safety Science*, *155*(August 2022), 105892. https://doi.org/10.1016/j.ssci.2022.105892

Nuan, Q. X. (2014). The sinking of the Costa Concordia. *Sea World*, *04*, 40–43.

Oldenburg, M., J. et al. (2009). Seafaring stressors aboard merchant and passenger ships. *International Journal of Public Health*, *2*. https://doi.org/10.1007/s00038-009-7067-z

PANG, R. M. (2017). *Study on the improvement of the environmental rescue system for maritime disasters under the International Rescue Convention 1989* [Dalian Maritime University]. https://doi.org/CMFD201702&filename=1017196432.nh

Pauksztat, B., Grech, M. R., & Kitada, M. (2022). The impact of the COVID-19 pandemic on seafarers' mental health and chronic fatigue: Beneficial effects of onboard peer support, external support and Internet access. *Marine Policy*, *137*(December 2021), 104942. https://doi.org/10.1016/j.marpol.2021.104942

Pedersen, E. (2003). Simulator studies on a collision avoidance display that facilitates efficient and precise assessment of evasive manoeuvres in congested Waterways. *The Journal of Navigation*, *56*(3), 422–427.

Press Office of the Ministry of Transport of the People's Republic of China. (2021). *China Crew Development Report 2020*.

Rameshkumar, M. (2020). Employee engagement as an antecedent of organizational commitment – A study on Indian seafaring officers. *Asian Journal of Shipping and Logistics*, *36*(3), 105–112. https://doi.org/10.1016/j.ajsl.2019.11.003

Sampson, H., Turgo, N., Acejo, I., Ellis, N., & Tang, L. (2019). 'Between a Rock and a Hard Place': The Implications of Lost Autonomy and Trust for Professionals at Sea. *Work, Employment and Society*, *33*(4), 648–665. https://doi.org/10.1177/0950017018821284

Sellberg, C., Wiig, A. C., & Säljö, R. (2022). Mastering the artful practice of navigation: The situated endorsement of professional competence in post-simulation evaluations. *Studies in Educational Evaluation*, *72*(May 2021). https://doi.org/10.1016/j.stueduc.2021.101111

Shahbakhsh, M., Emad, G. R., & Cahoon, S. (2021). Industrial revolutions and transition of the maritime industry_ The case of Seafarer's role in autonomous shipping. *The Asian Journal of Shipping and Logistics*, *38*(1), 10–18. https://doi.org/10.1016/j.ajsl.2021.11.004

Shen, Z. Q. (2019). Before and after the STCW Convention. *China Ship Inspection*, *09*, 104–108.

Song, L., Huang, Z., Zhang, H., Tian, K., Yin, N., Xu, Y., Gan, L., Wang, J., Chen, J.,

Shu, Y., & Zheng, C. (2021). The urgency to address the occupational health of chinese seafarers for sustainable development. *Marine Policy*, *129*(April), 104518. https://doi.org/10.1016/j.marpol.2021.104518

Størkersen, K. V., & Thorvaldsen, T. (2021). Traps and tricks of safety management at sea. *Safety Science*, *134*(October 2020). https://doi.org/10.1016/j.ssci.2020.105081

Tang, L., Abila, S., Kitada, M., Malecosio, S., & Montes, K. K. (2022). Seafarers' mental health during the COVID-19 pandemic: An examination of current supportive measures and their perceived effectiveness. *Marine Policy*, *145*(July), 105276. https://doi.org/10.1016/j.marpol.2022.105276

Uflaz, E., Akyuz, E., Arslan, O., & Celik, E. (2022). A quantitative effectiveness analysis to improve the safety management system (SMS) implementation on-board ship. *Safety Science*, *156*(August), 105913. https://doi.org/10.1016/j.ssci.2022.105913

Ungureanu, C. C. (2014). Intercultural Education, a Response to Contemporary Multilingual Societies and a New Challenge for Maritime Education and Training (MET) Institutions. *Procedia - Social and Behavioral Sciences*, *116*, 4260–4263. https://doi.org/10.1016/j.sbspro.2014.01.928

Wan, Z., Liu, Y., Jiang, Y., Chen, J., & Wang, Z. (2023). Burnout and work ability: A study on mental health of Chinese seafarers from the job demand resource model perspective. *Ocean and Coastal Management*, *237*(January), 106517. https://doi.org/10.1016/j.ocecoaman.2023.106517

Xu, M. M. (2012). When will the nickel ore shipping disaster end. *China Ship Inspection*, *02*, 26–27.

Yashnikova, N. (2022). Modelling developing readiness of maritime graduates for profession-oriented foreign-language communication by means of contextual learning. *Transportation Research Procedia*, *63*, 167–177. https://doi.org/10.1016/j.trpro.2022.06.002

Yildirim, U., Toygar, A., & Çolakoğlu, C. (2022). Compensation effect of wages on decent work: A study on seafarers attitudes. *Marine Policy*, *143*(March), 1–7. https://doi.org/10.1016/j.marpol.2022.105155

Ying Qibo. (2020). Reflections on the remote review of flag state supervision and inspection. *China Maritime*, *01*, 39–42. https://doi.org/10.16831/j.cnki.issn1673-2278.2020.01.014

Yu, Y. F. (2015). Crew quality and safety at sea. *Tianjin Navigation*, *03*, 30–32.

Zhang, W. L. & Cui, J. H. (2022). Problems of China's operational grade crew education from the crew development report. *Tianjin Navigation*, *03*, 76–79.

Zhang, C. (2014). A big inventory of maritime disasters - International. *Zhujiang Water Transport*, *13*, 28–31. https://doi.org/10.14125/j.cnki.zjsy.2014.13.090

Zhu, J. (2006). The Titanic tragedy repeats itself - the sinking of the Egyptian passenger ship Salam 98 in the Red Sea. *Sea World*, *03*, 24–29.

Kaukiainen, Y. (2014). The role of shipping in the 'second stage of globalisation.' *International Journal of Maritime History,* 26(1), 64–81. https://doi.org/10.1177/0843871413514505