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## Analysis on the challenges of safety supervision on small and medium-sized vessels in waters of NingBo-ZhouShan port and sustainable strategies

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**WORLD MARITIME UNIVERSITY**

Dalian, China

**ANALYSIS ON THE CHALLENGES OF  
SUPERVISION ON SMALL AND MEDIUM  
SIZED VESSELS IN WATERS OF  
NINGBO-ZHOUSHAN PORT AND  
SUSTAINABLE STRATEGIES**

By

**JIANG JIE**

**The People's Republic of China**

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**

**MSEM**

2020

## DECLARATION

I certify that all the materials in this dissertation that are 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: \_\_\_\_\_

Date: \_\_\_\_\_

**Supervised by: DR. FENGWU WANG**  
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**Co-assessor:**

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## ABSTRACT

Title of Dissertation: **Analysis on the challenges of safety supervision on small and medium-sized vessels in waters of NingBo-ZhouShan port and sustainable strategies**

Degree: **MSc**

Port of Ningbo-Zhoushan with its ample superior resources and natural conditions, plays an important role in the economic development of China. Many international liner ships come and go frequently every day. However, small and medium-sized ships in the waters of the port which are generally old, with poor safety technology, lax safety management, and low crew quality, have always been the protagonists of maritime illegal acts and traffic accidents in the waters, and their supervision has posed enormous difficulties for many years. It is necessary and urgent to study the operation status and to enhance safety supervision of small and medium-sized vessels in this area.

Based on years of experience in Maritime supervision of small and medium-sized ships, the author provides independent thinking on the difficulties and methods of supervision of small and medium-sized ships through on-site investigation, literature research, descriptive statistical analysis and other methods. Based on the characteristics of Ningbo-Zhoushan Port, this paper puts forward some suggestions and a series of feasible schemes for the safety supervision of small and medium-sized ships. It is hoped that these schemes and thoughts can provide practical reference for the safety supervision of small and medium-sized ships in waters of Ningbo-Zhoushan port and in China.

**KEY WORDS:** Small and medium-sized ships, Maritime supervision, Supervision countermeasures, Ship inspection, Safety inspection, Anti-pollution

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## LIST OF ABBREVIATIONS

ECDIS	Electronic Nautical Charts and Electronic Chart Display and Information Systems
AIS	Automatic Identification System
CCTV	Closed Circuit Television
COLREGS	Convention on the International Regulations for Preventing Collisions at Sea, 1972
DG ship	Dangerous cargo ship
EU	Europe
FSC	Flag State Control
FSCO	Flag State Control Officer
GPS	Global Position System
MARPOL	Maritime Agreement Regarding Oil Pollution
M.E.	Main engine
MLC	Maritime Labor Convention
MSA	Maritime Safety Administration
NA	Not applicable
OWS	Oily Water Separator
PPM	Parts Per Million
QC	Quality Control
SMS	Safety Management System
TQC	Total Quality Control
VTS	Vessel Traffic Service

# CHAPTER 1

## INTRODUCTION

### 1.1 Background

In daily Maritime management, people tend to pay more attention to PSC inspection, GHG discharge control, ballast water management, low sulfur oil and other topics of large ships and international issues, and always neglect small and medium-sized ships. However, the problems of small and medium-sized ships are often more serious, and the number of small and medium-sized ships far exceeds that of large ships.

In recent years, with the river-sea combined transport, large, small and fast ships coexist, and the Maritime transport industry develops rapidly. Those small and medium-sized ships have made great contributions to local economic development, however, they also bring many risks.

According to statistics, from 2017 to 2019, more than 90% of ship accidents happened in China involve ships which are less than 3,000 GT, (China MSA) and such problems as inadequate company management, poor ship quality, crew failure to comply with navigation regulations and poor response ability are common. It is a great threat to the safe navigation in China. This situation is more common in the waters of Ningbo-Zhoushan Port, where the route is complicated with thousands of islands large and small, and a large number of small and medium-sized vessels. As shown in the Figure 1.1, it is a partly screenshot of Ningbo-Zhoushan Port, in the picture, each triangle represents one ship, there are a lot of them and the navigation environment is very complex. It is urgent to form a set of Maritime supervision system which is effective and sustainable.



Figure 1.1-Partly screenshot of Ningbo-Zhoushan Port  
 Source: Screenshot by the author on Shipxy.com

In this paper, the author carries out deep analysis on the current status of small and medium-sized vessels operating in the waters of Ningbo-Zhoushan port as well as analysis on different means of maritime supervision, and then puts forward feasible and sustainable maritime supervision methods which may effectively improve the safety management level of small and medium-sized ships and the safe navigation capacity of Ningbo-Zhoushan coastal waters. Besides, it is hoped that these schemes and thoughts can provide practical reference for the safety supervision of small and medium-sized ships in other water areas in China.

## 1.2 Defining on small and Medium-sized ships

The small and medium-sized ships studied in this paper refer to the domestic coastal navigation ships with a gross tonnage of less than 3000 GT, among which the focus is putted on ships under 1000GT navigating in the waters of Ningbo-Zhoushan Port.

The small and medium-sized vessels sailing in waters of Ningbo-Zhoushan Port have five characteristics: Small, Scattered, Chaotic, Poor and Dangerous. "Small" means the tonnage of ship is small, the scale of shipping company is small and the business volume is small; "Scattered" means the location of the operation is scattered, and the management of company is loose; "Chaotic" means the composition of the company's shares is chaotic, and the market order is chaotic, the company management is chaotic;

"poor" means the ship condition is poor, the crew quality is poor, and the port management level is poor; "dangerous" means high risk of navigation, high risk of operation and high risk of anchorage.

### **1.3 Research approach**

The main research object of this paper is the safety supervision of small and medium-sized vessels in the waters of Ningbo-Zhoushan Port which has the characteristics of complex shipping routes, thousands of small islands, great number of vessels, and complex Marine functional zoning system. According to the navigation environment characteristics of Ningbo-Zhoushan Port and the development status of small and medium-sized vessels, the overall research concept of this paper is to follow the process of "Raise problems--Analyze problems--Solve problems". The main ideas and processes of the research are shown in Figure 1.2, Firstly, it introduces the background of the project, finds out the problems existing in the daily Maritime management of small and medium-sized ships in the waters of Ningbo-Zhoushan Port. Then search relevant literature, analyze the main regulatory experience and research results at home and abroad, through cause analysis find the reasons for their formation. And finally, the author based on the study, try to look for countermeasures for the problems. This paper comprehensively analyzes the current mainstream administrative management theory and explores the feasibility of applying the theory to optimize the supervision of small and medium-sized vessels in waters of Ningbo-Zhoushan Port.

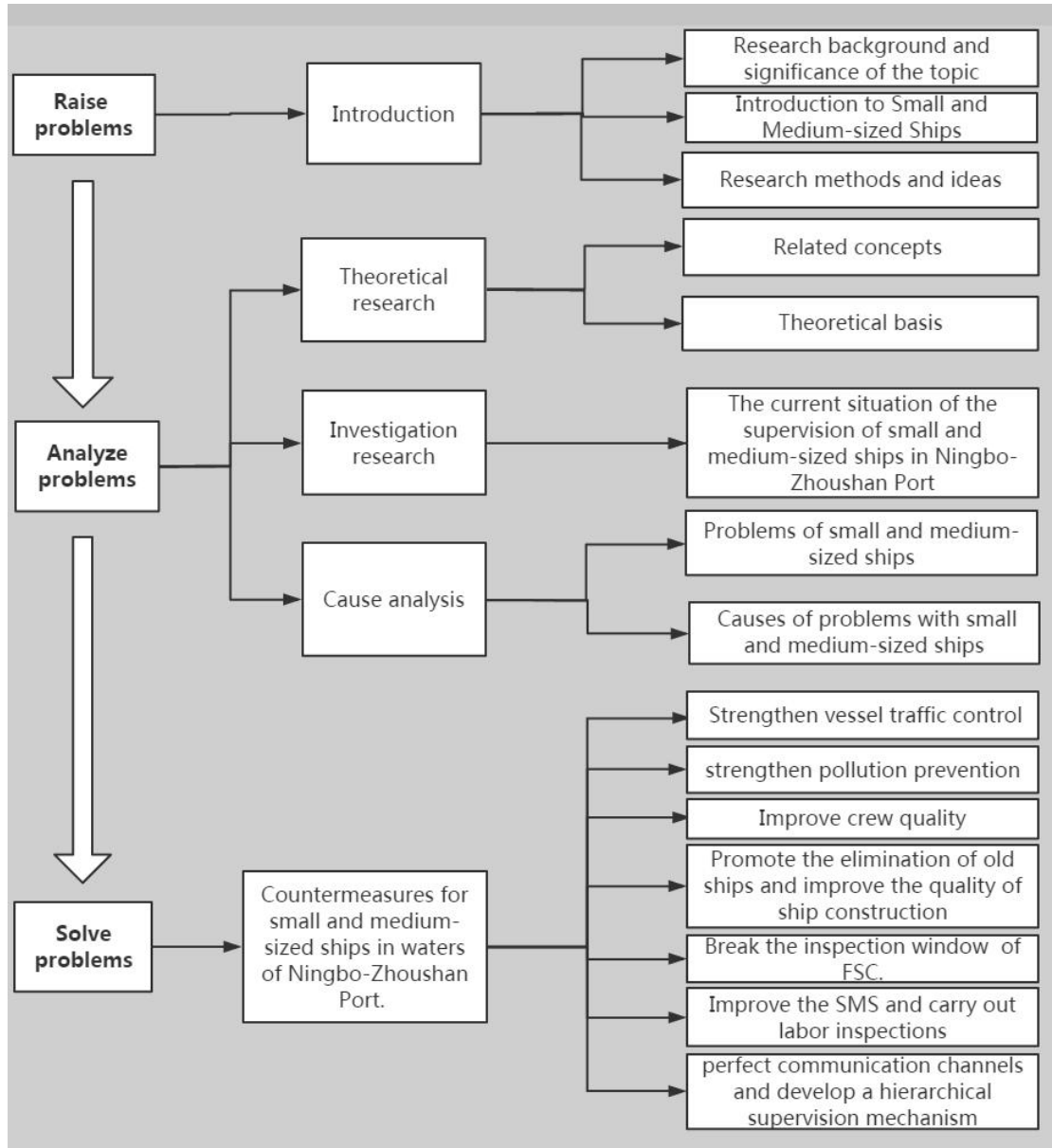


Figure 1.2-Processes of the this paper

Source: Compiled by the author based on the construction of this paper.

## 1.4 Methodology

### 1.4.1 Literature review

Periodicals, monographs, and papers related to the regulations regarding small and medium-sized ships are collected through online and offline means, such as surfing the Internet and visiting the library, and situation at home and abroad is understood and summarized to obtain theoretical support.



#### **1.4.2 Questionnaire survey**

Questionnaire survey is conducted where some officers from Ningbo MSA, Zhoushan MSA, and the crews to the port were investigated to obtain the current status and development trend of the supervision of small and medium-sized vessels in this area.

#### **1.4.3 Interview method**

The interview includes individual interview and group interview. The study is conducted mainly by symposiums and supplemented by individual interviews. Discussions were held to hear the views of representatives of various maritime departments, enterprises and seafarers, and more comprehensive information was collected through interviews, on the basis of which further understanding about the supervision and operation status of small and medium-sized ships in Ningbo-Zhoushan port areas is acquired.

#### **1.4.4 Descriptive statistical analysis**

A basic statistical method is used for sorting and summarizing survey data to show the distribution of data. It mainly analyzes the frequency, central tendency and dispersion degree of data, and involves the mean value, standard deviation and other indicators, so as to facilitate the analysis and calculation of the primary data collected.

#### **1.4.5 System analysis**

Through literature research and interview research, common supervision methods and rectification methods of domestic and foreign Maritime departments are clarified. Through systematic analysis, the author summarized the main reasons for the difficulty of supervision on small and medium-sized ships, and put forward suggestions and measures for improvement from the aspects of crew management, ship survey and pollution prevention management, etc.

### **1.5 Structure of dissertation**

This paper consists of seven chapters, The second chapter introduces the supervision methods for small and medium-sized ships at home and abroad. The third chapter introduced some related concepts and theoretical basis of the research. The fourth chapter briefly introduces the basic situation of Ningbo-Zhoushan Port from the angle of navigation, climate, hydrology and so on. Chapter five introduces the achievements made by the Ningbo MSA and Zhoushan MSA in the supervision of small and medium-sized ships, analyzes the existing problems of small and medium-sized ships and the causes of the problems. The sixth chapter is the core of this paper where, based on the study of the previous chapters, the author puts forward some suggestions on supervision of small and medium-sized ships. Chapter seven is the summary of the whole paper.

## CHAPTER2

### Supervision methods at home and abroad

It has great reference significance to study the supervision status of small and medium-sized vessels at home and abroad, it help a lot in finding more scientific supervision means. According to the characteristics of the study object, the author selects the supervision of Guangdong MSA and Cangnan MSA as references for research. As for the foreign part, the author selects the Maritime regulation countermeasures of European countries and the United States. At the same time, the ideas on small and medium-sized ships of some famous scholars at home and abroad are analyzed during this chapter.

#### 2.1 Common supervision means of China MSA

##### 2.1.1 On-site inspection

###### *2.1.1.1 FSC inspection*

FSC inspection is one of the most common regulatory approaches at home and abroad. It can strike low-standard ships effectively. It is a detailed safety inspection carried out by more than two FSCOs, and it mainly inspects the ship's certificates, equipment, construction structure, etc. The inspection basically covers all the contents of the ship. Among them, issues concerning fire fighting, life saving and pollution prevention are mandatory inspection items. Inspectors can determine the depth and duration of the inspection based on the ship's condition.

###### *2.1.1.2 General inspection*

General inspection is a kind of on-site inspection of a lower degree. Its a random inspection carried out by inspectors for the arrived ships. It will not be limited by the inspection window. MSA inspectors could decide whether on board inspection should be carried out according to the specific conditions observed, such as the appearance of the ship, ship operation, cargo loading, etc. The general inspection normally focuses on the inspection of manning, ship certificates, the usage of AIS, GPS and other key

equipment. FSC inspection could be carried out if obvious non-conformity was found during the inspection.

#### *2.1.1.3 Special inspection*

Special inspection is a kind of concentrated inspection which is commonly carried out by MSA in a short period of time and aimed at a certain kind of ship or a certain illegal act. The special inspection is generally divided into the early publicity and deployment, the middle stage activities, the later stage experience summary and other processes, and the activity time can be one month or one year, etc.

#### *2.1.1.4 Company visit*

MSA officers visit shipping companies to conduct on-site inspection of the company's system construction and operation. The way that the shipping company attends to production safety issues can directly reflect its ship safety management level. If the top managers of a company pay more attention to ship safety operation, then the ship safety management level will inevitably be improved.

### **2.1.2 On-site cruise and Electronic cruise**

#### *2.1.2.1 On-site cruise*

On site cruise includes water cruise and land cruise. Cruising on water focuses on inspection and management of navigable environment, while cruising on land focuses on checking the operation of the port and the berthing situation of ships. Both of the two cruise methods focus on the on-site inspection of ships at berth. If abnormal conditions of individual ships were found during the cruise, officers from MSA can carry out on board inspection.

#### *2.1.2.2 Electronic cruise*

At present, Maritime departments at home and abroad have the practice of conducting electronic inspection through AIS, GPS and other positioning equipment equipped on board. For example, the electronic cruise inspection system and CCTV system are commonly used by China MSA. The electronic cruise system can quickly check the

distribution and dynamics of ships arrived, and efficiently select the inspection target, and contact the ships with potential violations through high-frequency telephone. The CCTV system are installed with high-definition cameras in the key waters of the port to film the on-site water in real time, so that the duty officers can see the real-time dynamics of the waters in the office, which reduces the government administrative costs and improves the efficiency of administrative work.

### **2.1.3 Administrative punishment**

Administrative punishment is one of the common means of law enforcement by Maritime departments at home and abroad. It forces small and medium-sized ships and its crews to abide by Maritime traffic rules and other Maritime laws and regulations by means of imposing fines and giving warnings, so as to ensure the safe navigation of ships. The amount of penalty can be RMB 3,000 to 100,000. Common reasons for administrative penalties among small and medium-sized ships include ship overloaded, insufficient manning, AIS failure, don't implementing ship reporting system, and unreported fire-working on board,etc.

### **2.1.4 Forum**

Forums are held where, representatives of shipping companies and crews are invited to join discussions or to publicize a certain policy or certain matters which need attention and carry out investigate, so as to understand the difficulties encountered by the shipowners and to note their suggestions. This is an efficient communication process that can often play a better role in communication and coordination.

## **2.2 Supervision on small and medium-sized ships in China**

### **2.2.1 Guangdong MSA—Strengthen vessel traffic control**

The Pearl River Estuary is rich in navigation resources. It has access to the South China Sea, borders Hong Kong and Macao, and borders Shenzhen, Zhuhai,

Zhongshan, Dongguan, Guangzhou, Foshan, etc. It is a distribution center for goods at home and abroad. The vessel traffic is very busy, with large vessel traffic flow and high density. Among them, small vessels play a major role in the comprehensive transport system of the Pearl River Estuary waters. According to statistics, small ships account for about one third of the total traffic in the Pearl River Estuary. The navigable conditions and density of ships in this water area are similar to those in Port of Ningbo-Zhoushan, hence it is of great reference significance.

The main waterway of the Pearl River Estuary is long and narrow, and the narrowest place is only around 100 meters, so ships will encounter the situation of passing at small distances, especially when there are large ships sailing in the waterway, they may encounter quite emergency situation, which greatly increases the risk of navigation. Guangdong MSA organizes and guides the traffic of small ships in the Pearl River Estuary. Through joint efforts with local government departments, the main channel is expanded, and shallow water channels suitable for small vessels are dredged on both sides of the main channel or in appropriate waters, so as to implement the separation of large and small vessels, and the channel was rationally planned to reduce the crossing of vessels.(Cheng, 2016)

### **2.2.2 Cangnan MSA—Guide the transformation of shipping companies**

Cangnan Port is located near the Ningbo-Zhoushan Port, it only takes around 2 hours to navigate from one place to another. Although its navigation environment is different from that of Ningbo-Zhoushan port, they bear great similarity in the supervision objects involved -- small and medium-sized ships, so the Maritime supervision in this area have a certain reference significance too.

Cangnan MSA together with local governments, pays close attention to the shipping market, and increases investment in the shipping industry, and promotes the transformation and upgrading of shipping companies. Some extremely ill-performed

companies are eliminated, meanwhile, reorganization of large-scale shipping companies are encouraged to replace those that are lax in safety management, poor operation and of small scale. Relevant supporting policies are introduced to guide the large-scale construction of shipping companies. The application of new service technologies is promoted, such as the Internet plus, the internet of ships and the internet of things in the shipping industry.(Liu, 2018) At the same time, Cangnan MSA pays attention to the cultivation of leading enterprises, so as to drive a group of shipping companies to realize large-scale and intensive operation and management, and enhance the core competitiveness of market players.

### **2.2.3 Research carried out by Chinese scholars**

Zhou Hongbing, Zhang Tao and Fan Houwu (2011) mainly put forward the scheme designed for the navigation route of small ships in the western waters of Shenzhen, so as to prevent small ships from occupying the channel of large ships and reduce the navigation risks brought by small ships by planning the navigation route.(Zhou, 2011)

Ying Sanzi (2011), in "A Simple Analysis of The Problems and Countermeasures of The Seafarers' Textual research on The Coastal Sand Carriers in Wenling", revealed that the owners of sand carriers in Wenling usually reduce manning, replace higher-level seafarers with lower-level seafarers, or even employ unlicensed personnel. This is partly because older and less educated crews on small ships can hardly adapt to computer-based paperless examination and they cannot get the certificate of competency, which leads to the shortage of small and medium-sized ship crews. (Ying, 2011)

Chang, guosong, Yang Kunpeng (2012) pointed out that the Maritime traffic department should strengthen the cooperation with local government, to give full play to their own professional advantage, actively communicate with relevant local

departments, make contribution to local economic development and the Maritime safety, and meanwhile, improve its influence and the important embodiment of their duties.(Chang, 2012)

Shi Xinhua and Yu Na (2012) mentioned that traffic accident control of small and medium-sized ships were closely related with training of Crew operational ability, so it is necessary to improve the quality of the crews.(Shi, 2012)

Li Xintong (2014) mentioned that Tianjin Port's dual channel was put into use on January 1, 2014, making the separation of large ships and small ships a reality. This became the pioneer among China's ports in terms of improving the efficiency and safety level of artificial channel passage through management and technological innovation, and improving the navigation environment of small ships.(Li, 2014)

Xu Chenyi (2015) put forward in *New Public Management: New Thinking of China's Service-oriented Government Construction* that new public management concept should be implemented to promote the construction of service-oriented government. First of all, we should learn the basic knowledge of new public management, re-understand and summarize the experience of the government's administrative reform from the perspective of new public management, and apply the concept to the government's administrative reform most directly and effectively. Then, performance evaluation should be integrated into the construction of service-oriented government, and the new public management concept should be used to standardize performance evaluation, so that power can be exercised in the sunshine. Finally, the reform of the human resource management of government departments should be carried out in combination with the new public management concept. While strengthening the publicity of the new public management concept, the legal system corresponding to the administrative reform should be introduced, and systematic training should be carried out in accordance with the actual situation of the staff of various departments.(Xu, 2015)



## **2.3 Foreign research on Maritime supervision**

### **2.3.1 Maritime supervision in European countries**

At present, European Maritime management is mainly based on the mode of enterprise-oriented government, which means that public authorities use the resources available to them to create greater efficiency and effectiveness in the same manner as what entrepreneurs do. For example, Nordic countries have introduced some ideas and practices of enterprise management into the public sector. The Danish Maritime Board have set the board of directors responsible to shareholders as the highest authority. These shareholders are mainly from Danish shipping and fishing communities, as well as employers and employees from domestic and other foreign organizations, including shipowners' associations, shippers' associations and petroleum industry associations. (Ridolfi,1994)

The Maritime authorities of EU countries achieve effective Maritime supervision through strict market access. The EU ensures the safety of the shipping market through a combination of pre-safety and post-safety monitoring measures. According to the actual needs of shipping, the technical requirements of newly built ships should be revised in a timely manner. For some special cases, different guidelines should be formulated for different navigation areas. Ships sailing within a certain area must meet all the technical requirements of the Maritime authorities within the area before they can sail therein.(Li, 2014)

In terms of regulating the excess capacity structure in the shipping market, ship-owners are required to pay annual contributions and ship-breaking subsidies to the state-established ship-breaking funds every year by setting up ship-breaking funds and replacing old ships with new ones to push old ships out of the market. According to the actual demand of the shipping market, a ship-breaking fund should be established, and economic measures should be taken to effectively regulate and control the shipping capacity, so as to avoid the excessive growth of existing and

future shipping capacity.

### **2.3.2 Maritime supervision in the United States**

The United States conducts Maritime regulation by granting Maritime authorities the power to make relevant rules. The main Maritime laws are Maritime precedents, Maritime statutes and international Maritime regulations that the United States participates and concludes. The Maritime legal system of the United States is relatively complete and stable compared with that of other countries.

For example, the US Port and Waterway Safety Act of 1972 first provided Maritime administration with laws to follow, while the Port and Waterway Safety Act of 1994 gave law enforcement officials the highest jurisdiction to safeguard Maritime security and protect shipping. The Port and Waterway Safety Act was amended in 2002 in accordance with the Maritime Transport Safety Act. The United States attaches great importance to the great role of shipping industry in economic development, so it has a high legislative efficiency in the field of navigation legislation, and can always adjust laws and regulations according to the current regulatory situation. The United States passed shipping legislation full of national protectionism to limit the amount of domestic shipping capacity in the United States, emphasizing the role of the U.S. merchant fleet to protect domestic waterway transportation. (Zhu, 2009)

For example, the Jones Act requires that a ship must meet three conditions before it can navigate in the waters of USA : (1) the ship was built in the United States; (2) the ship is registered and certified in the United States; (3) the owner of the ship is a U.S. citizen, and most of the crew members are U.S. citizens, Failure to meet the above three conditions will result in forfeiture of the goods.(Hu, 2003) The United States remains positive about the Jones Act, although it has made some adjustments to the passenger liner and tanker jurisdiction of the Jones Act due to international pressure.

### **2.3.3 Foreign scholars' understanding of ship supervision**

Inoue Xinsan deals with the potential collision risk in a certain water area from two aspects in his article "Quantitative Evaluation of Ship Operating Burden", and takes this as an index to quantitatively represent the potential danger level of ships sailing under the traffic environment. (Dai, 2003) Japanese Marine traffic engineering experts and scholars have made remarkable achievements in the safety evaluation of the ship operating environment and traffic environment by using the methods of Marine traffic flow simulation and ship operating simulator.

British scholars Vldimierm. Trbojevic and Barryj.Carr proposed the port navigation safety management system based on risk degree, and put forward the improvement plan of safety management through the analysis and evaluation of ship traffic safety.(Smallman,1994)

American scholars Ansell and Gash defined collaborative governance as “ a kind of governance arrangement in which one or more public institutions directly guarantee a close connection with non-state participants in the formal, consensus-oriented collective decision process in the decision-making oriented by public policy or public management.” (Zheng, 2016)

Culpepper states that "collaborative governance refers to government and non-government sectors working together within a given policy area, in this process, the government has no awareness of the problem to be solved and no choice of solutions arbitrary power." (Newman, 2004)

John Donahue maintains that "collaborative governance has eight characteristics: formal, lasting, centralized, institutional diversity, utility, stability and volatility, initiative, problem-driven and opportunistic driven."(John, 2004)

## **2.4 Chapter summary**

Through the analysis on the supervision of small and medium-sized vessels at home and abroad, this chapter further clarifies the universality of the problems in the supervision of small and medium-sized vessels, and urgently needs to put forward sustainable supervision suggestions. The safety supervision of small and medium-sized vessels is of great research significance. At present, relevant maritime departments at home and abroad have not formed a unified and effective supervision model.

Through the summary of the experience of domestic and foreign maritime supervision in this chapter, there are some supervision methods have good reference significance, such as improving shipping company management, strengthening ship traffic control, etc. Also, during this chapter, we have a certain understanding of the application of some theoretical basis in European and American countries, the next chapter the author will analyze the relevant concepts and theoretical basis.

## **CHAPTER 3**

### **Concepts and theoretical basis**

To study the safety supervision of small and medium-sized vessels in Ningbo-Zhoushan Port, it is necessary to understand the relevant concepts and theoretical basis. In this chapter the author introduces the concepts of Maritime supervision, Maritime informatization, ship safety management, etc., and elaborates Informatization theory, Holistic government theory, Maritime public management theory, human-machine-environment-control system in depth, to lay a foundation for further research.

#### **3.1 Related Concepts**

##### **3.1.1 Maritime supervision**

Maritime supervision in China is a manifestation of the administrative functions exercised by the MSA of the People's Republic of China. It includes the functions of administrative management and law enforcement, such as the prevention of pollution from ships and Maritime security, the supervision and administration of water traffic safety, the inspection and registration of ships and related water facilities. According to the current Maritime laws and regulations, the specific Maritime supervision implemented includes administrative inspection activities, administrative licensing activities, administrative coercion, administrative penalties, administration, etc. Among them, water traffic safety supervision is the core content of Maritime supervision function, including the supervision and management of the SMS of shipowners and shipping companies and the responsibility for the investigation and handling of water traffic accidents, pollution accidents and illegal cases from ships.

MSA is the main body of Maritime supervision, which can be divided into agencies directly under the Ministry of Transport and local Maritime agencies. There are two

Maritime departments in Ningbo-Zhoushan Port, they are Ningbo MSA and Zhoushan MSA, who exercise Maritime supervision functions as directly affiliated Maritime institutions. The Maritime supervision mentioned in this paper is the general term of routine Maritime supervision.

### **3.1.2 Maritime informatization**

Maritime informatization refers to the application of advanced and mature information technologies such as network technology, software, equipment and hardware.in maritime supervision, for the purpose of promoting maritime efficiency, serving diversified maritime supervision technologies, and improving maritime supervision capability

Instead of applying all advanced information technology to Maritime regulation , Maritime informatization searches for information technology suitable for Maritime affairs, and it adheres to the concept of Maritime business demand-oriented and explores information technology suitable for Maritime supervision. It focuses on strengthening maritime informatization personnel training, and forms a complete set of information construction directions and concepts suitable for maritime affairs.

### **3.1.3 Ship safety management**

Ship safety management is a process in which the management absorbs the essence of modern management theory to form a knowledge system based on ship safety issues, and then coordinates the resources of the organization to achieve safety objectives by means of planning, organization, leadership and control. Its goal is to protect the safety of life and property at sea, protect the marine environment, make navigation safer and the ocean cleaner. The object of ship safety management is people, machine and environment. It includes ship operation system and its close relation periphery. Control not only refers to the narrow sense management, but also includes the control and adjustment of people, machinery and environment, as well as the control and

limitation of risks and accidents. The safety management should focus on the prevention of accidents, therefore, the study of ship safety management has to focus on the relevant theories of ship safety.

## **3.2 Theoretical basis**

### **3.2.1 Informatization theory**

The concept of "Informatization" was first put forward by the Japanese scholar Muesao Tadao. Since then, scholars have been deepening and developing the theoretical system of Informatization. "Knowledge Society" published by the United Nations in 1998 pointed out that information was a social process, is the process of social development and evolution, rather than a process of the simple application of modern information technology. Management processes, organizations, production skills, and tools require change, and this change needs to occur throughout the entire process of providing a product or service.

Zhou Hongren, a Chinese expert on informatization, made a further study on the development of informatization. He states that the development of informatization has gone through four stages: "firstly, there is the emergence of information technology; Secondly there is information revolution; Thirdly, the process of global informatization is promoted by the information revolution. Fourthly, mankind is ultimately led by the information revolution and Informatization to the information society. (Zhou, 2018)

E-Government arises at the historic moment with the rapid development of information technology, and different countries have different names for it. HOLMES, a scholar, agrees that E-government is a proper term which refers to the use of information technology, especially Internet technology, to facilitate the public, cost-oriented benefits, and this E-government model provides services to the public in a better way.

Inspired by this theory, the author of this paper does not stay at the technical level when studying the safety supervision of small and medium-sized ships in the waters of Ningbo-Zhoushan Port, but focuses on the combination of information means with supervision and service to establish a comprehensive government service platform. It is a "one-stop" solution platform built according to the different needs of service objects, so as to realize the deep integration of information technology, supervision business and service, solve the problem of information island, reduce the repeated data entry, and optimize the audit management process. With the goal of "Informatization of government services and intelligentization of water supervision", the proper business coordination and effective service can be facilitated.

### **3.2.2 Holistic government theory**

The Holistic government theory was put forward by The British scholar Perry Hicks. In the 1980s, the new public management theory took the government function and customer demand as the orientation, which made the public service fragmented. The Holistic government theory is the response to this situation. In the book "Integral Government" published by Professor Hicks in 1997, he first proposed the concept of Integral governance, from four aspects, namely, policies, norms, supervision and services. It organically coordinates the public sector, functional division, information technology and other fragmented issues, forming a systematic theoretical system, which can achieve seamless and overall coordination across departments.(Perry Hicks,1997) The overall government theory consists of the following four parts.

#### *3.2.2.1 promote Cross-department cooperation.*

The purpose of the government as a whole is to stimulate the vitality of cross-sectorism, which includes the traditional means of cooperation among the personnel of different departments, groups of ministers and different organizations. By absorbing the experience of cooperation between departments in the field of social



services and taking overall coordination as the concept, cross-department and cross-function cooperation is carried out.

#### *3.2.2.2 Integrate coordination mechanism*

The core mechanism of the holistic government theory is to integrate institutions and operate in coordination with the support of network technology.

#### *3.2.2.3 Limit the transfer of government costs*

It is necessary for the government as a whole to formulate corresponding policies and discuss policies to reduce the transfer costs of public service agencies and improve the government's ability to comprehensively solve problems.

#### *3.2.2.4 Overall budget and procurement*

An important part of overall government is to change the traditional way of budgeting and procurement. Holistic government theory emphasizes the importance of cross-sectoral collaboration.

### **3.2.3 Maritime Public Management Theory**

The mission of public management is to serve the public and pursue the public interest, which requires that the mission of Maritime public management should be serve the public and pursue the public interest. When analyzing public management departments in the article "A Preliminary Study on the Basic Issues of Public Management", Wang Huiyan states that "in China, management entities can be divided into six categories based on the distance between them and the center of public power. The fourth category is the public sector, which relies on law and authority to conduct public affairs." (Wang,2002)

Maritime agencies are law enforcement agencies authorized by the state to supervise and administer water traffic safety, and are public departments providing public

administration in the Maritime industry. Water traffic safety, Anti-pollution and Maritime laws, standards and policies, navigation channels and anchorage areas are all Maritime public service articles provided by Maritime public organizations.

The establishment of China MSA directly targeted the four factors: crew, ship, ship management and environment. In recent years, on the basis of deepening the reform, the Maritime authorities have made strategic adjustments to the existing work priorities. One of the key tasks of the competent maritime authorities will be the management and improvement of navigable environment in water, elimination of regulatory difficulties and formation of a long-term mechanism.

### 3.2.4 Human-machine-environment-control system theory

The "Human-Machine-Environment-Control" system is the basic element structure of ship safety operation. A comprehensive and in-depth study of the system has been carried out to form a disciplinary theoretical system, aiming at providing general theoretical guidance and specific norms for ship safety management. The interaction between the elements is shown in the Figure 3.1.

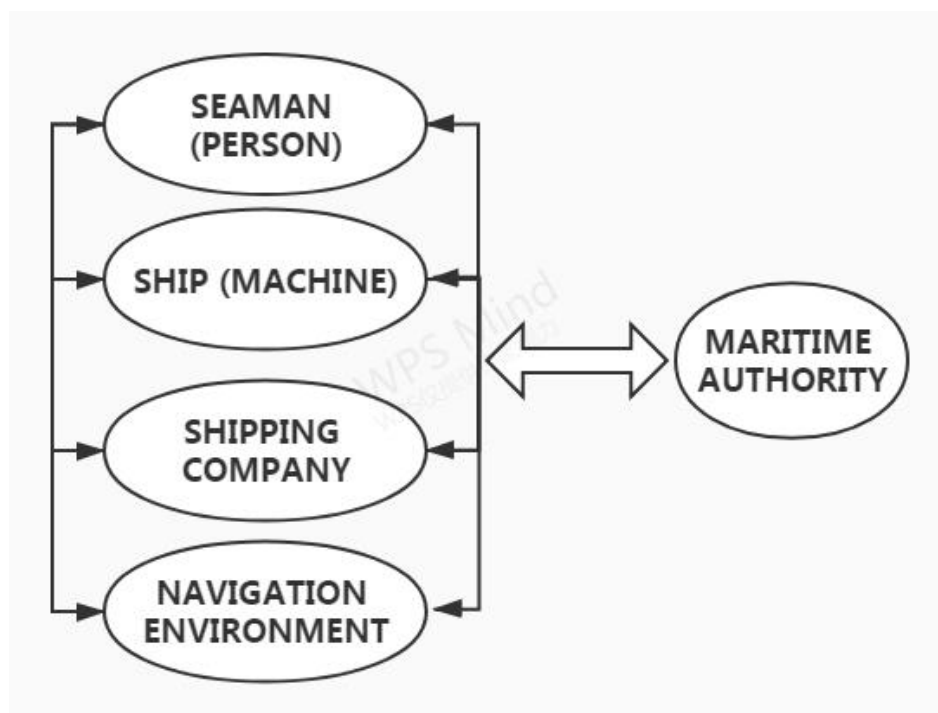


Figure 3.1–Basic elements of ship navigation safety

Source: <https://image.baidu.com/search/index?word>

Seaman belong to the "human" element; Ships and goods belong to "machine" elements; Navigation channels and ports are "environmental" elements; Shipping companies belong to the "management" element. Control elements should cover human, machine, environmental elements and all relationship areas, mainly including legal rules, norms, standards, procedures, technologies and methods. On the one hand, the basic elements of ship safety operation not only pay attention to the function of each element, but also pay more attention to the relationship, interaction and mutual influence among these four elements, as well as their coordination mode, which can help us understand and analyze the causes of ship accidents. Human-machine system is manifested as the influence of machine on human safety, and human should adapt to and control the machine. The key point of research is the human-machine safety response, and the safety ergonomics is the focus of this area. Human-environment relationship shows that the environment affects people's safety, and people should adapt to the environment and moderately improve the environment. Machine-environment relationship shows that the environment affects the safety of the machine. The machine must adapt to and protect the environment. The comprehensive relationship between human, machine and environment is the key area of accidents and safety control.

### **3.3 Chapter summary**

This chapter introduces some concepts of maritime regulation and four theoretical basis that will be applied to the study, and also, the feasibility of the theoretical basis were analyzed. It provides a research tool and theoretical basis for the following research, use them to find out the problems, analyze the causes of the problems and propose solutions for the safety supervision of small and medium-sized vessels in the waters of Ningbo Zhoushan Port.

## CHAPTER 4

### **Brief introduction of Ningbo-Zhoushan Port**

Ningbo-zhoushan port is an ideal deep water port in the east coast of China. It is close to the junction of the main coastal waterway and the golden waterway of the Yangtze River. The port has deep water and small waves, with unique location advantages and excellent port conditions. With the implementation of the economic development strategy along the Yangtze River and the construction of Shanghai international shipping center, Ningbo-Zhoushan Port has become the container trunk port of the Yangtze River Delta, the national strategic material reserve base and the transfer center of foreign trade bulk raw material. It is an ideal distribution center for Chinese coastal areas to radiate distant seas to foreign ports. It is a set of inland port, estuary port and seaport in one of the multifunctional, comprehensive modern port.

Ningbo-Zhoushan Port is composed of 19 ports including Beilun, Liuheng, Qushan and Chuanshan, etc., with a total of more than 620 production berths. Among them, there are nearly 160 large-scale berths above 10,000 tons, and more than 90 large and extra-large deep-water berths above 50,000 tons. (Ying, 2019) In 2019, The cargo throughput of Ningbo-Zhoushan Port reached 1.119 billion tons, ranking the largest in the world for 11 consecutive years.

#### **4.1 Ship routing system in the waters of Ningbo-Zhoushan Port**

Ship routing system means that in the waters outside ports with high navigation density, the competent authorities set up some special airway measures to reduce the situation of self-designed shipping routes, regulate the traffic flow of ships, reduce collision accidents and improve the passing efficiency.

Ship reporting system means that a ship sailing at sea provides ship information to the ship reporting center in a certain communication procedure and report format in a certain area. The navigation information includes the name of the ship, the navigation

plan and the cargo loaded. After the VTS center has mastered the navigation information of the ship, it can provide traffic management, navigation assistance services, emergency assistance, etc. to ships.

As early as 2010, The Ningbo-Zhoushan Port began to implement the "Ningbo-Zhoushan Port Core Port Deep water Route Ship Routing System", "Ningbo-Zhoushan Port Core Port Area Deep water Route Ship Reporting System" and "Ningbo-Zhoushan Port Core Port Deep Water Route Ship routing System Management Regulations" (referred to as "Two Systems one Regulation"). The implementation of the "two systems one Regulation" standardizes the traffic order of ships systemically and clarifies the relationship of ships' collision avoidance.

In order to regulate the order of Maritime traffic and improve the navigation safety of ships, the new editions of "Ningbo-Zhoushan Port Core Port Deep water Route Ship Routing System" and "Ningbo-Zhoushan Port Core Port Deep water Route Ship Reporting System" were released on August 1, 2016. The new routing system are shown in Figure 4.1, the ship routing system was marked in red line.



Figure 4.1 - Schematic diagram of ship routing and reporting system of Ningbo-Zhoushan Port  
Source: Ningbo MSA.

## 4.2 Natural conditions of Ningbo-Zhoushan Port

### 4.2.1 Atmosphere

Ningbo-Zhoushan Port belongs to the north subtropical monsoon climate. Winter is controlled by the north cold high pressure, prevailing northwest wind, cold and dry; In summer, the subtropical high in the Northwest Pacific Ocean is covered with southeast wind, warm and humid. In the spring and autumn monsoon transition period, there is more rainy weather. The four seasons are distinct throughout the year. The perennial average temperature is 16.6°C.

### 4.2.2 Rain

There are two rainy months in annual precipitation in Ningbo-zhoushan district, the first rainy season is from March to July, and the spring rainy period is from March to

May, with the rainfall accounting for 26.7% of the whole year. June to July is the plum rain period, the precipitation accounting for 24.6% of the whole year. The second rainy season occurs from August to September, with rainfall accounting for 23.2% of the annual total, which is mainly determined by typhoon activities. In a year with a lot of typhoons, there are heavy rainstorms. The longest continuous precipitation day is 19 days.

#### 4.2.3 Wind conditions

The wind speed varies greatly with the seasons, more northerly winds in winter and southerly winds in summer. The wind speed is slightly higher in winter and slightly lower in summer. Maximum wind speed 17-54.2m/s. Due to the influence of topography, wind conditions vary greatly from place to place. The wind conditions of the main port sites are shown in Table 1, in which the wind speed unit is M /s.

Table 4.1-Statistic of main ports

<b>POSITION</b> <b>ITEM</b>	<b>BEILUN</b>	<b>MEISHAN</b>	<b>SHIPU</b>	<b>DINGHAI</b>	<b>DAISHAN</b>	<b>SHENGSI</b>
<b>Average wind velocity</b>	5.1	3.7	5.5	5.0	5.8	7.0
<b>Direction of prevailing wind</b>	NW	N	N	NNW	NNE	NNW
<b>Direction of strong wind</b>	WNW	NW	NE	NW	N	N
<b>Maximum wind velocity</b>	29	17	36	28	37	54.2

Source: Ma, Y. D. Study on environmental Risk Assessment of oil spill in Port of Ningbo-Zhoushan.

Ningbo Zhoushan sea area is vulnerable to tropical storms from July to September every year. Typhoons average 3.9 times a year, of which strong typhoons account for 82%. The wind directions of tropical storms are mostly NNW~NNE and ENE. The longest duration of a tropical storm is about 2-3 days.

#### 4.3 Hydrology

### 4.3.1 Tide

Beilun, Chuanshan, Daxie ports and the western waters of Zhoushan are irregular semi-daily tides; Meishan Port, Shipu Port, Xiangshan port, Xiazhimen Channel and the waters of eastern Zhoushan are regular half-diurnal tides. The Table 4.2 shows the characteristic value of tidal level in the main port areas.

Table 4.2-Statistic of tide character of each port

PORTS ITEM	BEILUN	MEISHAN	SHIPU	DINGHAI	LAOTANG SHAN	DAISHAN
Highest tide	4.85	5.0	3.68	4.48	4.81	3.08
Lowest tide	0.04	-0.04	-2.89	-0.08	-0.08	-2.05
Average high tide	2.94	3.83	2.14	2.81	2.81	1.14
Average low tide	1.13	1.17	-1.40	0.90	0.90	-0.80
Maximum tidal range	3.74	4.67	6.08	3.67	3.67	4.02
Mean tidal range	1.82	2.68	3.54	2.02	2.02	1.95
Starting point	WUSONG	JIADING	Yellow sea base level	Theoretical depth datum		Yellow sea base level

Source: Ma, Y. D. Study on environmental Risk Assessment of oil spill in Port of Ningbo-Zhoushan.

### 4.3.2 Current

The tidal current is mostly reciprocating flow, the main trend of ebb and flow is consistent with the isobath, and the tidal current in local sea area slightly rotates. The maximum velocity occurs 2-4h after the high (low) tide, the summer velocity is greater than the winter velocity, The big tide velocity is greater than the small tide velocity. Under the influence of topography, the tidal current and velocity differ greatly in each port area.

### 4.3.3 Wave

This sea area is close to the East China Sea, and the long-period waves can be introduced into this sea area. The waves are mainly northerly in winter and southward in summer. The Figure 4.3 shows some wave conditions of certain sea areas.



Table 4.3-Statistic of wave character of each port

<b>ITEM \ PORTS</b>	<b>BEILUN</b>	<b>CHUAN SHAN</b>	<b>SHIPU</b>	<b>DINGHAI</b>	<b>DAISHAN</b>	<b>SHENGSI</b>
<b>Wave direction</b>	NW-NNW	ENE	NE	SE	N'	NE
<b>Maximum wave height</b>	4.0	3.6	2.3	2.5	3.4	11.5
<b>Cycle</b>	7.1	6.8	5.4	5.8	6.5	19.8

Source: Ma, Y. D. Study on environmental Risk Assessment of oil spill in Port of Ningbo-Zhoushan.

#### 4.4 Chapter summary

This chapter introduces ship routing system, natural conditions and hydrology of the waters of Ningbo-Zhoushan Port. Through the study of this chapter, we have a clear understanding of the geographical characteristics and navigable environment of Ningbo Zhoushan Port. There are many islands, small cargo vessels, fishing boats etc., the navigation environment is very complex there, the safety supervision of small and medium-sized vessels in this water areas is extremely difficult. In the process of studying the safety supervision problems of small and medium-sized vessels in this area, it is necessary to formulate relevant solutions based on the navigation environment characteristics of the water area, so as to form sustainable safety supervision measures and continuously improve the safety management level of small and medium-sized vessels there.

## CHAPTER 5

### Situation of supervision on small and medium-sized ships in waters of Ningbo-Zhoushan Port

The safety supervision of small and medium-sized ships has always been the focus of daily supervision of the Maritime departments of Ningbo and Zhoushan. On the basis of routine supervision means such as on-site inspection, FSC inspection, administrative penalty, electronic cruise inspection etc., the Maritime authorities of the two places have carried out a number of special inspection activities for small and medium-sized vessels in the past two years, and good regulatory results have been achieved.

#### 5.1 Achievements obtained

##### 5.1.1 Special rectification of small and medium-sized ships

In 2018, both Ningbo and Zhoushan Maritime Authorities launched a special rectification campaign for small and medium-sized vessels. MSA officers from both places conducted key rectification of such vessels through FSC inspection, on-site supervision, daily supervision and inspection of the company, SMS audit, etc., and carried out actions by means of open investigation, random inspection, joint law enforcement, etc. The target of the special rectification was Chinese ships with a gross tonnage of less than 3,000 and their shipping companies bearing the responsibility of safety and pollution prevention. Remarkable results have been achieved during the activity. The following Table 5.1 shows the key points of the special activities.

Table 5.1 Key points of supervision

Inspection target	Key points of supervision
	Ship survey. Check whether the ship is subject to regular annual survey,

SHIP	intermediate survey, additional survey, etc.
	Certificates. Verify the validity of the ship's legal certificates and documents, the conformity of the ship's actual navigation area with the certificate, the equip of the ship's Marine navigation books and materials, the ship's standard radio license, the ship's station call sign or MMSI, etc.
	Navigation, berthing and operation of the vessel. Including: checking the equipment of the ship's navigation books and materials; Timely and accurate reporting of ship arrivals and departures; The vessel shall observe the navigation, berthing and operation rules; Information entry of AIS equipment, etc.
	The establishment and operation of SMS on board, ship safety and pollution prevention management system. To verify the implementation of ship safety management activities in accordance with the requirements of the SMS; The maintenance of the ship's key equipment; The implementation of ship emergency drills, etc.
CREW MEMBERS	Manning issue. Verify whether the ship has a true and valid Minimum Safety Manning Certificate and whether there is insufficient manning, etc.
	Verify the authenticity of crew service qualifications.
	Seaman certificates. Verify that the competency certificates and training certificates held by the crew meet the requirements for the type of vessel, navigation area, tonnage or main engine power.
	Fatigue. Check whether the actual manning of the ship meets the requirement of rest time for the crew according to the duty rules and whether there is obvious fatigue behavior of the crew on duty.
	Crew operation. Inspect the crew's familiarity with and implementation of the SMS, operational skills and safety knowledge level of the key equipment, as well as their familiarity with the navigation plan,

	navigation law of special waters and COLREGS, etc.
	Emergency reaction ability. Inspect the crew's emergency drills and response capabilities for on board lifesaving, fire fighting, pollution prevention, ship collision, grounding, and bad weather navigation.
	Watch keeping. Check the crew's familiarity with and implementation of watch keeping rules.
	Living and working condition. The inspection and treatment of living facilities, catering services, working or resting conditions of crew members, medical treatment and health care on board will be emphasized.
SHIPPING COMPANY	Check the establishment and operation of the company's safety management system.
	Shore-based support. Inspect the company's shore-based support, technical guidance and embarkation inspection of the ship
	Personnel management. Check whether the personnel of shore-based safety management of the company meet the requirements of the Regulations on The Administration of Domestic Waterway Transportation; Whether the company's main security managers have part-time jobs.
	Ship management. Check whether the company has a ship under management but does not implement normal management at all.

Source: Compiled by the author based on the Investigation of Ningbo MSA.

### 5.1.2 Special inspection on sand carriers

Sand carriers which often have the characteristics of insufficient manning, ship tonnage fraud, old, poor maintenance condition etc., have always been the key targets of supervision in the waters of Ningbo-Zhoushan port. In order to further improve the standard and safe operation of sand carriers in the waters of Ningbo-Zhoushan Port,

Maritime Safety Administration launched a special inspection campaign for sand carriers for 14 months from March 2019 to May 2020. According to the degree of difficulty in correcting deficiencies, the FSC inspection for sand carriers was carried out in two stages. The inspection of first stage was focused on the ship appearance and the second stage was focused on the hull structure. The following Table 5.2 shows the key inspection contents for sand carriers at each stage.

Table 5.2 - Key inspection contents for sand carriers

Stage	Key point of inspection
FIRST STAGE	The ship's nationality certificate, Minimum manning certificate and statutory survey certificate shall be provided
	Actual manning and certifications of the ship;
	The mark of Load line, ship's name, port of registry, etc.
	Inspection on important engine equipment, bridge communication and navigation equipment, anchoring and mooring equipment, etc.
	Equipment for Fire-fighting, life-saving and anti-pollution ;
	Weather tight installations on board;
	The loading condition of the ship;
	The crew's familiarity of the ship's navigation, emergency equipment and systems, and navigational rules.
SECOND STAGE	The usage and maintenance of hatch covers for cargo hold ;
	Alterations or damage to cargo holds, hatchways and other important parts;
	The hull structure, welding technology, water tightness;
	Whether the main dimensions of the ship, including the depth, overall length, and width of the ship, are consistent with the survey certificate.
	Whether the ship's main equipment is added, reduced or replaced without permission (such as main engine, generator, steering gear, etc.)

Source: Compiled by the author based on the Investigation of Ningbo MSA.

During the special FSC inspection period, the FSCO completed inspection of a total number of 267 sand carriers, 19 of which were detained. The total number of deficiency is 5633, and the average deficiency of a single ship is 21.1. This activity has proved to be effective.

The overall distribution of deficiency is shown in the pie chart presented in Figure 5.1, it is easy to observe that the deficiencies related to lifesaving, fire fighting and radio equipment account for more than half, indicating that among sand carriers, the phenomenon of not paying attention to internal safety management is quite serious.

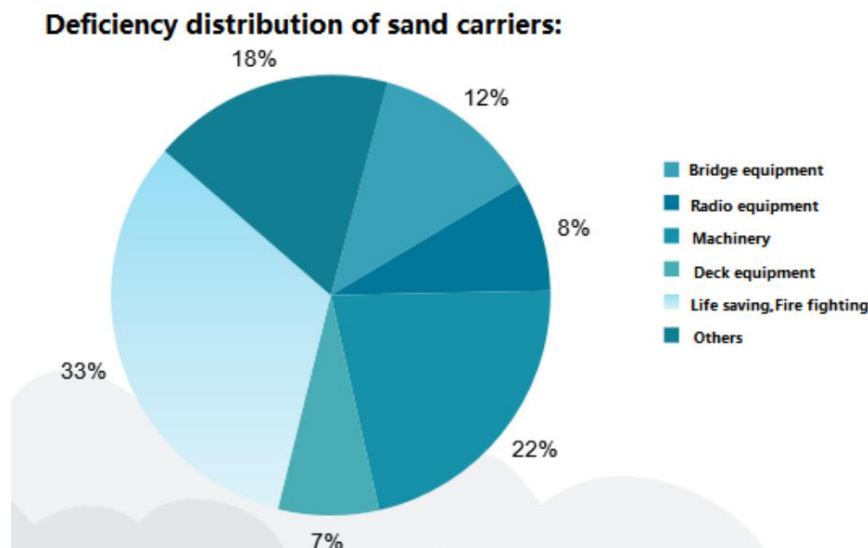


Figure 5.1 - Deficiency distribution of sand carriers.  
Source: Ningbo MSA.

During the special inspection process, a batch of ships with serious safety hazards and a number of typical deficiencies were found, and Table 5.3 shows some typical deficiencies of sand carriers.

Table 5.3 – Typical deficiencies of sand carriers

Deficiency code	Deficiency description
0912	Separate the after part of the cargo hold with bulkhead without authorization and add a pump room.
1250	Some sand carriers privately rebuilt or removed the hatch cover of the cargo hold.
1220	The load line mark is moved up or forward without permission, and the mark is not marked permanently. Deck lines are not permanently marked.
0910	The main deck of the ship is raised without permission, and the load line marks are moved up synchronously. Thus achieving the purpose of loading more cargo, it is also a disguised overload, at the expense of the ship's reserve buoyancy.
0988	There is no emergency escape way in the engine room or the dimensions of emergency exit did not meet the specification requirements.
0988	The exhaust gas pipe of the main engine passing through the emergency escape passage of the engine room.
1270	The door of engine room, kitchen and the wall of kitchen etc., do not meet the A60 fire separation requirements.
1420	The ship increase or decrease generators at will, without inspection and agree by survey departments; The models of main engine and auxiliary engine are inconsistent with the ship's survey certificate.
0912	Unauthorized opening of engine room bulkhead

Source: Compiled by the author based on the Investigation of Ningbo MSA.

Corresponding to the above Table 5.3, the following Figure 5.2 shows some photos of serious deficiency concerning illegal reconstruction, and all of them were marked with deficiency code on it.



Figure 5.2 – Illegal reconstruction of sand carriers  
 Source: Photos taken by the author during FSC inspection

### 5.1.3 Special inspection on lifesaving equipment

The Ningbo MSA and Zhoushan MSA launched a special inspection of life-saving equipment for small and medium-sized vessels from May to December 2019. The special inspection mainly focused on the life jackets, immersion suit, life rafts, life buoys, lifeboats and their landing and releasing devices on domestic sea-going ships. Through the special inspection, the unqualified life-saving equipment of small and medium-sized ships has been effectively removed, and the life-saving equipment sufficiency has been obviously improved. Inspection content are elaborated as follows:

#### 5.1.3.1 FSC inspection on life-saving equipment.

The Marine Department carried out inspection of life-saving equipment in strict accordance with the requirements of the relevant scheme. During FSC inspection and



on-site supervision, all deficiencies in life jackets, immersion suit and life buoy were rectified before sailing, and those with serious deficiency were detained.

#### *5.1.3.2 Carry out supervision on survey quality.*

When it was discovered that although the relevant life-saving equipment had undergone special inspection by certain ship surveyor, but there were still serious problems or the life-saving equipment had major quality problems, it was reported to the superior department.

#### *5.1.3.3 All of the passenger were inspected.*

During the special inspection period, the joint ship inspection department completed the special inspection of life-saving equipment for all of the passenger ships in its jurisdiction.

### **5.1.4 Special inspection on Long-term off-management ships**

In order to eliminate the hidden dangers of water traffic and ensure the continuous stability of the security situation in the waters under its jurisdiction, both MSA of Ningbo and Zhoushan launched a special inspection for long-term off-management ships. Long-term off-management vessels refer to domestic vessels that have not been registered for dormancy, or reported their arrival and departure records, or accept on-site supervision for over one year. (Zhao, 2018) Through detailed screening, Ningbo MSA identified more than 100 vessels that had been out of control for a long time, among which 80% were small and medium-sized vessels. The Maritime departments of the two places have taken multiple measures including strengthening on-site supervision, strengthening the ship registration administration, strict regulation of shipping companies, deepening departmental collaboration etc.

Through the special inspection, ships of long-term off-management became fully covered by the twp Maritime authorities, and a number of small and medium-sized

ships with low standards were forced to dismantle themselves or leave the waters of Ningbo-Zhoushan port.

## 5.2 Existing problems

### 5.2.1 Frequent safety accidents

Small vessels are the leading cause of all kinds of ship traffic accidents every year. Among the accidents in Waters of Ningbo-Zhoushan in recent years, small and medium-sized vessels account for more than 75%, and have always been one of the main sources of danger for the safe navigation of ships in these waters. (Ningbo MSA)

For example, in March 2018, vessel X (494GT) carrying about 800 tons of sands collided with vessel Y (499GT) while sailing in the waters of Ningbo port. The accident caused heavy damage to the stern of ship X. The Figure 5.3 shows there is a big hole in the stern of ship X.



Figure 5.3 – Damage of ship X.

Source: Photo taken by the author during on-site inspection.

In September 2018, an inter-island transport ship (299GT) lost its rudder while sailing in the waters close to Zhenghai port of Ningbo, causing the ship to lose control and resulted in collision.

In May 2019, when ship “Z” (499 ) was berthing in the Waters of Yongjiang River of Ningbo it sank because the steel plate on both sides of the cargo hold were rusted seriously and partially penetrated, leading to water leaking into a cargo hold through the hole. The damage caused was the loss of the whole ship and the navigation order in the waters was hampered as well. Figure 5.4 shows the sinking state of ship”Z”.



Figure 5.4 - Ship “Z” sink in the water.

Source: Photo took by the author during on-site inspection.

Accidents among small and medium-sized ships happened a lot every year. At present, the types of accidents of these ships mainly include collision, self-sinking, person overboard and work-related injuries.

### **5.2.2 High resignation rate of seafarers**

The theme of year 2020's World Seafarers' Day is “Seafarers Are Key Workers”. The

shipping industry has higher and higher requirements for the quality of seafarers, and more and more attention is paid to seafarers. However, the generally low average quality of the crew served on small and medium-sized ships has been one of the main reasons for the difficulty in supervision and frequent accidents of small and medium-sized ships. (Yu, 2012) The low quality and aging of crews on small and medium-sized ships is obvious and the resignation rate is high, which is one of the main cause of supervision difficulties in waters of Ningbo-Zhoushan port.

### 5.2.3 Poor ship quality

At present, the construction of small and medium-sized ships in China is generally low in quality and such problems as several ships using one set of drawings, inconsistent ship drawings, insufficient strength of hull structure are frequently discovered. (Qi, 2010) On the one hand, shipowners are pursuing low cost, not willing to spend too much money on building ships. On the other hand, the business of shipbuilding enterprises is not standard, and the competition is vicious. Table 5.4 shows some typical deficiencies of small and medium-sized ships navigating in waters of Ningbo-Zhoushan port.

Table 5.4 - Typical deficiencies of small and medium-sized ships

Deficiency code	Deficiency description
9999	The overall layout of the engine room is inconsistent with the final drawing.
0912	The Fire-proof level of bulkhead inconsistent with the fire control plan.
1275	No effective ventilation in engine room.
9999	The depth of ship inconsistent with the ship's survey certificate.
1240	The length, width and other dimensions of the cargo hold are inconsistent with the final drawing.
1240	The two cargo hold were merged into one.

1240	The hatch cover was not installed in the cargo hold as per the design drawing.
9999	Layout inspection of tanks (increase or decrease, rebuild or move tank).
1421	Increase or decrease generator or other equipment at will.
1430	No emergency steering gear system.

Source: Compiled by the author based on Investigation of Ningbo MSA and the author's working experience.

## 5.2.4 Serious marine pollution

### 5.2.4.1 Discharging oily water illegally

During inspection, it was found that crews of many small ships did not treat oily water as required. Many crews were not clear about the requirements of the convention and regulations, and they were not familiar with oily water separator, did not know the limit of PPM and the limit of the distance from the shore for the oily water to be legally discharged. Often, the bilge was directly discharged into the sea during navigation. (Ou, 2014) In addition, some crew may discharge bilge directly at night. Also, it was found that some crews did not store the oily water in the designated oil tanks as required, on the contrary, they stored it in temporary drums so that it could be sold when alongside.

### 5.2.4.2 Discharging sewage overboard directly

According to the investigation by the author, many small and medium-sized vessels failed to use domestic sewage treatment equipment normally, and the direct discharge of domestic sewage was common. The overboard valve was often kept open, and the sewage treatment plant was isolated (as is shown in the Figure 5.5). Even, some small ships with a gross tonnage of less than 500 always sailed in fixed waters, and their pipelines of sewage treatment plant were not connected at all.



Figure 5.5 – Sewage treatment plant out of service.  
Source: Photos taken by the author during FSC inspection.

#### 5.2.4.3 Failure to dispose garbage as required

Some crew members failed to collect, treat and recycle garbage according to the Garbage Management Plan, and did not set up dustbins with different colors of red, yellow and blue. They felt that it was troublesome to send the garbage ashore for disposal. When ships berthed, crews would hurriedly go ashore for traveling and shopping, and the garbage were directly thrown into the sea during the voyage, for the sake of reducing their workload. When asked about the disposal requirements of the garbage, they were not clear. Even, some crews thought that the ship's garbage could be thrown overboard directly after departure, and they did not know the special disposal requirements for different kinds of garbage at all.

#### 5.2.4.4 Poor maintenance of anti-fouling equipment

Although some small and medium-sized ships are equipped with marine anti-fouling equipment, they could not work normally due to the poor maintenance of oily water separator, sewage treatment plant, sewage pumps, sewage pipelines, valves, standard discharge joints, etc. In the Table 5.5, it shows some deficiencies about the poor maintenance of anti-fouling equipment.

Table 5.5 - Deficiencies of anti-fouling equipment caused by poor maintenance.

DEVICE	DEFICIENCY
Oily Water Separator	There is no Form approval certificate for OWS.
	OWS do not have standard discharge connectors.
	The anti-pollution equipment and structure equipped are not consistent with those recorded in the attachment of the Anti-Oil Pollution Certificate
	The OWS cannot be started and the power is not connected
	Not equipped with felt, sawdust and other materials as required in the Oil Pollution Emergency Plan
	The cylinder of OWS is corroded and have hole on it
	The filter of OWS is blocked
	The sludge pump of OWS is not working properly
	The discharge valve of the OWS fails
Sewage Treatment Plant	The level gauge of sewage storage tank cannot be identified
	High level alarm failure of sewage storage tank
	The air pump of sewage treatment plant failure
	Wrong connection of overflow pipe of sewage treatment plant
	The crushing pump of sewage treatment plant cannot be started
	Inadequate supply of sewage treatment drugs

Source: Compiled by the author based on investigation of Ningbo MSA and the author's working experience.

### **5.3 Causes of the problems mentioned**

#### **5.3.1 Causes of frequent accidents**

##### *5.3.1.1 Improper stowage of goods*

Small and medium-sized vessels are often operated by self-employed owners. In order to maximize profits, shipowners tend to stow irregular goods or even carry illegal goods. There are always problems of overloading, improper loading, carrying goods of ultra high, ultra wide, or dangerous goods; improperly lashed goods, improperly installed or operated hatch covers and even illegally stowed cargo on both sides of the deck blocking the emergency passage, etc.

##### *5.3.1.2 The crews' quality is low*

Due to the bad working conditions, low salary, long time tough work, it is always difficult to attract high-quality crews to work aboard small ships. Most of them are primary and secondary school students. (Luo, 2017) Many crews of Ningbo, Zhoushan area is transferred from fishermen, and they are not familiar with ship routing and reporting system, nor modern navigational equipment such as AIS, GPS and ACDIS on board. According to the author's random survey of 100 crew members served on 20 small and medium-sized ships sailing in the waters of Ningbo-Zhoushan port, the author made the Figure 5.6, it is a educational background distribution pie chart. From the chart we can clearly find that 70% of crews' education background are under junior high school level.



## Education background of crews on small and medium-sized ships

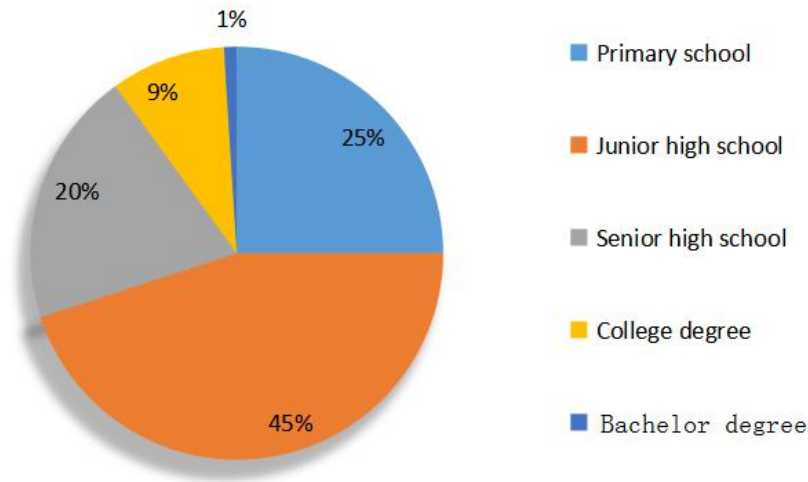


Figure 5.6 – Education background of crews on small and medium-sized ships.  
Source: Compiled by the author based on investigation.

### 5.3.1.3 *The ship doesn't meet minimum manning requirements*

In some private-owned ships, the crew members are relatives and friends. When a certain person leaves the ship, his/her seaman certificate still remains on board. When officers of MSA come on board for inspection, they often made up different excuses to justify his absence, such as going ashore to buy groceries or going to the hospital for medical treatment, etc. (Gu, 2019) In order to meet the ships' manning requirements, some private shipowners even rent seaman certificates and record the crew's employment information in the maritime system, so as to make the ship smoothly pass the supervision procedures of MSA. But in fact the crew whose certificates were presented are not working on the ship at all.

### 5.3.1.4 *Fatigue*

The reduction in the number of crew members results in increased workload, reduced rest hour and impaired physical and mental health of the crew. As is shown in Figure 5.7, the output increases when crew's workload increase, but when it approaches the overload point, it would lead to lost control, leading to a rapid decline in performance,

hence there would be no capacity remained for correcting the mistakes made during navigation.

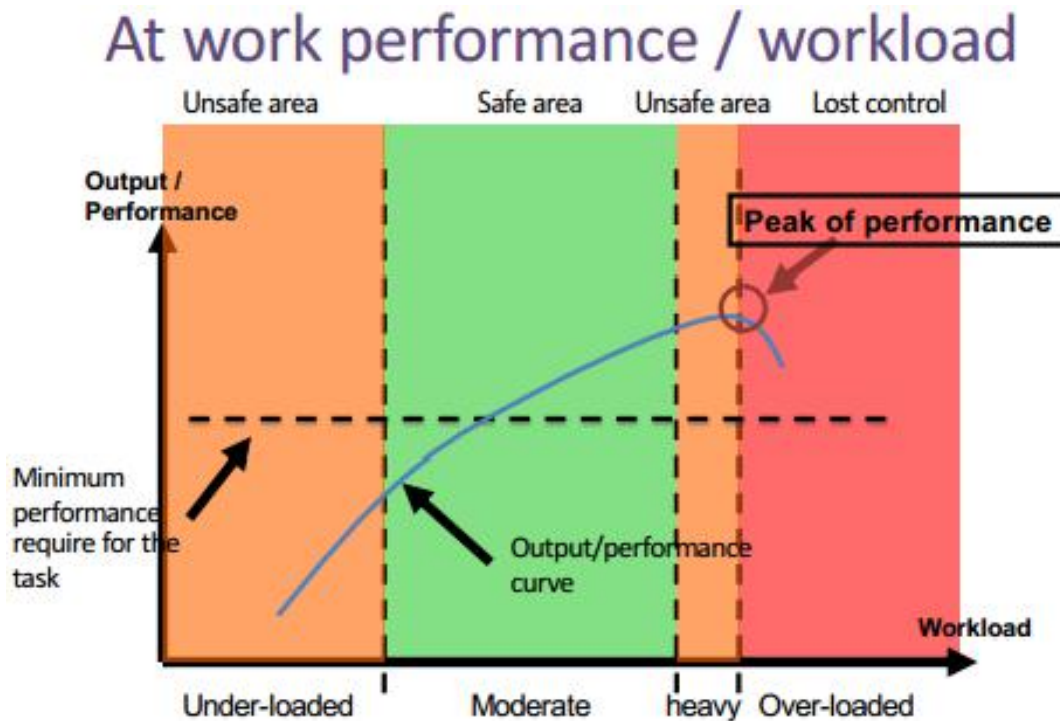


Figure 5.7 –Work performance / workload

Source: Dr. R. Baumler / JP Clostermann from WMU.

### 5.3.1.5 Unauthorized reconstruction

In addition to the movement of goods caused by bad sea conditions and improper lashing of goods, many accidents are also related to the unauthorized reconstruction. (Li, 2012) For example, as shown in the Figure 5.8, in order to facilitate the drainage of the cargo hold, the shipowner opened up the wall between front and after cargo hold without authorization, and this lead to poor ship stability. Once one cargo hold was flooded, both of them would be flooded.



Figure 5.8 – Unauthorized reconstruction.  
Source: Photos taken by the author during FSC inspection.

### 5.3.2 Causes of the loss of seaman

#### 5.3.2.1 *Weakened professional attractiveness of the seaman*

With the development of society and economy, domestic prices and land income levels have risen, the advantages of being a seafarer are gradually lost, and the career attractiveness has declined. Meanwhile, the crew's own sense of professional honor has been significantly reduced, when the recognition of social status has declined, and the career channels have been narrower. The income gap between work on ships and ashore continues to shrink, which objectively makes it difficult to attract newcomers to take up an occupation as a seaman.

#### 5.3.2.2 *Heavy workload on board*

The weather at sea changes frequently, and many people suffer from seasickness, which poses a great safety risk. Besides the working environment of small and medium-sized ships is even graver, with small working and living space, loud noise

and severe ship vibration. Crew members need to work on board for a long time when sailing, and the life at sea is relatively boring with the information blocked, and they also need to bear huge psychological and physical pressure. (Qian, 2019) For young people who pursue individuality and advocate freedom, comparing with the shore job, the profession of seaman is not attractive, so young people join the crew team much less than the older generation.

#### *5.3.2.3 Lack of proper crew management from ship owners*

Shipowners of small and medium-sized ships often have the following two problems, one is the lack of humane care for the crew. In order to maximize profits, some ship owners only care about their own capital safety and returns, lacking humanistic care, ignoring the minimum spiritual needs of the crew, and even inadvertently violating the legitimate rights and interests of the crew; (Fan, 2019) The other is the lack of investment in crew safety training, which has led to many safety accidents caused by human factors.

#### *5.3.2.4 Aging problem*

The author of this article randomly surveyed 100 Maritime graduates of Dalian Maritime University in 2020. Only 31.5% of graduates chose seafarers as their first job and all of them chose to work on large ships with comfortable working environment, and the proportion of working on small and medium-sized ships is zero. The average age of crews working on small and medium-sized ship are growing. According to the author's random survey of 100 crew members whom served on 20 small and medium-sized ships which sailing in the waters of Ningbo-Zhoushan port, the following age distribution chart (Figure 5.9) was obtained. It shows that 50% of them are between 40-50 years old and 20% of them are over 50 years old, only 10% of them are under 30 years old, the aging problem is very serious.

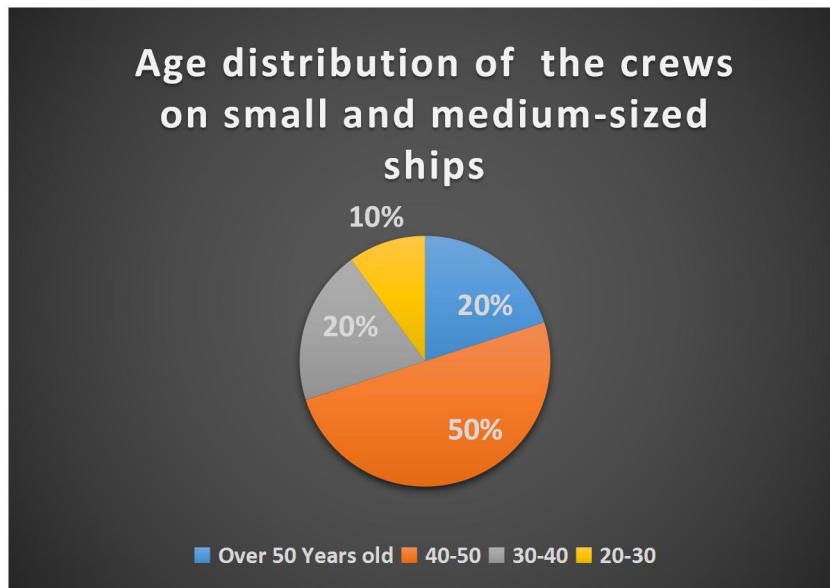


Figure 5.9 – Education background of crews on small and medium-sezed ships.  
Source: Compiled by the author based on investigation.

### 5.3.3 Causes of poor ship quality

#### 5.3.3.1 *Loose management of shipyard*

The internal management of small shipyard is poor, lack of professional technical personnel and quality managers. Most of the small shipyard lack effective internal quality management, and the construction of every part of the ship is outsourced to contractors most of whom do not have independent legal persons and qualifications. The workers employed by the contractor have great mobility, and their technical level and quality are uneven. In addition, the shipyard cannot effectively manage the production workers, so the construction quality of ships is unstable and cannot be guaranteed.

#### 5.3.3.2 *Vicious competition among shipyard*

In order to win more shipbuilding orders, many operators of small and medium-sized ship yards take advantage of low cost and short period as the means to gain and win in market competition, giving no regards to the quality of ship construction. In order to minimize the construct cost, a set of drawings is often used for several ships, and old materials, old equipment are used during ship building. The ship yards which should

take the ship quality as the pillar give up the quality, resulting in the emergence of a large number of low-quality ships.

#### *5.3.3.3 Loose management of ship survey department*

Firstly, the number of surveyors can not meet the rapid development of shipbuilding industry. From drawing review to on-site inspection, it is difficult to ensure the survey of every link and every part of the ship in the shipbuilding process. The quality of ship surveyor is uneven, and they are in need of long-term and effective professional technical training and knowledge update. Secondly, local shipping survey departments are administratively managed by the local government, which is to some extent restricted and interfered by the local economic goals such as developing the shipping industry or water transportation industry, so it is difficult for local shipping survey departments to effectively perform the statutory inspection functions.

### **5.3.4 Causes of marine pollution hazards**

#### *5.3.4.1 Insufficient awareness of anti-pollution*

During the inspection, it was found that many shipowners of small and medium-sized ships only focus on economic benefits and disregard the requirements stipulated by the conventions and national laws and regulations in anti-pollution management, it is considered that it is not necessary or they believe the discharge of oil and garbage from the ship has little impact on Marine pollution. Most of the crew members have a weak awareness of anti-pollution requirements, claiming that they do the anti-pollution work is only to cope with the inspection by the MSA officers.

#### *5.3.4.2 The loose supervision on anti-pollution*

Although the MSA has increased the on-site supervision and management of ship anti-pollution, it only works in a phased and selective way. Anti-fouling inspection of the small and medium-sized ships can only be carried out during FSC inspection, and the intervals between inspections of anti-pollution equipment and inspections of

crew operational capability are very long, and sometimes due to the limited time for on board inspection, the inspection of anti-pollution is not in-depth;(Ma, 2010) The inspection is always carried out only focused on the anti-pollution certificates, documents, etc., are checked without detailed inspection of the equipment or operations.

#### *5.3.4.3 Insufficient pollutant reception facilities in port*

The pollutant reception facilities in the waters of Ningbo-Zhoushan port are insufficient. For example, a large number of small and medium-sized vessels frequent arrival in and depart from the waters of Ningbo Yongjiang River, with an average of 500 vessels coming in and going out per day calling at nearly 60 docks in the area.(Ningbo MSA) However, there is only one reception ship in the whole area, which is far more from enough to meet the demand. In addition, some receiving boats only have interest in recovering the waste oil which have economic returns, they are not active in receiving and disposing the oily water and other ship pollutants which have no economic value. Also, there are some unlicensed private ships in the area to recover residual oil, which leads to the confusion in the management of the ship's waste oil, and this also aggravates the difficulty in management for the competent authority.

### **5.4 Chapter summary**

The maritime departments of Ningbo and Zhoushan have been committed to the safety supervision of ships in the waters of Ningbo Zhoushan Port. Some special inspections had been carried out on small and medium-sized vessels on the basis of daily supervision, including special inspection on sand carriers, special inspection of lifesaving equipment and special inspection on Long-term off-management ships, etc. Some achievements have been made, however, the problems have an obvious trend of rebound. There are problems including frequent safety accidents, high resignation rate of seafarers, poor ship quality, serious pollution, etc. There are many causes for these problems, mainly including improper stowage of goods, low crews' quality, aging

problem, poor ship quality, weak anti-pollution awareness and so on.

Combined with the comprehensive analysis of this chapter, the author put forward some sustainable safety supervision suggestions for small and medium-sized ships which navigated in waters of Ningbo-Zhoushan port in the following chapter.



## CHAPTER 6

### Supervision recommendations

Based on the research and analysis in the previous chapters, the author combined with his years of working experience as MSA officer and seafarer, summarized the following supervisory suggestions. It is hope all these plans and thoughts can provide practical reference for the safety supervision of small and medium-sized ships in the waters of Ningbo-Zhoushan Port.

#### 6.1 Strengthen traffic control on small and medium-sized vessels

The ship routing system of waters of Ningbo-Zhoushan port have been designed and put into operation, however, the phenomenon of crossing the waterway illegally by small and medium-sized ships still occurs frequently. Many crews of small and medium-sized ships have fluke mentality, do not sail according to the prescribed route, they take shortcuts, and cross the waterways. To eliminate this state, the author gives the following suggestions.

##### 6.1.1 Carry out VTS control on small ships

Give full play to the supervision of the VTS control center and the CCTV video monitoring system, and warn the offending vessels in advance in the form of high frequency telephone. If the situation is serious, the case can be investigated by means of screen capture, sound recording, video recording, etc., and administrative penalty can be imposed..

##### 6.1.2 Guide ships to avoid the peak sailing hours

In order to save fuel costs, small and medium-sized vessels in the waters of Ningbo-Zhoushan Port generally wait for entry and exit when the current is high or low, and there is an obvious peak sailing time in the waters. For example, a large number of sand carriers enter and leave the Yongjiang River during the ebb and flow period every day, squeezing each other into the channel, causing chaos in the

navigation order, etc. The information of peak hours can be provided to large ships, so that the ship can adjust the departure and arrival time to avoid meeting with the peak flow of small ships.

### **6.1.3 Carry out inspection at night**

In order to avoid the inspection by the MSA officers during the day time, the shipowners of some small ships often choose to sail at night, and there are usually many rule-violating issues, such as overloading, insufficient personnel, cross-navigation zone and other violations. Maritime departments should carry out inspections at different time according to this situation, random spot checks at night can be carried out, to severely crack down on illegal operations by ships at night.

## **6.2 Suggestions for improving crews' management**

### **6.2.1 Carry out manning supervision during navigation**

It is difficult to obtain evidence of insufficient personnel during berthing, the author suggests to carry out inspection during navigation. If the ship is not adequately manned during the voyage, the inspector can directly collect evidence on the spot and put administrative penalty. (Qu, 2019) Of course, the inspection during the navigation should be conducted in open waters to ensure that the embarkation inspection does not affect the safe navigation of the ship.

### **6.2.2 Improve the crew's social security system**

The law on social security for seafarers shall be promulgated as soon as possible, and provisions for social security for seafarers shall be set up. Require shipping companies to establish an enterprise pension system, and give full play to the role of the seaman union. (Lu, 2016) Raise the minimum wage level, exempt or reduce individual income tax on crew members. The Figure 6.1 shows the Maalow's Hierarchy of Needs, it includes Physiological needs, Safety needs, Love and

belonging, Esteem and Self-actualization. It is clear that physiological needs and safety needs are the foundation of the pyramid, only by improving the crew's social security system can the crew's sense of safety be continuously improved, so as to attract more people to join the seaman.

## Maslow's Hierarchy of Needs

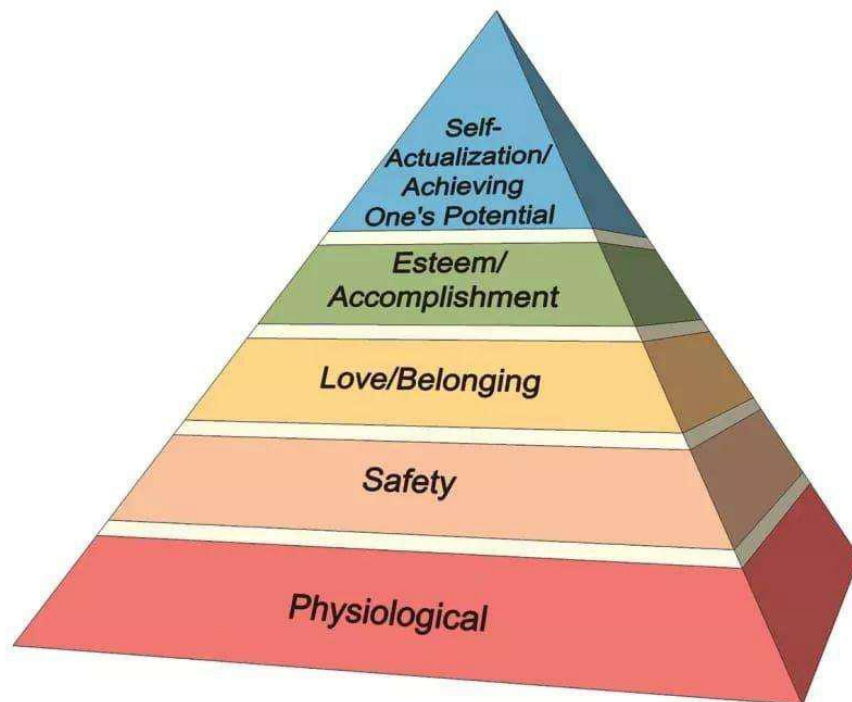


Figure 6. 1 - Maslow's Hierarchy of Needs

Source: <https://image.baidu.com/search/index?tn=baiduimage&ps>

### 6.2.3 Establish crew's integrity management system

The author suggests to establish an integrity rating system for seaman. The crew's integrity rating shall be graded according to the seaman's integrity record. And set up different award and punishment system for different grades. For example, crew members with serious problems, such as repeatedly breaking the law, inadequate performance of duties, false academic qualifications and fake work experience shall be blacklisted, their rank promotion period shall be extended, and even, their seaman's certificate can be revoked. (Zhuang, 2018) The seafarers with high integrity can be

encouraged by shortening the promotion period of their ranks. Select the captain of good credit, extend the inspection window of the ship which the captain is boarded, and reduce the inspection frequency.

#### **6.2.4 Strengthen crews' information management through "Internet +"**

Further improve the information collection of the crew on small and medium-sized ships, set up a data center for them, and the information to be collected can include fingerprint collection, certificate level, appointment and dismissal status, education background, age, etc. (Ying, 2019) The static and dynamic information of all seafarers will be stored in a unified format in the seafarers' information storage center, and the seafarers' information inquiry service will be provided to the competent authority or specific users such as the seafarers themselves, shipping companies, etc., so as to achieve the shipping company and crew win-win situation.

#### **6.2.5 Easy the Seaman Certificate Exams**

The entry threshold for seafarers in China is relatively high, and a certain education level is required to participate in the Seaman Certificate Exam, which is difficult and the passing rate is low. The author believe that for the crews of small and medium-sized ships, their education level is generally low, so exams for this group of people should be more practice-oriented with less weight on theoretical knowledge. For those who really love to work on board, it should be easy to pass the exam with proper training and personal efforts. In different kinds of training, more attention should be paid to the cultivation and assessment of crew's operational competence. For example, the proportion of practical operation should be increased in the courses of ship maneuvering simulator, various professional training certificates, etc., to reduce the difficulty of exams. In this way, more willing young people can be attracted to the seafarer occupation.

### **6.3 Suggestions for improving the ship quality**

Based on the study in Chapter 5, in order to improve the ship building quality and eliminate the hidden dangers of low-quality ships, the author puts forward the following suggestions.

### **6.3.1 Strengthen the management of surveyors**

Ship survey institutions are the enforcers of the state regulations of ship survey and marine installations and its the ultimate gatekeepers of ship construction quality. The ship survey institutions shall fully guarantee the comprehensiveness and effectiveness of the inspections and be responsible for the quality of the items inspected. Therefore, MSA should take all effective measures to effectively solve the problem of lax inspection of ship survey, ensure the comprehensiveness and effectiveness of inspection, and prevent low-quality ships from entering the shipping market.

1) Fully establish the law enforcement status of ship survey institutions, straighten out the management system, so that ship surveyors can truly perform the duties of statutory inspection on behalf of the state.

2) Strengthen the construction of surveyors' teams, and rationally allocate ship surveyors and improve the training mechanism for surveyors. Establish a talent management mechanism that combines introduction and training and focuses on independent training to strengthen the professional training of survey technologists. (Qiu, 2014)

3) Establish the post-inspection responsibility system for ship surveyors indicating clearly practices to be rewarded and punished so as to fully mobilize the enthusiasm and initiative of ship surveyors.

### **6.3.2 Establish TQC system**

Vessel is a complex aquatic building, and the quality management of shipyard is

complex. At present, the construction quality of small and medium-sized ships is in urgent need of improvement. The author suggests that TQC should be introduced into the construction of small and medium-sized ships. TQC stands for Total Quality Control, with quality as the core and full participation as the foundation, its fundamental purpose is to achieve the long-term success of the organization through customer satisfaction and promote the interests of all members of the organization and society as a whole.(Zhu, 2017) QC team activity is essentially a kind of self-checking system. In terms of hull fabrication, the QC team system as is shown in the Figure 6.2 can be envisaged due to different shipyard conditions.

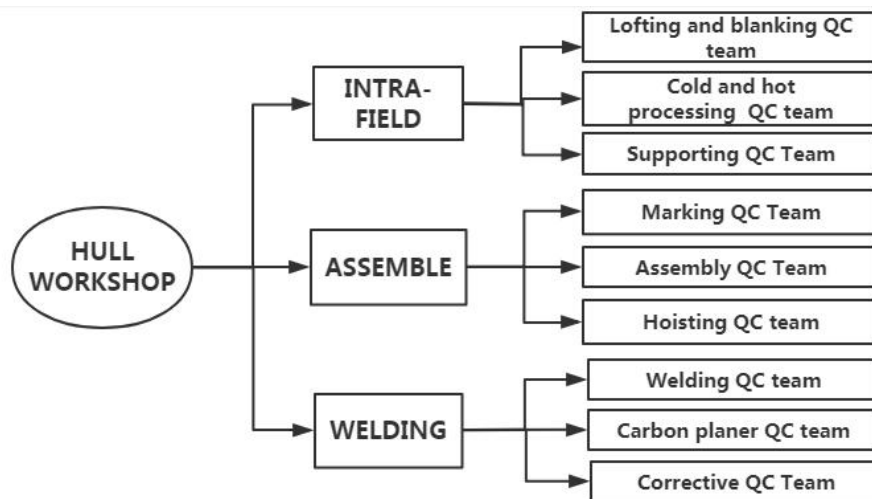


Figure 6.2- QC team system.

Source: Compiled by the author based on the references.

### 6.3.4 Use standardized construction

Standardization is the symbol of modern industry, and it shines brilliantly in the automobile industry. The production experience and production mode derived from standardization also bring great reference value to many industries, making the production capacity of modern industry experience explosive growth. But the implementation of standardized construction on large ship is difficult due to the complex comprehensive properties, the wide range of aspects involved, the relatively narrow demand, and the huge cost of construction funds.(Tian, 2016) However, in the

field of small and medium-sized ships, standardized construction is feasible.

For example, the Standard ship construction of Darmen Shipbuilding group in the Netherlands has been very successful. The company's standardization has reduced construction costs, greatly improved production efficiency, and greatly guaranteed the stability of quality, and avoided a lot of risks. The standardization involves the following items:

1) The standardization of design. The company has a strong design center and a standardized database, with detailed drawings for every part on board, specific instructions for every process, and a data center that is constantly maintained and updated as per technological and market changes.

2) Production standardization. Darmen Group adopts unified standards for equipment ordering, personnel training, and construction plans and strategies, which enables a unified style to be formed during the construction process and consistent products are produced.

3) The standardization of material supply. Darmen Group adopts global procurement, and has formed a stable and reliable supply chain for many years. All materials are standardized, and has formed its own number and system, a strong standardized database, so that the supply of materials is fast and accurate.

### **6.3.5 Improve the welding process**

The weld length of a single ship can reach 10,000-200,000 m, (Wu, 2018) so improve the welding process have great significance. The welding quality of small ships navigating in waters of Ningbo-Zhoushan port is generally poor, as is shown in the Figure 6.3, spot welding, desoldering, welding seam and so on can always be found.



Figure 6.3 – Poor welding quality

Source: Photos took by the author during FSC inspection.

The poor welding quality of ships is difficult to rectify after they are delivered. In order to improve the welding quality of small and medium-sized ships, the author suggests all welders must pass special training and examination, and be recognized by the relevant classification society before taking up the post; The ship survey department should strengthen the inspection of the welding quality in the construction stage, ships with poor welding quality should not pass the survey; Cooperate with local governments to close the small shipyards with poor shipbuilding quality and backward technology, and support the development of high-class shipyards.

#### **6.4 Suggestions for anti-pollution**

##### **6.4.1 Strengthen anti-pollution management in shipping companies**

MSA shall do a good job in the supervision and administration of pollution prevention of shipping companies. If pollution incidents occur repeatedly on ships belonging to



one company, it should be in the blacklist and all of its ships should be on the blacklist. (Liu, 2011) In this way, the shipping company is pushed to increase the anti-pollution management, strengthen the ship's own standardized management of anti-pollution, and hence it will take the initiative to practice anti-pollution on board.

#### **6.4.2 Raise the crews' awareness of anti-pollution**

Many cases of Maritime pollution are caused by the crew's lack of awareness of pollution prevention or poor operation ability. In the course of ship safety inspection or on-site supervision, the competent authority should inspect the crew's operation ability of anti-pollution, take the inspection of their ability and consciousness as one of the key contents, strictly punish the crew members who failed to meet the requirements, and establish a tracking system for the inspection of crew members' anti-pollution operation ability.

#### **6.4.3 Intensify inspections on anti-pollution**

Maritime departments, on the basis of the existing FSC inspection, should put the anti-pollution inspection into the on-site supervision, so as to standardize and strengthen the anti-pollution inspection on ships. At the same time, the tracking inspection system should be established by setting up inspection files for the ships found with deficiencies in the previous inspection, and implement tracking management to eliminate the fluke psychology of shipowners.

#### **6.4.4 Cooperation with ship survey department**

If the MSA officers find the anti-pollution equipment of one ship was inconsistent with its anti-pollution certificate during on-site inspection, they should timely notify the surveyors. When conducting survey, the surveyor shall strengthen the inspection of the anti-pollution equipment. If the oily water separator, sewage treatment, sludge tank, etc., do not meet the requirements of the code, (Song, 2010) surveyors shall not issue the "Anti-Pollution Certificate", so as to strengthen the anti-pollution

management from the source.

## **6.5 Perfect the SMS construction**

### **6.5.1 Raise the awareness of safety responsibility of shipping companies**

The degree of awareness of safety production of shipping companies is directly reflected in the level of ship safety management. The depth and frequency of inspection for shipping companies whose ships often have accidents, violations of rules should be increased, so as to put pressure on the manager. Inspection should pay attention to whether the deficiencies found before have been rectified properly, if not, severe punishment should be imposed. In this way, the managers of the company would pay attention to the safe operation of the ship and the management level of their ships will be improved gradually.

### **6.5.2 Crack down the ineffective escrow**

One of the main reasons shipowners entrust their ships to a qualified management company for "escrow" is to save money. It is suggested that we should limit the passing rate of the initial audit of "escrow" ships, and establish a centralized talk system before the audit of such ships, that is, to convene the shipowner and management company, and further emphasize the requirements of Maritime safety operation. In the audit of such ships, experienced and excellent auditors should be selected in priority. If non-conformance is found, rectification shall be strictly required. If major problems are found in the operation of the system, the audit shall be suspended as the case may be, and the "escrow" ship shall operate the SMS strictly with a higher standard.

### **6.5.3 Carry out self-inspection before departure**

Ask the ship to conduct self-inspection concerning the key equipment before sailing, so as to enhance the crew's understanding of their own ship's safety situation, improve

the crew's safety awareness, and further implement the ship's main responsibility for production safety. The ship should establish a standing book of "Self-examination table before departure" . The standing book shall at least include whether the AIS, GPS, main engine, generator, fire pump, etc. are in normal condition, also, MSA officers should carry out irregular inspection of the records in the later on-site inspection, focusing on whether the Self-examination Form is filled in properly and is in line with the actual conditions.

## **6.6 Set up communication channels among different departments**

### **6.6.1 Establish information sharing mechanism between MSA and Banks**

The shipping industry is capital-intensive, high-risk and highly liquid, and it is difficult for banks to monitor ships and evaluate the credit of shipping companies. At the same time, the vast majority of small and medium-sized shipping companies are private owned, financial difficulties are particularly prominent in their operation. The author suggests to establish the information sharing mechanism between the MSA and banks and to build the security information contact channel. MSA provides the bank with the safety management level and potential risks of the shipping companies, and provides professional assessment information for the bank loan risk warning system.

### **6.6.2 Establish We-Chat groups for information sharing**

Establish We-Chat groups for sharing information. Invite administrative counterpart into the We-Chat group, including shipowners, shipping companies and senior crews of small and medium-sized ships etc. Timely send the latest Maritime regulations, special inspection activities, severe weather warnings, etc., so as to improve the efficiency of communication.

### **6.6.3 Establish a joint supervision mechanism**

Invite officers from ports, cargo owners, shipping companies, agent companies, etc.

set up a joint supervision mechanism together. The MSA timely inform ports, cargo owners and companies the information of low-quality ships, help them to actively choose good ships for consignment, and rely on the power of ports and cargo owners, reject low-standard ships, so as to urge low-standard ships to actively strengthen their management, improve their technical conditions, and ultimately achieve continuous stability of Maritime safety.

### 6.7 Establish a classification and hierarchical supervision mechanism

In order to strike low-standard vessels arrived, and ensure a good navigation situation in Ningbo-Zhoushan Port, it is suggested to establish a classification and hierarchical supervision mechanism for small and medium-sized vessels arrived. The author of this paper envisages the establishment of a red-yellow card mechanism. Table 6.1 shows the definition of red and yellow card ships.

Table 6.1 – Ways of definition for red and yellow card ships

RED CARD SHIP	1. Ships detained twice or more in the recent 12 months by Ningbo MSA and Zhoushan MSA.
	2. All ships of the same company whose ships have been detained more than twice in the recent 12 months.
	3. Ships tracked by the China MSA.
	4. Ships that forged ship certificates and documents.
	5. Vessels that do not report before arrive or departure, do not respond to VTS calls, and intentionally close AIS.
	6. Ships that illegally mark the name of the ship or change the mark of the load line.
	7. Vessels that are primarily responsible for a serious accident in the waters of Ningbo-Zhoushan Port.
	8. Ships that have not been inspected for a long time (over 10 months).
	1. Vessels that are primarily responsible for a small accidents in the

YELLOW CARD SHIP	waters of Ningbo-Zhoushan Port.
	2. Ships that violates the regulations fails to accept the investigation and handling by the MSA on time or fails to pay the fine in time.
	3. All ships of the company in which the ship has a continuous accident risk.
	4. All the ships of the companies that have external incorruptible acts and have been interviewed by the Discipline inspection Department of MSA.
	5. Co-investigation ships, including co-investigation ships issued by Ningbo MSA, Zhoushan MSA and others.
	6. Special supervision ships, such as coal transport ships, passenger ships, sand carriers, DG cargo ships, etc.
	7. Vessels designated by the bureau for inspection in accordance with the requirements of seasonal and periodical work.

Source: Compiled by the author based on the author's supervise advice.

Both red and yellow card ships should be inspected every time they arrive at the port.. Set up a team of security experts, and the team members will conduct strict FSC inspection for red card ships. For red card ships, the supervision frequency and intensity for both the ship and its company will be increased, and additional audit would be carried out for the company if necessary. The Marine department should carry out on-site supervision of the yellow card vessels when it arrived, safety inspection shall be carried out if any obvious non-conformity is found during the inspection.

## 6.8 Other suggestions

### 6.8.1 Promote the old ships upgrading

At present, in the latest opinions on The Implementation of The Compulsory Scrapping System for Transport Ships, the compulsory scrapping age for small and medium-sized cargo ships is more than 30 years. However, it is rare for small and

medium-sized vessels that are still in normal operation condition in the waters to be over 20 years. In addition, due to market demand and other factors, around 2004, a large number of low-quality ships were built, and the safety and technical conditions of these ships were extremely poor. For such vessels, it is recommended that the related functional departments should organize a comprehensive security screening and safety assessment, and focus on assessment of hull structure, such as the thickness of the shell plating, cargo beam, strength of the frame etc., according to the evaluation results, using the method of risk assessment and forecasting, determine the best age for scrap. The author puts forward the following suggestions for the disposal of old ships navigated in waters of Ningbo- Zhoushan port:

- 1) Formulate a unified standard based on the safety assessment results and select a batch of low-standard ships that should be eliminated in priority.
- 2) The state can introduce incentive and subsidy policies for the optimal scrapping age, so as to stimulate and guide individual shipowners to scrap old ships as soon as possible, and put subsidy policies for building new ships and realize industrial transformation and upgrading;
- 3) Due to the high cost and long service cycle of ships, it is suggested that relevant state departments strictly examine and approve the capacity of small and medium-sized cargo ships, and resolutely prevent new-building low-quality ships from entering the shipping market.

### **6.8.2 Break the window period of low-standard ships**

It is found that many shipowners of small and medium-sized vessels do not want to accept FSC inspection in Ningbo-Zhoushan port, because they are worried about the strict inspection there. Before the window of FSC inspection opened, they usually choose to leave Ningbo and accept the FSC inspection in other ports, and after

finished the inspection, they return to the waters of Ningbo-Zhoushan Port, which make it impossible for local Maritime authorities to effectively supervise and control the vessels. The author suggests that Maritime authorities should break the limitation of inspection window period and carry out random inspection on such low-standard vessels. MSA officers should increase the frequency of inspections, deal with problems strictly when they are found, detain low-standard ships, and punish illegal behaviors when they are detected, so as to create a high-pressure supervision situation.

### **6.8.3 Strengthen labor inspection**

With the entry into force of the MLC 2006 in China, the MSA took the lead in the inspection of labor conditions of domestic navigable vessels in Zhejiang, Shanghai and Shandong in 2018. Ningbo MSA and Zhoushan MSA began work on the project in 2019. As mentioned above, the living facilities on small and medium-sized cargo ships are obviously insufficient. Therefore, it is necessary to urge vessels to timely improve living and working conditions with the help of labor condition inspection. To effectively protect the normal work and life rights and interests of the crew during the voyage, enhance the sense of honor and enthusiasm to be as a seaman.

## **6.9 Chapter summary**

The content of this chapter is the main results of the research on the safety supervision of small and medium-sized ships in waters of Ningbo-Zhoushan port. The author makes a thorough study of the causes of the problems and puts forward eight safety supervision suggestions which are about anti-pollution, safety management, crew training, ship building, etc. According to the research, these countermeasures have good regulatory effect and sustainability. It is hoped that the supervision suggestions put forward in this chapter can provide reference for the maritime supervision of small and medium-sized vessels in Ningbo-Zhoushan Port.

## CHAPTER 7

### SUMMARY and CONCLUSIONS

Supervision of small and medium-sized cargo ships is a common problem for Maritime organizations in China. The safety management and pollution prevention of small and medium-sized vessels in the waters of Ningbo-Zhoushan Port is a complex, long-term and a wide range systematic project. It requires the joint efforts and close cooperation of all parties, including shipping companies, Maritime administrations, port group, ship survey departments and border guard, etc., to actively explore the efficient safety supervision mode.

In this paper, the author takes the safety supervision of small and medium-sized ships in waters of Ningbo-Zhoushan port as the research object. Based on informatization theory, holistic government theory, Maritime public management theory and human-machine-environment-control system theory, etc., the author carried out in-depth analysis of the current situation of supervision, existing problems and the causes of the problems of small and medium-sized cargo ships in the waters of Ningbo-Zhoushan Port.

Through the study of this paper, the author summarized eight regulatory recommendations, including improving the quality of the crews, strengthening vessel traffic flow control, promoting the obsolescence of old ships, improving the ships' building quality, perfecting the construction of SMS, breaking the inspection window of small ships, carrying out labor inspection, establishing security information communication channels, establishing a classification management mechanism, etc. The author intends to contribute to give some help and suggestions to the Maritime supervision, form the working consensus and supervision joint force, and make contributions to eliminate the security risks of small and medium-sized cargo ships, and hence improve the ship safety and technical status.



Through questionnaire, literature study, case study, System analysis, interview and statistical analysis, this paper makes a deep and quantitative analysis of the situation of safety supervision on small and medium-sized vessels. It qualitatively analyzes the reasons for the difficulties in the supervising small and medium-sized vessels, and basically establishes the safety supervision mechanism of small and medium-sized vessels with sustainable development. It provides reference for Maritime authorities on the safety supervision of small and medium-sized vessels.

However, due to the limitations of the author's knowledge and the research time of this paper, the literature collected is not sufficient, the theory and method used are not complete, and the factors and weights of the evaluation system obtained are not absolutely reasonable. There are still many inadequacies in this paper, which needs to be corrected and improved continuously.

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## APPENDIX: A

### Self-inspection list of ships before departure(general)

Number	Inspect item	Result		
		Yes	No	NA
<b>BRIDGE</b>				
1	Whether all the certificates of ship and crews are complete and valid			
2	Whether the number of crews on board meet the minimum manning requirements			
3	Whether the navigation equipment, communication equipment are working normally			
4	AIS work normally			
5	Signal lights, sound signals are working normally			
6	Security inspection carried out before departure			
<b>LIVE SAVING &amp; FIRE FIGHTING</b>				
1	Whether the lifeboat, life raft and their life-equipment are working properly			
2	Whether the personal life-saving equipment is complete and the working condition is good			
3	Fire alarm system work properly			
4	Emergency fire pump work properly			
5	Whether the personal firefighting equipment is in good condition			
6	Whether the fire doors, quick closing valves, etc., are in good condition			
<b>DECK DEPARTMENT</b>				
1	Whether the hull structure is in good condition			
2	Weather tight door, watertight device are in good condition			
3	Whether the stowage, isolation and lashing of cargo meets the requirements			
4	Whether the mooring equipment is in good condition			
5	The load line mark are clear and not overloaded			
<b>ENGINE DEPARTMENT</b>				
1	Whether the M/E and its attachments working properly			
2	Whether the boiler and its attachments working properly			
3	The main generator and emergency generator working properly			
4	The steering system working properly			
5	The anti-pollution equipment working properly			



**APPENDIX: B**

**Questionnaire for students of DMU whom graduated at 2020**

Name		Major	
Class		Age	
1	Would you choose to be a seaman for your first job?		
2	Would you like to be a seaman for all your life?		
3	How many years you suppose to sailing at sea?		
4	Would you like to work on a small or medium-sized ship?		
5	Which ship you wish to work on, domestic ship or on foreign ship?		
6	What job would you choose if you did not to be a seaman? (Postgraduate, MSA, shipping company, etc.)		
7	What do you find attractive about being a seaman?		
8	What do you think is bad about being a seaman?		

## APPENDIX: C

### Questionnaire for crews on small and medium-sized ships

Ship name		Position		Years worked as a seaman	
Sex		Age		Education background	
1	Are you satisfied with your working condition?				
2	Are you satisfied with your living condition?				
3	Are you satisfied with your salary?				
4	Do you have any mental problem during sailing?				
5	Are you familiar with navigation equipment(such as AIS,GPS, ECDIS, ETC.)?				
6	How long you normally served on board?				
7	Do you feel happy with your job?				
8	Do you have any suggestions for improving the safety supervision on small and medium sized ship?				
9	Did your ship carried out on board training regularly?				