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A comparative study of marine accident investigation agencies

学位名	修士(工学)
学位授与機関	東京海洋大学
学位授与年度	2020
URL	http://id.nii.ac.jp/1342/00001986/

Master's Thesis

**A COMPARATIVE STUDY OF MARINE
ACCIDENT INVESTIGATION AGENCIES**

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Graduate School of Marine Science and Technology
Tokyo University of Marine Science and Technology
Master's course of Maritime Technology and Logistics

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Abstract

Shipping is the most important way of transporting goods between countries. With the expansion of international trade, the shipping of marine vessels is becoming more and more busy. At the same time, ship accidents will also cause a large number of people, environment, and economic losses. How to prevent accidents from happening again, countries around the world have specialized organizations to investigate accidents, such as Chinese MSA, Japanese JTSA, US NTSB, and UK MAIB. The IMO has also been established internationally to strengthen cooperation among countries, because maintaining maritime transport security requires the efforts of various countries. Different countries have different methods of investigating accidents. Learning from each other can promote the improvement of accident investigation levels.

This article collects the regulations and handling methods for the investigation of marine accidents in China, Japan, the United States, and the United Kingdom, and delves into the reasons for the establishment of independent investigation agencies in Japan, the United States, and the United Kingdom.

It draws some suggestions worth learning for MSA in China. The specific recommendations are as follows:

- 1) The independent investigation organization makes the investigation process not affected by other organizations or individuals, guarantees the objectivity of the investigation.
- 2) An independent investigation agency can satisfy the public's need for accident investigation transparency.

After that, we adopted the performance measurement methods of BSC and CAF. We compares the marine accident investigation agencies from the four perspectives of investment, learning and training, internal management, and result, then selects a lot of representative indexes of maritime investigation agencies from the four perspectives, including 6 second-level indexes and 21 third-level indexes. According to the table, the relevant data of the maritime investigation organizations of China and Japan are collected and compared. Through the comparison of this table, we can know the strengths and weaknesses of a maritime accident investigation agencies.

In the comparative study of marine accident investigation agencies, previously only stay subjective and general comparison, and the results are not supported by data and lack of scientific. Our performance measurement form turns the comparative study into an objective and quantitative research process, and the results are clearer and more convincing.

China and Japan scored 61.4 points and 62.2 points in the comparison of the table. Although the total scores of the two countries are close, there are great differences in the evaluation of many indexes. After extracting the indexes which has large difference, it is found that the differences mainly reflect five aspects: investment, transparency, international cooperation and achievement.

- 1) The investment of MSA in China is very large. The reason may be that the larger MSA in China requires more funds.
- 2) The transparency of JTSA in Japan is very high.

- 3) Japan JTSCB is also stronger than China MSA in international cooperation.
- 4) In the case of casualties, although China has more accidents and fatalities than Japan, Japan has caused too much economic losses.
- 5) In terms of achievements, China is better to Japan.

Keyword: Marine accident investigation agency, Marine Safety Administration, Japan Transport Safety Board, Performance measurement

Acronyms

MSA: Marine Safety Administration of China
MLIT: Ministry of Land, Infrastructure, Transport and Tourism
JCG: Japan Coast Guard
JTSB: Japan Transport Safety Board
JMAT: Japan Marine Accident Tribunal
USCG: United States Coast Guard
NTSB: National Transport Safety Board
FAA: Federal Aviation Administration
MCA: Maritime and Coastguard Agency
MAIB: Marine Accident Investigation Branch
IMO: International Maritime Organization
BSC: Balanced Scorecard
CAF: Common Assessment Framework

Chapter1. Introduction

This chapter introduces the research background and research methods. Previous comparative studies on maritime investigation agencies of various countries are very general, and we find out the original intention of establishing independent investigation agencies in Japan, the United States and the United Kingdom. After that, a comparative table is established to change such comparative studies from subjective to objective, and the form is used to compare the maritime investigation agencies of China and Japan.

1.1 Background

1.1.1 The purpose and significance of this study

Shipping has always been the most important mode of transportation in international trade due to its huge freight volume and cheap transportation costs. Shipping accounts for more than two-thirds of the total international trade. As the scale of world trade further expands, the demand for ships will also increase, and types of ships are also increasing. In recent years, the capacity of the global fleet has increased year by year. At the same time, maritime safety accidents will cause huge economic losses. For example, in 2019, China's direct economic losses due to maritime traffic accidents have reached 170 million yuan. Every year, maritime traffic accidents cause a lot of casualties. In fact, in many countries the crew is a very dangerous occupation, especially fishing boat crews, in addition, people are becoming more and more aware of environmental protection, and ship accidents can cause very serious pollution, such as oil tanker accidents causing a large amount of oil leakage. How to manage maritime traffic, reduce the occurrence of accidents, reduce the economic and personnel losses caused by accidents, and protect the global environment are of concern to modern society.

In order to ensure the safety of maritime shipping and reduce accidents, various countries have established accident investigation agencies, like Maritime Safety Administration of the people's Republic of China (MSA), Japan Coast Guard (JCG), Japan Transport Safety Board (JTSA), Japan Marine Accident Tribunal (JMAT), United States Coast Guard (USCG), National Transportation Safety Board (NTSB), Maritime and Coastguard Agency (MCA), Marine Accident Investigation Branch (MAIB). Many international organizations have also been established between countries, the most well-known being the International Maritime Organization (IMO). With the international trade exchanges, the maritime fleet is navigating between various countries, as a result it is not enough to rely on the efforts of one country to reduce marine accidents. All countries in the world need to deepen their understanding and learn from each other and make progress together to improve the safety level of shipping.

In recent years, the MSA of the Ministry of Transport of China communicates with other countries in accident investigations and send maritime investigators to overseas training and study, because China's investigation and research on maritime accidents are still a long way from developed countries, and the experience of foreign countries can be used in many ways. Every country should draw on the advantages of other

countries and combine with their own actual situation, design the most suitable investigation agency. Institutions in various countries have their own unique features. This article collected some information on the maritime investigation agencies in China, Japan, the United States, and the United Kingdom. We gave a detailed introduction to the maritime investigation agencies in these countries, and pointed out the United Kingdom, the United States, and Japan why those countries establish independent investigation agencies, and finally designed a performance evaluation form, for comparing the differences between China's MSA and Japan's JTSB.

1.1.2 The related research in recent years

1) Comparative study on the structure maritime investigation agencies

There are many comparative studies on the institutional structure of ship accident investigation agencies among countries. In China alone, there are many scholars and MSA employees have done comparative studies between China and other countries' investigation agencies and have provided many valuable opinions on the work of MSA in China.

Maritime Investigator Hu Xichen (2005) [Fu ying haishi diaochaguan moni diaocha peixun "Simulation investigation training for Chinese maritime investigators in UK"]⁽¹⁾ led 20 maritime investigators from all over China to the UK for a three-week maritime simulation survey training. It is proposed to first solve the shortage of Chinese maritime investigators, recruit some people with maritime experience and integrate some of the existing investigators to form a full-time maritime investigation team. Zhang Xiaodong (2009) of the Shanghai Maritime Department [Yingguo haishi yu haian jingweishu "Maritime and Coastguard Agency"]⁽²⁾ conducted a deep inspection of the British MCA organization and proposed that in addition to the development of hardware, China's marine accident investigation agencies should also reduce accidents through education and legislation. Wu Yanguo and Song Bingbing of Shandong MSA (2009) [Haishi diaochaguan fu mei moni diaocha peixun zongjie (In Chinese) "Summary of training for maritime investigation officers in the United States"]⁽³⁾ organized by the MSA of the Ministry of Transport in 2009 for a three-week training. After learning about the work of USCG and NTSB, they claimed it is necessary to establish a maritime safety accident laboratory as soon as possible, speed up the investigation preparation, strengthen the investigation of human factors and expand the team of maritime investigators. Dalian MSA Shang Dexi and Liu Peng (2012) [Zhongwai haishi diaocha duibi ji zhongguo haishi diaocha fazhang jianyi (In Chinese) "Comparison of maritime investigation between China and foreign countries"]⁽⁴⁾ conducted a survey on the maritime investigation mechanism of the United Kingdom, the United States and Japan, and proposed to strengthen the construction of the Chinese maritime investigation team and separate Administrative investigation and safety investigation, the accident investigation should be graded, and the investigation resources should be concentrated on major accidents. Li Huawen of Guangdong MSA and Liu Jingsheng of Liaoning MSA (2013) [Yingguo haishi diaocha tixi dui woguo de qishi (In Chinese) "Enlightenment from the British Maritime Investigation System"]⁽⁵⁾ through the

exchange and learning opportunities of MSA, they went to MAIB in the UK for 6 months and have a deep understanding of the British maritime investigation system. It is proposed that the existing MSA investigation in China is conducive to the comprehensive utilization of personnel and equipment, but because the competent authority has the right to determine responsibility, the discovery of the truth of the accident will be restricted under the game of multi-party interests. Guangdong MSA Huang Jie (2016) [Zhongmei liangguo haishi diaocha de bijiao ji jianyi (In Chinese) "Comparison and suggestion of maritime investigation between China and the United States "]⁽⁶⁾ went to the United States in 2016 to participate in maritime investigation training, learn the American investigation mechanism and experience, and proposed that China's maritime investigation should invite relevant stakeholders to participate in accident investigation and improve transparency and industrial credibility, and increase the disclosure of accident reports.

These studies indicate that China's MSA has always maintained communication with foreign advanced maritime investigation agencies. By sending maritime investigators to study abroad, China's MSA can keep pace with the world's leading countries, enhance the level of China's maritime investigations, and enable international maritime navigation safer. The views put forward by these scholars and maritime investigators can reflect the three outstanding problems in China's maritime investigations. First, there are insufficient maritime investigators, and fewer experienced investigators. Second, administrative investigation and safety investigation need to be separated. Third, the transparency of accident investigations needs to be further improved, and the publicity of accident investigations should be increased.

Comparative research on the institutional structure of maritime investigation agencies in the world has already begun. The United Kingdom and the United States are in a leading position in maritime investigations, so their research often focuses on the techniques of some investigations and the improvement of their own internal reflection. South Korea, China, Japan and some other countries have done a lot of research on the comparison of maritime agencies in various countries.

Dane Mellan, Mason Ruffing, Victor Zeng (2009) of NTSB "Improving the quality of accident investigation"⁽⁷⁾ in the United States compared the investigation of the Office of Marine Safety of NTSB with the investigations of other agencies, and proposed that the IMO's definition should be used for the cause factors and increase the focus on security incidents to enhance NTSB's work. Zhen Song (1999) "A comparative study of practices in China and certain countries"⁽⁸⁾ compares the maritime surveys of China, Japan, Germany, the United States and the United Kingdom. It is proposed that because China has a long coastline and a large fleet, the most important thing is not to change the existing maritime investigation agency organization, but to improve and standardize the qualification requirements for maritime investigators within MSA. The Japan Marine Accident Inquiry and Safety Investigation Association⁽⁹⁾ (2002) collected and compared the information of the maritime investigation agencies in the United Kingdom, the United States, Finland, Sweden, and the Netherlands, and proposed that the JMAT should notify the relevant flag state and establish an international affairs office in advance after the marine accident then the judgment shall be notified to IMO

and the flag state.

2) Research on the current performance measurement of maritime investigation agencies

As early as in various countries in the ancient world, there were evaluation methods for their own officials, but most of the evaluations at that time were more abstract. Since the 1850s, countries around the world have begun to pay more and more attention to the research of performance evaluation and have formulated quantitative and intuitive standards for evaluation. Whether it is a government agency, various management organizations or enterprises, they are gradually exploring the establishment of their own organizations. The organization's performance evaluation has accumulated a lot of evaluation experience in line with the actual situation of various countries and organizations.

The performance evaluation of the government in Europe and the United States can be traced back to 1910, Morris L. Cooke in the "Academic and Industrial Efficiency"⁽¹⁰⁾ research report proposed how to implement the evaluation of university work efficiency. Robert Owen introduced performance appraisal to the industrial sector in England in the 19th century. During World War II, Clarence. E. Ridley and Herbert. A. Simon⁽¹¹⁾ of the United States published "Technique of Appraising Standards". The book proposed that the assessment needs to cover several aspects (need, cost, effort, Performance, results). In Europe and the United States, it is generally believed that performance indicators have been widely used in enterprises since 1980. At that time, the common use of performance indicators was to understand the school running and profitability of European and American countries. Performance indicators have become an effective tool for the country to evaluate schools and an important means for the country to formulate education policies, allocate school funds and strengthen school management. With the strengthening of the government's cost consciousness and the public's increased awareness of the government's effectiveness, the government performance evaluation activity has become a major political activity that is flourishing. In 1993, the "Government Performance and Results Act" was formally promulgated by the US Congress. This law is a landmark legislation in the performance reform exploration practice of the United Kingdom, the United States, and Japan. Relatively mature stage. But for a period of time after that, it did not receive the attention of the US government. Until 1998, the Clinton government formulated a ten-year plan based on this law, requiring all federal agencies to use performance evaluation technology to formulate strategic plans and the budget link for the coming year.

The performance evaluation methods that have been recognized so far and have been widely used include: Balanced Scorecard (BSC), Key Performance Indicator Method (KPI), 360-degree Feedback Evaluation Method, PDCA performance evaluation method, and Common Assessment Framework (CAF) etc.

Balanced scorecard: Robert, S Kaplan⁽¹²⁾, 1996 and others have developed a comprehensive, systematic, and effective performance evaluation index system that examines corporate management achievements, namely the balanced scorecard. The balanced scorecard system designs various measurement indicators from four angles of

financial indicators, customer satisfaction, internal business processes, and innovation and learning ability, and applies them to the evaluation of management performance. Supervision on progress made in assets, enhancement of future sustainable development capabilities, and maintenance of competitive advantage.

KPI-Key Performance Indication: The KPI-Key Performance Indication is an innovation to the traditional concept of performance evaluation. It is a tactical goal of operability through the layered decomposition of the company's macro strategic goals. The quantifiable key indicators that reflect and evaluate the business status of the enterprise, through the traction of KPIs, synchronize the personal work goals and functional work goals of employees with the company's strategic development goals. The application of KPI method for assessment will help the integration of enterprise organizational structure, improve enterprise efficiency, streamline unnecessary organizations, unnecessary processes and unnecessary systems.

360-degree feedback: It is called multi-source evaluation or comprehensive evaluation, and people who are closely related to the evaluator, including the evaluator's superiors, colleagues, subordinates, etc., will make anonymous evaluation. At the same time, the evaluator also conducts self-evaluation, and then the professional will compare the self-evaluation according to the evaluation of the relevant personnel and want the evaluator to provide feedback to help the evaluator improve its ability level and work performance.

PDCA performance appraisal method: P (plan) refers to formulating plan, D (do) refers to implementation plan, C (check) refers to checking execution results to find out problems, A (action) processes the inspection results, and successful experience is promoted, To sum up the lessons of failure. The above four processes are repeated in cycles, and one cycle ends to solve some problems and achieve a spiral upward. This method focuses on the improvement of information communication and efficiency, and emphasizes communication and commitment, which is conducive to improving the effectiveness of performance evaluation.

Common Assessment Framework (CAF): In 1998, the European Public Administration wanted to establish a common European quality framework for all public sectors as a tool for self-assessment. In 1998 and 1999, the European Foundation for Quality Management, the German Speyer Institute and the European School of Administration completed the initial design of the universal evaluation framework. The framework aims to establish a common management quality assessment framework that is applicable to all public sectors and provides a simple and easy assessment tool for the public sector. CAF is easy to master, simple to operate, and very suitable for the public sector. Using this framework, you can quickly discover the advantages and areas for improvement of the organization. It is very versatile and easy to self-evaluate.

The performance appraisal of maritime institutions is also a kind of performance appraisal of government departments. To objectively evaluate the business performance of various maritime agencies and provide the basis for decision-making for the highest maritime management agencies, around 2002, China began to study and establish a performance measurement system for MSA business work. Since then, many MSA employees and university scholars have conducted research on the performance

measurement system of China's maritime investigation system and have put forward a lot of opinions and opinions to help improve the performance evaluation system of China's maritime system. Nantong MSA Shen Daoming (2002) [Jianli zhishu MSA gongzuo pingjia zhibiao tixi (In Chinese) " Establish the performance measurement system of MSA work directly under "]⁽¹³⁾ pointed out that it was necessary and feasible for China's MSA to establish an index evaluation system at that time, and put forward opinions on the selection of feature indexes and weight distribution. Index chart of main features. Nantong MSA Xiong Chunyan (2010) [Haishi xitong jixiao guanli xianzhuang ji gajjin jianyi (In China) " Present situation and improvement suggestions of maritime system performance management"]⁽¹⁴⁾ pointed out that China's maritime personnel has been increasing in recent years, and the quality of staff has also become obvious. It is believed that performance evaluation should be used more scientifically, such as: to reduce the influence of subjective factors, use the assessment results for post, salary adjustment and training. Zhang Xin (2017) "Research on Performance Evaluation System Design of Y Maritime Safety Administration"⁽¹⁵⁾ integrates two performance evaluation methods, the balanced scorecard and the common performance evaluation framework of European public organizations. According to the actual situation of Y-MSA, from "public interest, public, business functions, learning and learning The four aspects of "innovation" build an indicator system, which is used in cooperation with YMSA to solve the problems of low business level of Y-MSA, low work quality of employees, low utilization rate of financial funds, and low enthusiasm of cadres. Wang Xiaoyan (2018) of the Beihai Navigation Support Center [Wanshan haishi xitong shiye danwei jixiao kaohe de jianyi (In Chinese) "Suggestions for improving the performance measurement of maritime investigation system"]⁽¹⁶⁾ believes that the current MSA performance evaluation has problems such as the difficulty of quantifying the evaluation indicators and the low application of the evaluation results. As a result, deficiencies in work are improved

In European and American countries, maritime agencies belong to the state's administrative agencies. Starting personnel are managed in accordance with national public officials, and performance evaluations are also conducted in accordance with the relevant national evaluation system. NTSB in the United States has always used an evaluation system to manage the implementation of their strategies, promote active management and staff participation throughout the organization, and help NTSB achieve its goals.⁽⁹⁾ By establishing an assessment system, the UK evaluates every person on an annual basis, and finally conducts a general evaluation. According to the advantages and disadvantages, rewards and ups and downs are implemented to fully mobilize the enthusiasm of the staff, improve the scientific of government administration, and enhance the government. Integrity and efficacy.

1.2 Research of this article

1.2.1 Main research content

The first half of the paper is about the basic information about the maritime investigation agencies in China, Japan, the United States and the United Kingdom and the reasons for their establishment. Regarding the information collection of maritime

investigation agencies in various countries, the author consults a large number of documents (including the websites of various countries, introduction materials, articles published by internal employees, and papers written by scholars) to contact maritime organizations of various countries (to the British MAIB and the US NTSB E-mail consultation, application for information disclosure to China MSA through official channels), field visits to relevant staff (visit Japan's JTSB, face-to-face consultation with some senior Chinese maritime investigators). Although the author's available resources are limited, we try our best to contact all parties to ensure the accuracy and completeness of the information. From the aspects of internal organizational structure, system regulations, investigation procedures, etc., the maritime investigation organizations of China, Japan, the United States, and the United Kingdom are aggregated to provide information support for comparative studies of relevant maritime investigation organizations. Afterwards, the author learned that IMO, in order to reduce the probability of recurrence of the accident, proposed that each country should establish an independent maritime investigation agency to investigate the accident and completely separate the safety investigation from other forms of investigation. For the British MAIB and the US NTSB, it has long been a maritime investigation organization that meets the IMO requirements. The Japanese JTSB also added an investigation of ship accidents to the original railway aviation accident investigation organization, so the author further investigated that before the IMO made the request, the initial reasons for the establishment of the British MAIB, the US NTSB, and the Japan JTSB, then were to find something worth learning from these reasons.

The second half of the paper introduces an evaluation form designed by the author to compare the maritime investigation agencies of various countries. Using this form, the original general comparison can be turned into a specific quantitative comparison. After having a relatively rich understanding of the maritime survey organizations in China, Japan, the United States and the United Kingdom, the author considers to design a performance measurement form that includes 4 first-level indicators, 7 second-level indicators, and 31 third-level indicators. By using that form we make a quantitative comparison about maritime agencies of China and Japan, and the advantages and disadvantages of the maritime investigations in China and Japan are provided to provide research directions for the future development of the maritime investigations of the two countries. The data used in the table, China's data comes from public information such as news and statistical data officially released by China's MSA. Some data such as MSA's 2019 budget and social satisfaction are provided by the author through the official method. Reports and statistics from the JTSB and JCG. Some human resource information and social impacts related to the JTSB are provided by the members of the JTSB. Initially, we planned to collect data from four countries and compare the four countries together. However, due to the impact of the global pneumonia epidemic in 2020, school suspensions and some unit shutdowns, the scope of the research had to be placed on China and Japan. After that, we hope to have the opportunity to continue to improve the performance measurement form, including the allocation of weights, the selection of indexes, the improvement of calculation methods, and the addition of comparison countries. We also hope that others can participate in the continued

development of the study.

1.2.2 The innovation of this article

After looking up the information of maritime investigation agencies of various countries and reading a large number of comparative literatures on maritime investigation agencies, the author found that most scholars simply compare several agencies together to see what other countries own but they do not have in their countries. And then put forward suggestions to establish the same or to change the existing to be the same as other country, many views are not objective. The author believes that everyone should really study in a good place, but they should not blindly think that other countries are good, and there is no need to become the same as other countries. In addition, most of the existing articles have not considered why the United Kingdom established MAIB, the United States established NTSB, and Japan established JTSB. The author's view is that these organizations were established to solve problems, so we explored the reasons for the establishment of these organizations can find the problems they faced at the time, which is very helpful for us to reflect on ourselves. If there are similar problems, we need to learn how to solve them. If the same problems do not exist, we do not have to waste resources to follow other countries. Therefore, the author went deep into the reasons for the establishment of NTSB, MAIB, and JTSB, hoping to be able to treat the maritime investigation organizations of various countries in a rational and objective manner. To study why the maritime investigation agencies of various countries were established, which has not been done before

Then came a method to quantitatively and objectively compare the maritime investigation agencies of various countries. The existing knowledge of performance measurement is used to compare maritime investigation agencies of various countries. The previous comparative studies of maritime investigation agencies of various countries mostly stayed on the framework of the organization, the investigation process, and the cultivation of talents. In fact, these are not specific enough, but they are compared with each other in appearance, and the conclusions and suggestions are often drawn. It is based on the author's subjective feelings and judgments. It is precisely because these suggestions lack data that the subjectivity is very strong. Both can be said that these suggestions will greatly reduce the occurrence of accidents, and some people will say that this will only waste resources. So many suggestions have not been adopted by the relevant maritime investigation agencies. The author wants to find a way to compare the existing data of different countries' IMO and change the comparative study of IMO from subjective judgment to the comparison of factual data. Through these real data, we can reflect where a country's maritime investigation organization is strong, where it is poor, and after we understand what's good and what's bad, we can see why other countries do well in their poor places, and finally learn from each other's strengths to make up for their weaknesses, which is the right way to improve a maritime investigation organization. The performance measurement form proposed in this paper is designed after combining the two performance measurement methods of BSC and CAF. The BSC evaluates a company from four aspects: financial perspective, customer perspective, internal business process, learning and growth. The evaluation indicators

come from the organization strategy, which transforms the organization's mission and strategy into tangible goals and measurement indicators. Compared with other traditional assessment methods, the system not only focuses on performance management and financial aspects, but also pays attention to the future development of an enterprise. However, the BSC is still mainly aimed at enterprises and companies. For government departments such as maritime investigation organizations that do not aim to make profits, they also need to learn from the CAF. In the CAF theory, performance, customer, employee, and social outcome elements are realized through internal management such as leadership, policy or strategy, human resources, partners, and resources, and change management.

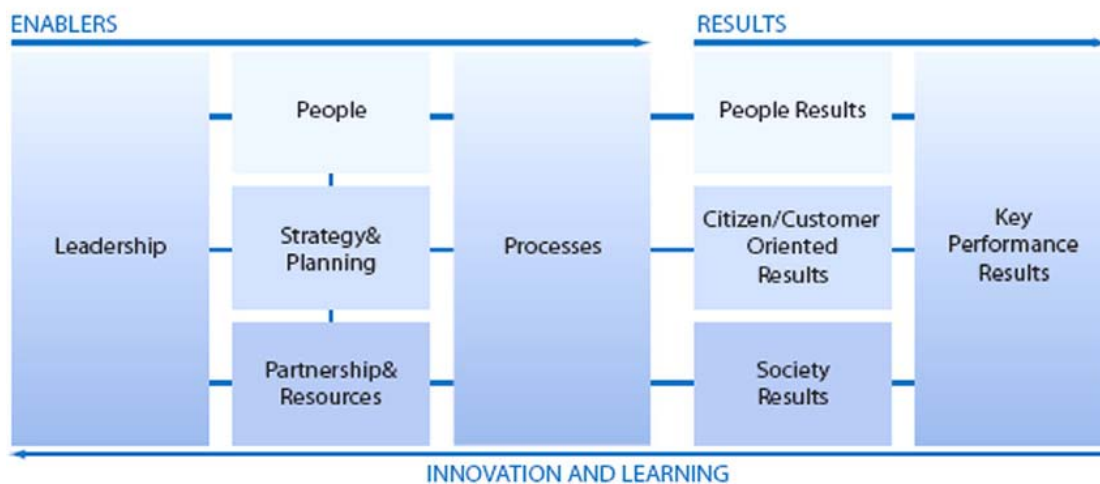


Figure 1 The CAF Model

In the end, the performance measurement form designed in this paper uses the four major aspects of finance, internal management, learning and training, and results (customers) given by the BSC on the overall framework. In the selection of evaluation indicators, more consideration is drawn from the CAF, focusing on the use of data that reflects social impact.

Chapter2. Introduction of maritime investigation institutions of various countries

This chapter introduces the maritime accident investigation of IMO, China, Japan, USA and UK in detail. The content includes the organization of the investigation, the process of the investigation, the relevant provisions of the investigation and so on.

2.1 Information about IMO

2.1.1 Introduction to IMO

In 1948, the United Nations adopted the "Intergovernmental Maritime Consultative Organization IMCO" and the first conference was held in 1949. IMCO was established in 1982, it was renamed the International Maritime Organization IMO. IMO is a specialized agency of the United Nations responsible for the safety of maritime navigation and the prevention of marine pollution from ships. It is headquartered in London, United Kingdom. The main purpose of the organization is to provide shipping technical cooperation opportunities between governments engaged in international trade, encourage countries to promote maritime safety, improve ship navigation efficiency, prevent and control ships to marine pollution to adopt the highest standard of uniform, deal with relevant Legal Issues.

When the IMO was first established, their main goal was to ensure the safety of the sea. By the 1967 Torrey Canyon accident, 120,000 tons of oil had flowed into the sea, causing pollution. In the following years, IMO started to prevent pollution caused by tankers and the discharge of wastewater from the engine room of ships. IMO has also established a system to provide compensation to those who suffer economic losses from pollution.

The rescue system was established in 1970, and the Global Maritime Disaster and Safety System (GMDSS) began to be used in 1988. By 1999, GMDSS has been fully used. For ships that have an accident at sea, the system can automatically send information to the sea Ship safety is greatly guaranteed.

Afterwards, people began to pay attention to the human factors in ships. The 1998 International Safety Management Regulations began to be implemented in all types of ships. The 1997 STCW Treaty entered into force. The right to implement the treaty.

There are currently 174 members of the International Maritime Organization. The governing body of the International Maritime Organization is the Assembly, which is composed of all member states and convenes every two years to discuss the budget of the next year and the technical resolutions and recommendations made by the subsidiary bodies in the previous two years.

There are 40 members of the International Maritime Organization Council, which are divided into three categories: A, B and C. Class A directors are 10 major shipping countries, Class B directors are the 10 countries with the largest maritime trade volume, and Class C directors are 20 regional representatives. The Council enables the executive and important decision-making bodies of the International Maritime Organization to

hold a conference every two years to re-elect the Council and the President.

2.1.2 Internal organization of IMO

The International Maritime Organization consists of the Assembly, the Council and the five main committees: Maritime Safety Committee (MSC), The Marine Environment Protection Committee (MEPC), Legal Committee, Technical Cooperation Committee, Facilitation Committee. There are also small subsidiary committees to support the main committees.⁽¹⁷⁾

Assembly: It is the highest administrative organ of the International Maritime Organization. It is composed of member states and meets every two years or according to special needs. The main responsibilities are to approve the work plan, audit the financial budget, and determine the financial arrangements and elect the Council.

Council: The term of office is two years and is elected by the Assembly after each meeting. It is the executive organ of the International Maritime Organization and is responsible to the Assembly under the Assembly. During the closing of the conference, the council is responsible for all the responsibilities of the conference, except for providing advice to the government on maritime safety and marine pollution.

Other functions of the council are:

- a) coordinate the activities of the organs of the Organization;
- b) consider the draft work program and budget estimates of the Organization and submit them to the Assembly;
- c) receive reports and proposals of the Committees and other organs and submit them to the Assembly and Member States, with comments and recommendations as appropriate.
- d) appoint the Secretary-General, subject to the approval of the Assembly;
- e) enter into agreements or arrangements concerning the relationship of the organization with other organizations, subject to approval by the Assembly.

Maritime Safety Committee (MSC):

The Maritime Safety Committee is the highest technical department of the International Maritime Organization and is composed of all Member States. The functions of the maritime safety organization are: within the jurisdiction of the International Maritime Organization, to assist in the improvement of navigation, vessel structure and equipment, staffing, collision avoidance rules, dangerous goods handling, maritime safety equipment and equipment, hydrological information, nautical records, marine accident investigation, Rescue and other matters that directly affect maritime safety. In addition, it is required to perform the tasks conferred by the IMO Convention or within its scope of work assigned by any international organization to the Maritime Safety Committee. It is also responsible for supporting the General Assembly in drafting and issuing safety recommendations and guidelines.

Marine Environment Protection Committee:

It is composed of all Member States and has the right to consider any matters related to the prevention and control of ship pollution within the organization. The Marine

Environmental Protection Committee adopts and revises the Convention to achieve management.

Subsidiary committee:

Maritime Safety Committee and the Marine Environment Protection Committee cooperate in their work through many subsidiary committees, which are also open to all Member States. The subsidiary committee includes: Sub-Committee on Human Element, Training and Watchkeeping (HTW), Sub-Committee on Implementation of IMO Instruments (III), Sub-Committee on Navigation, Communications and Search and Rescue (NCSR), Sub-Committee on Pollution Prevention and Response (PPR), Sub-Committee on Ship Design and Construction (SDC), Sub-Committee on Ship Systems and Equipment (SSE), Sub-Committee on Carriage of Cargoes and Containers (CCC).

Legal Committee:

It is responsible for handling all legal issues within the scope of the International Maritime Organization and is composed of all member states. It was established in 1967 as a subsidiary body to deal with some legal issues in marine accidents. The Legal Committee is also responsible for tasks assigned by other international organizations and tasks undertaken by the International Maritime Organization.

Technical Cooperation Committee:

Responsible for the implementation of technical cooperation projects within the scope of the International Maritime Organization. Composed of all Member States, it was established in 1969 as a subsidiary body of the Council.

Facilitation Committee:

It was established as a subsidiary organization of the Council in 1972 and became a complete committee in 2008. It is composed of all Member States and is responsible for the work of IMO and related issues related to the convenience of international maritime traffic, and aims to eliminate unnecessary procedures and red tape in international shipping.

Secretariat:

The Maritime Secretariat is composed of the Secretary General and approximately 300 international personnel based in London.

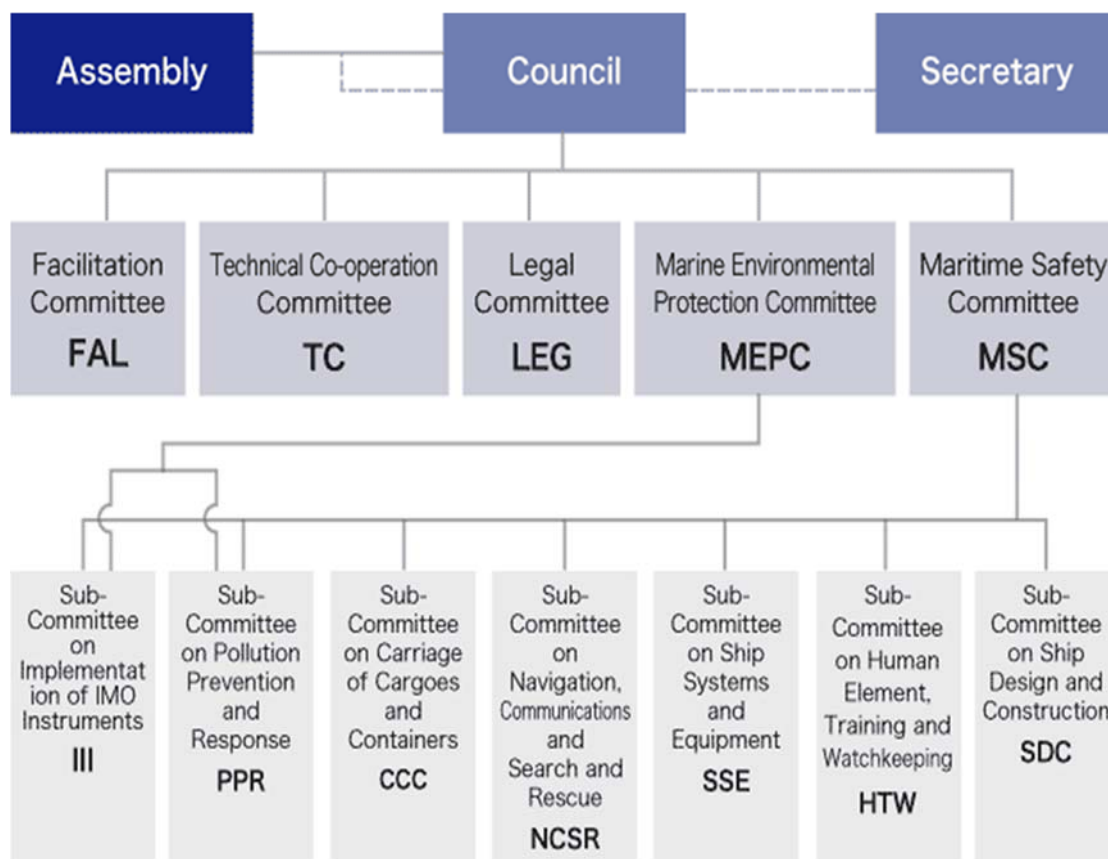


Figure 2 Chart of IMO Organization

2.1.3 Some important IMO conventions

Safety of Life at Sea (SOLAS) : It is a unified principle and related rules jointly formulated by all Member States, aimed at enhancing maritime human safety. The Convention applies to ships engaged in international voyages, and provides for the inspection of ships, the inspection of life-saving equipment of cargo ships, the inspection of radio equipment of cargo ships, the inspection of hull machinery and equipment, and inspection certificates.

International Convention for the Prevention of Pollution from Ships (MARPOL): Member States are aware that ships deliberately and deliberately discharge oil and other harmful substances is a serious environmental pollution. The Convention aims to eliminate the intentional discharge of oil and other harmful substances to pollute the environment. The convention includes six phases: the rules for preventing oil pollution, the rules for controlling the pollution of toxic liquid substances in bulk, the rules for preventing the pollution of harmful substances in marine packaging, the rules for preventing the pollution of domestic sewage from ships, the rules for preventing the pollution of garbage by ships, and the rules for preventing air pollution from ships.

Standards of Training, Certification and Watchkeeping for Seafarers (STCW): Mainly used to control the professional and technical qualities and duty behavior of seafarers. The implementation of the Convention promotes the improvement of the quality of seafarers of Member States, guarantees the safety of life and property at sea

and protects the marine environment on a global scale, and effectively controls the impact of human factors on marine accidents Influence and play a positive role. The Convention highlights the importance of the human factor in navigational safety, and stipulates the internationally acceptable minimum standards for crew training, certification and duty.

Load Lines (LL): To guarantee the safety of life and property at sea, the International Maritime Organization formulated uniform principles and standards on the weight limits of ships on international navigation in 1966.

2.1.4 Some regulations of IMO concerning the investigation of marine accidents

At the 84th session of the Maritime Safety Committee of the International Maritime Organization, on May 16, 2008, resolution MSC.255(84) adopted the CODE OF THE INTERNATIONAL STANDARDS AND RECOMMENDED PRACTICES FOR A SAFETY INVESTIGATION INTO A MARINE CASUALTY OR MARINE INCIDENT (CASUALTY INVESTIGATION CODE). The first and second parts of the CODE are mandatory provisions and entered into force on January 1, 2010. Part 1 introduces the purpose of passing the rule and the definition of some terms. Part 2 establishes the criteria for the investigation. The third part of the CODE is the International Maritime Organization's recommendations for specific investigation methods for marine accident investigations.

In the first part, the aim of safety investigation is stated: *Marine safety investigation does not seek to apportion blame or determine liability. A marine safety investigation should be separate from, and independent of, any other form investigations (Casualty Investigation Code 2008).*⁽¹⁸⁾

In the second part, Code defines some terms of safety investigation, for example: *a very serious casualty involving the total loss of the ship or a death or severe damage to the environment (Casualty Investigation Code 2008).*⁽¹⁸⁾

Marine accidents refer to events that are directly related to the operation of the ship and cause the following conditions:

- 1) the death of, or serious injury to, a person.
- 2) the loss of a person from a ship.
- 3) the loss, presumed loss or abandonment of a ship
- 4) material damage to a ship
- 5) the stranding or disabling of a ship, or the involvement of a ship in a collision.
- 6) material damage to marine infrastructure external to a ship, that could seriously endanger the safety of the ship, another ship or an individual; or
- 7) severe damage to the environment, or the potential for severe damage to the environment, brought about by the damage of a ship or ships.

Maritime incidents refer to incidents other than marine accidents that are directly related to the operation of the ship or that would otherwise endanger the ship, its occupants, or any other person or environment if not corrected, but marine incidents do not include intent to harm ships and individuals Or intentional actions and omissions of the environment.

The investigation must ensure that the investigator conducting the maritime safety

investigation is impartial and objective, and the maritime safety investigation must be able to be carried out without the instruction and interference of any person or organization that may affect the results of the investigation.

Very serious marine accidents refer to marine accidents involving total damage to the ship or death or serious environmental damage. It is required to conduct a safety investigation for each very serious marine accident and submit the investigation report of each very serious marine accident to the International Maritime Organization. When a maritime safety investigation is conducted on a non-very serious maritime accident or maritime incident, and a maritime safety investigation report is made, and the information contained therein can prevent future maritime accident or maritime incident or reduce its severity, the final text Need to submit to the International Maritime Organization.

The investigation report should include the following:

- 1) A summary of the basic facts of the marine accident or marine incident, and whether it caused death, injury or pollution.
- 2) The status of the ship country, ship owner, operator, company and classification society listed in the safety management certificate.
- 3) Any relevant details about the ship's scale and engine, as well as the crew's statement, working procedures and other matters such as working hours on board.
- 4) Detailed statement of marine accident or marine incident.
- 5) Analysis and comment on the triggering factors, including any mechanical factors, human factors and organizational factors.
- 6) Discussion of the results of the maritime safety investigation, including confirmation of safety issues, and conclusions of the maritime safety investigation
- 7) Where applicable, recommendations aimed at preventing future marine accidents and incidents.

2.2 Organizations of marine accident investigation in China

2.2.1 History

(1) Port supervision and management model (1949-1985)

After the establishment of China in 1949, the Central Government established the Navigation Administration Office in the General Administration of Maritime Transport of the Ministry of Communications to be responsible for the supervision and management of maritime traffic safety. The supervisory authority, under the name of "People's Republic of China Port Supervision", uniformly exercises the functions of marine traffic safety supervision and management. After the reform and opening, various port administration departments that were hit by the Cultural Revolution gradually resumed their safety inspections. In the early 1980s, the Water Safety Supervision Bureau was set up in the Ministry of Communications, the port supervision was set up in major coastal ports, the Yangtze River Navigation Administration Bureau and Heilongjiang Navigation Administration Bureau were established in the Yangtze

River and Heilongjiang, and the provinces, autonomous regions and municipalities directly under the Central Government Or the Shipping Bureau of the Ministry of Communications may set up a port and shipping supervision office or a vehicle and ship supervision office, and set up a port and shipping supervision or vehicle and ship supervision at major ports.

(2) The "Marine Supervision Bureau" management mode (1985-1998)

In 1985, the State Council made a decision to reform the water transportation safety supervision and management system. According to the principle of separation of government and enterprise, A maritime safety supervision and management system in which the central and local divisions of labor are responsible has been established, 14 maritime safety supervision bureaus have been established, and a dual leadership system has been implemented between the Ministry of Communications and the local city government, with the Ministry of Communications as the leading system. The water safety supervision of the Yangtze River, Pearl River and Heilongjiang River is under the unified responsibility of the port and shipping supervision agencies established by the Ministry of Communications; other inland river waters are the responsibility of the port and shipping supervision agencies established by the communications departments of the provinces, autonomous regions and municipalities directly under the Central Government. According to statistics, in addition to Beijing and Tibet, 28 provinces, autonomous regions, and municipalities directly under the Central Government have established water safety supervision agencies, basically forming a water transportation safety layout covering national waters. In 1989, the port management system reform with the separation of government and enterprise as the core was implemented. The central and local port authorities were independent from the port authority. The management system had a major breakthrough. The Safety Supervision Bureau and Ship Supervision were established in the Ministry of Communications. Bureau, the coastal port established the Maritime Safety Supervision Bureau to independently perform its functions, and the local transportation authority has also set up port and shipping supervision and ship inspection agencies accordingly.

(3) "MSA" management mode stage (1998-present)

In 1998, with the approval of the State Council, the People's Republic of China Port Authority (Safety Supervision Bureau of the Ministry of Communications) and the Ship Inspection Bureau of the People's Republic of China (Ship Inspection Bureau of the Ministry of Communications) merged to form the MSA of the People's Republic of China (MSA), which is directly under the Ministry of Communications. Institutions, the coastal waters (including islands) and ports in China, open waters and important inter-provincial navigable inland river trunk lines and ports are classified as centrally managed waters, and the maritime management agency directly under the Ministry of Communications sets up vertical management; Waters such as inland rivers, lakes, and reservoirs are zoned as locally managed waters. The people's governments of provinces, autonomous regions, and municipalities directly under the Central Government establish local maritime management agencies to implement the management. There are 18 direct maritime agencies in coastal areas and major inter-provincial inland river routes and important ports. While setting up and establishing directly under the

maritime agency, the Ministry of Communications also regulated the names of local management water management agencies. At present, a total of 27 provinces (autonomous regions and municipalities) and a construction corps have established local maritime agencies in the Ministry of Communications. With the establishment of the MSA of the Ministry of Transport and the completion of the reform of the national maritime safety supervision and management system, the maritime safety supervision and management system has covered national waters.

2.2.2 Structure of MSA

The MSA of the People's Republic of China is an administrative agency directly under the Ministry of Transport and implements a vertical management system. It performs administrative management and law enforcement duties such as supervision and management of water traffic safety, inspection and registration of ships and related water facilities, prevention of ship pollution and navigational security. There are 15 direct MSA and 3 maritime support centers in various regions of the country: Shanghai MSA, Tianjin MSA, Liaoning MSA, Hebei MSA, Shandong MSA, Zhejiang MSA, Fujian MSA, Guangdong MSA, Guangxi MSA, Hainan MSA, Yangtze River MSA, Jiangsu MSA, MSA in Heilongjiang, MSA in Shenzhen, MSA in Lianyungang, Beihai Navigation Support Center, Donghai Navigation Support Center, South China Sea Navigation Support Center.



Figure 3 15 Direct MSA and 3 Maritime Support Centers

In addition to the MSA directly under the Ministry of Transport, local MSAs were established in 27 provinces, municipalities, autonomous regions, and one production and construction corps in China. Most local MSAs are managed by the local

transportation department.

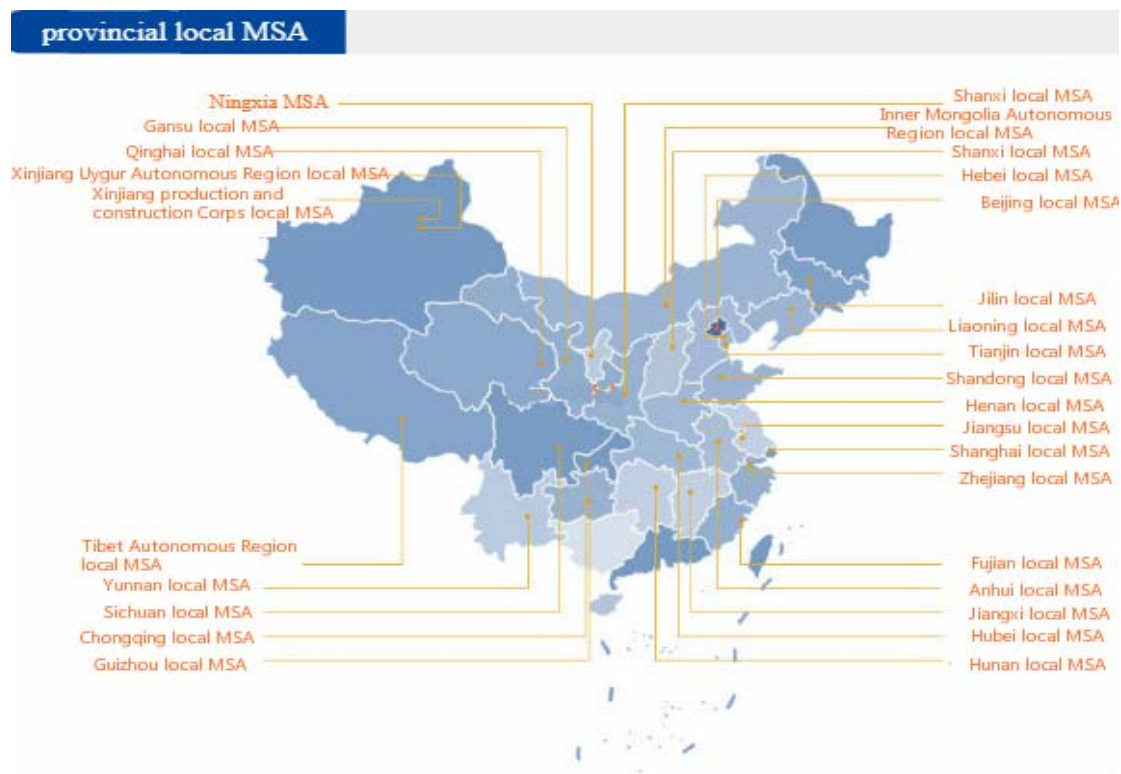


Figure 4 27 Local MSA

MSA internal departments:⁽¹⁹⁾

MSA Office: Responsible for organizing and coordinating the daily affairs of the organs of the Bureau, responsible for the management of secretaries, information, files, letters and visits, confidentiality and administrative affairs of the organs.

Policy and Law Office: Organizing the formulation of maritime policies and comprehensive the law of the sea, undertaking maritime legislation planning and coordination; organizing the formulation of technical regulations and rules for the legal inspection of ships and offshore installations; managing the legal work of the national maritime system; guiding the maritime system in accordance with the law, Organize the implementation of law enforcement supervision and inspection; centrally manage the interpretation of maritime regulations.

General Navigation Management Department: manage the navigation order and navigation environment; organize the implementation of water patrol law enforcement and traffic control, maintain water traffic order; be responsible for the planning and management of waterways such as waterways, restricted navigation areas, traffic control areas, anchorages and safe operation areas; Obstruction review and supervision and inspection of water and underwater construction operations; responsible for management of salvage of sunken ships and removal of obstacles; removal of navigation warnings; management of ship reporting system.

Ship Supervision Department: Responsible for ship registration and airworthiness management; manage ship safety inspections and be responsible for the cooperation of port state supervision and cooperation in the Asia-Pacific region; approve the temporary entry of foreign national ships into China's non-open waters, undertake the relevant approval work for port opening to the outside world; Management of relevant procedures in the port; responsible for ship security and anti-piracy work; handling the work of the China Convenient Transportation Committee Office.

Hazardous pipe and anti-pollution department: Responsible for the supervision and management of pollution caused by the safe transportation of ships; responsible for the safety supervision and management of ships carrying dangerous goods and other goods; responsible for container supervision and inspection and management of dangerous goods containers; Safety supervision and management work; supervise and manage the construction of ship oil spill pollution emergency system; participate in the investigation and handling of ship pollution accidents; undertake the work of the ship oil pollution compensation fund committee secretariat.

Ship Inspection and Management Office: manages the inspection and technical supervision of ships, water facilities, shipping cargo containers, marine products, etc.; supervises and administers the statutory inspection and certification of Chinese ships, offshore facilities and foreign national offshore facilities operating in China's coastal areas Work; verify the qualifications of the ship inspection agency and the surveyor and implement supervision and management; undertake the determination of inspection authorization matters; be responsible for the implementation of supervision and management of the establishment of representative offices in China by foreign ship inspection organizations.

Ship Technical Standards Division: undertake the specific work of formulating fishing vessel inspection standards.

Crew Management Office: Responsible for crew management. Organize and formulate the eligibility criteria for crew, pilot and magnetic compass correction personnel; manage the training, examination and certification of crew, pilot and magnetic compass correction personnel; verify the qualifications of the training organizations for crew, pilot and magnetic compass correction personnel and manage Its quality system review; responsible for the management of seafarers' certificates; responsible for the management of the ship's minimum safety manning; responsible for the management of seafarer development and seafarer's professional security, seafarer labor market, etc.; responsible for the qualification approval and supervision of seafarer service organizations and seafarer dispatched organizations .

Safety Management Department: Responsible for the comprehensive management of water transportation safety; comprehensively coordinate and guide the safety production of water transportation; responsible for the supervision and management of

the safety and pollution prevention of shipping companies; responsible for the management of the audit of shipping companies and ship safety management systems; manage and guide the water transportation Investigation, handling, statistical analysis and closing of accidents and pollution accidents; specifically organizing or participating in the investigation and handling of major mega water traffic accidents and pollution accidents; responsible for the reporting and safety investigation of foreign-related marine accidents or incidents; taking the lead in carrying out the whole country Analysis and assessment of the safety situation of water traffic.

Navigational Security Management Office: manage coastal beacons and radio navigation; take charge of seaports port channel surveying and mapping management; manage maritime safety communications; centrally manage traffic system surveying and mapping; organize compilation, publication, and correction of relevant navigation books and materials in China's sea area ; Organizing and implementing the operation and maintenance of navigation support facilities such as navigation marks and maritime safety communications; responsible for the related affairs of International Search and Rescue Satellite Organization; guiding the relevant business work of various navigation support centers.

Tax collection and inspection department: responsible for the daily collection and management of non-tax revenues such as ship port charges, port construction fees, ship inspection fees and ship oil pollution damage compensation funds; drafting management measures for the collection of maritime non-tax revenues, and responsible for daily supervision and inspection; Undertake the collection and management of entrusted items such as vehicle and vessel use tax; undertake the daily management and statistical analysis of the maritime system fee collection bills.

2.2.3 Maritime Safety Investigation and Water Traffic Accident Investigation

After the 2010 IMO CODE was included in the first and second parts of the SOLAS treaty, the CODE emphasized that the purpose of the investigation of marine accidents is not accountability and punishment and separated from other administrative, civil, criminal and other investigations, China refers to investigations carried out in accordance with this rule as "maritime safety investigations", while administrative investigations carried out in accordance with Chinese laws and regulations on water traffic accidents are referred to as "water traffic accident investigations".⁽²⁰⁾

The maritime safety investigation does not exclude, interfere with, or replace the water traffic accident investigation. It is carried out in parallel with the water traffic accident investigation. The maritime safety investigation can obtain evidence of the water traffic accident investigation. Any information of the maritime safety investigation is not provided to the administrative, acting, civil investigation or judicial organs or departments.

1) Maritime Safety Investigation

Conduct maritime safety investigations on "very serious accidents" as stipulated in

the IMO CODE of Chinese ships on international voyages, foreign vessels on waters under Chinese jurisdiction, and other accidents that can provide lessons for the shipping industry. China MSA has a full-time maritime safety investigation department (i.e. safety management office) to perform the accident investigation duties required by the IMO accident investigation rules. The MSA of the Ministry of Transport organized training for safety investigators and selected and appointed qualified maritime safety investigators for maritime safety investigations. The maritime safety investigators are divided into three levels: chief investigator, chief investigator and deputy chief investigator. The chief investigator and the deputy chief investigator have one or more of the following technical categories: navigation and collision avoidance rules, causes of marine pollution, flag State certificate of competence, interview techniques, evidence collection and evaluation of human factors.

At present, the Ministry of Transport MSA has actively fulfilled the IMO investigation requirements in terms of investigation forms and investigators through the establishment of maritime safety investigation departments and the establishment of a team of safety investigation officers. But in fact, the maritime safety investigation department (safety management office) within the MSA of the Ministry of Transport is not a full-time safety investigation, but also performs the national waterborne traffic accident administrative investigation; while there is no full-time safety investigation officer in China Safety investigators also assume the responsibility of administrative investigations. There is no obvious classification management mechanism for maritime administrative investigators and safety investigators.

2) Water Traffic Accident Investigation

Water traffic accident investigation is a series of activities carried out in accordance with the law in order to ascertain the cause, process, and extent and scope of damage, determine the nature of the accident, and determine the responsibility of the parties to the accident. . Use surveys, photographs, inquiries, appraisals, inspections and other means to collect evidence, analyze all factors related to the accident, including human factors, and study the details of water traffic accidents. After clarifying the responsibilities of the personnel involved in the accident, the maritime authority will put forward suggestions to strengthen safety management, punish offenders, announce the results of the investigation, and mediate civil disputes caused by the accident.

According to the "Shuishang jiaotong shigu diaocha chuli chengxu zhinan (In Chinese) Guidelines for investigation procedures of water traffic accidents " issued by MSA in 2001, MSA in China investigates and handles water traffic accidents according to the following procedure⁽²¹⁾:

- 1) The maritime agency and its investigating officer pass the "Water Traffic Accident Report" submitted by the shipowner concerned, the records of the ship traffic management center, the reports of the maritime alarm platform and search and rescue center, the notice of the local government, and the news media reports Learned that a ship accident occurred.
- 2) After receiving the report of the water traffic accident, the maritime authority shall report level by level and, if the ship's safety conditions permit, conduct

an investigation on the ship in question. For those who are about to arrive at this port, they will be notified after arriving. If they are sailing to other Chinese ports, they will be allowed to go to the target port as appropriate, and they will be sent to investigate or entrust the destination maritime authority to investigate. Sailing to the designated place for investigation; ships anchored or moored are waiting for investigation in situ. The maritime authority with jurisdiction shall establish an investigation team and appoint the investigation team leader.

- 3) Before the investigation is officially started, the investigator should first understand the basic situation such as the location, time, type, damage caused, and type and nationality of the ship involved, and decide the content and steps of collecting evidence. For general-level accidents, the number of maritime investigators of the investigation team shall not exceed 7; the number of maritime investigation officers of the investigation team of major accidents shall not exceed 9; The maritime investigator of a major accident investigation team of more than 30 persons shall generally not exceed 20 persons.
- 4) Collect the accident data, ship's basic information, ship's record certificate, navigation data, accident related personnel information, weather and sea conditions, accident occurrence, assistance and pollution removal as much as possible.
- 5) If the investigator believes that management or other problems may have been discovered during the investigation, an in-depth understanding of the accident is required. For example, whether the ship operator's operation and management of the ship, and the maritime authority's supervision and management of the maritime system have violated the provisions or have insufficient work. If a party involved in an accident commits illegal deductions in accordance with the standard, the crew's certificate shall be detained for the crew deducting up to 15 points in a cycle.
- 6) Mediation of civil disputes caused by traffic accidents.
- 7) Verification of losses, including direct and indirect economic losses, casualties, loss of ships and facilities, destruction of the ecological environment, and rescue, salvage, cleanup, and disposal costs resulting from accidents.
- 8) After completing the cause analysis and responsibility determination, compile a water traffic accident investigation report as required, and report to the general accident level and above. Finally, it puts forward safety suggestions to prevent similar accidents.

In order to strengthen the level of maritime investigations in China, fully manage and allocate human resources for maritime investigations, improve investigation capabilities and ensure the quality of investigator, the Ministry of Transport of China began standardizing unified supervision of the training, assessment and registration of investigators in January 2009 , formulate training plans, exam outlines, and issue maritime investigator certificates. The maritime investigator is divided into three levels: senior maritime investigator, intermediate maritime investigator and assistant maritime

investigator. Each level has two types of foreign-related and non-foreign-related.

Assistant Maritime Investigator:

- (1) Hold a maritime administrative law enforcement certificate
- (2) College degree or above in maritime related majors
- (3) Participated in maritime work for more than three years and engaged in the investigation and handling of water traffic accidents for more than one year.
- (4) Passed the appropriate training by the assistant maritime investigator and passed the examination
- (5) After annual assessment, registration is valid

Intermediate Maritime Investigator:

- (1) Hold a maritime administrative law enforcement certificate
- (2) With a college degree or above in the relevant maritime major
- (3) Participate in maritime work for more than 8 years, have the status of assistant maritime investigator for more than 5 years, or have been engaged in the investigation and handling of water traffic accidents and the qualifications of senior crew on board have accumulated more than 10 years, or have engaged in the investigation of water accidents for more than 10 years
- (4) Pass the Intermediate Maritime Investigator Qualification Training Exam
- (5) After annual assessment, registration is valid

Senior Maritime Investigator:

- (1) Hold a maritime administrative law enforcement certificate
- (2) College degree or above in maritime related majors
- (3) Participate in maritime work for more than 10 years, have an intermediate maritime investigator qualification for more than 5 years, or have been engaged in the investigation and handling of water traffic accidents and the qualifications of senior crew on board have accumulated more than 15 years, or have engaged in the investigation and handling of water traffic accidents for more than 15 years ;
- (4) Qualified training by senior maritime investigator, passed the examination
- (5) After annual assessment, registration is valid

The foreign-related maritime investigator must be at least Chinese college English test-4 or equivalent; or equivalent in other foreign languages. Senior maritime investigators can organize or preside over all levels of marine traffic accident investigations. Intermediate maritime investigators may organize or preside over the investigation of water traffic accidents of major accidents and below; auxiliary maritime investigators may organize or preside over the investigation of small traffic accidents. Personnel holding a maritime investigator certificate can participate in the investigation of accidents at all levels. Foreign-related accidents require senior maritime investigators or intermediate maritime investigator organizations with foreign qualifications.

2.2.4 Some definitions of maritime accident in China

In order to regulate the statistics and reporting of water traffic accidents, China published the "Shuishang jiaotong shigu tongji banfa (In Chinese) Measures for

statistics of water traffic accidents" in 2002. However, with the improvement of other domestic laws and regulations, the 2002 version of the " Measures for statistics of water traffic accidents " found that the water traffic accident statistics: the scope is incomplete, the classification standards for water traffic accidents are not synchronized, the types of water traffic accident statistics are incomplete, and the relevant technical regulations are unclear and need to be revised. So in 2014, the original " Measures for statistics of water traffic accidents " was revised in 2015.

According to the statistical measures, ship accidents are classified according to factors such as casualties, direct economic loss, or water environment pollution:⁽²¹⁾

- (1) Special serious accidents: those that cause more than 30 deaths (including disappearances), or more than 100 serious injuries, or ship spills of more than 1,000 tons that cause water pollution, or more than 100 million yuan in direct economic losses.
- (2) Very serious accidents: those that caused more than 10 deaths and 30 deaths (including disappearances), or more than 50 people and less than 100 serious injuries, or vessels that spilled 500 tons or more and less than 1,000 tons and caused water pollution, or 50 million yuan, accidents with direct economic losses of less than 100 million yuan.
- (3) Serious accidents: those that caused more than 3 deaths (including missing) or less than 10 people, or seriously injured more than 10 or less than 50 people, or caused water pollution from ships with oil spills of more than 100 tons but less than 500 tons, or 10 million yuan Accidents with direct economic losses of more than 50 million yuan.
- (4) General accidents: those that cause more than 1 death but more than 3 deaths (including disappearances), or more than 1 death and less than 10 serious injuries, or ships that spill oil from 1 to 100 tons and cause water pollution, or more than 1 million yuan Accidents with direct economic losses below 10 million yuan.
- (5) Incidents refer to accidents that do not reach the general accident level.

In the old version of the accident statistics method, the classification of the accident level changes according to the size of the ship:

Table 1 Old version of classification of the accident level

	Very serious accidents	Serious accidents	General accidents	Incidents
Ships with more than 3,000 gross tonnage or with a main engine power of more than 3,000 kW	More than 3 deaths or more than 5 million yuan in direct economic losses	1-2 deaths or direct economic loss of less than 5 million yuan and more than 3 million yuan	The person is seriously injured, or the direct economic loss is less than 3 million yuan and more than 500,000 yuan	Accidents not above the general accident level

More than 500 gross tons and less than 3000 gross tons or the main engine power is more than 1500 kilowatts and less than 3000 kilowatts	More than 3 deaths or more than 3 million yuan in direct economic losses	1-2 deaths, or direct economic loss of less than 3 million yuan and more than 500,000 yuan	Serious injury or direct economic loss of less than 500,000 yuan and more than 200,000 yuan	Accidents not above the general accident level
Ships below 500 gross tonnage or with a main engine power below 1500 kW	More than 3 deaths or direct economic loss of more than 500,000 yuan	1-2 deaths or direct economic loss of less than 500,000 yuan and more than 200,000 yuan	Serious injury or direct economic loss of less than 200,000 yuan and more than 100,000 yuan	Accidents not above the general accident level

Compared with the old and new accident classification methods, we can find that the old version has many unreasonable places, such as a ship accident that did not cause deaths, but a large number of people were injured. The distribution according to the old version should belong to a general accident. But in the new version, the accident level will be evaluated according to the number of injured people. According to the old version, it is not very reasonable to divide according to the size of the ship. An accident of a ship under 500 tons caused an economic loss of 500,000 yuan, and an accident of a ship of 3,000 tons caused an economic loss of 5 million yuan. Both of these accidents are major accidents in the old version of the statistical method, but it is clear that the consequences of accidents caused by 3000-ton ships are more serious. In addition, the old statistical methods did not take environmental pollution into account. Therefore, in the new version of the statistical method, first, "special major accidents" are added on the basis of the original four categories of major accidents, major accidents, general accidents, and minor accidents; Make a distinction; third, the environmental pollution is included in the judgment standard; fourth, the accident level is divided according to the number of serious injuries.

The new version of the statistical method classifies water traffic accidents as:

- (1) Collision: An accident caused by collision between two or more ships.
- (2) Stranding: If a ship is placed on a shoal and causes suspension or damage, it shall be counted as a stranding accident. If the ship is grounded for more than 7 days, but the damage does not meet the general accident grade standard, the statistics shall be calculated according to the general grade accident; if the damage is above the general accident grade standard, the direct economic loss caused by the accident shall be calculated.
- (3) Reef collision: If a ship touches a reef or is placed on the reef and causes damage, it shall be counted as a reef accident.
- (4) Allision: ships touching quay walls, docks, navigation marks, bridge piers,

floating facilities, drilling platforms and other water or underwater structures or marine accidents, sunken objects, wooden piles, fish grids and other obstacles and causing damage. Damage accident statistics.

- (5) Wave damage: Ships are damaged due to the impact of waves generated by other ships, according to the statistics of wave damage accidents.
- (6) Fire and explosion: Ships are damaged by fire or explosion caused by natural or man-made factors. Statistics are based on fire and explosion accidents.
- (7) Wind disasters: Ships suffered losses due to strong storms. According to the statistics of wind disasters, a ship is counted as an accident
- (8) Sinking: Ships are sunk, capsized, or totally damaged due to overload, stowage or improper loading, improper operation, hull water entry, or other unknown reasons. Statistics are based on self-sinking accidents, except for ship sinking caused by other accidents.
- (9) Operational pollution: If a ship causes environmental pollution in waters due to collision, stranding, reef collision, touch, wave damage, fire, explosion, wind disaster and self-sinking accident, statistics shall be made according to the types of accidents causing water pollution. The environmental pollution of waters caused by ships other than the circumstances specified in the preceding paragraph shall be counted according to operational pollution accidents
- (10) Other water traffic accidents that cause casualties: Direct economic losses, or water pollution: damage or loss of machinery parts or important attachments that affect airworthiness, as well as accidents such as injury or accidental fall into the water, etc., according to "Other Statistics of casualties, direct economic losses, and water traffic accidents caused by water pollution.

The new version of the statistical method for the classification of accidents has also been modified on the basis of the old version: First, the new version of the ninth type of accident, which lists operational pollution as a type of accident, it can be seen that China has become more and more concerned about marine environmental problems; the second is to take the accidents that occurred during the ship's navigation and production process as a type of accident. It is clear that the crew's injuries at work and the damage to the ship's machinery are also within the scope of the accident statistics. It can be seen that more and more attention has been paid to the safety of crew and efforts have been made to improve the safety of production environment.

2.2.5 Accident statistics in China in recent years

In January 2018, MSA, Guangdong, China released the "Guangdong MSA guanxiaqu 2017 nian shuishang jiaotong shigu fenxi baogao (In Chinese) Analysis report on water traffic accidents in 2017 in Guangdong MSA "⁽²²⁾, which was the first statistical analysis of annual water traffic accidents in China. In this report, the accidents in the MSA jurisdiction of Guangdong are classified and analyzed according to the type of accident, location, time of occurrence, tonnage and characteristics of the ship. In terms of types of accidents, in 2017, wind disasters, collisions, work-related injuries, and accidental overwater accidents accounted for the most, accounting for 78.6% of the total; from the location of the accident, the Pearl River Mouth was the main place of

accident; from the time of the accident, in April、 May, due to the arrival of the foggy season, many water collisions occurred; in August and September, typhoon seasons caused frequent typhoons and self-sinking accidents, and the prevailing winter gale accidents in December also increased; from the tonnage of ships, ships from 500 to 3000 tons are accidents The main tonnages that occurred, the main types of ships that occurred in bulk carrier and dry cargo accidents.

In March 2019, the MSA of the Ministry of Transport released the "Shuishang jiaoyong anquan xingshi baogao (In Chinese) Report on water traffic safety situation "(²³) for the first time, which summarized and analyzed the 2018 water traffic safety situation, accident occurrence rules and causes. In 2018, there were 176 water traffic accidents with general accident grades and above in Chinese transportation ships. Among them, 64 accidents caused no casualties, 88 accidents with 1-2 deaths, 22 accidents with 3-9 deaths, and 2 accidents with more than 10 deaths.

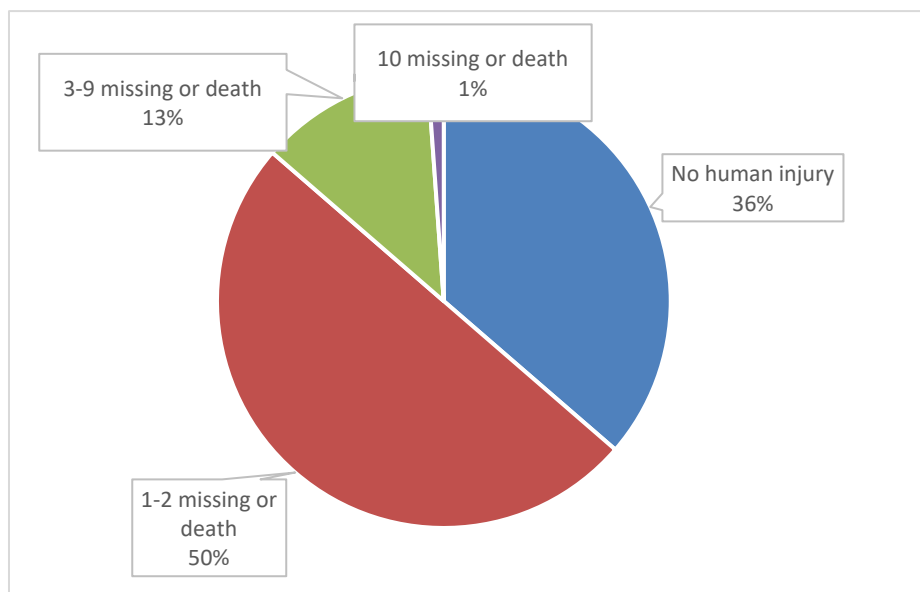


Figure 5 Accidents causing death or missing

Among the 112 water traffic accidents involving deaths and missing persons, there were 36 collision accidents, 34 self-sinking accidents, 5 touch accidents, and 37 other casualties.

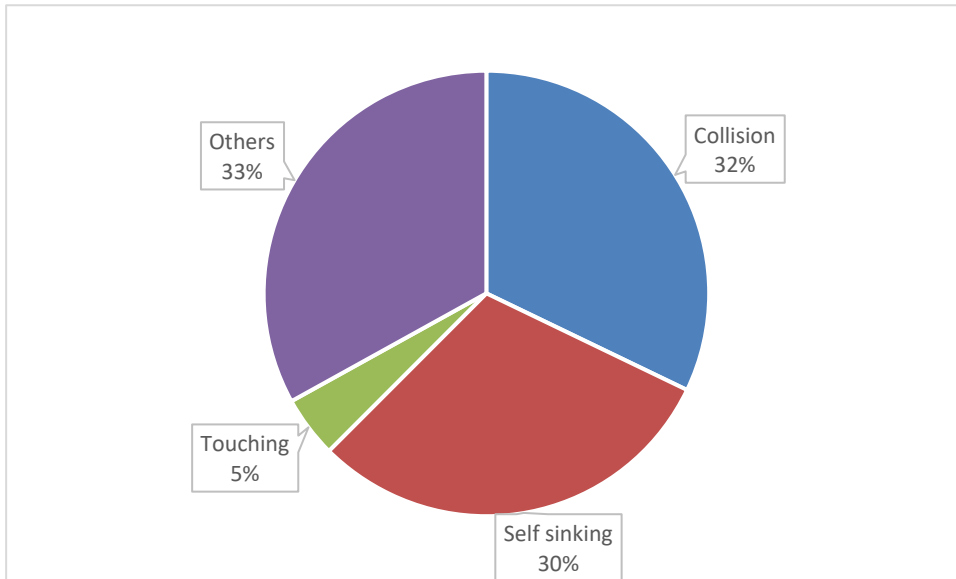


Figure 6 Types of accidents involving deaths and missing

Among the 35 Chinese transport ships that caused the death of more than 2 people, 8 ships carried steel products, 26 ships carried gravel goods, and the rest were ships carrying coal, cement, containers and other bulk goods.

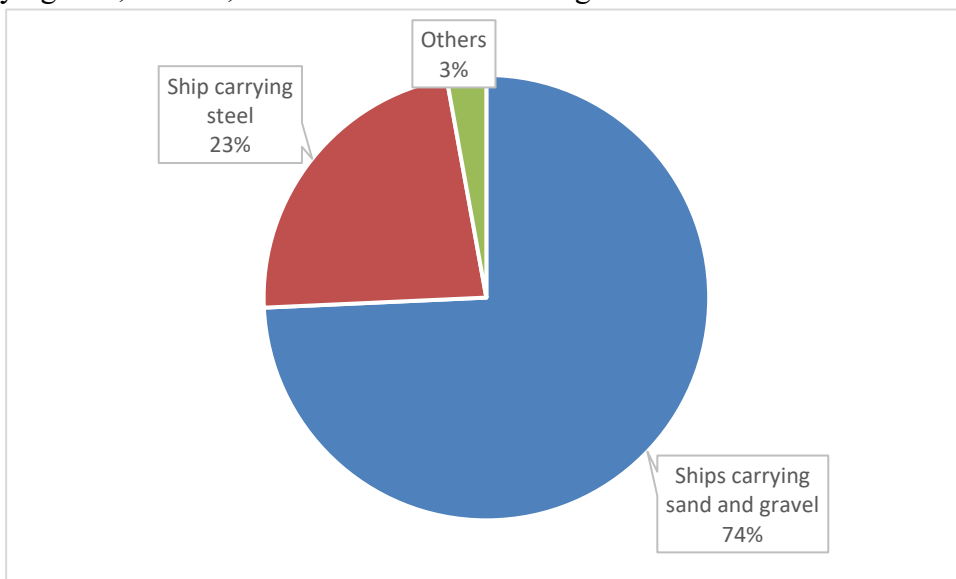


Figure 7 Proportion of different cargo ships in death and missing accidents

Judging from the tonnage of ships, ships under 3,000 tons are the main body of death and disappearance incidents, and the total number of incidents and the number of deaths and disappearances exceed 87.5%. In view of the reasons for the ship accidents in 2018, objective weather reasons such as low visibility led to 19 collision accidents with 30 deaths and deaths; the storm caused 16 self-sinking accidents and 53 deaths. The subjective reason is that deliberate violations of laws and regulations have increased, and companies have failed to implement their responsibility for safety education

management.

2.3 Organizations of marine accident investigation in Japan

There are three organizations involved in the investigation of marine accidents in Japan: JCG, JTBSB, and JMAT. All three are subordinate agencies of the Ministry of Land, Infrastructure, Transport and Tourism of Japan (MLIT), and the JTBSB and JCG are both external agencies of MLIT, and JMAT is a special agency of the MLIT as shown in the Shipwreck Trial. The responsibilities of the three are very different, and the focus of investigations on marine accidents is also different.

The main responsibilities of JCG are: security management at sea (illegal fishing, illegal operation of foreign fishing vessels, illegal transportation, piracy, terrorist incidents, suspicious ships), security in the territorial sea, rescue of marine accidents, protection of the marine environment, response to natural disasters and accidents , Investigation of marine conditions, maintenance of maritime traffic safety and handling of maritime relations with other countries. Criminal punishment according to Japanese law.

The main responsibility of the JMAT is to punish the crew, pilots, and pilots of small ships in accordance with the Shipwreck Trial Law in order to ensure the safety of marine traffic. Cancel crew certificate, stop business, warning.

The main responsibility of the JTBSB is to investigate the causes of aviation, railway and maritime accidents, and report to the Minister of Land, Infrastructure and Transport on the premise of not being held accountable, and to directly advise the accident-related enterprises .

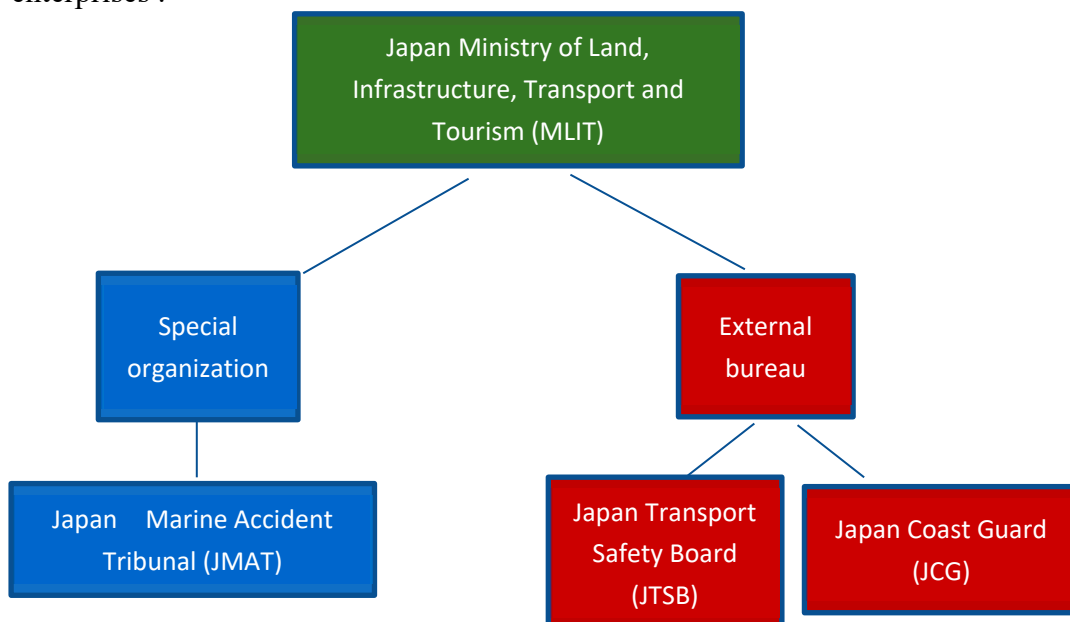


Figure 8 Relation between JMAT, JTBSB and JCG

2.3.1 History

1) JCG

Before World War II, Japan's maritime law and order was maintained by the old Japanese navy. After the war, the Japanese navy disintegrated, leaving only the sea sweeping troops to clear the mines left by the war. The Japanese government wants to establish a maritime security organization, but because the United Nations General Headquarters of the Supreme Commander for the Allied Powers (GHQ) has been vigilant against the resurrection of the Japanese Navy, Japan's maritime security force expansion work has not progressed.

In 1946, cholera from the Korean peninsula was registered in Japan from Kyushu, which had a great impact. Because it is suspected that the source of the inflow is illegal entry and smuggling, GHQ allows the Japanese government the authority to ban illegal entry. In the same year, the Immigrant Ship Monitoring Division was established at the Maritime Administration of the Ministry of Transport of Japan, and the Immigrant Ship Monitoring Division was established at the Kyushu Maritime Safety Administration. During this period, GHQ recognized the problems of Japanese coast and harbor security, and Miels, who recruited the US coast guard, made a study of Japan's coast and harbor security. Based on the US Coastal Guard Force, Miels proposed to establish an integrated maritime security management agency. In 1948, an external agency, JCG, was established with the then Ministry of Transport (now the Ministry of Land, Infrastructure, Transport and Tourism) to take charge of maritime security, rescue and traffic maintenance in Japan.

When the JCG was established, the sea-sweeping force in charge of sea-sweeping was transferred to the JCG as the sea-scanning section of the Security Bureau. When the Korean War broke out in 1950, due to the lack of power of the United Nations forces to eliminate North Korean mines, the US Far East Navy ordered the Minister of Transport to send JCG's sea-sweeping forces to take charge of the sea-sweeping work on the Korean Peninsula. Later in 1952, the JCG Affiliated Marine Guard, which was closer to the military organization, was established, but soon separated as a guard and became the later Marine Self-Defense Force. JCG has been preserved as the foreign bureau of the Ministry of Land, Infrastructure, Transport and Tourism.

2) JMAT

In 1948, the center Marine Accident Inquiry Agency (MAIA) was established in Tokyo, and local MAIA were established in Otaru, Yokohama, Osaka, and Moji. In 1949, MAIA was established as an external agency of the Ministry of Transport. Local MAIA has seven locations in Hakodate, Sendai, Yokohama, Kobe, Hiroshima, Moji and Naha Branch, and Nagasaki.

In 2008, it was reorganized by JMAT, an external agency of the MLIT, and the function of investigating the causes of accidents was transferred to the JTSCB, and the administrative sanctions and other trial functions were transferred to the JMAT. The new JMAT inherits the original JMAT and includes the Tokyo JMAT that review major marine accident, Hakodate, Sendai, Yokohama, Kobe, Hiroshima, Moji and Naha Branch seven local JMAT.

3) JTSCB

In 1971, two serious aviation accidents occurred in Japan. In order to organize the investigation of aviation accidents to prevent the recurrence of similar accidents, an aviation accident investigation committee was established in 1974. By the 1990s, several serious railway accidents had occurred in Japan, so in 2001 the Aviation and Railway Accident Investigation Committee was established.

By 2008, IMO made requirements for the investigation of marine accidents, and proposed to separate the cause investigation and the responsibility investigation. Therefore, in order to find out the causes of marine accident, prevent the recurrence of accidents, and strengthen and integrate the investigation of accidents in the three aspects of sea, land, and air, in October 2008, the original Aviation and Railway Accident Investigation Committee was added to investigate the causes of marine accidents, JTSB was established. The staff of the JTSB is appointed by the Minister of MLIT. After the reorganization, the JTSB, as an external agency, has independent personnel management rights, and has the right to directly advise individuals and companies related to the cause of the accident.

2.3.2 Structure

1) JCG

JCG is an external agency of Japan's Ministry of Land, Infrastructure, Transport and Tourism. It is mainly composed of JCG Headquarters, 11 local marine security headquarters and personnel education agencies. Educational institutions include the Maritime Security University, the Maritime Security School, the Maritime Security School Division and the Maritime Security School Miyagi Branch, which train the necessary skills and knowledge for JCG staff. The Maritime Security Headquarters in the 11 administrative areas has the Maritime Security Department, Aviation Base, Maritime Security Agency and Special Rescue Base and other organizations. The naming method starts from Hokkaido as the first district, rotates clockwise along the right side of the Japanese archipelago and names them in numerical order. The jurisdiction is shown in the figure below:

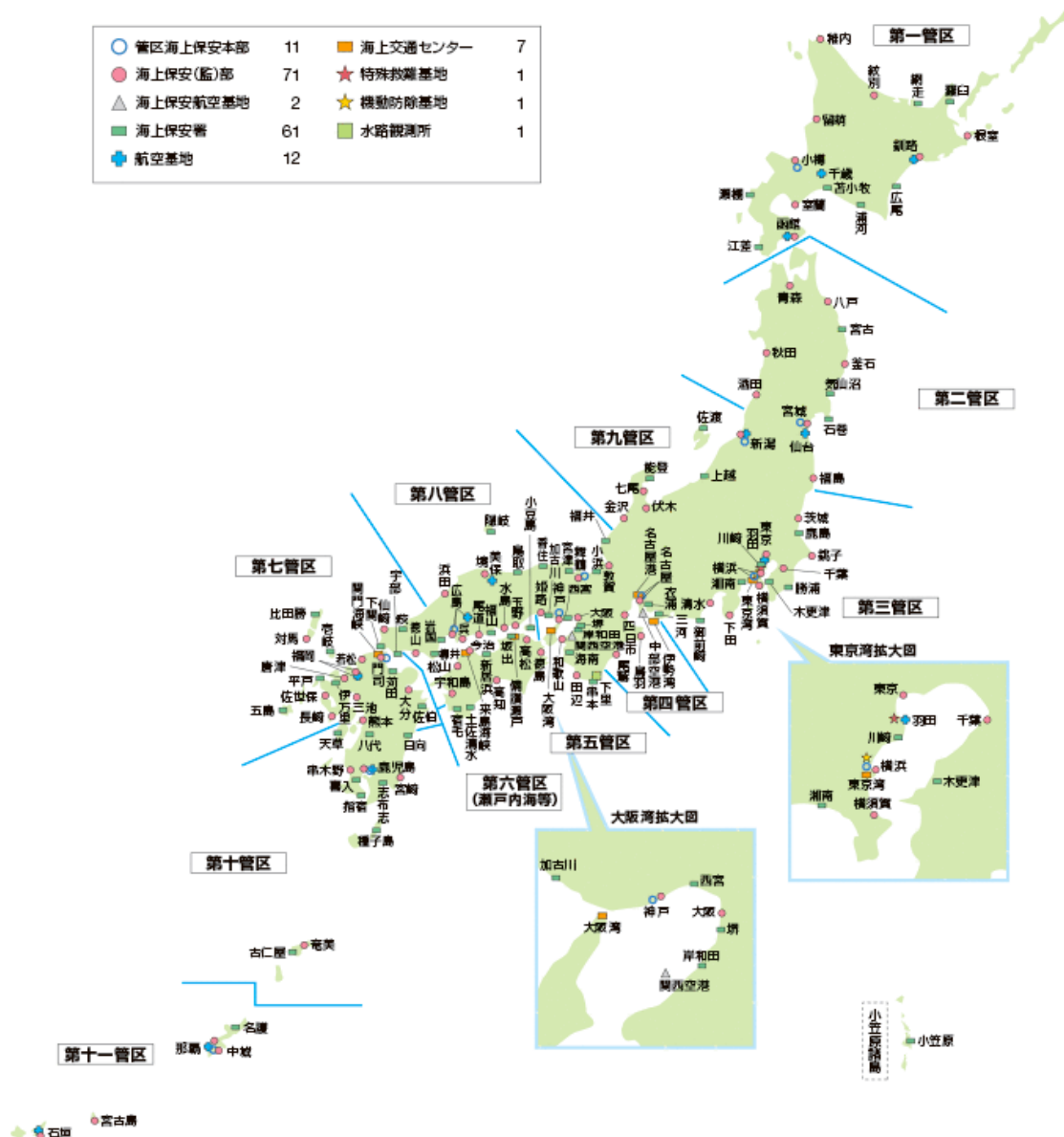


Figure 9 11 local marine security headquarters of JCG

The internal organization of JCG is divided into General Affairs Department, Equipment Technology Department, Security Department, Marine Information Department, Transportation Department, Chief Inspector and Inspector⁽²⁴⁾.

General Affairs Department: responsible for document management and legal review; evaluation, implementation, disclosure and adjustment of policies; related statistical work of the department; maintenance of communication systems; disclosure and protection of information and intelligence; management of budget funds and income; appointment and removal of staff And punishment; management training of instructors at the University of Maritime Security; handling of international affairs and maintenance of international relations; assistance to victims of crime; and work not belonging to other departments.

Equipment Technology Department: JCG ship and aircraft related work; JCG related equipment work; management of all JCG property.

The Ministry of Security and Rescue: Prevent the occurrence of illegal incidents at sea; the investigation of sea crimes, evidence search, arrest of prisoners; the investigation of the cause of death of people at sea and other related investigations; prevent illegal immigration and smuggling; prevent piracy and terrorist incidents; assist in international search Action; provide rescue to ships, personnel, and cargoes that have encountered marine accidents, salvage drifting and sunken items; prevent marine environment pollution.

Ocean Information Department: making waterway maps and aerial maps; seawater surveys, seismic volcano observations, airway surveying and mapping; coastal waterway surveys; continental shelf and island reef surveys; international marine information exchange

Ministry of Communications: lighthouse management; release of meteorological conditions and sea waves; management of various airway signs; responsible for removing obstacles that hinder water traffic; investigation of marine accidents to prevent accidents from recurring;

Chief Inspector: Responsible for improving JCG's work, inspecting JCG's related business annually; monitoring the investigation of accidents.

2) JMAT

JMAT consists of the JMAT in Tokyo and the Local JMAT. The Tokyo JMAT is responsible for the trial of major marine accidents, usually by three judges, and the local JMAT are responsible for accidents other than major marine accidents within their jurisdiction, usually by a local judge.

Local JMAT include Hakodate Local JMAT, Sendai Local JMAT, Yokohama Local JMAT, Kobe Local JMAT, Hiroshima Local JMAT, Moji Local JMAT, Moji Local JMAT Naha JMAT Nagasaki JMAT.



Figure 10 Local JMAT and Tokyo JMAT

Inside the JMAT, there are a director, chief adjudicator, adjudicator, chief director officer, director, general affairs section, and secretary section. There are directors, judges, directors, and clerks in local marine accidents trials. The director is responsible for investigating the marine accident, judging whether the accident was caused by the intention or negligence of the relevant personnel, and ruling the punishment of the responsible personnel. The adjudicator is responsible for making judgments based on

the evidence provided by the director and the responsible personnel. The clerk is responsible for recording the trial process.

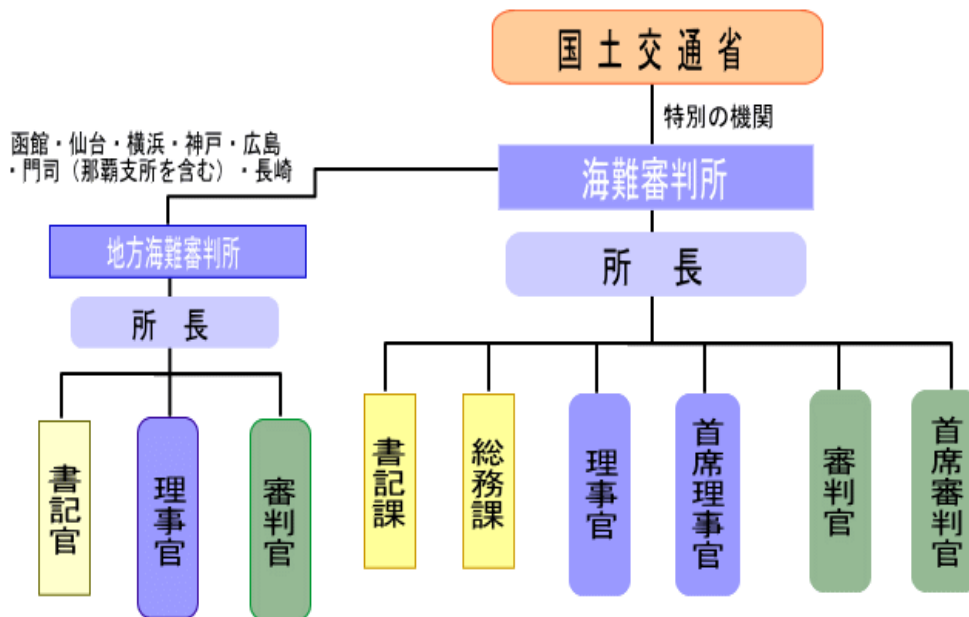


Figure 11 Chart of JMAT organization

3) JTSB

The JTSB is composed of committees, bureaus and local offices. There are 1 chairman and 12 members in the committee. The composition of the committee consists of the chairman and the committee appointed by the Minister of MLIT. The committee covers law, aviation, railway, shipbuilding and human factor analysis.

The bureau is responsible for handling the specific affairs of the JTSB. The aviation, railway and ship accident investigators are responsible for the on-site investigation of the accident. Among them, the aviation accident investigator is composed of 25 experts including aircraft inspectors, aviation controllers, and aviation industry practitioner test officers. The railway accident investigator consists of a total of 19 professionals in the design and manufacture of railway tracks, railway operation management and inspection, and meteorological experts. The ship accident investigator is composed of 23 experienced experts including captain, chief engineer, marine security officer and ship inspector. The Counselor is composed of an accident prevention and analysis officer responsible for analyzing and reporting accident reports, issuing safety instructions, and an accident adjustment officer who coordinates various agencies and provides information to victims during accident investigation. A total of 27 accident prevention analysis officers and accident adjustment officers. The General Affairs Division is responsible for international negotiations and external broadcasting.⁽²⁵⁾

A total of 60 people has been set up in 8 local offices in Japan (Hakodate, Sendai, Yokohama, Kobe, Hiroshima, Moji, Nagasaki and Naha), mainly responsible for investigation of ship accidents in various regions.

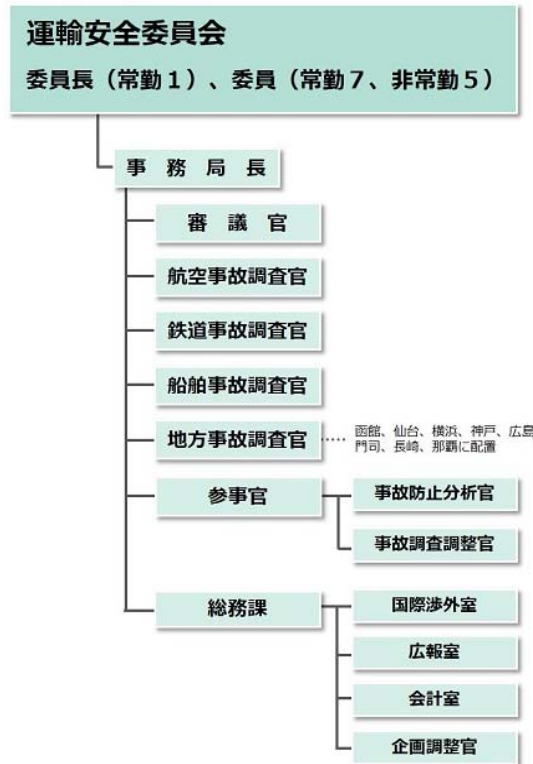


Figure 12 Chart of JTSB organization

2.3.3 Investigation Process

Japan's three marine accident investigation agencies will conduct three investigations on accidents, mainly for some larger accidents and educational accidents. The purpose of the investigation is different between the three. Among them, JCG's investigation is based on the rescue of the ship in distress, the salvage of marine accidents and floating objects, and the imposition of criminal penalties for violations. The purpose of the investigation of the JMAT is to provide punishment warnings to the personnel involved in the accident or deliberately causing the accident in accordance with the relevant laws and regulations. The punishment forms include cancellation of the crew certificate of the relevant personnel, suspension of business penalties, and caution. The purpose of the JTSB's investigation is to learn lessons from the accident, prevent the accident from happening again, and do not hold accountable.

In the investigation, the three institutions conduct independent investigations, and there is a question of the order of investigation. After the accident, JCG first started investigating the accident based on the information received, and criminalized those involved in the violation of the law; then, if the JTSB deemed it necessary to investigate the accident, the cause of the accident was investigated because the investigations conducted by the JTSB will not be held accountable, and it is necessary for the relevant accident personnel to tell the truth. If JMAT conducts the investigation first, the accident-related personnel may hide some things that are harmful to themselves. Finally, the JMAT investigate the accident and prosecutes those who may have intentionally or

negligently involved in the accident.

1) JCG

Because JCG's mission is to ensure safety and security at sea, JCG needs to provide navigation assistance and rescue and other services. Upon learning of the accident, JCG immediately carried out the rescue work, and then the marine accident investigator started the accident investigation, and at the same time searched the criminal evidence based on the accident. If the evidence found in the investigation can prove the crime, JCG will exercise judicial power to collect evidence. When investigating an accident, the marine accident investigator needs to conduct a basic analysis of the accident, arrange specific rescue work and prevent accidents from recurring based on the results.

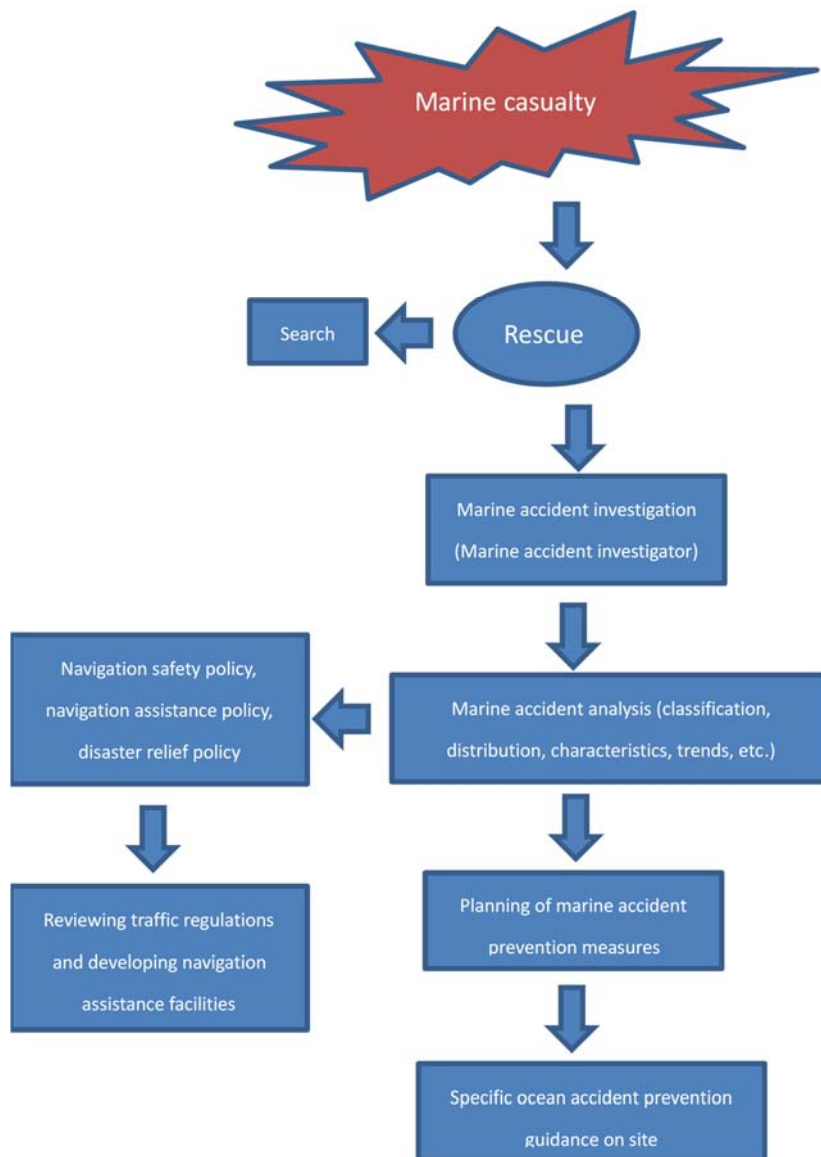


Figure 13 JCG Investigation process

2) JMAT

After a marine accident occurred, the director of the JMAT learned of the accident through television, news, or other media or the MLIT, the maritime security officer, the police, and the local government, and the director immediately began investigation. First, inquire about the personnel involved in the accident, and at the same time check the ship and marine accident, check the relevant documents of the ship and the crew, and collect useful evidence. According to the results of the investigation, the board of directors needs to go to the local or Tokyo JMAT to make a complaint if it needs to punish the crew.

After the start of the marine accident trial, one or three judges and recorders attended. The director, defendant and defendant's assistant submitted evidence and debated. The director presented his punishment opinion, and the defendant stated his punishment opinion on the director view. The judge examines and interrogates the evidence presented by the director and the defendant and conducts a trial.

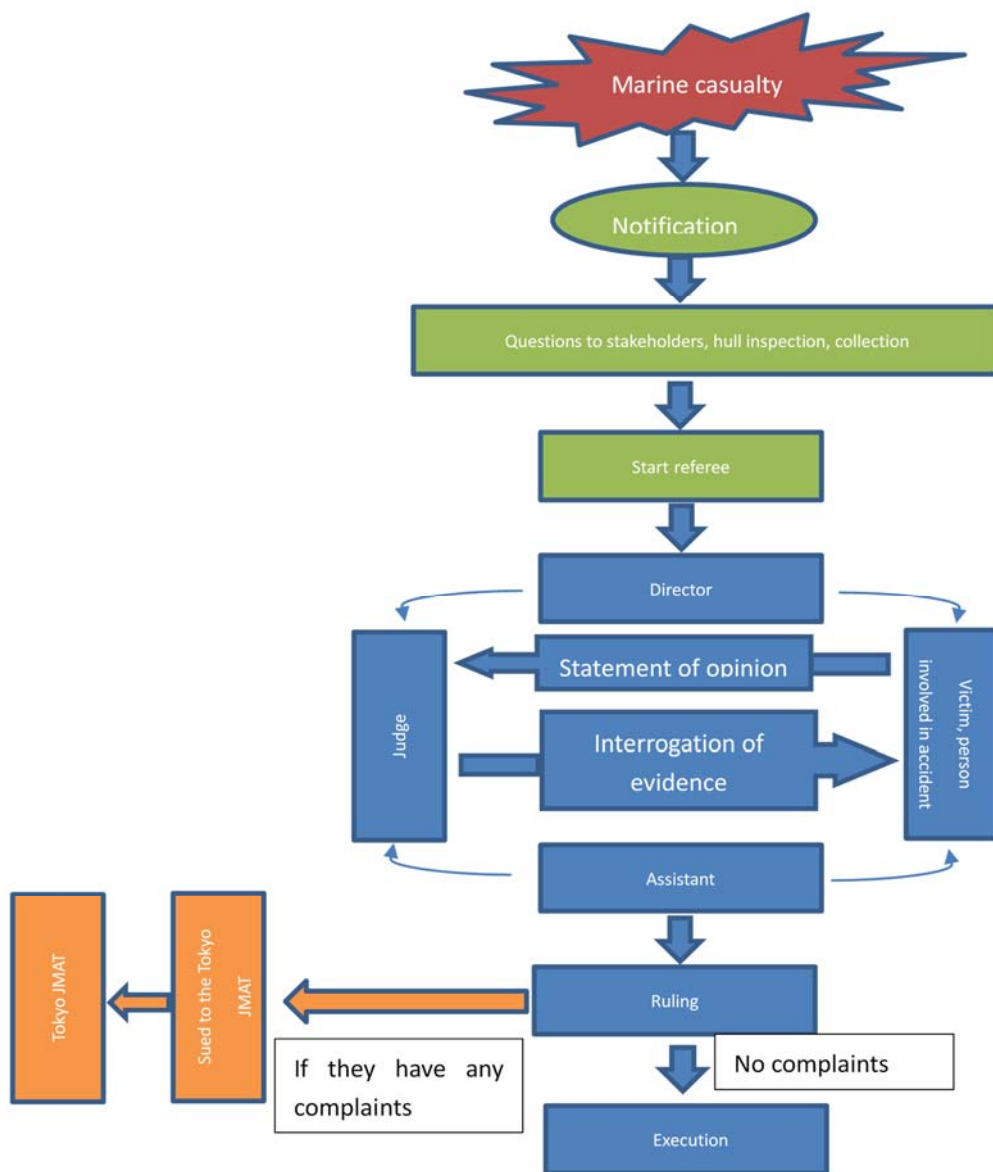


Figure 14 JMAT investigation process

The relevant qualifications of the JMAT for the director are:

Director:

1. Possessing the qualification of a first-class seafarer, with more than two years of experience as an offshore or ocean-going captain or chief.
2. Engaged in one or more of the following occupations, totaling more than five years
 - 1) JMAT deputy chairman with a certain title or above
 - 2) Assistant
 - 3) JCG officer above a certain level
 - 4) JMAT officer with a certain title or above
 - 5) Ship inspector or marine technology test officer with a certain title or above
 - 6) Ship and shipping, professors or associate professors.
 - 7) Qualification for summary judgement

Deputy Director:

1. Certificate of Competency for First Class Marine Technician
2. Engaged in one or more of the following occupations for a total of 6 years
 - 1) JCG officer, a JMAT officer or a ship inspector with a second-level certificate.
 - 2) Instructors of shipping and shipping and related disciplines in educational institutions with a second-level certificate.
 - 3) Captains, navigators, commanders or officers of offshore and ocean-going ships.
3. Engaged in one or more of the following occupations for a total of 8 years
 - 1) JCG officer with a certificate of competence for third-class navigation
 - 2) JMAT officer with Certificate of Competency in third-class Marine Technician
 - 3) A ship inspector or a marine technology test officer with a certificate of third-class.

3) JTSTB

The JTSTB is informed of the accident from the JCG, the Maritime Administration Office, the Police Officer, and the municipal, village, and village chiefs. It appoints the responsible investigator, investigator, and coordinates with the JCG to notify the country involved in the accident. Afterwards, it is distributed to the ship accident investigator and the local accident investigator for investigation according to the size of the accident.

The Tokyo JTSTB investigator is responsible for major ship accident investigations. Starting from the confession and meteorological information of crew, passengers, witnesses, etc., relevant material evidence and ship damage are collected, and the experimental analysis is carried out and make accident reports through the committee's deliberations. If necessary, convene a hearing of the opinions of relevant personnel and research scholars. After listening to the opinions of the personnel involved in the accident, it is handed over to the committee for deliberation and a report to the Minister of MLIT. If the Minister of MLIT deems it necessary, he will advise the relevant

personnel, submit opinions to the relevant administrative organs, and report to the IMO.

The local accident investigator also collects relevant material evidence, asks the accident-related personnel, writes an accident report and submits it to the committee for consideration. For minor accidents, it does not need to be submitted to the committee to directly listen to the opinions of the accident-related personnel. After deliberation by the committee, report to the Minister of MLIT.

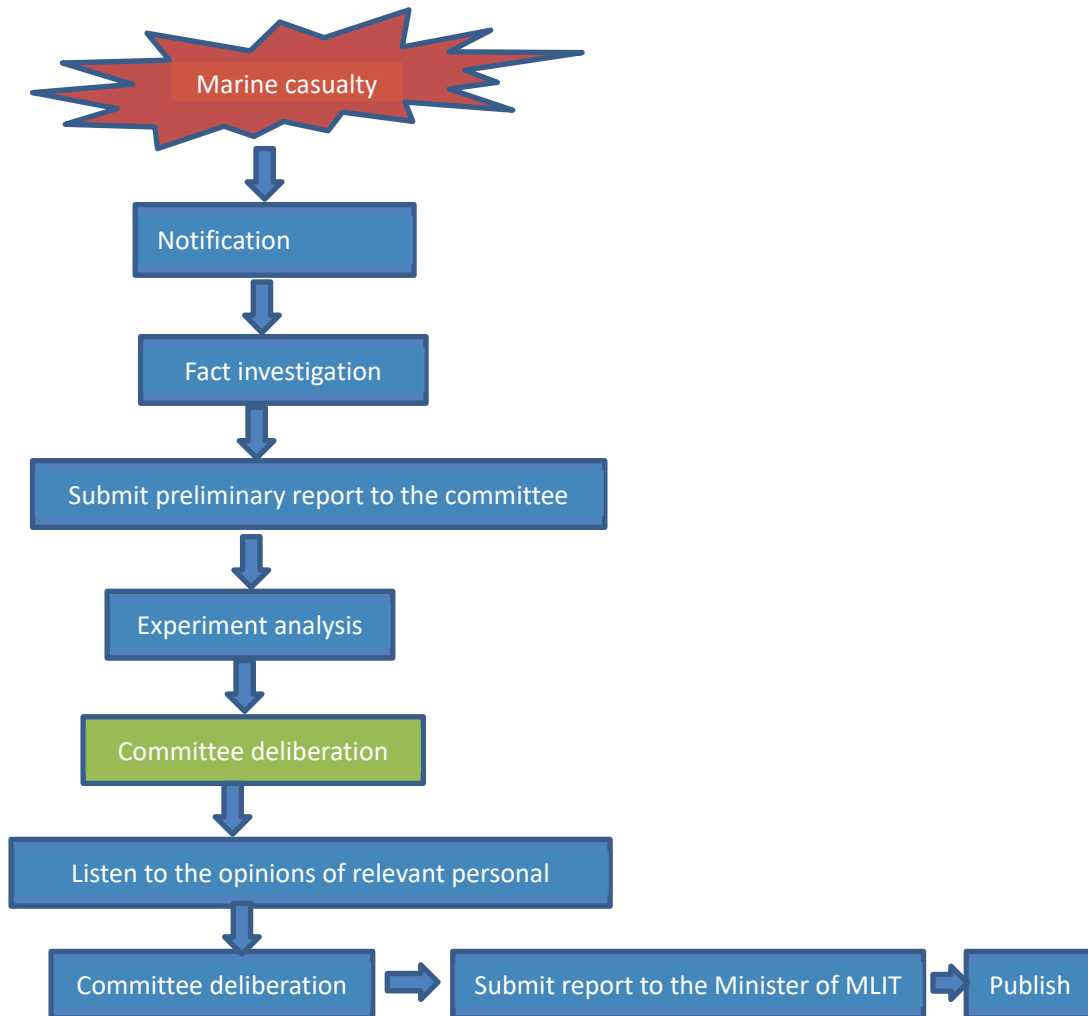


Figure 15 JTSC investigation process

The JTSC arranges different levels of review work according to the severity of the accident.

Table 2 different levels of Review Department

Review Department	The severity of the accident
Committee	The committee determined a special serious accident based on the victimization situation, social impact, etc.
General Department	very serious accident ①More than 10 people died or disappeared

	<p>② More than 20 people were killed, missing or seriously injured (Both ① and ② are limited to the passenger transportation industry) Other accidents identified by the committee</p>
Aviation Department	Aviation accidents and aviation major events (except for deliberation by the General Department)
Railways Department	Railway accidents or major railway events (except for deliberation by the General Ministry)
Maritime Department	<p>Major marine accidents and marine incidents identified by the Commission (except for deliberation by general ministries and special maritime departments)</p> <p>Major marine accidents are defined as:</p> <p>① The passenger is dead or missing or two or more people are seriously injured. ② More than five people are missing. ③ The ship in international navigation is totally damaged or the person is missing. ④ Oil leakage from ships caused major environmental pollution. ⑤ The damage caused by the ship's accident has not been done before. ⑥ Causes major social impact. ⑦ The cause of the accident is difficult to identify. ⑧ It is worth learning to prevent the recurrence of accidents and reduce the damage caused by accidents.</p>
Maritime Affairs Section	Marine accidents and marine incidents (except for deliberation by general ministries and maritime ministries)

The JTSA has clear regulations regarding the qualifications of accident investigators:

1. Born after 1965, 13 years of ship-related experience after graduating from a technical college or 11 years of work experience in ship industry after graduating from university
2. Persons who meet any of the following conditions:
 - 1) Obtain the first-class nautical seafarer or the certificate of the engine.
 - 2) Obtained a second-level nautical seafarer or seafarer certificate of the engine and has less than 6 years of experience
- A. Engaged in maritime related work such as JCG officer and ship inspector.

- B. In higher education institutions or secondary education institutions, engaged in teaching work related to ship and shipping, engine.
- C. As a captain, seafarer, commander or officer on ships or fishing vessels and vessels with a gross tonnage of over 1,000 tons.
- 3) Obtained a third-class nautical seafarer or third-class certificate of engine, plus 8 years of working experience in A, B and C above.
- 4) The chairman of the committee identified talents with human factors analysis, meteorological analysis and other professional knowledge related to accidents.

2.3.4 Some definitions of maritime accident in Japan

Both the JTSB and the JMAT use the Marine Accident Judgment Law to define marine accidents. The JMAT Law defines marine accidents in terms of damage to ships and other hardware equipment, injuries to personnel, and threats to ship navigation, as follows⁽²⁶⁾:

1. The ship or other facilities outside the ship are damaged during the operation of the ship:

Regardless of the size of the ship or the state of use, accidents such as collision, stranding, ship overturning, fire, etc. during use have caused damage to the ship and equipment on board.

2. Casualties of ships and ship equipment during operation:

Personnel fell into the cabin or seawater due to the shaking of the hull; casualties were caused by the hit of the rope; poisoning gas poisoning or hypoxia accident; death or injury occurred in the car ferry

3. Hazard to the safety of the ship and obstacles to shipping:

The dumping of the cargo may cause the ship to tilt and sink; the fuel depletion causes the ship to drift at sea; the ship is stranded and the ship is unable to sail.

The types of accidents are divided into:

- 1) Conflict: The ship collides with or touches another ship that is sailing or moored, and the two ships are damaged.
- 2) Conflict (single): The ship collides or contacts with the shore wall, trestle, light buoy and other facilities, and the ship or both the ship and the facility are damaged.
- 3) Stranding: Ships and shoals, reefs, marine accidents, etc. beneath the surface are stranded and the hull is damaged below the waterline.
- 4) Sunken: The ship loses buoyancy due to the intrusion of seawater, and the hull sinks below the water surface.
- 5) Water immersion: The ship is wet due to sea water intrusion, cargo, etc., but it does not cause the ship to lose buoyancy.
- 6) Overturning: Floating state where the ship has lost its resilience due to scattered cargo, water ingress, rudder turning, etc.
- 7) Suffering: The causes and composition of various marine accidents cannot be classified as a kind of marine accident, or do not belong to any other type of marine accidents.
- 8) Missing: The whereabouts of the ship are unknown.

- 9) Fire: A fire occurs on the ship, which is taken as a damage, and removes the fire caused by other marine accidents.
- 10) Explosion: The cargo is exploded due to fire and chemical reaction, and the ship is damaged.
- 11) Injury to the institution: the main engine and auxiliary machinery malfunction, or the fuel, air, electrical appliances and other systems are damaged.
- 12) Damage to ancillary equipment: the hull was not damaged, and the ship's attachments were damaged.
- 13) Facility damage: The ship is in conflict or contact with facilities other than the ship. Although the hull is not damaged, the facility is damaged.
- 14) Accidents such as fatalities and injuries: The ship's construction equipment or operation is relevant, and the crew members and passengers have suffered fatalities or whereabouts are unknown. It is not caused by other marine accidents.
- 15) Safety obstruction: There is no damage to the ship, poor cargo stacking, and there is a risk of overturning when the hull tilts, and a serious danger occurs.
- 16) Impediments to shipping: No damage to the ship, insufficient fuel and clean water reserves lead to inability to sail, and the risk increases over time.

2.3.5 Accident statistics in Japan in recent years

Due to the different investigation purposes of the JCG, the JMAT, and the JTSB and the employees and the number of people is different, the number of marine accidents counted by three Japanese agencies is completely different. Because JCG is responsible for providing assistance to the ship in distress and the injured marine personnel, regardless of the size of the accident, the crew will notify JCG after the accident. Therefore, JCG has received the most accident reports. According to the statistics of JCG, the number of ships in need of rescue in Japan due to accidents is about 1600-1700 ships each year. The JAMT conducts preliminary investigations on approximately 800-900 accidents involving approximately 1100 ships, and then prosecutes approximately 300 accidents caused by fault or intention. The JTSB investigates some major accidents or accidents that are worthy of reflection and education. About 800 cases of accidents occur each year and will continue to investigate about 500 accidents left in the previous year.

The following is the data of the marine accident statistics by Japan's JCG in 2018⁽²⁷⁾. In that year, a total of 1704 ship accidents needed JCG help:

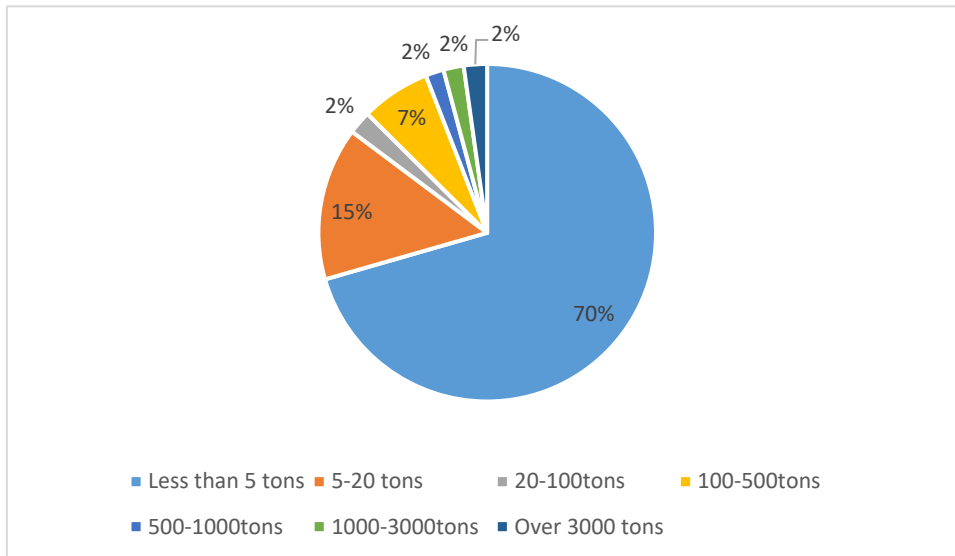


Figure 16 Accidents that classified according to the size of the ship (JCG)

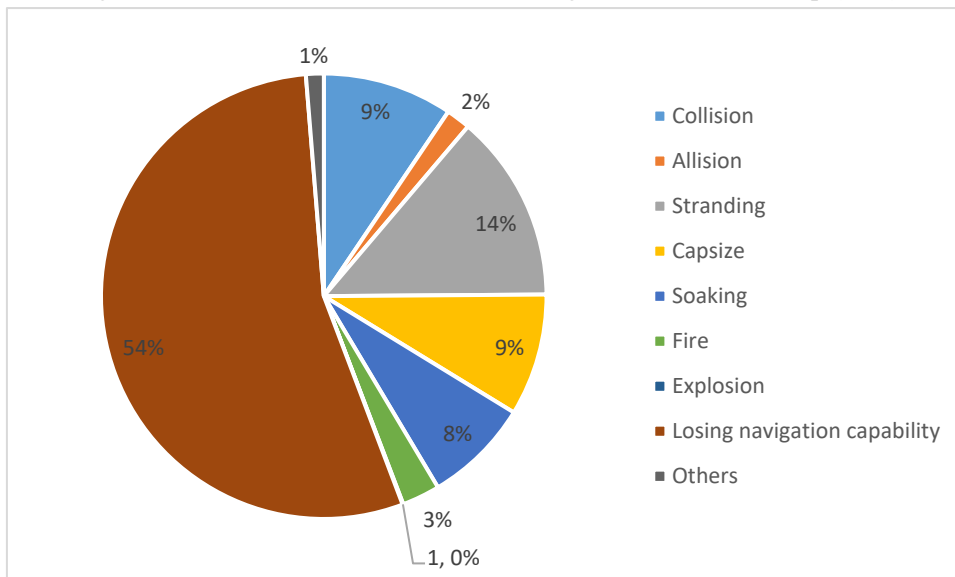


Figure 17 Accidents are classified according to the types of accidents (JCG)

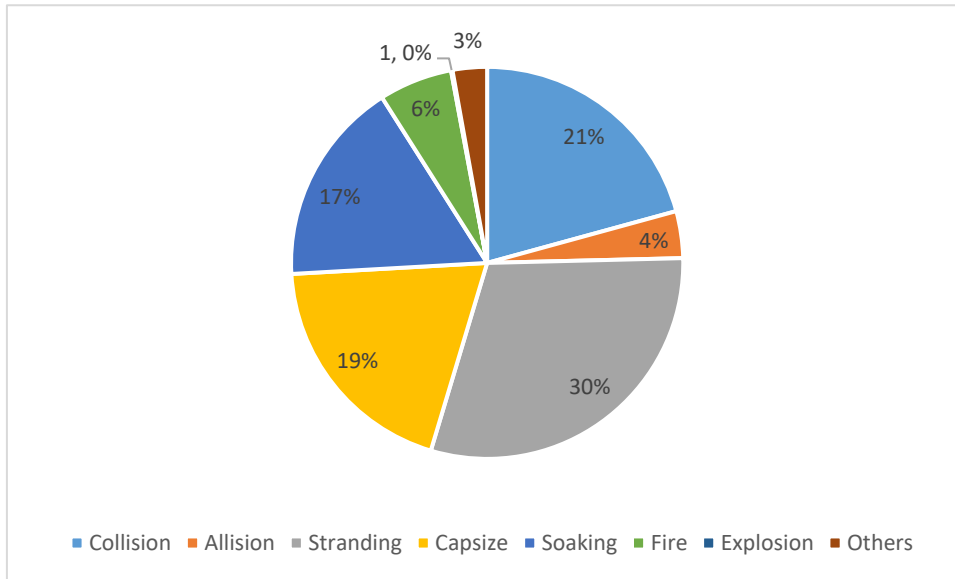


Figure 18 Accidents are classified according to the types of accidents (Remove the accidents about losing navigation capability)

According to the statistics of JCG, it can be clearly seen that in 2018, 70% of the marine accidents in Japan that required JCG assistance were caused by small boats under 5 tons. In addition, many ships suffered from small accidents such as insufficient fuel and insufficient fresh water. As a result, these accidents are not necessary for the JMAT and the JTSB to investigate, but JCG will provide assistance to the accident ship. Therefore, in the statistics provided by JCG, the loss of navigation ability accounts for the vast majority. Excluding such accidents as loss of navigational ability, it can be seen that ship accidents caused by collision, touch, and stranding accounted for 55%.

Also in 2018, the JMAT conducted investigations on 832 ship accidents involving 1,102 ships and prosecuted 320 of them⁽²⁸⁾. The following is the statistics of the JMAT.

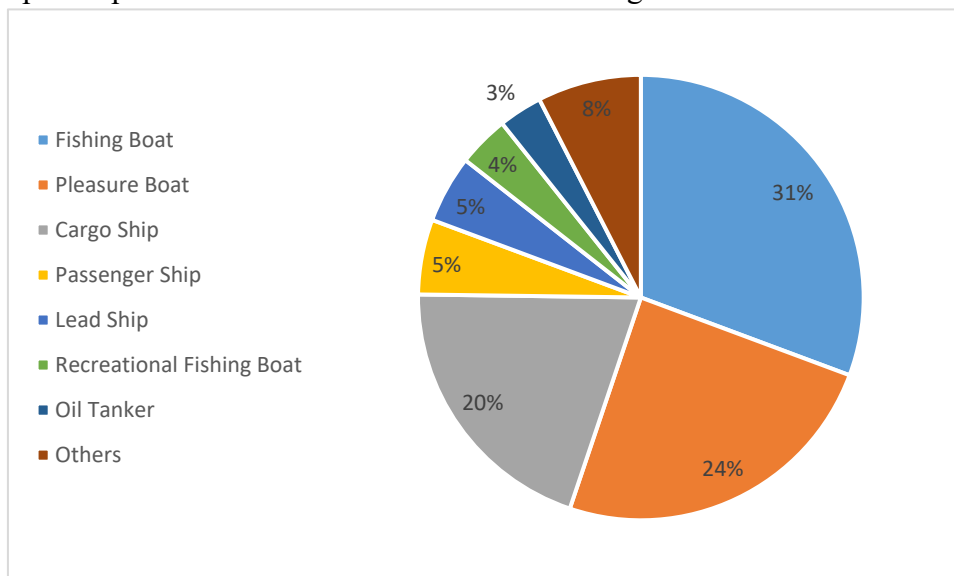


Figure 19 Accidents that classified according to the type of ship (JMAT)

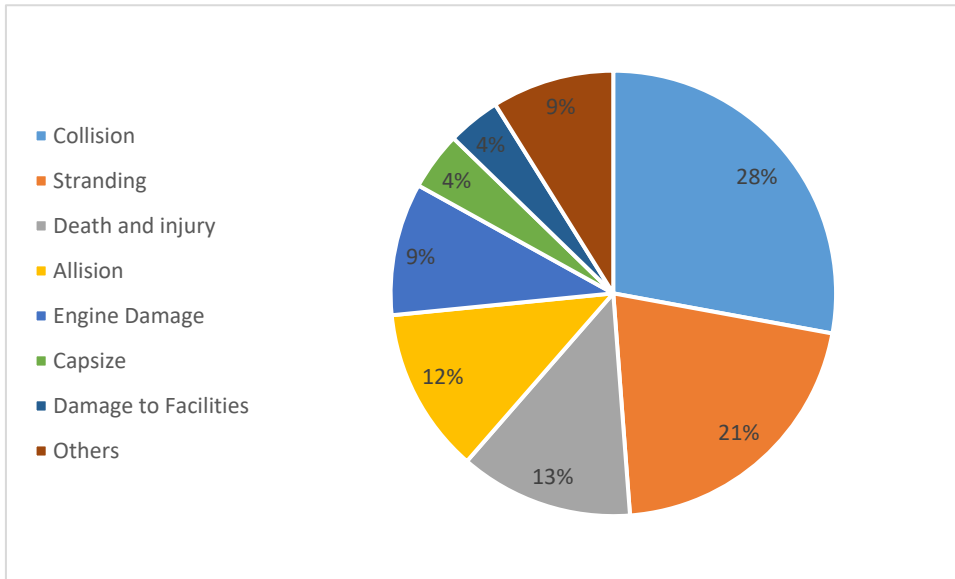


Figure 20 Accidents that classified according to the type of accident (JMAT)

In the survey data of the JMAT the accidents caused by collisions and stranding accounted for the majority of the ships, which is consistent with the JCG statistics except for the loss of navigation capabilities. In addition, from the perspective of the type of accident ship, fishing vessels and yachts account for about 55%, while most yachts and some small fishing vessels have relatively small tonnages, which is also in line with JCG statistics. The proportion of accidents is as high as 85%.

The JTSB has completed investigations on 830 ship accidents in 2018⁽²⁹⁾. The relevant situation is shown in the figure below:

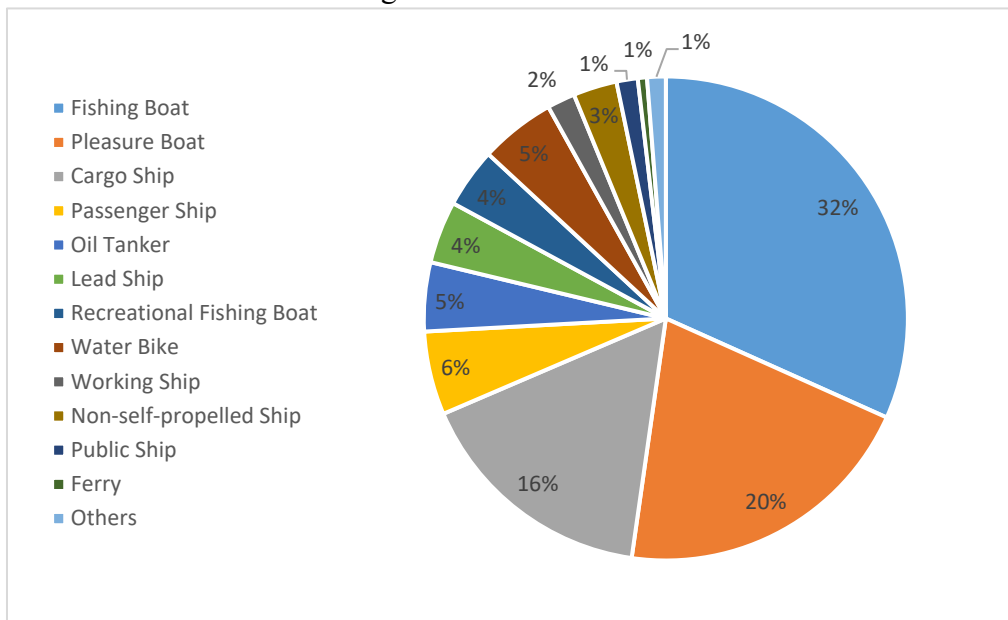


Figure 21 Accidents that classified according to the type of ship (JTSB)

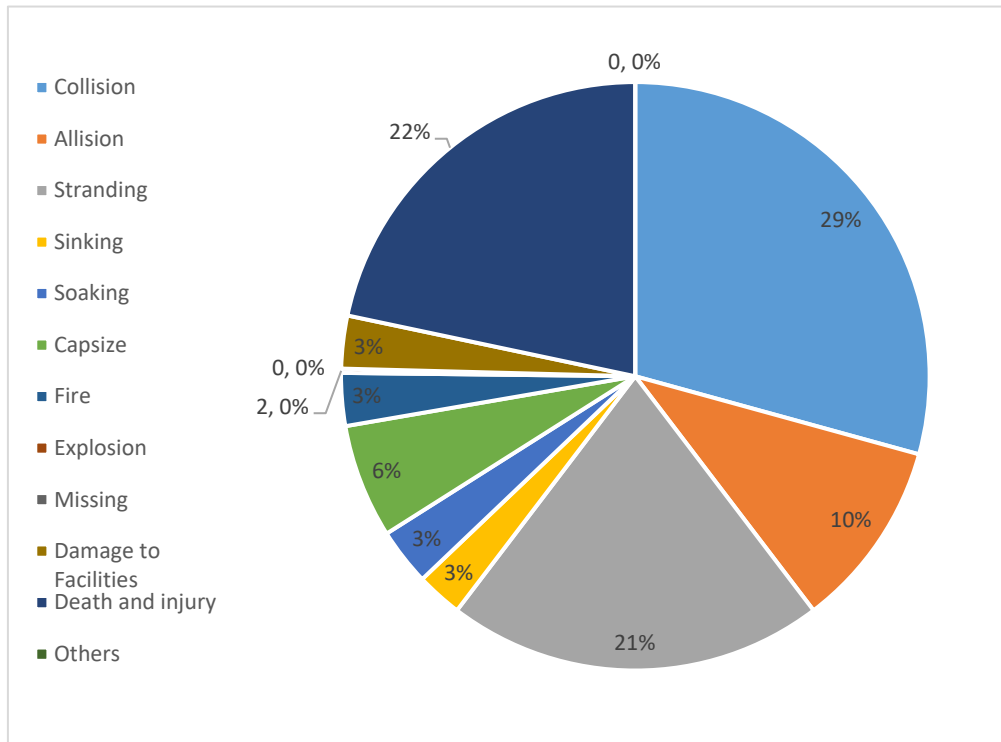


Figure 22 Accidents that classified according to the type of accident (JTSA)

By comparing the statistics of the Japanese marine accident data provided by the JTSA in 2018 with the data of the JCG and the JMAT, we can see two obvious commonalities: First, the collision and stranding accidents of ships account for a very large proportion, about 50%-60%. The second is that some small fishing boats and yachts are the main types of accidents.

2.4 Organizations of marine accident investigation in USA

The United States has two investigation agencies for marine accidents, USCG and NTSB.

USCG is mainly responsible for the enforcement of coastal defense, maritime search and rescue, and the law of the sea. It belongs to one of the five armed forces of the United States, belongs to the Department of Homeland Security in peacetime, and belongs to the U.S. Navy during wartime (transferred to the U.S. Navy during World War I and World War II.). The main tasks are navigation in ice areas, protection of marine living resources, marine environmental protection, maritime security, navigation assistance, search and rescue, maritime defense alert, enforcement of maritime laws, prevention of illegal immigrants, protection of the safety of port channels and coasts, and interception of drug transportation.

The US NTSB is an independent investigation agency responsible for the investigation of civil traffic accidents, including high-speed traffic accidents, marine accidents, pipeline transportation accidents, railway accidents, aviation accidents, and is also responsible for investigating the transportation of dangerous goods. The organization also assists the US military and foreign governments in the investigation

of related accidents. Headquartered in Seattle, Washington, with regional offices in Anchorage, Alaska; Denver, Colorado; and Ashburn, Virginia.

2.4.1 History

1) History of USCG

USCG was developed by an organization composed of 10 early ships. At the beginning, their purpose was to protect the maritime trade and prevent smuggling. By the 19th and 20th centuries, the size of the organization expanded with the increase of national strength, and it was named the United States Revenue Cutter Service.

In 1915, it merged with the United States Life-Saving Service to increase the maritime rescue mission, so the name was changed to USCG and belonged to the United States Congress. Life-Saving Service has many sites along the US coast to provide assistance to victims at sea. Afterwards, USCG gradually expanded its business scope. In 1939, it was responsible for maritime navigation assistance, including the management of lighthouses along the US coast. In 1946, the functions of the Bureau of Marine Inspection and Navigation were handed over to USCG. Since then, USCG has begun to manage the issuance of US merchant shipping certificates and the safety of merchant ships. In 1967, USCG was transferred from the original US Treasury Department to the newly formed US Department of Transportation. Later, due to the September 11 terrorist attacks in 2001, USCG was transferred to the Department of Homeland Security for more effective protection of US property.

2) NTSB

NTSB originated in 1926 when the US Department of Commerce decided to investigate aviation incidents, and then established Federal Aviation Administration (FAA) in 1940.

In 1967, the United States Congress merged all the transportation departments of the United States at that time to form the Department of Transportation and set NTSB as an independent institution in the Department of Transportation.

In 1974, Congress separated NTSB from the Ministry of Transport and became a completely independent investigation agency. Without interference from any transportation organization, NTSB can investigate the accident from the most objective angle. In 1996, Congress requested NTSB to help the families of victims of aviation accidents. Later, the assistance was extended to all families of victims of traffic accidents.

In 2000, in order to improve the professional quality of the staff and the wider application of professional investigation knowledge to the transportation industry, NTSB chose George Washington University Virginia Campus as NTSB training college, which was later renamed NTSB Training Center.

2.4.2 Structure

1) USCG

The U.S. Coast Guard is headquartered in Washington, DC, and divides its jurisdiction into the Pacific and Atlantic regions. The Pacific region includes the 11th,

13th, 14th and 17th regions, and the Atlantic region includes the 1st and 5th regions, 7th tube area, 8th tube area and 9th tube area.



Figure 23 USCG headquarter and 9 regions

There are mission support department, operation department and reporting department at USCG Washington DC headquarters.

Mission support departments include: Human Resources Division, Engineering and Logistics, Information Technology Division, Procurement Division, Material Transportation Management Division, War Readiness Command, Coast Guard Academy, Mission Support Integration Division, Security Policy and Management Division⁽³⁰⁾.

Human Resources Department: Responsible for the personnel arrangement of the Marine Guard.

Engineering and Logistics Division: Provide adequate technical, engineering and material assistance to the Coast Guard. Including the provision of various ships, aircraft, vehicles, construction and maintenance of coastal facilities and various equipment.

Information Technology Division: Provide fast and stable network connection, provide mobile devices, software and cloud data services.

Procurement Division: Responsible for USCG's annual procurement of approximately US\$1 billion in ships, aircraft, and command and communications electronic systems.

Material Transportation Management Office: Provide assistance to the logistics team during the operation, on duty 24/7 to ensure that the entire USCG can operate normally in the face of emergency.

Combat Readiness Command: Train and evaluate USCG personnel and provide trained staff.

Coast Guard Academy: To train leaders of the naval military forces that can perform

multiple tasks for the guard.

Mission Support Integration Division: Integrate the strategic arrangement and execution of the entire mission support department, reform management, and evaluate the organizational structure based on business conditions.

Security Policy and Management Division: responsible for improving the operational efficiency of the organization and reducing operational risks.

USCG's operations include the Response Strategy Division, Prevention Strategy Division, Military Force Division, Network Command, National Command Center, Global Transportation Coordination Office, Resource Management Office, International Affairs and Foreign Policy Office, Coast Guard Intelligence Office.

Response Strategy Department: Responsible for providing theoretical knowledge and formulating policies so that all Coast Guard members can efficiently complete maritime operations such as law enforcement and anti-terrorism at sea.

Prevention Strategy Division: Responsible for formulating and maintaining the Coast Guard's prevention policies and standards and unifying various actions to protect maritime safety.

Military Department: Responsible for providing and evaluating USCG's operational capabilities, and formulating standards for staffing, training, equipment, etc. to meet the needs of the mission.

Network Command: Plan the use of the network to ensure that the capabilities of the working network meet the operational needs.

National Command Center: Responsible for maintaining awareness of all major incidents of the Coast Guard and major incidents overseas, or events that may be related to the Coast Guard and the Department of Homeland Security.

Global Transportation Collaboration Office: responsible for providing full-time support among national agencies and acting as a coordinator among national agencies.

Resource Management Department: Responsible for USCG's resource allocation when performing tasks to ensure that resources are used reasonably and efficiently.

International Affairs Office: Promote foreign policy and national security through international exchanges and partnerships and promote global ocean governance.

Coast Guard Intelligence Division: The Intelligence Division is responsible for providing information support to combat commanders, strategic planners, and decision

makers, so that USCG can be ready to respond at any time.

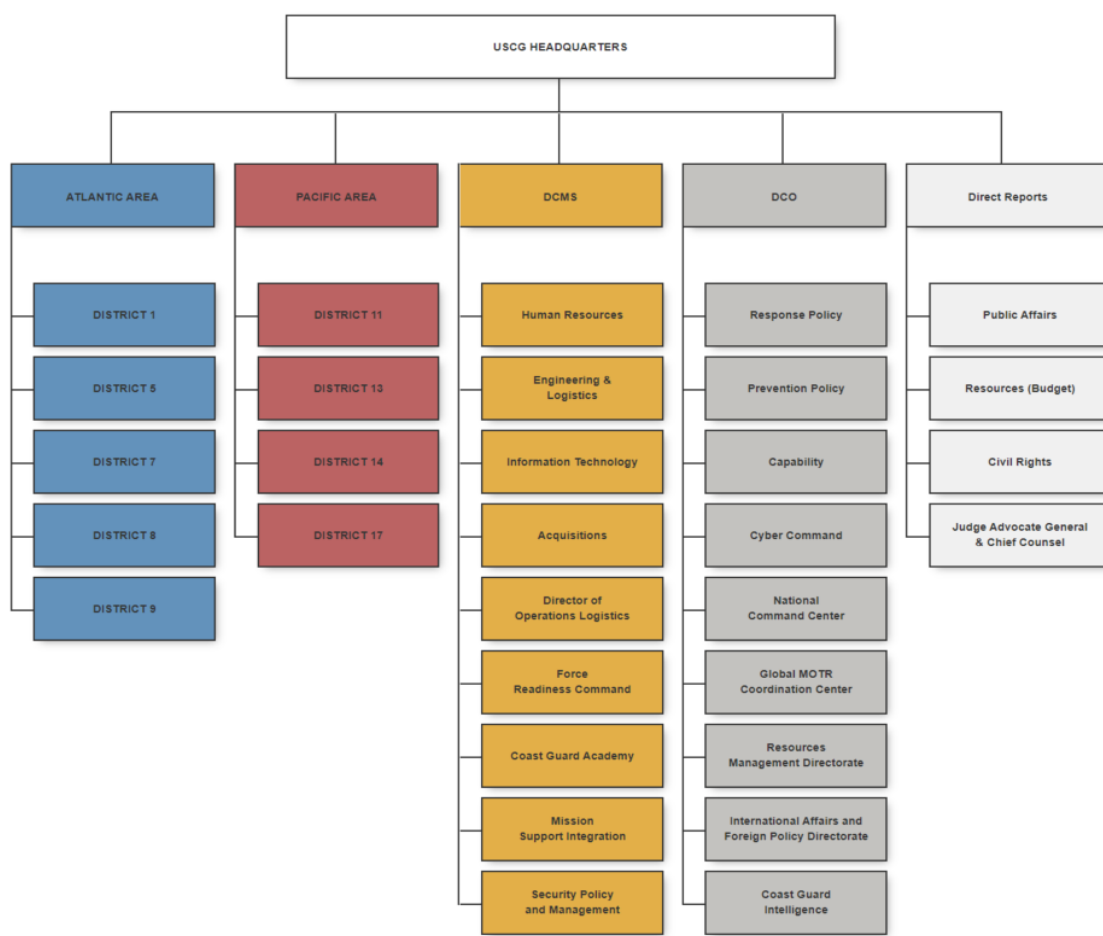


Figure 24 Chart of USCG organization

2) NTSB

NTSB is composed of five council members (including a council chairman and a council vice-chairman) for a five-year term. Each member is named by the president and passed by the senate. Among the five members, there must be no more than three members of the same political party, and it is guaranteed that at least three of them shall belong to the professional fields of accident recurrence, safety engineering, human factors, transportation safety, and transportation regulations.

NTSB sets up the following offices to report to the Chairman: Chief Financial Officer, General Counsel, General Manager’s Office, Security Advice and Communications, Office for Equal Employment Diversification and Inclusion⁽³¹⁾.

Chief Treasury Office: Responsible for NTSB’s financial resources, preparing the budget request submitted to Congress and executing the budget allocated to NTSB by Congress.

General counsel: responsible for providing legal advice, assistance and representation to NTSB. Ensuring that NTSB’s actions operate effectively under federal laws and regulations. At the same time, it prevents external organizations or

individuals from making unreasonable demands on investigators to ensure the independence of the investigation.

General Manager's Office: responsible for the daily operation of the organization, coordinating the work of all the personnel of the organization, the management of the personnel training center, the formulation of plans and goals, and submitting annual reports to Congress.

Security advice and communications: responsible for NTSB to communicate efficient and accurate information to Congress, victims and families of traffic accidents, state and local governments, and news media.

Employment Equality Diversity and Inclusion Office: Responsible for NTSB to eliminate conflicts and obstacles in the workplace, enhance team trust and teamwork.

The General Manager's Office is also responsible for the following departments: Research and Engineering Office, Railway Pipeline and Dangerous Goods Investigation Office, Aviation Safety Office, Highway Safety Office, Maritime Safety Office, Information Supervisor Office, Administration Office, and Administrative Law Judge Office.

Research and Engineering Office: responsible for providing technical support for accident investigation and safety recommendations.

Railway, Pipeline and Dangerous Goods Investigation Office: Responsible for investigating traffic accidents in railway, pipe and dangerous goods transportation.

Aviation Safety Office: Investigate all civil aviation accidents and participate in major foreign aviation accidents involving American airlines or American designed and manufactured equipment. Not only conduct safety investigations on a single accident, but also examine aviation safety issues from a broader perspective.

Highway Safety Office: Responsible for a wide range of highway traffic accidents, such as the collapse of highway bridge structures and accidents caused by vehicle collisions. In addition, according to the investigation, the common safety risks in car accidents are determined.

Maritime Office: Investigate major marine accidents in US waters or American ships worldwide, determine the cause of the accident and make safety recommendations.

Information Subjective Office: Provides strategic guidance and business support for the information system of the council, and is responsible for developing business products.

Administrative Office: Responsible for coordinating and managing various infrastructures to provide support for the organization’s actions. Manage human resources, manage equipment purchase and lease.

Administrative Law Judge's Office: When the Federal Aviation Administration or USCG adopts penalties such as disqualification of crew members and pilots, if the crew and pilots do not agree with the punishment, the Administrative Law Judge's Office acts as an appeal court.

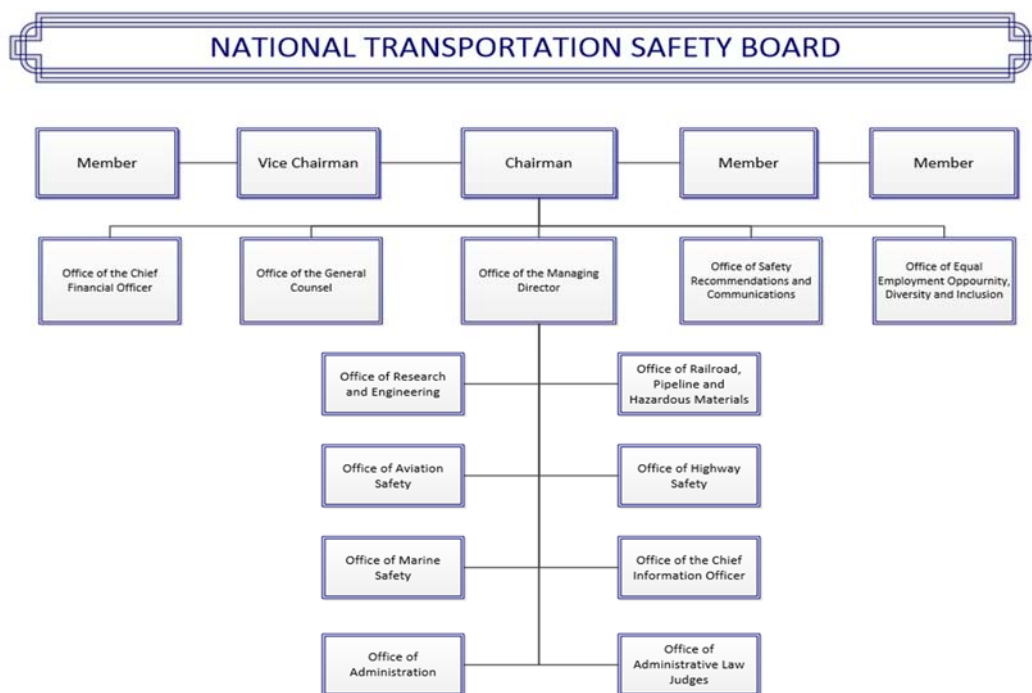


Figure 25 Chart of NTSB organization

2.4.3 Investigation Process

USCG is a comprehensive maritime law enforcement agency in the United States. It is responsible for the investigation of all marine accidents in the United States and its own investigations. As a result, administrative penalties are imposed and fines are imposed or crew certificates are cancelled.

NTSB is the highest procurator agency for transportation safety in the United States and is responsible for the investigation and handling of major transportation safety issues. The report and evidence are open to the public and submitted to Congress. The investigation may invite the relevant personnel of USCG, ship owner, insurance, pilotage agency, etc. to conduct a joint investigation without involving any accountability and penalties.

Because USCG and NTSB in the United States both need to investigate marine accidents, there is coordination between the two departments on issues such as

investigation sequence. Because USCG needs to rescue the accident ship, in most cases, USCG will rush to the scene and start a preliminary investigation of the accident. After that, NTSB investigators will go to the scene as soon as they know the accident.

1) USCG

When USCG learned of the accident, the local USCG investigator immediately took the investigation bag "go" bag to the scene. Immediately after arriving at the scene to understand the general information of the accident, including the name of the accident ship, the specific location, accident damage, casualties, and water pollution. The general NTSB investigators have also arrived at the scene at this time, NTSB and USCG will According to the existing memorandum agreement, the accident was further investigated.

USCG's local investigators collect various electronic records such as the voyage records of the accident ship, the communication system carried by the ship, and analyze the voyage conditions of the accident ship. USCG's National Investigation Center will send investigation teams to provide equipment and professional technical support as needed. Subsequently, an investigative team composed of USCG investigators and NTSB sent investigators went to the incident site to hear the preliminary investigation results of the local accident investigators.

Next, the mixed investigation team will review the accident scene, ship layout, ship design and structure, ship navigation performance, etc.

At the same time, NTSB laboratory conducts tests and analysis on the electronic records of the accident ship.

After completing the general investigation at the scene, the investigation team interviewed witnesses and some witnesses on board. According to the process of the accident, USCG uses the ship to reproduce the scene before the accident in the waters similar to the accident location, and restores the navigation situation of the accident ship on the computer according to the previous electronic record information, so as to understand the crew's driving action when the accident occurs.

After having a basic understanding of the accident, hold a hearing with the outside media and the public, provide some relevant accident evidence, let the audience understand the progress of the investigation of the accident, and upload the hearing video to the network. The investigation team will continue to collect as needed., visit relevant personnel to collect more information and documentation. USCG will share this information with NTSB.

According to USCG's investigation report policy, USCG will report the factual evidence, analysis, conclusions, safety recommendations and recommendations enforcement actions are reported and USCG's punishment results for those responsible for the accident are also reported.

Finally, all the evidence and related information are saved in USCG database, which is convenient for tracking down the accident case in the future when similar cases occurred.

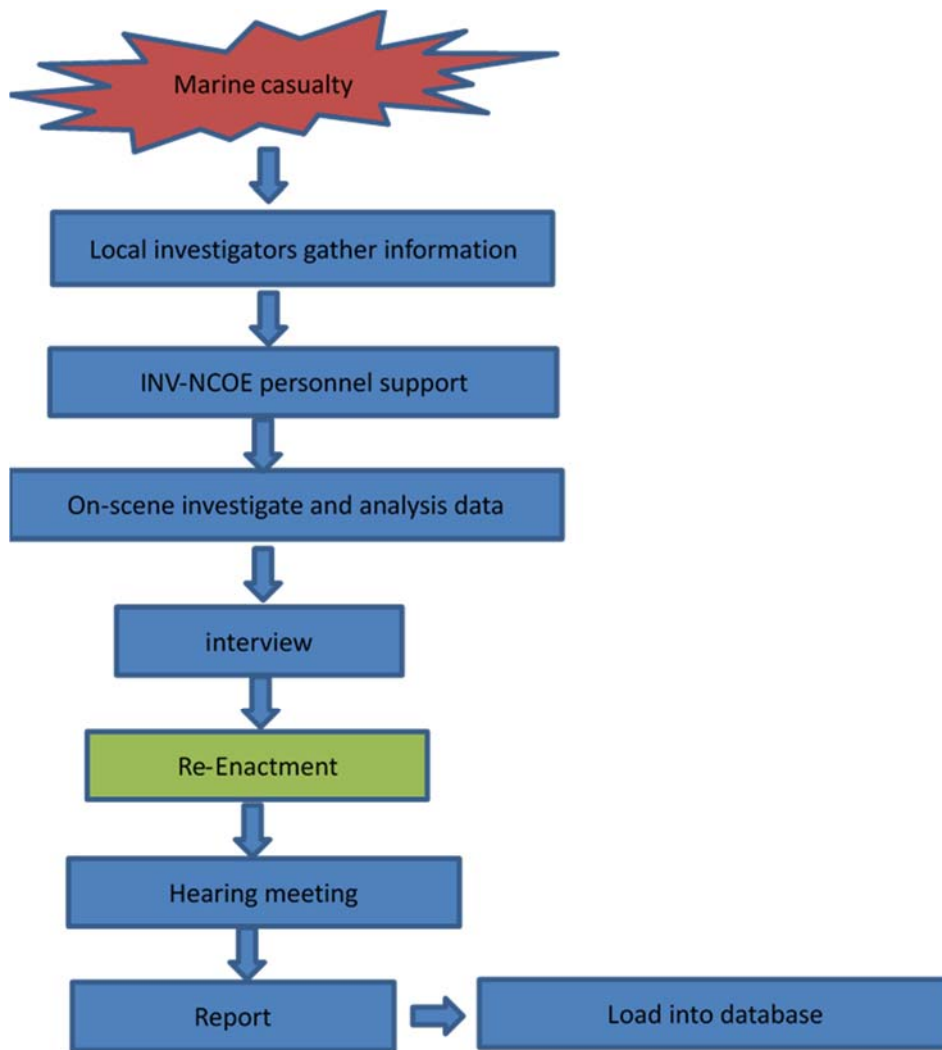


Figure 26 USCG investigation process

2) NTSB

The Maritime Safety Office, which is responsible for accident investigations in NTSB, investigates 30-40 accidents each year, and this department has only 21 people, including investigators, recorders, management and preparatory personnel.

There is a room at the Washington headquarters of NTSB, and a 24-hour duty system is implemented to accept accident reports from all aspects. The core of the accident investigation in NTSB is the "Go team" investigation team. The investigation team members are selected from experts at the headquarters in Washington, ranging from three or four to a dozen. The direct superior is a senior investigation with many years of NTSB work and industry experience. member.

During the rotation period, they must stay in the office 24 hours a day or keep in touch. When receiving the accident report, the go team will rush to the scene of the accident as soon as possible to carry out an investigation. If the accident is serious, members of the safety committee may also go together. After arriving at the scene of the accident, establish a headquarters, hold a working meeting, understand the local law, and carry out grouping to investigate the accident. The typical NTSB maritime

investigation team includes navigation, engineering, human factors, and escape emergency four groups. NTSB will also invite individuals or organizations with technical assistance to participate in the investigation as a party system, in addition to lawyers and insurance investigators.

During the on-site investigation phase, when members of the safety committee participate in the investigation team, one of the five members of the safety committee makes a brief presentation to the media about the investigation at least once a day. If the investigation team is led by an investigation staff, the committee member is the main speaker. In addition, the Office of Public Affairs keeps in touch with the media to ensure the transmission of real information.

The main task of NTSB is to make safety recommendations. The committee must immediately resolve the security issues discovered during the investigation, so it often makes recommendations before the investigation is complete. These suggestions may have nothing to do with the final cause of the accident, but they are based on some flaws found in the investigation.

As part of a major accident investigation, NTSB may hold a public hearing within 30 to 60 days after the investigation team returns. The first is to collect sworn testimony calling witnesses, and the second is to allow the public to understand the progress of the investigation.

After a long period of experimentation and analysis, the safety committee staff will draft a final report, including facts, analysis, conclusions, accident causes and recommendations. The board of directors then held a public meeting at NTSB headquarters to review the final report. Once the committee adopted the report, a summary of the report (including the committee's conclusions, possible causes, and safety recommendations) was posted on the committee's website. The full report will be released in a few weeks.

3) Memorandum agreement between NTSB and USCG⁽³²⁾

To coordinate many cooperation issues in the investigation process, two marine accident investigation agencies in the United States, such as who owns the leadership of the investigation saves the investigation resources of the United States to avoid unnecessary waste caused by repeated investigations. In fact, USCG conducts a preliminary investigation of all marine accidents, and then USCG commander makes a judgment based on the results of the preliminary investigation, if the accident meets the major marine accident standard and some other specific standards, USCG will inform NTSB. The relevant standards are as follows:

- 1) The accident is a major marine accident
- 2) The accident included a public ship and a non-public ship, causing the death of at least one person or property damage of USD 75,000.
- 3) The accident included a USCG vessel and a non-public vessel, at least one person was killed or \$75,000 in property damage.
- 4) For any major accident involving issues related to the implementation of USCG's safety functions, the safety functions of USCG may be search and rescue, nautical support, ship traffic systems, and the safety performance

of commercial ships.

If the accident meets NTSB's standards for participating in the investigation, USCG will lead the majority of the accident investigation process. Only in some particularly serious accident investigations will NTSB be in a leading position. Specially significant accidents are a subset of major accidents. There are also detailed provisions in the memorandum agreement regarding these accident situations:

- 1) The number of deaths and missing persons in commercial passenger ships reaches 3 or more
- 2) The number of deaths and serious injuries in any commercial ship reaches 12 people.
- 3) Commercial ships with a capacity of 1600 tons have lost their propulsion capacity.
- 4) Any marine accident where there is a death or missing person involves a road traffic system, such as a collision between a ship and a bridge, highway, railway, or coastal facility.
- 5) According to USCG Commander and NTSB Chairman, it is estimated that it will pose a serious threat to life, property and environment.
- 6) According to USCG Commander and NTSB Chairman estimates of serious security threats associated with USCG's maritime security functions.

When the accident meets any of the above conditions, the investigation will be led by NTSB. In addition, when the ship accident includes public ships and non-public ships, if USCG ship causes an accident, NTSB will lead the investigation.

In the joint investigation of NTSB and USCG, either party has the right to collect evidence and interview the accident's first responders and keep their analysis of the case independent. In terms of information sharing, NTSB and USCG agreed to share all the information, tests, testimonies, and evidence collected during the accident investigation. Because NTSB's investigation focuses on different, in many cases NTSB will ask USCG for a lot of additional information.

2.4.4 Some definitions of maritime accident in USA

US CFR 46 CFR 4.03-1⁽³³⁾ has the following definitions of marine accidents:

1. Any ship accident other than public ships (for the scope of the accident)
 - 1) Occurred in the navigable waters of U.S. territory or territory
 - 2) Any accident involving a US vessel
 - 3) Foreign tank vessel operating in U.S. waters and EEZ cause significant damage to the environment or material damage to the ship's navigation performance.
2. Incidents caused by or involving ships, including the following:
 - 1) Anyone on board fell into the water, injured or killed
 - 2) Any ship is stranded, anchored, sunk, drifting, colliding, touching, exploding, catching fire, or the ship's power, propulsion capability, maneuvering capability is lost, or any part of the ship's components or

cargo is damaged or lost; or Any situation that damages the navigation performance and efficiency of the ship; or any situation that causes serious harm to the environment.

- 3) Anyone who is injured or killed while diving from a boat and using a respirator.

There are also definitions for serious marine accidents. Any marine accident or injury causes the following results:

- 1) Cause one or more deaths
- 2) Causing crew, passengers or other personnel to be injured, requiring professional medical assistance other than first aid, and causing persons employed on board to provide commercial services to no longer be able to work normally.
- 3) Caused a property loss of US\$100,000.
- 4) The ship's actual detection or presumption is total loss
- 5) Any self-propelled ship of 100 tons or more is totally damaged.
- 6) Cause 10,000 gallons or more of oil to leak into the sailing waters.
- 7) Dangerous goods leak into the navigation waters or enter the natural environment.

There are clear rules for major accidents. Any accident that causes one or more of the following damage results:

- 1) 6 or more people died or missing
- 2) Ships of 100 tons and over lose their propulsion capacity
- 3) Resulting property loss of US\$500,000 and above
- 4) According to USCG Commander and NTSB Chairman, it is estimated that it will pose a serious threat to life, property and environment.

2.4.5 Accident statistics in USA in recent years

According to statistics from USCG and the US Department of Transportation, there were 684 serious marine accidents in the United States in 2018⁽³⁴⁾. With the situation is as follows:

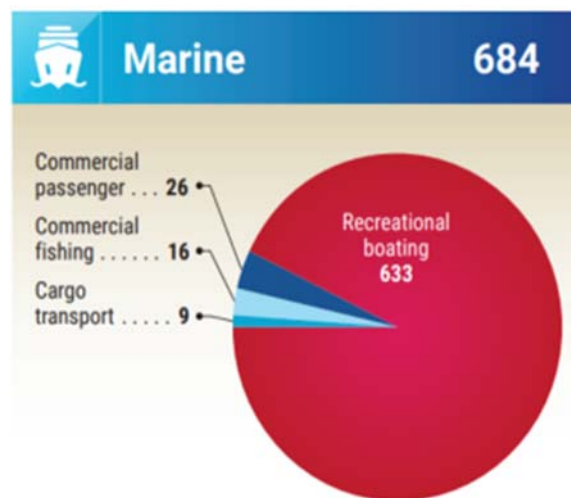


Figure 27 Accidents that classified according to the type of ship

For the United States, recreational ships are the absolute main type of accident ship, accounting for almost 93%. Some of the remaining accidents were caused by commercial passenger ships, fishing vessels and cargo ships.

2.5 Organizations of marine accident investigation in UK

There are two UK investigation agencies for marine accidents, one is the Maritime and Coast Guard (MCA), and the other is Marine Accident Investigation Branch (MAIB). There are many differences between the two in terms of function and investigation of accidents.

MCA belongs to the administrative organ of the British Ministry of Transport. It is composed of 1050 employees and 3500 employees and is responsible for matters related to British water safety. The main responsibilities include: ensuring the safety of life on ships in British waters, the safety of seafarers on all British ships, ensuring that the equipment onboard all British ships is normal, ensuring that all crew members on British ships have relevant documents, and protecting the British coast And the water environment to ensure the accuracy of the British charts, management of rescue volunteers, hydrological information, crew certificates and port supervision and inspection system.

MAIB is the world's earliest maritime investigation agency, and IMO promotes the safety investigation without responsibility investigation from the origin of MAIB. As an independent organization under the Ministry of Transport, MAIB has a very small organization, consisting of 35 people, and has 4 investigation teams. The main responsibilities include: investigating and judging the causes of accidents at sea, issuing reports and making recommendations on safety at sea, raising people's understanding of the ways in which marine accidents occur, and promoting international cooperation in the investigation of marine accidents. MAIB accepts approximately 1500-1800 types of marine accidents each year, from which an average of 30 accidents are investigated.

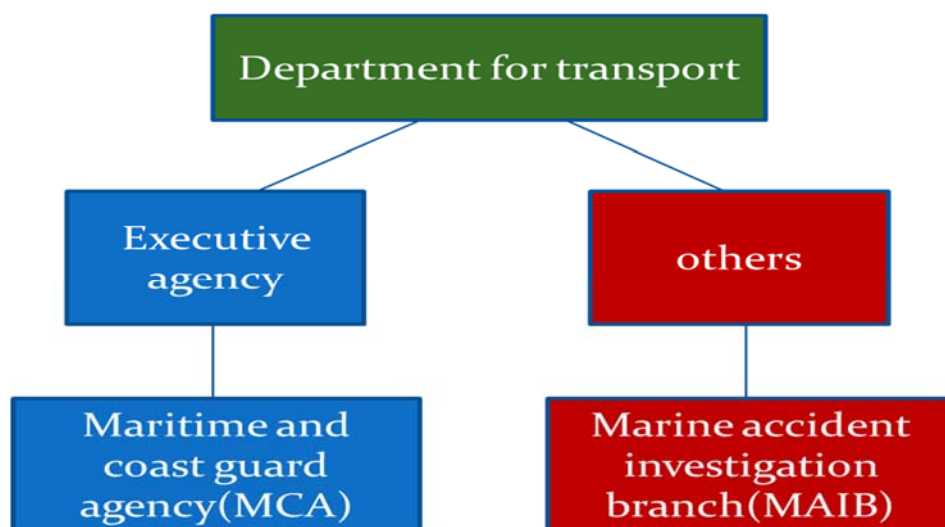


Figure 28 Relation between MCA and MAIB

2.5.1 History

1) MCA

In the eighteenth century in the United Kingdom, a large number of people engaged in smuggling and transportation to evade taxes. It is said that half of the tea that Britain drank at that time was imported into the UK by smuggling. Smugglers retaliated against the whistleblowers, murdered, or bribed officials, causing social chaos. In the early 19th century, the British Customs formed a maritime security force to fight smugglers. The guard was set up under the then Ministry of Finance. The first officer and captain were experienced fishermen and crew. Soon its scope of work included being responsible for marine accidents, protecting cargo and ships from hijacking, and receiving training in the use of life-saving tools. In 1822, the security organization was relocated back to the British Customs and was officially named the coast guard "coast guard". During this period, the Coast Guard helped many organizations protect their coastal security interests. It provides fleet movements to the British Navy, trains naval reserves, reports on changes in navigation standards, helps British Customs inspect ships, supervise unloading, collect coastal vessel fees, collect statistics on ships, and conduct coastal patrols. Help the Ministry of Trade assist ships in distress, participate in rescue, and receive sunken ships.

In 1856, the control of the Coast Guard was transferred from the customs to the British Navy. In 1923, the Coast Guard was set up under the Ministry of Trade. Unlike the early assistance provided to various departments, it began to devote itself to rescue, marine accident salvage, and coastal management. After the 1969 "Torrey canyon" oil spill, the Coast Guard assigned it as an early warning system for pollution prevention. In 1998, the marine safety agency and coastguard agency merged into the current maritime and coastguard agency, which is dedicated to reducing casualties at sea, protecting the marine environment, promoting the improvement of maritime safety standards, and 24-hour emergency response.

2) MAIB

Many times, when a major disaster occurs, it will cause some changes. The establishment of MAIB was caused by an accident. In 1987, a roll-on-roll-off ship overturned in Zeebrugge, England, resulting in 193 deaths. The British maritime investigator made a recommendation in the investigation report of the accident: Britain should have an independent marine accident investigation agency. Soon in 1989, MAIB was established as an independent institution in the Ministry of Transport, with its headquarters in Southampton.

2.5.2 Structure

1) MCA

MCA is composed of 1050 employees and 3500 volunteers. Headquartered in Southampton, UK, with collaboration centers and offices along the UK coast, MCA's internal high-level management structure is shown below⁽³⁵⁾:

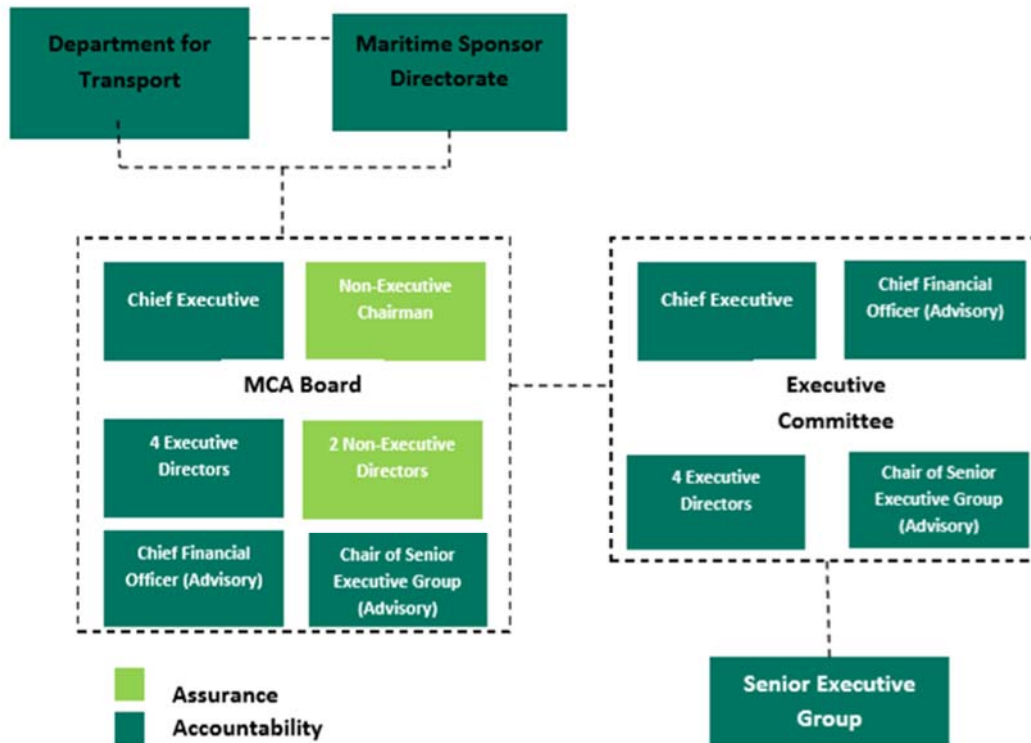


Figure 29 Chart of MCA organization

The Ministry of Transport of the United Kingdom manages the MCA through the Maritime sponsor directorate Maritime Sponsorship Council. The MCA's actions are monitored by the sponsorship council. The director general of the sponsorship council can be regarded as the owner of the MCA. The members of the sponsoring council include the maritime director as the promoter of the organization, the non-executive chair of the MCA, the chief executive of the MCA, the non-executive directors of the MCA, and the policy sponsor of the MCA policy. The CEO of MCA reports the performance of MCA to the sponsoring council, and the council provides opinion support and assistance to the CEO. The MCA-related projects and investment plans will be proposed on the sponsoring council and will eventually be reviewed by the investment committee of the Ministry of Transport.

MCA board The MCA board is the highest decision-making body of the MCA and is managed by the non-executive chairman. The MCA board is supported and supervised by the strategy and business of the executive committee and senior executive group. The Executive Committee meets once a month, mainly but not just referring to the recommendations of the senior executive team, to decide on organizational strategies. The senior executive team holds a meeting once a month to make operational decisions and provide organizational management recommendations to the executive committee.

The MCA Council consists of non-executive chairman, executive chairman, maritime operations and director of maritime operations and HM coastguard, director of strategy and corporate services, director of maritime safety and standards, director

of the UK ship register, chair financial officer, chair of the Senior executive group, as well as MCA non-executive director and a member of the sponsoring council.

The main task of Director of maritime operations and HM coastguard is to complete the 6 internationally recognized coasts through the National Coast Guard Action Network consisting of coastguard operation centers, volunteer coastguard rescue service, aeronautical rescue coordinate center, search and rescue helicopter Guard functions.

The main tasks of Director of strategy and corporate services are: strategic planning, performance monitoring, organizational management and financial control, employee and volunteer health and safety, information and communication technology, property management, human resource management, learning and development, and advanced information Responsible person.

Director of maritime safety and standards is mainly responsible for: the legal responsibility of the British flag management agency for safety, security and environmental protection, including British ships worldwide and foreign ships in British waters, passenger ships and fishing vessels in the UK. Safety, the United Kingdom's safe navigation system and civil hydrology are also long-term representatives of the United Kingdom in IMO to negotiate and supervise the maritime policies and interests of the United Kingdom and the IMO and EU. Is the senior person in charge of MCA investigation and testing transformation plan.

Director of the UK ship register's main task is to attract high-quality ship owners to register for British ship registration to ensure long-term business growth, providing ship registration, seafarer services, and inspection and audit services for all British ships.

In addition, MCA's Her Majesty's coastguard is responsible for providing emergency rescue services for British marine incidents. The working system of HM coastguard mainly includes a National Maritime Operation Center (NMOC), nine Coastguard Operation Centers (CGOC). The guard rescue team composed of staff and volunteers, helicopter rescue base and marine anti-pollution airport. NMOC is responsible for handling all incidents. No matter where the accident occurs, Dover's CGOC is responsible for 24 hours to check the traffic separation of the channel.

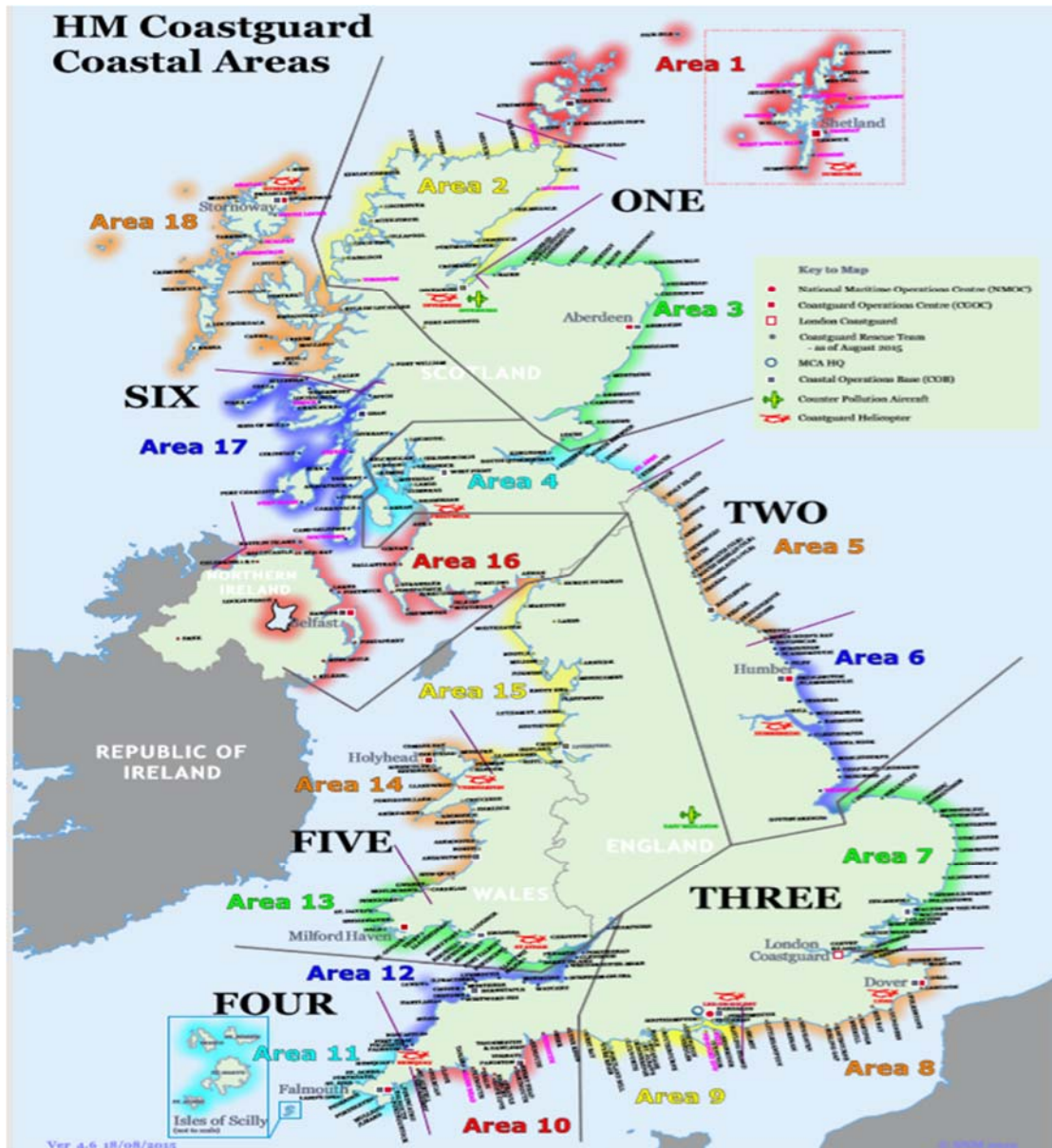


Figure 30 6 MCA regions

2) MAIB

MAIB is a very small organization consisting of only 35 people. 35 people need to be responsible for all technical work such as accident investigation, accident report production, and navigation-related data analysis. The chief inspector of MAIB reports directly to the State Secretary of the Ministry of Transport, which guarantees MAIB's autonomy.

The 12 investigators are divided into 4 investigative teams, each of which is led by a chief investigator, who will report to the deputy chief investigator. The investigation team implements a rotation system on call. Those involved in MAIB investigations are those with extensive experience in nautical, marine, or shipbuilding. If the first group includes an investigator with knowledge and experience of the agency, and two

maritime investigators plus an auxiliary investigation management, the second group has the same staffing as the first group, two nautical investigators, an agency In terms of investigators, the third group consists of a ship structure investigator, an agency investigator, a nautical investigator and an investigator responsible for managing one. The fourth group includes one for the organization, one for navigation, one for human factors, and one for investigation assistant management.

The personnel of the MAIB technical team will provide technical support to the investigators to help them solve the technical problems encountered at the investigation site.

The personnel of the MAIB publications team are responsible for producing the MAIB accident investigation report, including editing, typesetting, drawing, and printing. Every stage from the initial draft of the report needs to be involved.

The MAIB's accident investigation support staff is responsible for handling the initial notification of the accident. Through their MAIB, the investigation of the accident is started, and they also coordinate employees to go to the accident scene.

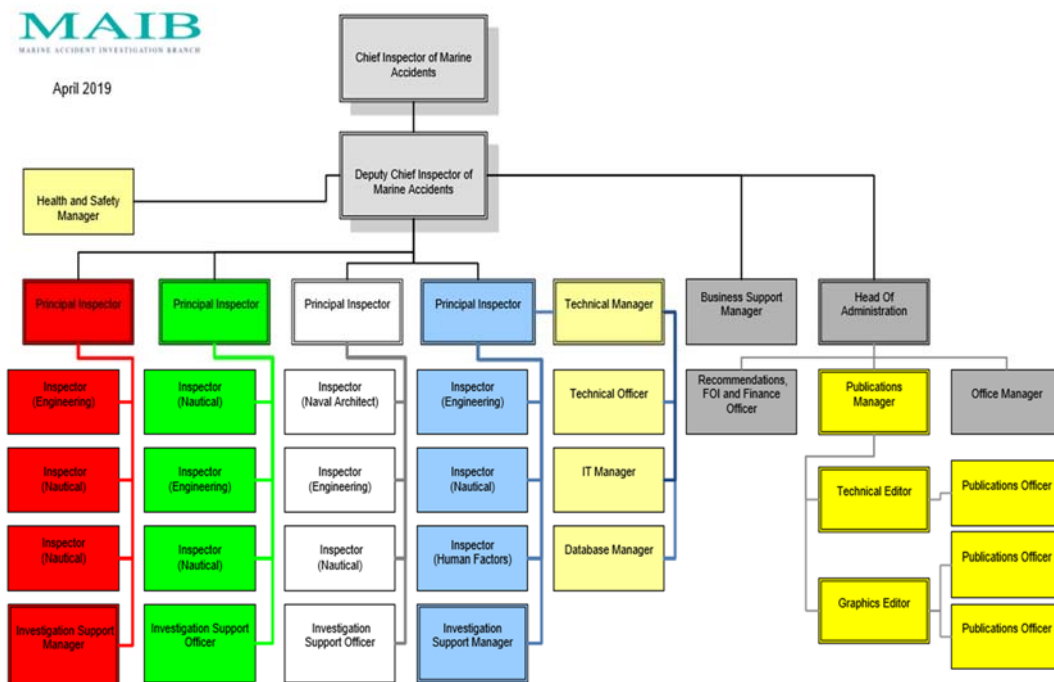


Figure 31 Chart of MAIB organization

2.5.3 Investigation Process

Since the MCA is responsible for accident handling and rescue work on the British sea, the MCA will receive the news of the accident as soon as possible and immediately go to the scene of the accident to start processing. MAIB investigates incidents involving British ships in British sailing waters or other parts of the world, mainly investigating very serious marine accidents. Very serious accidents refer to total damage to the ship, death, or serious pollution.

1) MCA

MCA is informed of the occurrence of accidents through VTS monitoring, accident information issued by parties to the accident, and many other means. Then the local MCA personnel immediately rushed to the scene to conduct the necessary rescue and accident investigation and provided the accident situation and information to MAIB. Investigate and collect the voyage records of the ship and the performance of the ship and interview the personnel related to the accident. There is no fixed model for MCA investigations, and the investigation reports are not made public. If any violations are found in the accident ship during the investigation, a decision is made based on the nature of the violation and the severity of the consequences. After investigation, the local MCA reports to the headquarters. Based on the various evidences reported, the headquarters analyzes whether further investigation is required, and issues accident investigations and rectification requests to shipowners, crew, and other accident-related parties. For existing violations, Submit the investigation evidence to the court to file a lawsuit.

2) MAIB

MAIB obtains the news of the accident through notifications from the crew, shipowners, MCA, or media reports and MAIB's 24-hour telephone reporting line.

Once a notification has been received, the duty principal inspector will classify the accident and determine if it falls within the MAIB's remit. If the accident is one that meets the MAIB criteria for investigation, the principal inspector will nominate a lead inspector and a preliminary assessment will begin. He will also arrange for the preservation of evidence, which could be either physical evidence such as the remains of a broken rope, or electronic evidence such as VDR or navigational data. Additionally, the lead inspector and incident support officer will begin to gather information on the vessel(s) involved and the location of the accident. Except when a safety investigation is started, a preliminary assessment is usually completed by office-based enquiries.

A safety investigation has several distinct stages, although not every stage is always required; it is not uncommon for some to overlap:

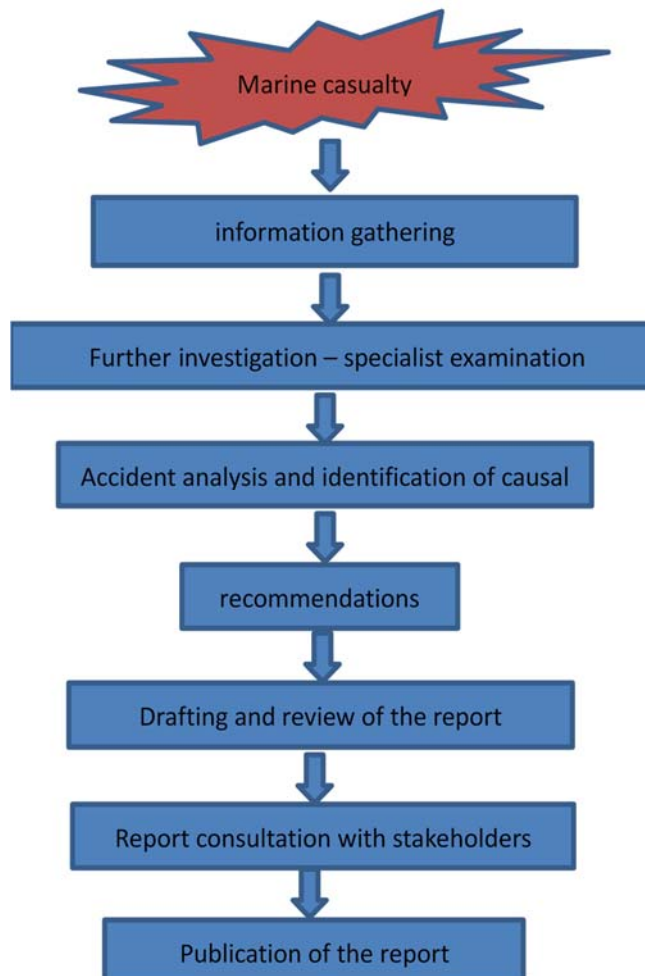


Figure 32 MAIB investigation process

The stakeholders are involved at each stage of the investigation. The investigation team itself must have the correct number of people with the necessary skills and equipment to liaise with the master and other authorities, interview crew and other stakeholders, and to gather and preserve evidence quickly and effectively. Although most deployed teams are made up of two inspectors the team can often be supplemented by additional inspectors and/or the technical team.

If items gathered during an investigation require testing by a third-party expert it can have a serious impact in increasing the length of time taken for the investigation. However, generally the MAIB aims to publish an investigation report eight months after an accident has occurred.

When all the accident data has been collected, the lead inspector – in consultation with the principal inspector – will use the facts of the case to identify the causal. This is the analysis stage. The lead inspector is then able to use the factors to determine the safety lessons that may be drawn from the accident.

Following the analysis stage, the Chief Inspector will consider if it is appropriate to make a recommendation. Recommendations are generally issued with the agreement of the receiving party.

The final stage of the MAIB investigation is the report consultation and publication phase. This is the opportunity for the stakeholders who may be adversely affected by the report's conclusions, to comment on the MAIB's draft report. The consultation is the last check on the facts before publication of the report and is a fundamental part of the process. The MAIB's objective can only be achieved through factually correct reports.

After the 30-day consultation period, final corrections are made if necessary. The report is then published and is made available to all through the MAIB's website. The publication team will also make every effort to ensure that the relevant industry bodies are aware of the report. And while the report will mark the end of the investigation, the data gathered may be used in support of safety studies or other future cases.

2.5.4 Some definitions of maritime accident in UK

According to the regulations of MAIB MGN 458 (M+F)⁽³⁶⁾, the accident is classified as: very serious marine casualties, serious marine casualties, and marine incidents.

A marine incident is an event or sequence of events other than those listed above which has occurred directly in connection with the operation of a ship that endangered, or if not corrected would endanger the safety of a ship, its occupants or any other person or the environment. 'Near misses' are marine incidents.

A marine casualty is an event or sequence of events that has resulted in any of the following and has occurred directly by or in connection with the operation of a ship involving-

- 1) the death of, or serious injury to, a person;
- 2) the loss of a person from a ship;
- 3) the loss, presumed loss or abandonment of a ship;
- 4) material damage to a ship;
- 5) the stranding or disabling of a ship, or the involvement of a ship in a collision;
- 6) material damage to marine infrastructure external of a ship, that could seriously endanger the safety of the ship, another ship or any individual, or
- 7) pollution, or the potential for such pollution to the environment caused by damage to a ship or ships.

A serious marine casualty is an event or sequence of events that has resulted in any of the following and has occurred directly by or in connection with the operation of a ship but does not qualify as a very serious marine casualty, that involves-

- 1) fire;
- 2) explosion;
- 3) collision.
- 4) grounding;
- 5) contact;
- 6) heavy weather damage, or
- 7) ice damage, or a suspected hull defect.
resulting in any of the following
 - a) the immobilization of the main engines;

- b) extensive accommodation damage;
- c) severe structural damage including penetration of the hull under water rendering the ship unfit to process;
- d) pollution, or
- e) a breakdown that necessitates towage or shore assistance.

A very serious marine casualty is an event or sequence of events that has resulted in any of the following and has occurred directly by or in connection with the operation of a ship

- 1) the total loss of a ship;
- 2) loss of life;
- 3) severe pollution.

2.5.5 Accident statistics in UK in recent years

In 2018, MAIB received a total of 1,227 ship accidents (including accidents and incidents) involving 1,339 ships, of which 744 accidents were related to commercial ships, and a total of 798 ships were injured to varying degrees in 744 accidents. MAIB divided the 744 accidents according to the severity of the accident⁽³⁷⁾.

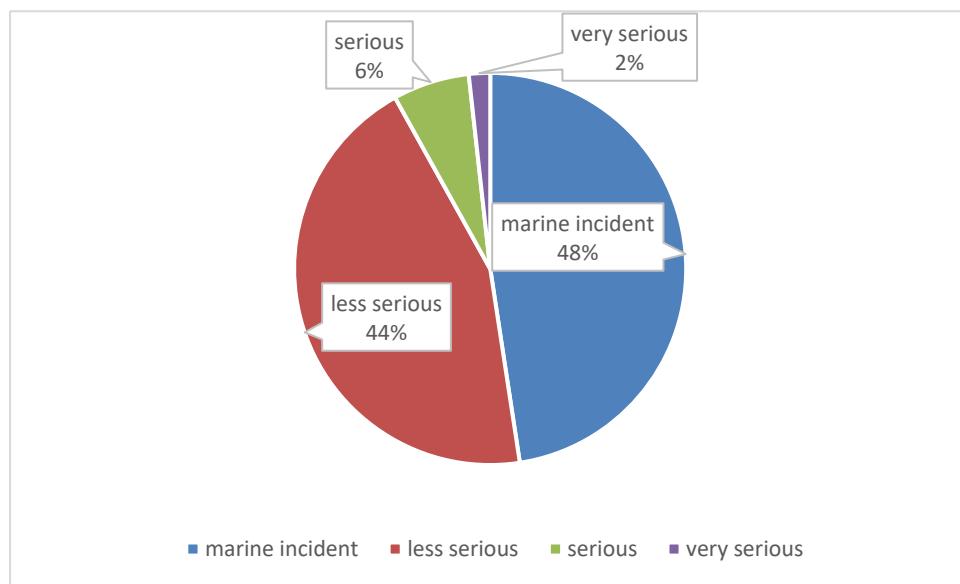


Figure 33 Accidents that classified according to severity

About half of these 744 accidents are marine incidents that cause less damage. The proportion of serious accidents and very serious accidents is very small.

In the statistics of MAIB, the 798 ships are divided into fishing vessels, merchant ships under 100 tons, merchant ships under 100 tons and above, and foreign national ships in British waters.

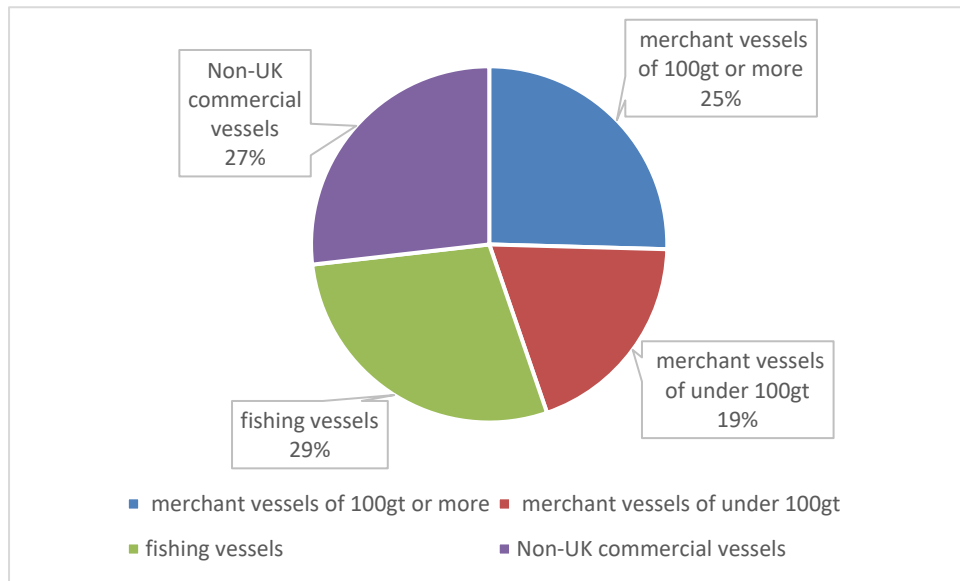


Figure 34 Accidents that classified according to the types of commercial vessels

It can be seen that in the accident information received by the British MAIB in 2018, fishing boats, non-UK ships, ships of 100 tons and above accounted for between 25%-30%. The proportion of ships under 100 tons is slightly smaller.

Chapter3. Reasons for establishing independent maritime accident investigation agencies in Japan, the USA and the UK

This chapter introduces the initial reasons for Japan, the United States and the United Kingdom to establish independent maritime accident investigation agencies, and draws some enlightenment from these reasons, as well as what China can learn from it.

3.1 JTSTB

Before the establishment of the JTSTB, the original Japanese JMAT was responsible for the administrative investigation of marine accidents. The Aviation and Railway Accident Investigation Committee is responsible for the safety investigation of aviation and railway accidents in Japan.

Because IMO required all countries in 2008 to separate accident safety investigations from other forms of investigations, a completely independent safety investigation is needed to ensure that investigations are not held accountable, so as to thoroughly investigate the cause of the accident and prevent the accident from happening again. Therefore, in response to IMO request, Japan handed over the original JMAT punishment function for accidents to the new JMAT, a special agency of the MLIT on October 1, 2008, and handed over the JMAT cause investigation function to the original Aviation and Railway Accident Investigation Committee became the JTSTB of the MLIT.

Since then, Japan has a unified body for the investigation of aviation, railway, and marine accidents, and has integrated various resources required for accident investigations, such as some fire, explosion, and human factors experts can participate in various accidents. During the investigation, the accident investigation capability was strengthened, and human resources were used more efficiently.

3.2 NTSB

In 1967, Congress consolidated all transportation agencies into a new U.S. Department of Transportation (DOT) and established NTSB as an independent agency placed within the DOT for administrative purposes. In creating NTSB, Congress envisioned that a single organization with a clearly defined mission could more effectively promote a higher level of safety in the transportation system than the individual modal agencies working separately (Annual report 2017) . Since 1967, NTSB has investigated accidents in the aviation, highway, marine, pipeline, and railroad modes, as well as accidents related to the transportation of hazardous materials.

In 1974, Congress reestablished NTSB as a completely separate entity, outside the DOT, reasoning that " ...No federal agency can properly perform such (investigatory) functions unless it is totally separate and independent from any other ... agency of the United States. " Because the DOT has broad operational and regulatory responsibilities

that affect the safety, adequacy, and efficiency of the transportation system, and transportation accidents may suggest deficiencies in that system, NTSB's independence was deemed necessary for proper oversight. NTSB, which has no authority to regulate, fund, or be directly involved in the operation of any mode of transportation, conducts investigations and makes recommendations from an objective viewpoint (Annual report 2017)⁽³⁴⁾.

3.3 MAIB

The establishment of the UK MAIB originated from a ship accident. After the accident, people began to reflect on the UK maritime industry, which led to a great reform in the investigation of maritime accidents. This accident was the overturning accident of the UK Herald of Free Enterprise, a Ro-Ro Ship.

In July 1987, the Hon Mr. Justice Sheen, UK Wreck Commissioner, published his formal investigation report into the capsizing of the ro-ro ferry the Herald of Free Enterprise. The report provided that the purpose of the investigation was ‘to inquire into the circumstances of the casualty and to establish its causes. But it has always been accepted that the Investigation has a second purpose, which is to see what lessons can be learned from the circumstances of the casualty which will contribute towards the safety of life at sea in the future’. The Hon Mr Justice Sheen went on to state that in the Herald of Free Enterprise inquiry the secondary function of the investigation had rightly taken on a major importance.

The formal investigation into the Herald of Free Enterprise disaster was not only notable for its findings but also for its recommendations designed to enhance future maritime safety. One such recommendation was that in order to satisfy the general public of the independence and transparency of formal investigations, they should be completed by a body that was ‘wholly separate from the Department’. Consequently, in 1989 the Marine Accident Investigation Branch was formed in Southampton, England. The Branch’s sole purpose is to improve safety at sea through the promulgation of the safety lessons learnt from marine accidents.

3.4 Some conclusions

From the reasons for the establishment of independent investigation agencies in various countries, it can be seen that independent investigation agencies have some help in accident investigation. we can summarize them as:

- 1) Various forces in investigation can be integrated to make the original investigation resources more widely used, improve resource utilization, and make the investigation more professional and accurate.
- 2) The independent investigation makes the investigation process not affected by other organizations or individuals, and ensures the objectivity of the investigation, helps people understand the true cause of the accident, and plays a role in preventing future accidents.
- 3) It plays a certain role in the supervision and inspection of some existing

government transportation departments. Some accidents also have some relations with the government's transportation management. An independent investigation can find problems in the transportation system which is under the management of government department.

- 4) The investigation of the accident by an independent investigation agency allows people to learn from the accident and prevent similar accidents from happening again.
- 5) An independent investigation agency can satisfy the public's need for accident investigation transparency.

3.5 Something China can learn from

Although MSA has separated the maritime safety investigation and the water traffic accident investigation, actually both are conducted by the same person named by MSA. So, in fact, MSA is failing to meet the requirements of IMO.

And according to the *Report on Water Traffic Safety Situation in 2018* published by MSA⁽²³⁾, the cause for the frequent accident is that “*the increase of intentional illegal acts is the main reason for the frequent accidents in 2018*”. Specifically, the lack of valid ship certificates, the shortage of ship crew, and the accidents caused by inland river vessels illegally engaged in maritime transport account for a large proportion of the total number of accidents. from last year. In addition, the poor quality of seafarers and the neglect of safety in production by shipping companies are also the causes of frequent accidents.

However, the main work of MSA is “management traffic safety and prevent ship pollution”, which includes supervise the safety production conditions of ship and safety management system of shipping enterprise; the management of qualification training, examination and certification for crew, pilots. It can be said that the cause of frequent accident is also related to the inadequate performance of the MSA, such as issuance of certificates for crew members who fail to meet the standards, or the failure to urge shipping enterprise to improve the safety management.

Therefore, for the purpose of achieving IMO standards and promoting MSA management, the establishment of an independent marine accident investigation team in China is of great help in improving the current safety of maritime navigation.

Chapter4. Comparison between China MSA and Japan JTSC

This chapter establishes a comparative system of marine accident investigation organizations of various countries and uses this system to compare China MSA and Japan JTSC from different angles. Through the comparison of this method, the advantages of China MSA and Japan JTSC are obtained. Then, some suggestions are given to improve the marine accident investigation agencies of the two countries.

4.1 Establishment and description of government performance measurement form

The measurement form used in this article is based on the BSC method and the CAF method. The BSC is used to inspect the organization in the large frame, and the CAF is used to consider the specific small indexes. In addition, some special indexes reflecting the maritime accident investigation agencies are also fully taken into account.

Among the evaluation methods for organizations, BSC is one of the most common methods, mainly from four perspectives of finance, customers, internal operations, learning and growth, to transform the organization's strategy into an operational measure. The core content of the BSC design is that the four selected angles represent the three main stakeholders of the organization: shareholders (government managers), customers (social public), and employees. Judging whether the performance indexes of these stakeholders are consistent with the organization's strategy can provide valuable reference value for institutional managers.

From a financial point of view, since the maritime accident investigation agency is a government organization and does not involve profit, the financial assessment of the maritime accident investigation agency only depends on the annual budget and budget allocation. The main source of motivation for an organization's operation is its budget.

The client is the service target of an organization. For the maritime accident investigation agency belonging to a government agency, the client can be regarded as the general public. The evaluation of the maritime accident investigation agency by the public is the truest reflection of the work results of the maritime investigation agencies.

Internal operations include the talent structure and management methods within an organization. Any organization is composed of various talents. Whether an organization can operate efficiently depends on its internal operations.

Learning and growth determine whether an organization has the ability to develop and reform. If an organization can grow and improve in the long term, then the future of this organization will definitely succeed. The investigation of an organization's ability to learn and grow mainly depends on the training of employees and learning with the outside.

Because the BSC's method of dividing the assessment angle is very easy to understand, and the assessment content is also very comprehensive, the framework of the assessment table in this article is designed according to these four perspectives of

BSC: Investment, Internal management, learning and training, and Results. We set these four inspection perspectives as level 1 inspection indicators.

These four indicators will also interact with each other. The Investment will support the normal operation of the organization and will also affect the Learning and Training of the organization by adjusting the allocation of Learning and Training. Learning and Training makes the organization develop progressively, and at the same time also promotes changes in the organization's Internal Management. Internal Management determines the organization's operating mode, and the management model also determines the organization's ability to Learning and Training. In the end, these effects will be reflected through the Results of the organization.

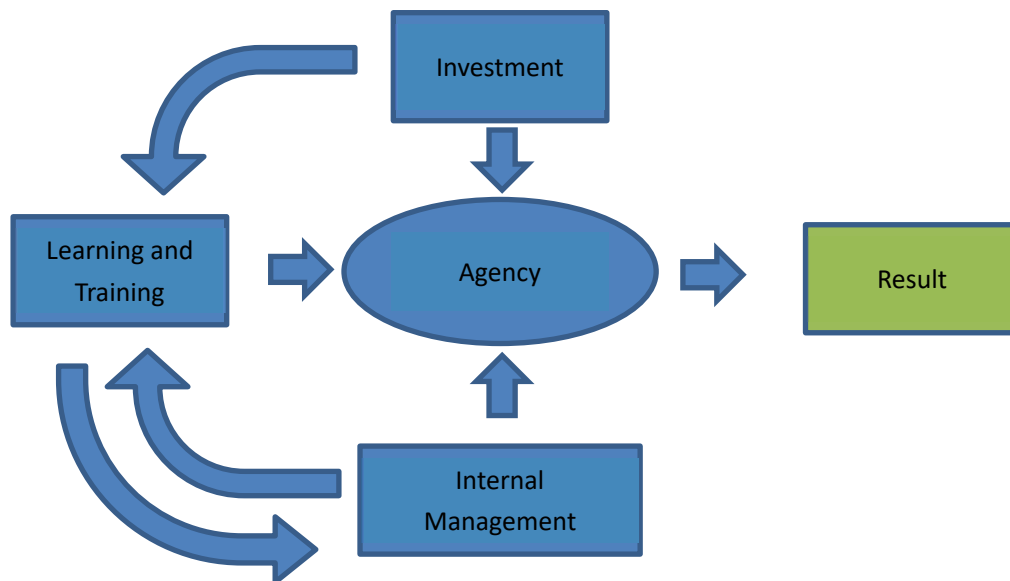


Figure 35 Relation between 4 first-level indexes

Afterwards, the design of the second and third level indexes is more based on some CAF references plus some unique indexes reflecting the maritime accident investigation agency. The use and promotion of CAF has been generally recognized by the countries of the European Union and is already an official tool in some countries. CAF's index system is divided into two major elements: "enablers" and "results", a total of 9 first-level criteria and 27 sub-criteria.

Among them, there are 5 first-level criteria and 19 sub-criteria. (1) leadership: a. Guidance given in the development and delivery of the organization's vision, mission and values, b. Development and implementation of organizational management System, c. Motivate and support employees and take appropriate roles, d. coordinate the relationship with politicians and relevant stakeholders; (2) strategy and planning: a. Collect relevant and current needs of stakeholders information, b. Develop, evaluate and revise the organization's strategy and planning, c. Implement the strategy and planning throughout the organization; (3) human resources management: a. Plan, manage and improve human resources closely related to the strategy and planning, b. Recognize, develop and use employee capabilities around the goals of individuals,

teams and organizations, c. Initiate dialogue and authorization with employees; (4) Partner and resource management: a. Develop and implement key partnerships, b .Develop and implement partnerships with citizens, c. Knowledge management, d. Financial management, e. Technical management, f. Housing and asset management; (5) Process and change management: a. Confirmation, design, management and improvement process , B. Development and provision of services and products for citizens, c. Planning and management of modernization and innovation.

There are 4 first-level criteria and 8 sub-criteria in the "result" element. (6) Citizen results: a. Citizen satisfaction measurement results, b. Citizen-oriented measurement indicators; (7) Employee results: a. Employee satisfaction and incentive measurement results, b. Employee results indicators; (8) Social results : A. Social performance results, b. Environmental performance results; (9) Key performance results: a. Achievement of goals, b. Financial performance.

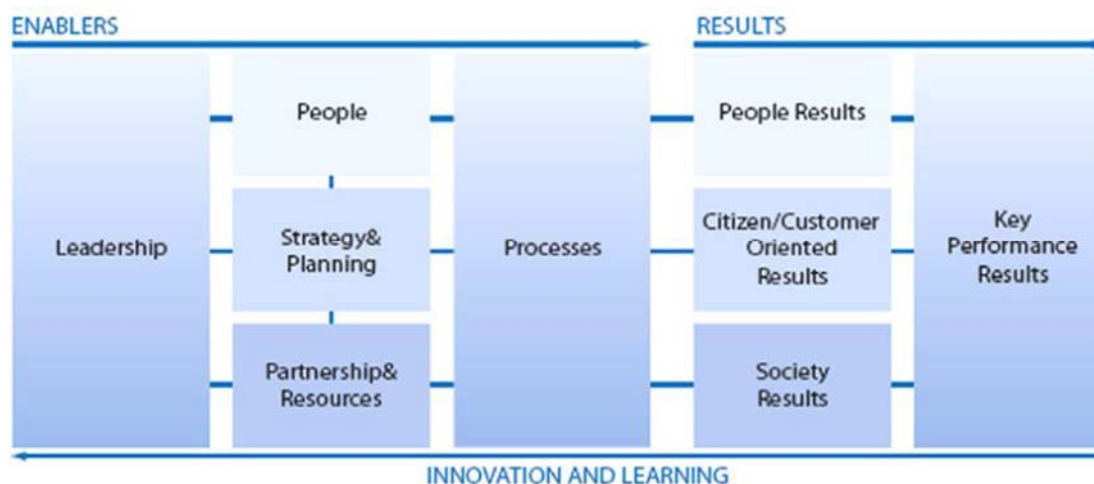


Figure 36 The CAF model

4.1.1 Investment

In terms of “investment” to the marine accident investigation organization, it mainly depends on the overall budget and budget allocation in various aspects. This paper designs 6 small three-level criteria for investment criterion:

Budget: The total budget received by China's MSA and Japan's JTSCB within one year.

Wages: The cost of the employee's basic salary for one year.

Three public spending: the sum of expenses for going abroad for business, receiving business, purchasing vehicles on official business and maintaining the vehicle within one year.

Maintenance: the sum of the maintenance cost of ships, electronic equipment and houses within one year.

Equipment purchase: the total purchase cost of special equipment within one year.

Training expenses: the sum of training expenses for employees within one year.

4.1.2 Internal management

For the “Internal management” of the maritime accident investigation agency, two secondary indexes of "Talent base" and "Transparency" were taken. Because the “Talent base” is the most basic unit that constitutes a maritime accident investigation agency, and "Transparency" is the basis of public trust in government departments.

The “Talent base” includes four three-level indexes:

Staff benefits: the sum of allowances, subsidies, bonuses, food and housing subsidies, medical subsidies, housing provident funds, etc. received by employees within one year.

Professional coverage: the professional scope covered by professional talents in the marine accident investigation agency.

Education: the proportion of various educational backgrounds of the workforce within the marine accident investigation agency.

Age structure: The age structure of the employees in the marine accident investigation agency.

“Transparency” includes four three-level indexes, namely:

The number of annual accident reports: the number of accident investigation reports published on the official website of the marine accident investigation agency within a year, and the number of accidents completed by the marine accident investigation agency within one year.

Application of information disclosure: applications for information disclosure received within one year, and the processing of relevant applications.

Earliest traceable report: the year of the earliest accident investigation report that can be found on the official website.

Timeliness of release of accident report: The time interval from the completion of the investigation report to the release on the website.

4.1.3 Learning and training

In terms of the “Learning and Training” inspection of marine accident investigation agency, two secondary indexes of "International cooperation" and "Staff training" were selected. The improvement of an institution requires learning from other better practitioners. For a country’s maritime accident investigation agency, the relevant training of overseas investigation agencies and IMO is the best learning opportunity. At the same time, it is also necessary to enhance the staff’s comprehensive quality skills from within.

"International cooperation" contains three three-level indexes, namely:

International conference proposal: proposals and plans submitted to international organizations within one year.

Assist investigation with foreign expert: Marine accidents jointly investigated with foreign maritime experts within one year.

International conference: The number of international conferences participated in a year.

"Staff training" contains three three-level indexes, namely:
Percentage of qualified staff: the proportion of employees holding corresponding qualification certificates in maritime accident investigation agencies.
Overseas training: Number of people sent to study abroad within one year.
Situation of new employees: the number of new employees.

4.1.4 Result

Since the purpose of the maritime agency's work is to reduce the loss of personnel and property caused by a marine accident, and the work services are targeted at the public. When assessing the investigation agency, this article starts from "Operational capacity", "Social influence", and "Achievement" 3 secondary indexes.

"Operational capacity" includes five three-level indexes, namely:

Number of investigations: The number of accidents investigated in a year, including the number of under investigations and completed.

Number of dead and missing: The number of deaths and missing persons caused by marine accidents within one year.

Number of total loss ships: The number of ships that have sunk and lost total damage within one year.

Economic losses: The economic loss caused by a marine accident within one year.

Average survey duration: Based on the investigation report issued by the maritime investigation agency, calculate the average time it takes to complete an accident investigation.

"Social influence" contains three three-level indexes, namely:

Public lecture: A publicity seminar on maritime safety knowledge organized by maritime accident investigation agencies to schools and enterprises within one year.

Social satisfaction: The public's satisfaction with the work of the maritime survey organization.

Website visitors: the number of people who visited the official website of the maritime investigation agency within one year.

"Achievement" contains three three-level indexes, namely:

Accident reduction: Compared with the previous year, the reduction rate of the number of marine accidents in the year, if the accident increases, the reduction rate is negative.

Economic losses reduction: Compared with the previous year, the reduction rate of economic losses caused by marine accidents during the year, if the economic loss increases, the reduction rate is negative.

Casualties reduction: Compared with the previous year, the reduction rate of the number of deaths and missing persons caused by maritime accidents in the year, if the number of deaths and missing persons increases, the reduction rate is a negative number.

Based on the above division method of the comparison assessment table, the preliminary table design of this article is as follows:

Table 3 Performance measurement form of marine accident investigation agency

Investment		budget
		wages
		three public spending
		maintenance
		equipment purchase
		training expenses
Internal Management	talent base	staff benefits
		professional coverage
		education
		age structure
	transparency	the number of annual accident reports
		application of information disclosure
		earliest traceable report
		timeliness of release of report
Learning and Training	international cooperation	international conference proposal
		assist investigation with foreign expert
		international conference
	staff training	percentage of qualified staff
		overseas training
		situation of new employees
Result	operational capacity	number of investigations
		number of dead and missing
		number of total loss ships
		economic losses
		average survey duration
	social influence	public lecture
		social satisfaction
		website visitors
	achievement	accident reduction
		economic losses reduction
		casualties reduction

The table has 4 first-level indexes, 7 second-level indexes, and 31 third-level indexes. By using this form, it is possible to compare marine accident investigation agencies of different countries from a very objective perspective. In addition, compared with some previous studies, this method quantifies the comparison process of marine accident investigation agencies in different countries, and the results obtained are more convincing. Comparisons can be made from multiple angles such as organizational size,

learning and development capabilities, participation in international affairs, social impact, and business processing capabilities. Through the process of comparison, we can learn the strengths and weaknesses of a marine accident investigation agency. Some suggestions can be put forward on the reform of maritime accident investigation agencies in the future.

4.2 Relevant data and description of China MSA

The data about MSA in China in the table is partly from the data information published on the official website of MSA, partly from the author's application through MSA's official channels, and partly based on the original data of MSA and obtained from the author's statistics. All data comes directly or indirectly from MSA's official release information. The specific data is shown in the following table:

Table 4 Performance measurement form of MSA

			China	
Investment		budget	129.1billion	
		wages	9.8billion	
		three public spending	1.4billion	
		maintenance	1.5billion	
		equipment purchase	142million	
		training expenses	796.7million	
Internal Management	talent base	staff benefits	30.1billion	
		professional coverage		
		education	81.3%Bachelor degree or above	
		age structure	40.5%under35 , 60%under 45	
	transparency	the number of annual accident reports	99/196	
		application of information disclosure	7/10	
		earliest traceable report	2015	
		timeliness of release of report	22.5months	
	Learning and Training	international cooperation	international conference proposal	43
			assist investigation with foreign expert	0
international conference			18	
staff training		percentage of qualified staff	93%	
		overseas training	0	
		situation of new employees	1168/1096	

			bachelor degree/36 master degree
Result	operational capacity	number of investigations	128
		number of dead and missing	140
		number of total loss ships	42
		economic losses	2.6billion
		average survey duration	4.2months
	social influence	public lecture	5000
		social satisfaction	95.70%
		website visitors	9813499
	achievement	accident reduction	27.3%
		economic losses reduction	42%
		casualties reduction	40.90%

1. Budget: According to the budget released by the MSA of the Ministry of transport of the People's Republic of China, in 2019, the financial appropriation revenue of the China MSA totaled 8489.7091 million RMB (129.1billion JPY).⁽³⁸⁾
2. Wages: In 2019, the basic wage income of the staff of the China MSA totaled 643.5401 million RMB (9.8billion JPY).⁽³⁸⁾
3. Three public spending (Expenses for going abroad on business, official reception, purchase and maintenance of vehicles): In 2019, the Three public spending of the China MSA totaled 88.8011 million RMB (1.4 billion JPY).⁽³⁸⁾
4. Maintenance: In 2019, the maintenance cost of ships, electronic equipment and office of the China MSA totaled 100.4316 million RMB (1.5 billion JPY).⁽³⁸⁾
5. Equipment purchase: In 2019, the budget of equipment purchase of the China MSA totaled 9.3413 million RMB (142 million JPY).⁽³⁸⁾
6. Training expenses: In 2019, the staff training expenses of the China MSA totaled 52.3985 million RMB (796.7 million JPY).⁽³⁸⁾
7. Staff benefits (Including work allowance, bonus, food and housing allowance, medical treatment, etc.): In 2019, the Staff benefits of the China MSA totaled 2.0281 billion RMB (30.1 billion JPY).⁽³⁸⁾
8. Professional coverage: The experts of the China MSA include ship pollution inspector, ship safety inspector, visa inspector, seafarer examination officer, VTS officer, etc.⁽³⁹⁾
9. Education: In 2019, 81.3% of the total staff are undergraduate or above.⁽³⁹⁾
10. Age structure: In 2019, 60% of the staff of the China MSA are under 45 years old, and 40.5% are under 35 years old.⁽³⁹⁾
11. The number of annual accident reports: Since all the accident investigations in 2017 have been completed, the data in 2017 is more accurate. In 2017, China Maritime Administration investigated 196 accidents and published 99 accident

- investigation reports on its website. The data is obtained from the accident investigation report of 2017 issued by the maritime administration of China.⁽⁴⁰⁾
12. Application of information disclosure: In 2019, the China MSA received 10 applications for information disclosure, and responded to 7 of them. And the China MSA did not have the relevant data, and one was a duplicate application.⁽⁴¹⁾
 13. Earliest report: The earliest accident report issued by the China MSA is 2015. Since the implementation of "Shuishang jiaotong shigu tongji banfa (In Chinese) Measures for statistics of water traffic accidents", that the general level accidents shall be reported to the China MSA.
 14. Timeliness of release of report (Time between the completion of the investigation report and its publication on the website of the MSA): Based on the statistical analysis of 164 in 408 reports available in China MSA, it is concluded that it will take an average of 22.5 months for the China MSA to publish the report to the website after the completion of investigation report.⁽⁴⁰⁾
 15. International conference proposal: In 2019, the MSA submitted 43 proposals to the international organization.⁽⁴²⁾
 16. Assist investigation with foreign expert: In 2019, the number of marine accident investigation that the China MSA conducted with foreign experts is 0.
 17. International conference: In 2019, the number of international conference that the China MSA attended is 18. Like Marine Accident Investigators' International Forum. According to the statistics of all relevant news information released by MSA in 2019.⁽⁴³⁾
 18. Percentage of qualified staff: In 2019, the number of staffs who have obtained certificates, such as ship pollution inspector, ship safety inspector, visa inspector, seafarer examination officer, VTS officer, accounts for 93% of the total.⁽³⁹⁾
 19. Oversea training: In 2019, the number of person who went abroad training arranged by the China MSA is 0.⁽⁴³⁾
 20. Situation of new employees: In 2019, the China MSA recruited 1168 people, of whom 1096 had bachelor's degree or above and 36 had master's degree. The data is obtained by the statistics of the employees employed in MSA civil service examination.⁽⁴⁴⁾
 21. Number of investigations: In 2019, there were 128 accidents of general level or above in China, and 128 accidents investigated by the China MSA.⁽⁴²⁾
 22. Number of deaths and missing: In 2019, the number of deaths and missing caused by marine accidents in China is 140.⁽⁴²⁾
 23. Number of total loss ships: In 2019, the number of total loss ships in China's water and overseas Chinese ships is 42.⁽⁴²⁾
 24. Economic lose: In 2019, China economic losses caused by maritime accidents totaled 170 million RMB (2.6 billion JPY).⁽⁴²⁾
 25. Average survey duration: Based on the analysis of all the accident reports published by the China MSA, it is concluded that the average survey duration in China is 4.2 months. According to the investigation report of 164 accidents from 2015 to 2019 issued by MSA.
 26. Public lecture: In 2019, the China MSA held 5000 public lecture to students,

shipping enterprises about the marine safety.⁽⁴²⁾

27. Social satisfaction (the public's satisfaction on the performance): In 2019, the China MSA did not carry out such survey work. But there were 8, half of the 15, directly affiliated MSA that conducted social satisfaction, which were Shandong 96.3%, Guangdong 99.56%, Lianyungang 93.18%, Guangxi 99.81%, Shenzhen 93.7%, Shanghai 93.7%, Tianjin 96.66%, Hebei 95%, Changjiang 94.31%. And the average is 95.7%. The social satisfaction data of MSA are from the information released by local MSA.
28. Website visitors: In 2019, the total number of visitors to the website of the China MSA is 9813499.⁽⁴¹⁾
29. Accident reduction: In 2019, 128 accident of general level accidents happened in China, 176 in 2018, and the reduction is 27.3%.
30. Economic lose reduction: In 2019, the economic losses caused by marine accident in China was 170 million RMB, and in 2018, the economic losses was 290 million RMB, 42% less.
31. Casualties reduction: In 2019, 140 people died or disappeared due to the marine accidents in China. In 2018, the number was 237. The reduction is 40.9%.

4.3 Relevant data and description of Japan JTBS

Information about the Japan Maritime Investigation Organization comes from some information and data officially released by JTBS. As of April 17, 2020, Japan's accident statistics for 2019 have not yet been released, so this article uses the accident statistics released by Japan's JTBS and JCG in 2018. The details are as follows:

Table 5 Performance measurement form of JTBS

			Japan
Investment		budget	2.1billion
		wages	1.1billion
		three public spending	10.8million
		maintenance	0.6million
		equipment purchase	3.4million
		training expenses	Unknow
Internal Management	talent base	staff benefits	0.6billion
		professional coverage	
		education	Unknow
		age structure	Unknow
	transparency	the number of annual accident reports	762/764

		application of information disclosure	Unknow
		earliest traceable report	2007
		timeliness of release of report	0.93months
Learning and Training	international cooperation	international conference proposal	Unknow
		assist investigation with foreign expert	7
		international conference	4
	staff training	percentage of qualified staff	Unknow
		overseas training	1
		situation of new employees	Unknow
Result	operational capacity	number of investigations	830
		number of dead and missing	75
		number of total loss ships	13
		economic losses	4.3billion
		average survey duration	5.7months
	social influence	public lecture	Unknow
		social satisfaction	Unknow
		website visitors	Unknow
	achievement	accident reduction	-20.9%
		economic losses reduction	74.40%
		casualties reduction	-33.90%

1. Budget: According to the budget issued by the Ministry of Land Infrastructure, Transport and Tourism in 2018, the total budget of JTBSB in 2018 was 2.1 billion JPY.⁽⁴⁵⁾
2. Wages: In 2018, the basic wage of the Japan JTBSB totaled 1.1 billion JPY.⁽⁴⁵⁾
3. Three public spending: In 2018, the three public spending of the Japan JTBSB totaled 10.8 million JPY.⁽⁴⁵⁾
4. Maintenance: In 2018, the maintenance cost of house of the Japan JTBSB totaled 0.6 million JPY.⁽⁴⁵⁾
5. Equipment purchase: In 2018, the equipment purchase of the Japan JTBSB totaled 3.4 million JPY.⁽⁴⁵⁾
6. Training expenses: Not found yet.
7. Staff benefits: In 2018, the staff benefits, like overtime allowance, housing allowance, children's allowance, etc. totaled 0.6 billion JPY.⁽⁴⁵⁾
8. Professional coverage: Composite materials science, jurisprudence, JCG officer, Shipbuilding, Human factor.
9. Education: Not found yet.
10. Age structure: Not found yet.
11. The number of annual accident reports: Considering the length of survey duration,

- 764 accidents were investigated in 2017 and 762 of them were published by the Japan JTSCB. According to the report published on JTSCB's official website.⁽⁴⁶⁾
12. Application of information disclosure: Not found yet.
 13. Earliest report: In the investigation reports published by the Japan JTSCB, the earliest available year is 2007. According to the report published on JTSCB's official website.⁽⁴⁷⁾
 14. Timeliness of release of report: 189 accidents occurred in 2019 plus 170 accidents occurred in 2017 were selected to calculate the time from completion to report to the public, with an average of 0.93 months.
 15. International conference proposal: Not found yet.
 16. Assist investigation with foreign expert: The investigators of the Japan JTSCB cooperated with foreign expert for 7 times in 2018.⁽⁴⁸⁾
 17. International conference: The number of international conference which the Japan JTSCB participated in is 3.⁽⁴⁸⁾
 18. Percentage of qualified staff: Not found yet.
 19. Number of overseas training: In 2018, the Japan JTSCB send a total of 1 person to overseas training and study.⁽⁴⁸⁾
 20. Situation of new employees: Not found yet.
 21. Number of investigations: In 2018, the Japan JTSCB investigated 830 maritime accidents. <https://jtsb.mlit.go.jp/jtsb/ship/ship-accident-toukei.php>
 22. Number of dead and missing: According to statistics released by the Japan Coast Guard, in 2018, there were 75 dead and missing persons caused by ship accidents.⁽⁴⁹⁾ Number of total loss ships: Since the accidents below general level (causing more than 1 million RMB economic losses) will not be counted to the China MSA, the number of total loss of the ship accident in Japan which is more than 100 tons is 13.⁽⁴⁹⁾
 24. Economic losses: According to the statistics released by the Japan Coast Guard in 2018, the economic losses caused by ship accidents totaled 4.3 billion JPY.⁽⁴⁹⁾
 25. Average survey duration: 189 accident reports occurred in 2019 plus 170 accident reports occurred in 2017 are selected to calculate the time of maritime accident investigation, and the average duration is 5.75 months.
 26. Public lecture: Not found yet.
 27. Social satisfaction: Not found yet.
 28. Website visitors: Not found yet.
 29. Accident reduction: According to the statistics released by the Japan Coast Guard, in 2017, the number of ship accidents with tonnage over 100 tons was 177, the number in 2018 was 214, with an increase of 20.9%.⁽⁵⁰⁾
 30. Economic losses reduction: According to the statistics released by the Japan Coast Guard, the economic loss caused by maritime accidents in 2017 was 16.80039 billion JPY, the economic losses in 2018 was 4.30587 billion JPY. The economic losses reduced 74.4%.⁽⁵⁰⁾
 31. Casualties reduction: According to the statistics released by the Japan Coast Guard, in 2017, the number of dead and missing caused by ship accidents was 56, the number in 2018 was 75, with an increase of 33.9%.⁽⁵⁰⁾

4.4 Score evaluation method

Due to the lack of some data in JTSD of Japan, based on the available data from China and Japan, the comparison table is reasonably simplified to obtain:

Table 6 Simplified performance measurement form

			China	Japan
Investment		budget	129.1billion	2.1billion
		wages	9.8billion	1.1billion
		three public spending	1.4billion	10.8million
		maintenance	1.5billion	0.6million
		equipment purchase	142million	3.4million
Internal Management	talent base	staff benefits	30.1billion	0.6billion
		professional coverage		
	transparency	the number of annual accident reports	99/196	762/764
		earliest traceable report	2015	2007
timeliness of release of reports		22.5months	0.93months	
Learning and Training	international cooperation	assist investigation with foreign expert	0	7
		international conference	18	3
	staff training	overseas training	0	1
Result	operational capacity	number of investigations	128	830
		number of dead and missing	140	75
		number of total loss ships	42	13
		economic losses	2.6billion	4.3billion
		average survey duration	4.2months	5.7months
	achievement	accident reduction	27.3%	-20.9%
		economic losses reduction	42%	74.40%
casualties reduction		40.90%	-33.90%	

Through the selection of indexes with accurate data, there are 4 first level indexes, 6 second level indexes and 21 third level indexes in the final table. Set a full score of 100. The distribution of 100 points in each small index is as follows:

Table 7 Distributed points in performance measurement form

			Points
Investment		budget	5
		wages	4
		three public spending	4
		maintenance	4
		equipment purchase	4
Internal Management	talent base	staff benefits	4
		professional coverage	5
	transparency	the number of annual accident reports	5
		earliest traceable report	5
timeliness of release of report		5	
Learning and Training	international cooperation	assist investigation with foreign expert	5
		international conference	5
	staff training	overseas training	5
Result	operational capacity	number of investigations	5
		number of dead and missing	5
		number of total loss ships	5
		economic losses	5
		average survey duration	5
	achievement	accident reduction	5
		economic losses reduction	5
		casualties reduction	5

The maritime accident investigation agencies compared in this article are China MSA and Japan JTSB. For a certain index, the scoring method can set the best performers to a full score of 5 points, and the worse ones are:

$$\text{Score of the poor} = \frac{\text{The poor}}{\text{The best}} \times 5$$

For example, in the “Budget” index, China’s MSA is 129.1billion higher than Japan’s JTSB’s 2.1billion, so China gets 5 points and Japan’s score is:

$$\text{Japan’s score} = \frac{2.1}{129.1} \times 5 \approx 0.1$$

The above scoring methods can be applied to 11 indexes: budget, wages, maintenance, equipment purchase, staff benefits, assistant investigation with foreign expert, international conference, overseas training, number of investigations.

In the “Three public spending” index, the less the budget spent in this item reflects that the government organizations spend less on unnecessary expenses. Japan's 10.8million is less than China's 9.8billion. Japan's performance in this index is better, and the full score is 4. China's score is:

$$\text{(three public spending)China's score} = \frac{10.8 \times 10^6}{9.8 \times 10^9} \times 4 \approx 0$$

In the “Professional coverage” index, the technical talents covered by the Chinese MSA include: ship pollution inspector, ship safety inspector, visa inspector, seafarer examination officer, VTS officer, etc. The technical talents covered by JTSB in Japan cover: materials science, jurisprudence, JCG officer, shipbuilding, and human factor. In contrast, Japan’s JTSB talents cover a wider range of professionals. Japan’s Professional coverage index is better than Japan with a perfect score of 5 points. China’s narrow MSA talents range mainly focuses on ship navigation and pollution. The score is subjectively given by the author. 3 points.

In the” Number of annual accident reports”, Japan’s JTSB investigated 764 accidents in 2017 and released 762 accident reports, with a release rate of 99.7%. China’s MSA investigated 196 accidents in 2017 and announced 99 of them the accident report has a release rate of 50.5%. So, Japan got a perfect score of 5 in this index, and China scored:

$$\text{(the number of annual accident reports)China's score} = \frac{50.5\%}{99.7\%} \times 5 \approx 2.5$$

In the “Earliest traceable report” index, the earliest traceable accident report of Japan’s JTSB was 2007, and the earliest traceable accident report of China’s MSA was 2015. Japan’s JTSB performed better in this index with a perfect score of 5 points, and China’s score was:

$$\text{(earliest traceable report) China's score} = \frac{2020 - 2015}{2020 - 2007} \times 5 \approx 1.9$$

In the “Timeliness of release of report” index, the average time for Japan’s JTSB investigation to complete an accident is 0.93 months before the release of the accident report, and China’s MSA takes an average of 22.5 months. Japan’s JTSB performed better in this project with a perfect score of 5 points, and China’s score was:

$$\text{(timeliness of release of report) China's score} = \frac{0.93}{22.5} \times 5 \approx 0.2$$

In the “Number of dead and missing” index, Japan lost 75 people in 2018 due to a ship accident, and China caused 140 people in a ship accident in 2019. Japan performed better in this index with a perfect score of 5 points. China’s score was:

$$\text{(number of dead and missing) China's score} = \frac{75}{140} \times 5 \approx 2.7$$

In the “Number of total loss ships”, Japan’s total loss of ships with more than 100 tons in 2018 was 13, and China’s total loss in 2019 was 42. Japan’s performance in this index was better than 5 points, and China’s score was:

$$\text{(number of total loss ships) China's score} = \frac{13}{42} \times 5 \approx 1.5$$

In the “Economic losses”, Japan’s economic losses due to ship accidents in 2018 were about 4.3 billion, and China’s economic losses caused by ship accidents in 2019 were 2.6 billion. China’s performance in this index is better, with a perfect score of 5 points. Japan’s score is:

$$\text{(economic losses) China's score} = \frac{2.6}{4.3} \times 5 \approx 3.0$$

In the “Average survey duration” index, according to the author's statistics, it takes 4.2 months to calculate an accident in China's MSA survey, and 5.7 months in Japan's JTSTB to investigate an accident on average. China's MSA performs better in this index, with a perfect score of 5 points. The score is:

$$(\text{average survey duration}) \text{ Japan's score} = \frac{4.2}{5.7} \times 5 \approx 3.7$$

In the “Accident reduction”, China's general disasters of 2019 and above were reduced by 27.3% compared with 2018. Japan's ship accidents of more than 100 tons in 2018 increased by 20.9 compared with 2017. China performed better in this index with a perfect score of 5 points. Since the number of accidents in Japan increased in 2018 compared to 2017, Japan scored 0 points in this index.

In “Economic losses reduction”, China’s economic losses due to ship accidents in 2019 decreased by 42% compared with 2018, and Japan’s economic losses due to ship accidents in 2018 decreased by 74.4% compared to 2017. Japan performed better in this event with a perfect score of 5 points, while China scored:

$$(\text{economic losses reduction}) \text{ China's score} = \frac{42\%}{74.4\%} \times 5 \approx 2.8$$

In “Casualties reduction”, China’s death toll due to ship accidents in 2019 decreased by 40.9% compared to 2018, and Japan’s death toll due to ship accidents in 2018 increased by 33.9% compared to 2017. The performance was better with a perfect score of 5 points. The number of deaths and missing persons in Japan increased so the score was 0 points.

Finally, the statistical results of the scores of all indexes in China and Japan are shown in the following table:

Table 8 Scores of China and Japan in all indexes

			China	Japan
Investment		budget	5	0.1
		wages	4	0.4
		three public spending	0	4
		maintenance	4	0.1
		equipment purchase	4	0.1
Internal Management	talent base	staff benefits	4	0.1
		professional coverage	3	5
	transparency	the number of annual accident reports	2.5	5
		earliest traceable report	1.9	5
		timeliness of release of report	0.2	5
Learning and Training	international cooperation	assist investigation with foreign expert	0	5
		international conference	5	0.8
	staff training	overseas training	0	5
Result	operational capacity	number of investigations	0.8	5
		number of dead and missing	2.7	5

		number of total loss ships	1.5	5
		economic losses	5	3
		average survey duration	5	3.7
	achievement	accident reduction	5	0
		economic losses reduction	2.8	5
		casualties reduction	5	0

4.5 Results analysis

Based on the results calculated in the table above, China MSA has a total score of 61.4 and Japan JTSB has a total score of 62.2. Although the total scores of the two agencies are very close, they differ greatly in the evaluation of some indexes. Mainly reflected in the following aspects:

- 1) In terms of “Investment”, the investment of China MSA is much greater than that of Japan JTSB. On the one hand, the reason for the analysis is that MSA is larger and requires more funds. In addition, China MSA has a wider business scope than Japan JTSB. It also needs to manage maritime traffic, requiring more personnel and equipment.
- 2) In terms of talents, Japan JTSB has a wider range of talents, and China MSA lacks talent resources in terms of materials and human factors.
- 3) In terms of “Transparency”, Japan JTSB is also more transparent, and the release rate and timeliness of accident investigation reports are far better than that of China MSA.
- 4) In terms of “International Cooperation”, the two have their own advantages. Japan JTSB have more cooperation with foreign investigators, and China MSA participates more in international conferences.
- 5) In terms of the “Number of investigations”, the number of accidents investigated by Japan JTSB each year greatly exceeds that of China MSA. The reason for this is that there are some minor accidents in China where MSA investigators will not carefully investigate and will not be included in the statistics. For handling these minor accidents, the staff of the MSA mainly mediated both parties in accident. In addition, China MSA is faster than Japan JTSB in investigating an accident.
- 6) In terms of “Operational capacity”, China’s marine accident is more serious than Japan. Whether it is the number of people who die or disappear each year due to ship accidents or the number of ships that are totally damaged each year, there are more economic losses due to ship accidents in Japan. It is the higher cost of Japanese ship equipment, cargo and accident assistance.
- 7) In terms of “Achievements”, China MSA has performed very well. Both the number of accidents and the number of deaths and missing persons are better than Japan. The reason may be that many of China marine accidents are caused by failure to comply with the regulations. It is easier to improve, and Japan’s maritime navigation order is mature and stable, and it is more difficult to improve.

In general, the differences between China MSA and Japan JTSA are mainly reflected in the five points of capital investment, transparency, international cooperation, casualties and business achievements, so the authors extracted the indexes and scores representing these five points for comparison. Japan JTSA different from the China MSA.

The indexes representing investment are budget, wages, three public spending, maintenance, and equipment purchase.

The indexes representing transparency are the number of annual accident reports, earliest traceable report, timeliness of release of report.

The indexes representing international cooperation are assistant investigation with foreign expert, international conference, overseas training.

The indexes representing the casualties of marine accident are number of dead and missing, number of total loss ships, economic losses.

The indexes representing achievements are number of investigations, accident reduction, economic losses reduction, casualties reduction, average survey duration.

Table 9 Differences between China MSA and Japan JTSA in 5 aspects

		China	Japan
Investment	budget	5	0.1
	wages	4	0.4
	three public spending	0	4
	maintenance	4	0
	equipment purchase	4	0.1
Transparency	the number of annual accident reports	2.5	5
	earliest traceable report	1.9	5
	timeliness of release of report	0.2	5
International Cooperation	assist investigation with foreign expert	0	5
	international conference	5	0.8
	overseas training	0	5
Casualties	number of dead and missing	2.7	5
	number of total loss ships	1.5	5
	economic losses	5	3
Achievement	number of investigations	0.8	5
	average survey duration	5	3.7
	accident reduction	5	0
	economic losses reduction	2.8	5
	casualties reduction	5	0

After averaging the scores corresponding to these extracted indexes, it represents the performance score in a certain aspect, such as:

China's budget scored 5 points, wages scored 4 points, three public spending scored 0 points, maintenance scored 4 points, and equipment purchase scored 4 points. Therefore, China's overall performance in investment is an average score of 3.4 points.

After extracting the above required indicators, a brief table is obtained. The larger the value in the table, the better the performance on this index:

Table 10 Score of China MSA and Japan JTSB in 5 aspects

	China	Japan
Investment	3.4	0.9
Transparency	1.5	5.0
International Cooperation	1.7	3.6
Casualties	3.1	4.3
Achievement	3.7	2.7

For easy and intuitive comparison, the five assessments reflecting the capabilities of the maritime survey organization are drawn into radar charts, as follows:

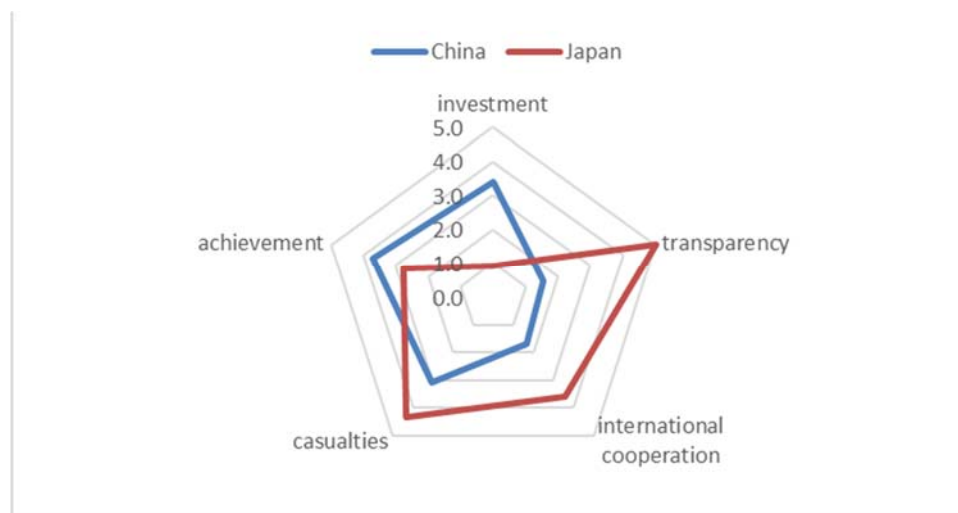


Figure 37 Comparison chart of maritime investigation agencies between China and Japan

From this radar chart, we can clearly see the gaps and differences between China MSA and Japan JTSB in the five areas of Investment, Transparency, International cooperation, Casualties, and Achievements.

- 1) The investment of MSA in China is very large. The reason may be that the larger MSA in China requires more funds.
- 2) The transparency of JTSCB in Japan is very high, mainly because the accident report is released in a timely manner, and almost all accident reports are published on the official website.
- 3) Japan JTSCB is also stronger than China MSA in international cooperation. Before that, MSA would send many maritime investigators to overseas training and study, but in 2019, it was not due to some reasons.
- 4) In the case of casualties, although China has more accidents and fatalities than Japan, Japan has caused too much economic losses.
- 5) In terms of achievements, China is better to Japan. On the one hand, it may be the result of a large amount of budget investment. On the other hand, it may be that the regulatory management of the Chinese maritime industry has greatly improved, and Japan has relatively matured and it is harder to improve.

Chapter 5. Conclusion

In this chapter, we summarize the characteristics of the maritime accident investigation agencies of various countries mentioned above, sorts out some conclusions, and draws some conclusions based on the results of China-Japan comparison. Afterwards, we made some reasonable suggestions for the future improvement direction of China MSA.

5.1 Characteristics of marine accident investigation agencies in each country

China's marine accident investigation is under the responsibility of the MSA under the Ministry of Transport of China. MSA conducts a responsibility investigation with administrative penalties and conducts safety investigations required by IMO. Although the safety investigation in accordance with IMO regulations is called "Maritime Safety Investigation" and the responsibility investigation in accordance with Chinese law is called "Water Traffic Accident Investigation", in fact, due to various reasons such as shortage of human resources, Often the same person is responsible for two sets of investigations.

Japanese marine accident investigation include JCG, JTSB, and JMST. All three are subordinate agencies of the MLIT, JTSB and JCG are foreign agencies of the MLIT, and JMST is a special agency of the MLIT. JCG is responsible for assistance in accidents and criminal investigations involving crimes. JTSB will judge whether it is necessary to conduct a safety investigation based on its own judgment. Finally, if the investigator of JMST finds that the person involved in the accident has deliberate or negligent behavior, it will be sued, and the punishment form is often the cancellation of the crew certificate, suspension, and admonishment.

USCG and NTSB are responsible for marine accident investigation in the United States. USCG is responsible for the assistance of the accident and the accident administrative investigation. It will arrive at the scene immediately after the accident and conduct a preliminary investigation of the accident. When USCG determines that the accident situation reaches a certain standard, it will notify NTSB to conduct a safety investigation. To avoid unnecessary waste of resources and repeated investigations between the two institutions, the specific work of the investigation is arranged according to relevant agreements.

UK marine accident investigation agencies include MCA and MAIB, both of which are subordinate agencies of the British Ministry of Transport. MCA is responsible for the assistance and handling of accidents. If any violations of relevant regulations are found in the investigation, MCA will bring a lawsuit to the court based on the investigation evidence. MAIB conducts safety investigations. The organization is very streamlined, and only about 30 accidents are carried out every year.

5.2 Differences in marine casualty standards

Compared with other countries, China is still relatively lenient in terms of the classification of accidents. The regulations of the most serious accidents in various countries are as follows:

Special serious accidents in China: those that caused more than 30 deaths (including disappearances), or more than 100 serious injuries, or ships that spilled more than 1,000 tons of oil and caused water pollution, or accidents that caused direct economic losses of more than 100 million yuan.

There are clear rules for major accidents in the United States. Any accidents that result in one or more of the following damages: dead and missing 6 people or more; ships of 100 tons and more lose their propulsion capacity; cause property losses of US\$500,000 and more; according to USCG commander and NTSB chairman, it is estimated, Accidents that pose a serious threat to property and the environment.

In UIK, a very serious marine casualty is an event or sequence of events that has resulted in any of the following and has occurred directly by or in connection with the operation of a ship

- a) the total loss of a ship;
- b) loss of life;
- c) severe pollution.

According to the classification criteria for China's accidents, the severity is much higher than the standards of the United States and UK. It shows that there will still be very serious accidents in China, and the safety level of maritime navigation is far lower than that of the United States and Britain.

5.3 Situation and characteristics of marine accident

According to the statistics of marine accidents in various countries in recent years, most of the accidents in China are caused by commercial ships engaged in production and transportation, while the accidents caused by personal entertainment yachts and boats in the United States, the United Kingdom and Japan account for a very high proportion. The reason for this is related to the national economic strength. Nationals in developed countries have a large number of small recreational vessels, and these personal recreational vessels are prone to accidents, and China is still under development. Most ships sailing at sea are engaged in economic production. Therefore, the main objects of the accident are some freight ships and fishing vessels.

5.4 Results of comparison between China and Japan

China MSA and Japan JTSB mainly focus on transparency, international cooperation, and effectiveness. China MSA is worse than Japan JTSB in terms of transparency and international exchanges, and it is better than Japan JTSB in achieving results. In response to these phenomena, the author makes the following suggestions:

- 1) For China increase the disclosure of accident investigations and try to publish

- every accident investigated to the public and the media.
- 2) After the accident investigation is completed, the accident report is released. In the investigation report issued by the statistical MSA, the author found a problem. Many investigation reports are uploaded at one certain time. It is best for MSA to release the report as soon as the report is finished.
 - 3) China MSA can conduct more cooperative investigations with foreign maritime investigators.
 - 4) China MSA can send some maritime investigators to Europe and the United States for training and learning.
 - 5) It has done a good job in reducing accidents and reducing casualties, mainly because it has strengthened law enforcement and strictly regulated the crew quality and ship operation management.
 - 6) For Japan JTSB, they can do some surveys on public satisfaction, because the ultimate service target of government organizations is the general public, and it is up to the public to judge whether the work of a government organization is good or bad.

5.5 Some problems in this article

Due to the lack of some data, the comparison table designed in this article can only be simplified based on the original version, which will cause the comparison results to be not objective and comprehensive. For example, in comparing the social influence of MSA and JTSB, the original service target of a government agency is the public. The lack of data in this area will naturally lead to a lack of comprehensive comparison.

In addition, there are some problems in the weight distribution of each indicator. The best way to assign is to consult the experts of the marine accident survey to conduct an in-depth study on the assessment indicator system. Each expert independently sets the weight of the assessment indicator first, and then The weights of the assessment indicators are averaged as the final weight. The weights in this article are distributed equally, so there is still some lack of objective scientific.

We hope to have the opportunity to cooperate with all parties in the future to continue to improve the problems in this article and improve the objectivity and scientific of the comparison method.

Acknowledgements

As time goes by, the life of studying in Japan is coming to an end, during which teachers, classmates, friends and family care and help me a lot. What I learned in Japan will be the wealth of my life. Here, I sincerely express my thanks to all those who have encouraged and supported me.

First of all, I would like to thank my teacher, Professor Takemoto, for his careful guidance. He has a broad vision in the analysis of marine accident. In the process of learning with him, I not only learned how to solve problems alone, but also fell in love with running. Through running, I can maintain my physical and mental health. His teaching by example will benefit me all my life. I would like to express my sincere thanks to Mr. Takemoto.

Thanks to Mr. Asano of Japan JTSA, Mr. Asano has provided us with a lot of information about the JTSA, which plays a great role in our research.

Similarly, I would like to thank Okudaira, Simizu, Kimu and others in the laboratory. Their presence has made the atmosphere of the laboratory very harmonious and pleasant. They have also given great help in my life and study, enriched my abroad life, made me better understand Japanese culture, and left good memories.

Duan, Yang, Bai and other Chinese students who studied in Japan together helped each other during their daily life and gave me great encouragement and help. I learned a lot from them. I would like to express my thanks here.

Finally, I would like to thank my parents deeply. Whenever I encounter difficulties in Japan, they always give me spiritual support behind me and make me better.

References

- (1) Hu Xichen. *Fu ying haishi diaochaguan moni diaocha peixun* (In Chinese) *Simulation investigation training for Chinese maritime investigators in UK*. MSA.2005
- (2) Zhang Xiaodong (2009). *Yingguo haishi yu haian jingweishu* (In Chinese) *Maritime and Coastguard Agency*. Shipping Management.2009. 031(002):38-39.
- (3) Wu Yanguo and Song Bingbing. *Haishi diaochaguan fu mei moni diaocha peixun zongjie* (In Chinese) *Summary of training for maritime investigation officers in the United States*. MSA.2009.
- (4) Shang Dexi and Liu Peng. *Zhongwai haishi diaocha duibi ji zhongguo haishi diaocha fazhang jianyi* (In Chinese) *Comparison of maritime investigation between China and foreign countries*. World Shipping.2012. 35(4):37-40
- (5) Li Huawen and Liu Jingsheng. *Yingguo haishi diaocha tixi dui woguo de qishi* (In Chinese) *Enlightenment from the British Maritime Investigation System*. World Shipping. 2013.36(7):22-24
- (6) Huang Jie. *Zhongmei liangguo haishi diaocha de bijiao ji jianyi* (In Chinese) *Comparison and suggestion of maritime investigation between China and the United States*. Pearl River Water Transport.2016. 00(2):42-44.
- (7) Dane Mellan, Mason Ruffing, Victor Zeng. *Improving the quality of accident investigation*. NTSB. 2009.
- (8) Zhen Song. *A comparative study of practices in China and certain countries*. Word Maritime University. 1999.
- (9) Marine Accident Inquiry and Safety Investigation Association. *Kainan chōsa no kokusai kyōryoku-ka ni kansuru kenkyū hōkoku-sho* (In Japanese) *Research Report on International Cooperation in Marine Accident Investigation*. Marine Accident Inquiry and Safety Investigation Association.2002.
- (10) Morris L. Cooke. *Academic and Industrial Efficiency*. New York.1910.
- (11) Clarence. E. Ridley and Herbert. A. Simon. *Technique of Appraising Standards*. Public Management. 1937. 46-49.
- (12) Kaplan, Robert S. *The Balanced Scorecard: Translating Strategy into Action*. Harvard Business Press. 1996.
- (13) Shen Daoming. *Jianli zhishu MSA gongzuo pingjia zhibiao tixi* (In Chinese) *Establish the performance measurement system of MSA work directly under*. China Water Transport. 2002. (8):49-50.
- (14) Xiong Chunyan. *Haishi xitong jixiao guanli xianzhuang ji gaijin jianyi* (In Chinese) *Present situation and improvement suggestions of maritime system performance management*. China Water Transport. 2010. 10(9):22-23.
- (15) Zhang Xin. *Research on Performance Evaluation System Design of Y Maritime Safety Administration*. Tianjin University of Commerce. 2017.
- (16) Wang Xiaoyan. *Wanshan haishi xitong shiye danwei jixiao kaohe de jianyi* (In Chinese) *Suggestions for improving the performance measurement of maritime investigation system*. Shipping Management. 2018.40(6): 19-21.
- (17) International Maritime Organization.
<http://www.imo.org/en/About/Pages/Structure.aspx>. 2020/6/20
- (18) International Maritime Organization. *CODE OF THE INTERNATIONAL STANDARDS AND RECOMMENDED PRACTICES FOR A SAFETY INVESTIGATION INTO A MARINE CASUALTY OR MARNE INCIDENT*. 2008.

-
- (19) Maritime Safety Administration. <https://www.msa.gov.cn/page/article.do?articleId=45AF5734-8B5D-429C-BAB3-F8EFD079E1AC&channelId=7B1BBBD5-BBF4-438F-8CDA-B026A8B5003F> (In Chinese). 2020/6/20
- (20) Maritime Safety Administration. *Guanyu zuohao shishi IMO guiding de tongzhi* (In Chinese) *Notice on making IMO regulations*. 2010.
- (21) Maritime Safety Administration. *Shuishang jiaotong shigu diaocha chuli chengxu zhinan* (In Chinese) [*Guidelines for investigation procedures of water traffic accidents*]. 2001.
- (22) Guangdong Maritime Safety Administration. *Guangdong MSA guanxiaqu 2017 nian shuishang jiaotong shigu fenxi baogao* (In Chinese) *Analysis report on water traffic accidents in 2017 in Guangdong MSA*. 2018.
- (23) Maritime Safety Administration. *Shuishang jiaoyong anquan xingshi baogao* (In Chinese) *Report on water traffic safety situation*. 2019.
- (24) Japan Coast Guard. <https://www.kaiho.mlit.go.jp/soshiki/> (In Japanese). 2020/6/20.
- (25) Japan Transport Safety Board. *Japan transport safety board leaflet*. [https://www.mlit.go.jp/jtsb/images/leaflet\(H31.4\).pdf](https://www.mlit.go.jp/jtsb/images/leaflet(H31.4).pdf) (In Japanese). 2019.
- (26) Japan Transport Safety Board. *Yougosetsumei* (In Japanese) *Explanation of terms*. https://www.mlit.go.jp/jtsb/kai/bunseki/bunsekikohosiryō/no3_pleasure/p_yougo_setumei.pdf. 2020/6/20.
- (27) Japan Coast Guard. *Annual report on JCG statistics*. Japan Coast Guard. 2019.
- (28) Japan Marine Accident Tribunal. *Marine accident trial*. Japan Marine Accident Tribunal. 2019.
- (29) Japan Transport Safety Board. *ship accident statistic*. Japan Transport Safety Board. 2020. <https://jtsb.mlit.go.jp/jtsb/ship/ship-accident-toukei.php>
- (30) United States Coast Guard. USCG Organization Chart. <https://www.uscg.mil/Units/Organization/>. 2020/6/20
- (31) National Transportation Safety Board. *About the National Transportation Safety Board Organization*. <https://www.nts.gov/about/organization/Pages/default.aspx>. 2020/6/20
- (32) National Transportation Safety Board, United States Coast Guard. *Memorandum Understanding Between the National Transportation Safety Board and the United States Coast Guard Regarding Marine Casualty Investigation*. 2008.
- (33) Code of the Federal Regulation. 46 CFR § 4.03-1 - *Marine casualty or accident*. 2005.
- (34) National Transportation Safety Board. *US Transportation Fatalities in 2018-by Mode*. Bureau of Transportation Statistics. 2019.
- (35) Maritime and Coastguard Agency. *Maritime and Coastguard Agency Annual Report and Accounts 2017-2018*. 2018.
- (36) Marine Accident Investigation Branch. *Marine Guidance Note 458*. 2012.
- (37) Marine Accident Investigation Branch. *Marine Accident Investigation Branch Annual Report 2018*. 2019.
- (38) Maritime Safety Administration. *Jiaotong yunshubu haishiju 2019 nian yusuan gongkai* (In Chinese) *Budget disclosure of Maritime Safety Administration of the Ministry of transport in 2019*. 2020.
- (39) Maritime Safety Administration. *Shisanwu renliziyuan fazhan guihua* (In Chinese) *The 13th five year plan for human resources development*. 2019.
- (40) Maritime Safety Administration. *Shigu diaocha baogao* (In Chinese) *Accident*

-
- Investigation* <https://www.msa.gov.cn/page/search.do>. 2020/6/20.
- (41) Maritime Safety Administration. *Haishiju 2019 niandu zhengfu wangzhan gongzuo niandu baogaobiao* (In Chinese) *Annual report of government website work of MSA in 2019*. 2020/6/20.
- (42) Maritime Safety Administration. *Quanguo haishi gongzuo huiyi* (In Chinese) *National maritime work conference*.
<https://www.msa.gov.cn/page/wap/wap.do?action=content&channelId=A1C5D4CC-DB15-493C-B2FC-A14C490D6331&articleId=169AD2E1-E81D-4EE6-B2AC-00AC2A47D4BF>. 2020/6/20.
- (43) Maritime Safety Administration. *Xinxi gongkai* (In Chinese) *Information disclosure*.
<https://www.msa.gov.cn/html/xxgk/index.html?type=1&navIndex=0>. 2020/6/20.
- (44) Maritime Safety Administration. *Gezhishu haishiju 2020niandu kaoshi lvyong gongwuyuan mianshi* (In Chinese) *Civil service examination recruitment situation*.
<https://www.msa.gov.cn/html/xxgk/rsxx/20200609/DBB1663C-C610-4FBE-A6BB-0D5CA297545C.html>. 2020/6/20.
- (45) Ministry of Land, Infrastructure, Transport and Tourism. *2018 General Account Expenditure Budget Items*. 2019.
- (46) Japan Transport Safety Board. *Report search results*.
https://jtsb.mlit.go.jp/jtsb/ship/ship-kensaku-list.php?init=1&type=accident&occur_year_from=2017&occur_month_from=&occur_year_to=2017&occur_month_to=&pub_year_from=&pub_month_from=&pub_year_to=&pub_month_to=&seq_accik=&selship=&seltonnage=&keyword=&keyword_op=and. 2020/6/20.
- (47) Japan Transport Safety Board. *Report search results*.
<https://jtsb.mlit.go.jp/jtsb/ship/ship-kensaku-list.php?sort=asc&by=o>. 2020/6/20.
- (48) Japan Transport Safety Board. *Annual report of Japan Transport Safety Board 2019*. 2019.
- (49) Japan Coast Guard. *Japan Coast Guard Annual report 2018*. 2019.
- (50) Japan Coast Guard. *Japan Coast Guard Annual report 2017*. 2018.