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Research on the establishment of promulgation system of maritime safety information in Chengshan Jiao VTS Center

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RESEARCH ON THE ESTABLISHMENT 0F PROMULGATION SYSTEM OF MARITIME SAFETY INFORMATION IN CHENGSHAN JIAO VTS CENTER

By

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DECLARATION

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

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

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ABSTRACT

Title of Research Paper: **Research on the Establishment of Promulgation System of Maritime Safety Information in Chengshan Jiao VTS Center**

Degree: **Msc**

The research paper is a research on the establishment of promulgation system of maritime safety information in Chengshan Jiao VTS center. Currently VTS center has been equipped with various advanced systems for information collection, which means it is capable of collecting comprehensive Maritime safety information. However, only limited information has been used properly. The primary means of promulgation is Information Service. The developments in communication technologies have made it possible for VTS centers to acquire the capability of exchanging information related to vessel traffic with ships, shipping companies and other parties by providing more reliable and versatile services.

In order to enhance and explore the VTS system performance and capabilities, through a questionnaire survey, the research investigates the information demands of different users – vessels and shipping companies. Furthermore, it tries to identify the appropriate means and modes of promulgation. With regard to the processing of collected information, spatial analysis is used in the research for identifying hotspot locations for maritime traffic in Chengshan Jiao waters. The three phases of the promulgation system, namely information collection, data processing, and information promulgation are summarized and further emphasized in the concluding chapter.

Keywords: Promulgation, Maritime Safety Information, Traffic Flow, Analysis, Statistics, Processing, Assessment,

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

AIS	Automatic Identification System
BBS	Bulletin Board System
CCTV	Closed Circuit Television
CSJ	Chengshan Jiao
DCPA	Distance to Closest Point of Approach
DSC	Digital Selective Calling
GMDSS	Global Maritime Distress and Safety System
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
IMO	International Maritime Organization
INMARSAT	International Maritime Satellite
INS	Information Service
LRIT	Long Range Identification and Tracking System
MSA	Maritime Safety Administration
MSC	Maritime Safety Committee
MSI	Maritime Safety Information
MT	Multi-Tracker
NAS	Navigational Assistance Service
NAVTEX	Navigational Telex
NBDP	Narrow Band Direct Printing Telegraphy
SOLAS	International Convention for the Safety of Life at Sea
SSB	Single Side Band
TCPA	Time to Closest Point of Approach
TOS	Traffic Organization Service

TSS	Traffic Separation Schemes
VHF	Very High Frequency
VTIS	Vessel Traffic Information Service
VTS	Vessel Traffic Service

Chapter 1 Introduction

1.1 Background of Research

Over the last decades, the average size of different types of ships has become large, making ships more difficult to maneuver, the average speed has increased, and numbers of ships have increased, requiring a change in collision avoidance (Nuutinen et al., 2006). Many Vessel Traffic Services have been established around the world as an effective solution for the increasing of traffic volume and density especially for congested coastal waters like Chengshan Jiao (CSJ) area where high traffic density and geographical aspects are posing risks to the navigation of merchant vessels.

In recent years, the Ministry of Transport (MoT) of China has increased investment in the establishment of Vessel Traffic Service (VTS) centers. Up to now, 30 VTS centers have been built and put into operation throughout China. (Li, Cheng & Kang, 2011) These VTS centers can basically cover major ports, fairways and important waters of China. Meanwhile, new equipment and systems are introduced in respect of data collection and analysis as well as supporting allied services of Search and Rescue (SAR). These include Automatic Identification System (AIS), Closed Circuit Television (CCTV) System, Long Range Identification and Tracking (LRIT) System,

etc. Due to the development of VTS, the safety, security and efficiency of waterways have been improved and the overall number of marine accidents[1] in VTS coverage has reduced sharply.

Vessel Traffic Service (VTS) is a type of shore service implemented by a "Competent Authority to improve the safety and efficiency of vessel traffic and to protect the environment" (IMO, 1997). According to IALA VTS Manual (2008), three types of services are offered by VTS, namely Information Service (INS), Traffic Organization Service (TOS), and Navigational Assistance Service (NAS). Then in IMO Resolution A.857(20) (1997), a clear distinction is made between a Port or Harbour VTS and a Coastal VTS. "In a Port or Harbour VTS a navigational assistance service and/or a traffic organization service is usually provided for, while in a Coastal VTS usually only an information service is rendered." Since CSJ VTS is a coastal VTS, so INS is destined to be its most important mission.

1.2 Maritime safety information

"Maritime safety information (MSI) means navigational and meteorological warnings, meteorological forecasts and other urgent safety-related messages"(IMO, 1991). This is the definition given in the IMO Resolution A.705(17), as amended "Promulgation of Maritime Safety Information" which sets out the organization, standards and methods to be used for the promulgation and reception of maritime safety information. It also states the importance of Maritime Safety Information:

> *Maritime safety information is of vital concern to all ships. It is therefore essential that common standards are applied to the collection, editing and*

[1] An unintended event resulting either in fatality, injury, ship loss or damage, property loss or damage, or environmental damage. (IALA, 2008, p18)

dissemination of this information. Only by doing so will the mariner be assured of receiving the information he needs, in a form which he understands, at the earliest possible time.

(IMO, 1991)

1.3 Means of promulgation

IALA recommends that more immediate means of promulgation should be considered such as a website, e-mail or other text transfer media (IALA, 2008, p140). However, the current situation is still quite rigid:

Information sharing is enforced by the use of VHF radio channels and requires reporting to the shore service at specific locations, reporting points, which are marked in the navigation chart. When reporting, destination and intentions (plans) as well as information on constraints, e.g. depths, are broadcasted via the VHF.

(Westrenen & Praetorius, 2012)

Most VTS centers are obtaining vessel traffic information through Radar systems and AIS systems, video signals through CCTV system, hydro meteorological information through sensors. Then all the information will be assessed before sending to vessels, shipping companies[2] and relevant parties by Internet, VHF, AIS, Radio, Fax, Telephone and Short Message Service (SMS). The pros and cons are evident: For example, for land users the means of promulgation by Internet, Telephone or Fax are more favorable, while these means are not appropriate for vessels due to high communication cost. Although means like VHF, AIS are more acceptable for vessels in VTS area, the receiving effect may be affected by the distance, weather,

[2] Shipping companies mean companies as defined in SOLAS regulation IX-1/1.2.

disturbance, information overload etc. One other problem is that the sending and receiving are not pertinent, which causes great waste to communication and information resources. For example, a vessel sometimes has to receive useless information. This increases ship's burden and may interfere with the receiving of more valuable information.

In addition, the analysis and processing of collected information still remain at a low level. There's a lack of quantitative analysis for marine traffic parameters such as vessels' track, density distribution and so on. The overall level of automation for both information collection and processing is not high. History data lacks statistics and is not properly used.

One important thing has to be mentioned here is the traditional user of VTS service is mainly limited to vessels, as the name "Vessel" traffic service suggests. I am not objecting this idea. However, the developments in communication technologies have made it possible for VTS centers to acquire the capability of exchanging information related to vessel traffic with ships, shipping companies and other parties by providing more reliable and versatile services (Ince et al., 1998, pp417-468). As the information hub, VTS centers can not only provide information for the primary user which is vessel, but also can extend their service to shipping companies, charterers, agents, pilot stations, harbor authorities, and whoever is involved in this industry. Because nowadays, all these interested parties are also very much involved with shipboard operations. Ship masters can feel direct pressure from different parties. IMO has recognized this matter even decades ago by the adoption of resolution A.443(XI) in 1979 "Decisions of the Shipmaster with regard to Maritime Safety and Marine Environment Protection"which invited governments to take the necessary steps to safeguard the shipmaster in the proper discharge of his

responsibilities in regard to maritime safety and the protection of the marine environment. But until now, this problem has not been solved and even becomes worse. The reason is that the shipping industry lacks willingness to respond to it (Baumler, 2013). As an ex-seafarer, I know that very well. For example, when ship is time chartered, master has to keep his ship run with contracted speed in good weather and sea conditions, otherwise, his ship may be on commercial risk of off hire. Sometimes commercial interest prevails over vessel's safety (Anderson, 2012). That's why I want to bring other users into this. I use many times "shipping companies" in this paper and although the questionnaire were mainly collected from vessels' and their companies, the users are not only limited to shipping companies. It also refers to other interested parties mentioned above.

For these reasons, based on the traffic information needs of different users and taking into consideration of navigational environment features, it is necessary to integrate the advantages of various means of information promulgation by establishing an information promulgation system. Through this system traffic information which is assessed to be useful or is requested can be sent to vessels by effective means, meanwhile traffic information can be sent to other users such as shipping companies and other interested parties by appropriate means. In this way, the communication and information resources can be properly managed, ship-shore communication can be improved, and ultimately VTS's social benefits can be enhanced.

1.3 The object of study

(1) To optimize VTS service mode

Presently the service objects of VTS centers are mainly vessels and the service mode is reflected by providing hydro meteorological information, navigational warning

and other information services. By the establishment of the information promulgation system (hereinafter referred to as “the System”) the information will be better collected through various sources, better analyzed using advanced techniques, better designed for different users, and better promulgation by different means. So the INS mode will be optimized.

(2) To enhance maritime safety in VTS area

Vessels have their limitation when navigating at sea and sometimes it’s hard to predict existing navigational risks. With the System, VTS centers can predict some risks in certain VTS areas by for example, traffic density distribution analysis and assessment. This information can be used by vessels to adjust their passages to minimize such risks. Accordingly maritime safety can be improved.

(3) To improve navigation efficiency

The System can achieve the function of automatic statistics of vessels passing a customized gate line and of traffic density distribution in a customized area. Through this function, VTS centers can identify critical areas in VTS coverage where navigation pressure is high. Then this information can be provided to both vessels and shipping companies, making them to consider how to avoid those areas. The navigation efficiency will be improved. In addition, based on the traffic information, VTS centers can also provide TOS to alleviate navigation pressure, for example, organize traffic by vessels size, speed, destinations.

(4) To better play the role of VTS in SAR and marine accident investigation

Since VTS center of China MSA has been turned into information center, coordination center and command center, its role in SAR and MAI is becoming more important. With the System, VTS center can better track and monitor the scene of

SAR and participate in organizing, coordinating and commanding rescue forces to improve the success rate of SAR; VTS center can use the function of playback to track down suspect vessels and provide objective evidence of the narrative of vessels involved in marine accidents.

(5) To Provide data for study and macro-decision-making

Through exploring the functions of VTS system in automatic statistics, traffic density analysis, vessels' track analysis etc., VTS centers will improve their ability to collect information. This information can be used for study of maritime institutes and it provides data basis for decision-making by China MSA.

1.4 Structure and Approaches

This paper uses CSJ VTS as an example. In order to find out the information needs of different users, questionnaires are designed and sent to vessels that pass CSJ VTS coverage and their companies. Based on the result of questionnaire survey, the paper explores the idea of establishing a Maritime Safety Information Promulgation System with which various resources such as VTS, AIS, LRIT etc. can be integrated and collected information can be better processed before sending to different users through VHF, AIS, Internet and other means so as to reduce navigational risks and enhance maritime safety and efficiency. Based on the idea, the content is structured to include:

(1) Navigational Environments in the Waters off CSJ Promontory;
(2) Means for Maritime Safety Information Communication;
(3) Maritime Safety Information analysis on the basis of VTS and AIS systems;
(4) Conceptual design and function realization;
(5) The Configuration of Promulgation System of Traffic Information.

Chapter 2 Navigational Environments in the Waters off CSJ Promontory

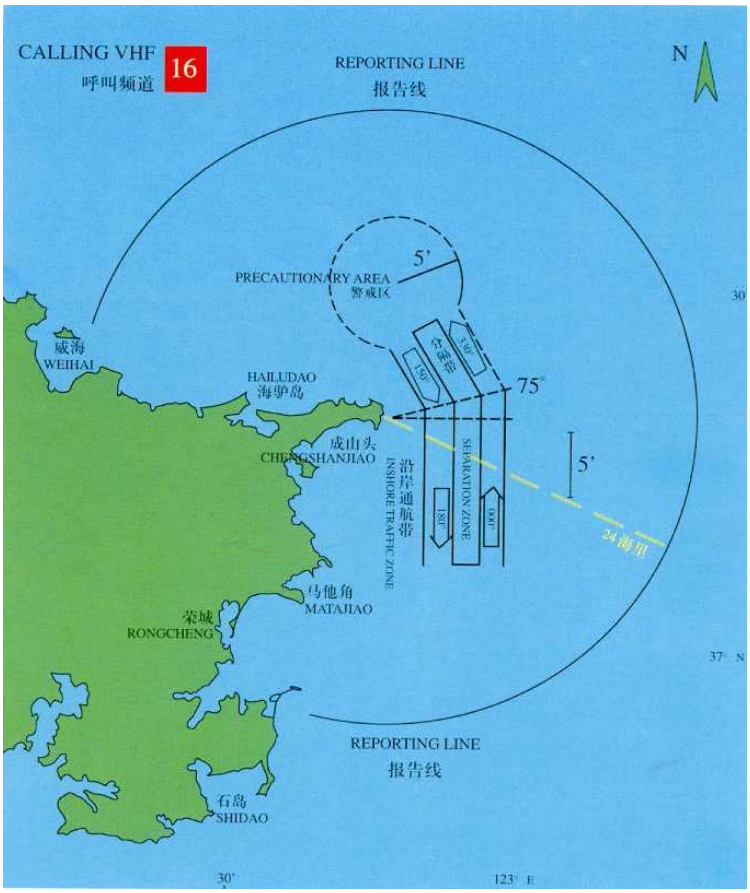

Figure 2-1 Chengshan Jiao VTS coverage

Source: Chengshan Jiao VTS Guide for Users.

2.1 Navigational Environment Overview

Seafarers can expect the most difficult part of a voyage in CSJ waters where traffic density is extremely high. Furthermore the complex geographical conditions make it even more difficult to maneuver. CSJ waters are well-known for its adverse natural environment. The CSJ promontory is called by many mariners “the Oriental Cape of Good Hope”. According to statistics shown in Table 2-1, annually for 127 days wind of Beaufort force (BF) 8 and above prevails in the area; Table 2-2 indicates that the annual average fog days is 82. That’s why CSJ waters is also called “Fog Cave”. The current is also strong in CSJ waters especially the interface area between the Yellow Sea and Bohai Sea. (Weihai MSA, 2012)

Table 2-1 Wind days statistics for each month from 1990-2010

Month	1	2	3	4	5	6	7	8	9	10	11	12	Total
Wind Days（≥BF8）	17.3	15.2	13.4	11.2	9.1	5	3.8	3.6	6.7	10.4	15.2	16.1	126.7
Wind Days（≥BF7）	19.3	16.2	14.5	13.2	10.1	6	4.2	4.0	7.2	11.3	16.0	18.0	140
Wind Days（≥BF6）	21.0	17.1	15.3	14.1	10.9	6.8	5.0	4.7	7.5	12.1	17.2	18.8	150.5

Source: Weihai MSA, (2012). Statistics of Chengshanjiao Promontory VTS.

Table 2-2 Fog days statistics for each month from 1990-2010

Month	1	2	3	4	5	6	7	8	9	10	11	12	Total
Average days	0.8	2.0	5.0	9.1	10.8	16.7	24.8	11.7	0.5	0.2	0.3	0.7	82.3
Max days	2	8	12	20	20	23	29	17	3	3	4	3	96

Source: Weihai MSA, (2012). Statistics of Chengshanjiao Promontory VTS.

2.2 Traffic Flow and Accidents Analysis

In CSJ waters Vessel traffic density is high and traffic flows are complex. This area is a must pass for merchant vessels in and exit of Bohai Sea where a large number of ports are located. Figure 2-2 indicates the huge number of transit vessels in CSJ area. And this area is also a famous fishing ground of China. For nearly all year round, fishing vessels are widespread in the VTS area. Although there's an IMO adopted TSS (shown in Figure 2-1) in operation which can regulate most of transiting merchant vessels, fishing boats are difficult to regulate.

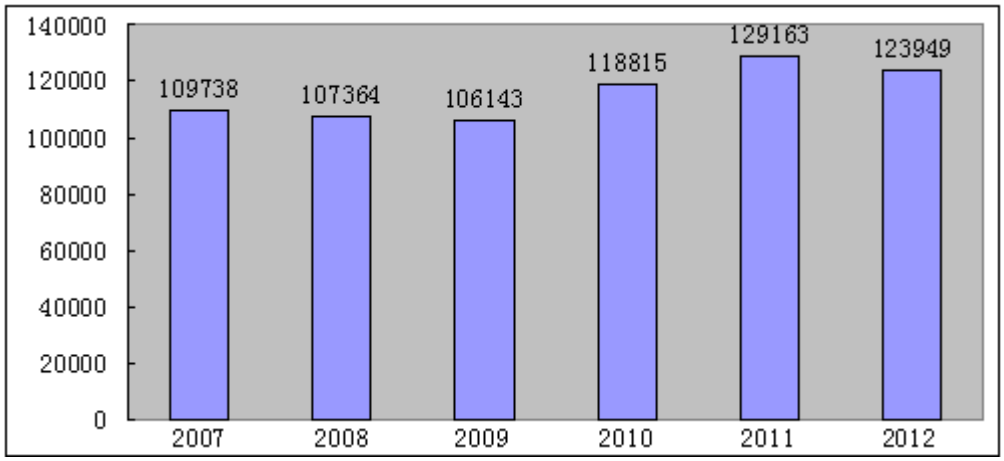

Figure 2-2 Annual number of transit vessels from 2007 to 2012

Source: Compiled by the author using Statistics data of CSJ VTS.

Because of the complexity of condition in CSJ waters, marine accidents are frequent in this area. As shown in Figure 2-3, most of marine accidents in waters of Shandong MSA happened in CSJ waters. From 2001 to 2010, there are 138 recorded marine accidents of different categories which caused huge human life and property loss as well as environmental damage. 95 out of the 128 are collisions, among which 64

cases are between merchant ships and fishing vessels (Weihai MSA, 2012).

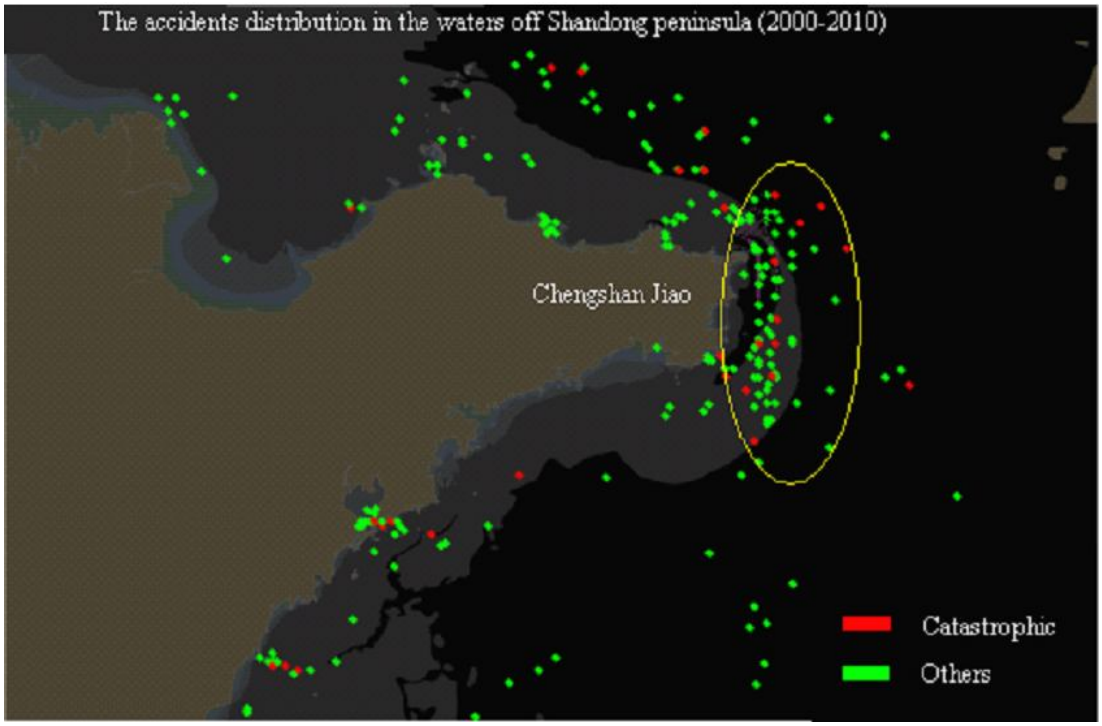

Figure 2-3 Marine accidents distribution in the waters of Shandong MSA

Source: Shandong MSA, 2011.

Chapter 3 Means for Maritime Safety Information Communication

3.1 Maritime safety information communication means

3.1.1 Regular means for land users

Land users in shipping context include shipowners, operators, managers and other interested parties. They are sometimes called “blunt end” of shipping activities. These users are playing an important role in maritime safety because they are remotely controlling or affecting shipboard operations. (Anderson, 2012) Land users are more used to means such as Internet, Telephone, SMS, Fax, Radio, Newspaper, etc. for information communication.

3.1.2 Various means for VTS centers

VTS centers are equipped with communication means such as VHF, MF/HF, AIS, Navtex, DSC, SSB, Radio, Fax, Telephone, Internet, etc.

3.1.3 Different means for vessels

“Ships are required to be capable of receiving maritime safety information broadcasts for the area in which they operate in accordance with the provisions of the

International Convention for the Safety of Life at Sea, 1974, as amended" (IMO, 2010). But generally speaking, means available at sea include VHF, MF/HF, NAVTEX, SSB, NBDP, EGC, Inmarsat, Fax etc.

3.2 The comparison between different means of communication

For each kind of means for information communication, the pros and cons are obvious. For example, Radio has the advantage of easy transmission, but the users cannot define information to receive; Internet almost incorporates all the advantages of communication, however, for vessels at sea, its use is still restricted due to high cost; VHF is convenient for ship-ship and ship-shore communication, but the coverage is restricted.

3.3 Questionnaire survey

In order to know the information need and means of promulgation, a questionnaire was initiated by the author supported by CSJ VTS Center. To complete the survey, 200 questionnaires were sent to vessels and 60 to shipping companies. Finally 121 were received from vessels and 50 from companies. The forms of the questionnaire are attached in the appendices.

Through the survey, it is found that for receiving of Maritime safety information in CSJ VTS area, vessels options are as follows: VHF ranked no.1 by 87%, AIS 45%, NAVTEX 44%, Inmarsat 16%, Internet 4%, SMS 3%，SSB 0.8%. For shipping companies: Internet 64%, Email 60%, SMS 54%, Radio 10%, TV 4%, other 2%. Both results are respectively reflected by Figure 3-1 and Figure 3-2.

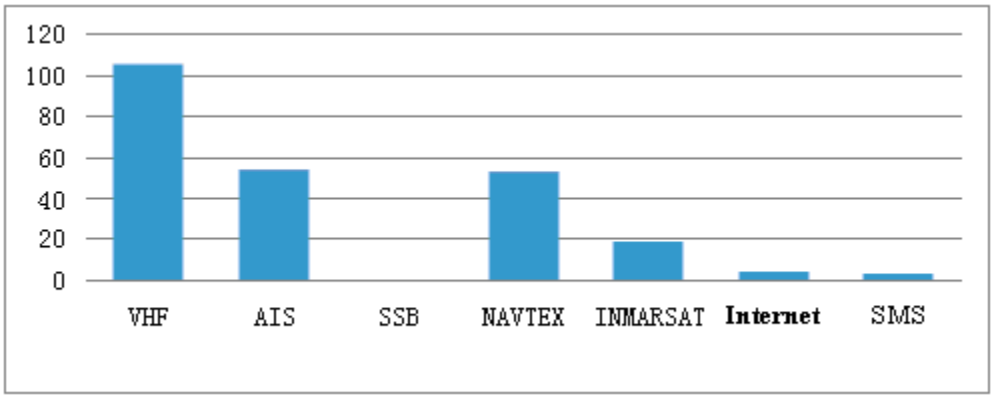

Figure 3-1 Vessels/seafarers' options for receiving Maritime safety information

Source: Compiled by the author based on questionnaire survey.

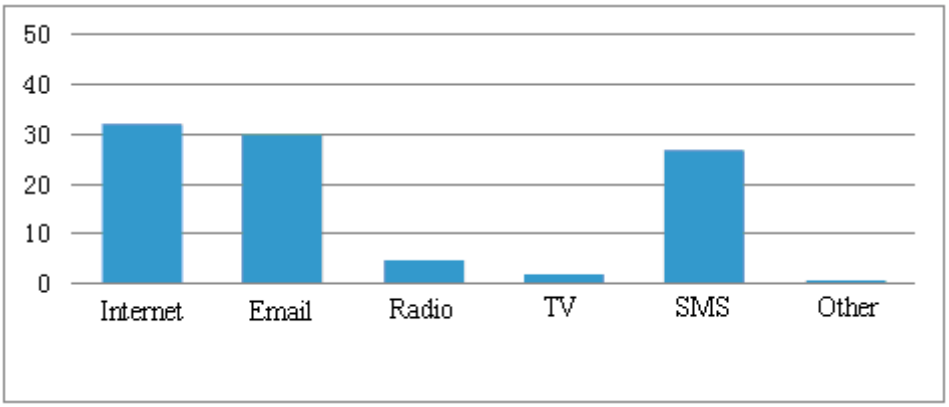

Figure 3-2 Companies' options for receiving Maritime safety information

Source: Compiled by the author based on questionnaire survey.

According to the feedback, it can be concluded that most vessels tend to receive Maritime safety information through VHF, AIS and NAVTEX, while most companies favor Internet, Email and SMS for receiving that information.

3.4 Solutions fulfilling the needs of different users

As the promulgator of information, the first priority is to ensure the information sent

out to different users is useful. The users of the Maritime safety information include mainly MSA itself (for other law enforcement departments), Seafarers, Shipping Companies. In order to ensure different users get necessary information through their favored means, the following solutions are proposed:

(1) Hierarchical promulgation

Hierarchical promulgation means to send information according to the importance of information. Maritime safety information can be divided into Routine, Important, Vital three kinds. (Standardization Administration of the People's Republic of China (SAC), 2009) Routine information is generic in nature such as navigational environment, ship routeing requirement etc. This kind of information can be promulgated by the publication of Sailing Directions which can be updated by Notices to Mariners internet or TV, Newspaper; Important information is useful for vessels' navigation or shore management such as traffic density, speed distribution, fishing vessels' concentrations; Vital information includes specific information for maritime safety, such as obstruction, special vessels' status, adverse weather, distress information etc. The latter two kinds of information can be sent out through VHF, AIS SMS / SRM (Safety Related Message), Internet etc. because it is urgent and the timeliness is important.

(2) Categorization of promulgation

Categorization of promulgation means to separate the information according to users and then to send through different means. As discussed above, different users prefer different means of receiving information. In addition, different users have different information need. This solution is concerned about users, for example, VHF, AIS and

NAVTEX can be used for sending information to seafarers, while Internet, Email, SMS can be used to sent information to companies.

Chapter 4 Maritime Safety Information Analysis

> *Maritime traffic analysis is growing in importance for many reasons: risk management, accident prevention and response planning. Since most decisions are location-sensitive, one important consideration in maritime traffic analysis involves maritime risk analysis, including spatial analysis to identify hot spots. Hot spots areas are concentrations of incidents within a limited geographical area that appear over time.*
>
> (Shahrabi & Pelot, 2007)

Spatial analysis is the method that is to be used for maritime traffic analysis in this paper. Because of the complicated navigational environment in CSJ waters as discussed in Chapter 2, it is important to identify hot spots in CSJ waters. To enable us to use spatial analysis, the first thing is to find the elements of traffic analysis.

4.1 The elements of maritime traffic analysis

4.1.1 Vessels' tracks distribution

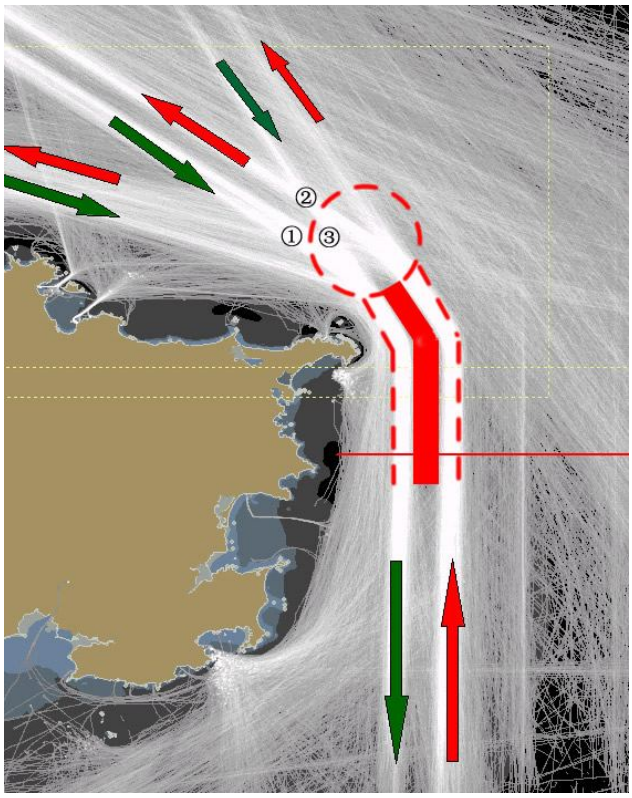

Figure 4-1 Vessels' AIS tracks distribution in CSJ VTS area.

Source: Weihai MSA, (2012). CSJ VTS center history data.

Vessels' tracks are the records of vessels' history courses. It is an important feature for illustrating shipping routes or traffic patterns in an area. The spatial distribution of vessels' tracks is a basic element of traffic flow. By studying this much information can be obtained such as the place, situation and rate of encountering. This is important for planning ship's routeing system. The tracks' distribution can be produced by Radar or AIS observation. Figure 4-1 is one image of vessels' AIS tracks obtained in CSJ VTS center in 2010. The brightness of tracks indicates the number of vessels using those routes.

4.1.2 The traffic flow statistics

Traffic flow means the number of vessels passing a place in a predifined time. This is another important marine traffic parameter. The value can reflect how busy an area is. To some extent, it can be used for predicting the congestion and riskiness of a certain area.

4.1.3 Vessels' type distribution

On the basis of traffic flow, to understand better the characteristics of vessel traffic, the traffic information can be further analyzed according to vessel types, nationalities, tonnage, breadth, LOA and drafts. Figure 4-2 is one example of vessels type distribution for vessels between CSJ and Dalian port in 2007. Actually we can customize parameters for type distribution. Figure 4-3 is using Deadweight to show distribution.

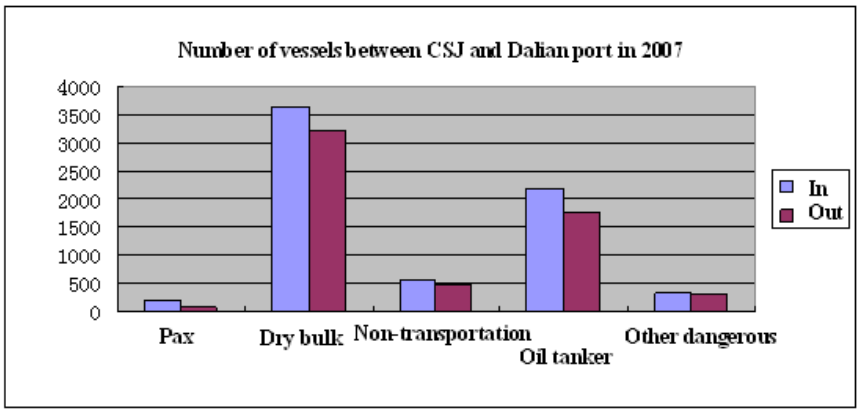

Figure 4-2 Vessels' type distribution

Source: Weihai MSA, (2012). History data of Chengshan Jiao VTS.

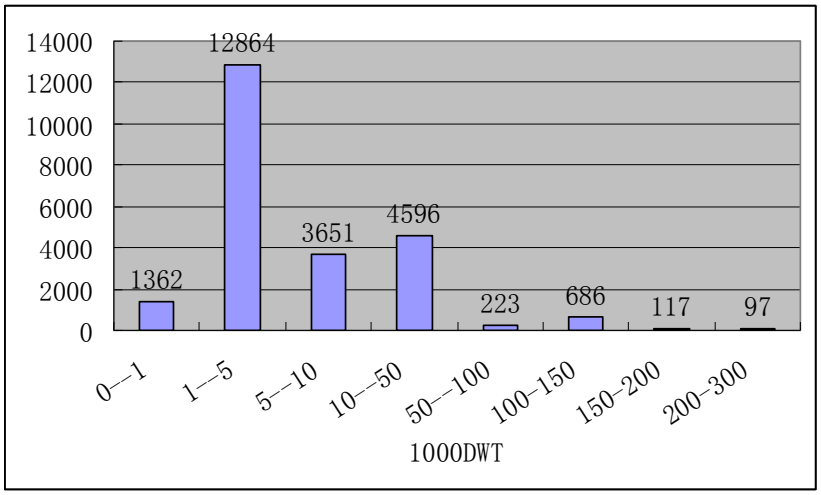

Figure 4-3 Vessels' DWT distribution in Tianjin Port Jan-Sept 2006.

Source: Tianjin MSA, (2006). VTS data of Tianjin VTS for 2006.

4.1.4 Traffic density distribution

Traffic density is an important factor for navigational environment. Where the density is high, the risk of accident is also high. So such area can be seen as critical area for supervision. Actually traffic density has two connotations: one is average density of vessels; the other is the vessels' spatial distribution.

4.1.5 Vessels' encounter rate

Encounter rate is used to estimate the risk involved when a single vessel is considered moving through a stream of vessels which are distributed randomly. Barratt, M.J (1973) provided the formula:

$$C = 2R\,\rho\,(V_R)$$

Where R=encounter radius,

ρ = density of stream (number of vessels per unit area),

V_R = mean speed of main stream relative to that of the vessel.

Compared with statistics of collision or collision rate, the statistics of encounter rate is more important for evaluating the marine traffic risks. Because after all the number of collision is far less than encounter, which causes actual sample data is quite limited, so the result will be less reliable. The statistics of encounter rate can avoid such limitations.

4.2 Traffic flow observation methods

4.2.1 Conventional observation methods

(1) Visual observation

This method is easy to conduct. It can be used to observe and record vessels passing a certain fairway or gate line. Vessels information such as name, type or nationality can be easily identified. However, this method cannot provide vessels' tracks, speed, or density data. Further more, the result can be affected by the distance and it's hard to carry out at night or when the visibility is restricted.

(2) Radar observation

Radar observation is the most basic method for marine traffic observation. It has the advantages of large range of observation, precise location and status of any vessels in coverage. More importantly, data like flow, density and pattern of traffic can all be collected. Radar observation is not restricted by normal weather conditions or lighting conditions, especially it is an effective method in restricted visibility. However, it also has its drawbacks such as the difficulty for detecting small targets at long distance, the disturbance by heavy weather or spurious echo (Wang, 2011).

(3) Aerial photograph

This method is suitable for the observation of vessel traffic in a vast area. It uses aircraft to take photographs to collect traffic information. “As a permanent record is obtained, it is possible for different parameters to be examined” (Leonard, 1979). However, it’s too expensive to carry out and this method is restricted by weather and lighting conditions.

4.2.2 Real-time observation technique based on AIS

AIS is a new type of navigational aids, its application in collision avoidance, ship-ship communication, ship-shore communication has proved to enhance maritime safety (Bai, 2006). Furthermore, it has significant in marine traffic flow investigation because of its advantages:

(1) Position accuracy: AIS incorporates the position data from GMDSS system, which can acquire the accuracy of 10 m in positioning. Other conventional methods such as Radar cannot compete.

(2) Real-time data: The conventional methods can provide dynamic data such course and speed by calculating vessels’ tracks, so there is some delay. But AIS can provide real-time static (name, call sign, IMO no.) and dynamic data (speed, heading, Rate of Turn).

(3) Prevention of some conventional problems: The problems of the conventional observation methods include the restrictions by natural factors like heavy rain, snow, storms, obstructions, etc. But AIS can avoid such problems.

(4) Automatic identification and reduction of workload: Maybe Visual observation can also get a vessel’s name, type, nationality; however, it cannot be conducted at night or in restricted visibility. But AIS can realize automatic identification. When the workload is reduced, so is the chance of human errors (Baumler, 2013).

Chapter 5 Conceptual Design and Function Realization

5.1 Maritime Traffic Analysis Based on AIS

The design of maritime traffic analysis based on AIS adopts C/S (Client/Server) configuration. The terminal can obtain the massive data stored in the Server. By the installed software, functions such as vessels' tracks analysis, traffic flow statistics can be achieved. Figure 5-1 is the interface of maritime traffic analysis software.

Figure 5-1 Maritime traffic analysis software interface

Source: Weihai MSA, (2012). Obtained from CSJ VTS center.

The main function of the software:

- Customize any section flow statistics
- Display image by threshold adjustment
- Automatic statistics by vessels' direction, type, speed, LOA, draft, etc.

5.1.1 Section statistics

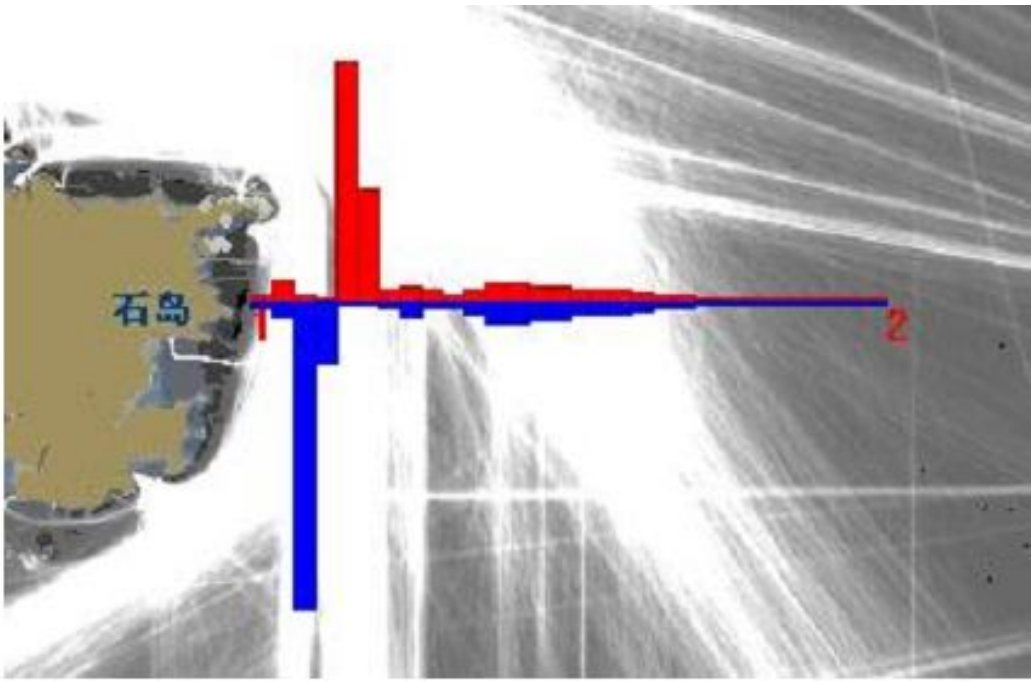

Figure 5-2 Vessels' tracks distribution

Source: Compiled by the author.

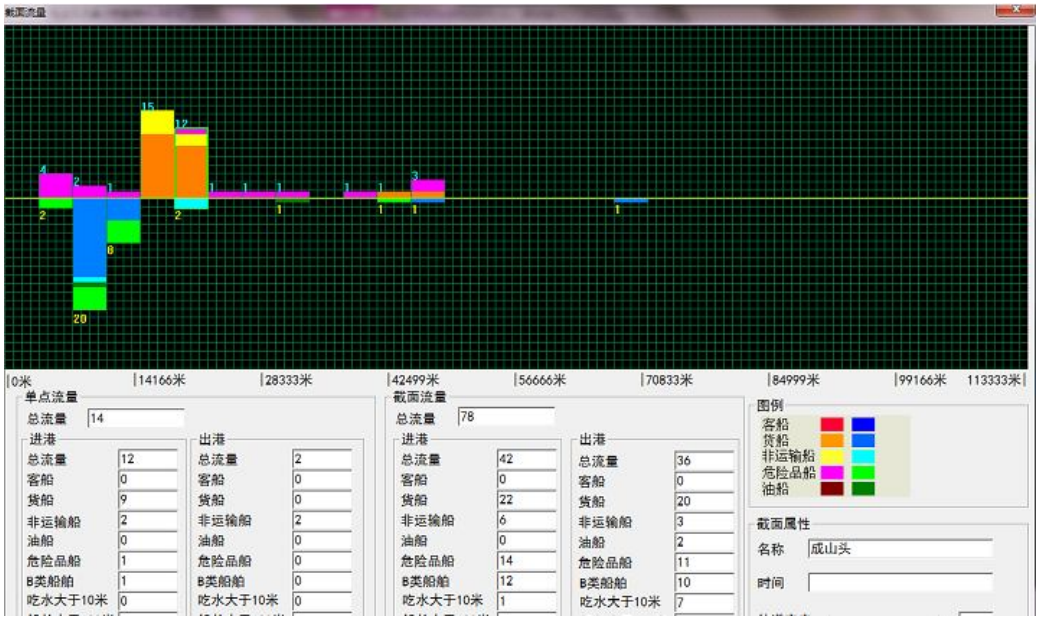

Figure 5-3 Detailed display of section statistics

Source: Compiled by the author.

By defining two points on the chart, the traffic flow statistics of this section connecting these two points can be realized. As shown in Figure 5-2, users can define display of two directions of traffic flow by red and blue color. Further more, detailed statistics data can also be displayed like in Figure 5-3.

5.1.2 Filter display

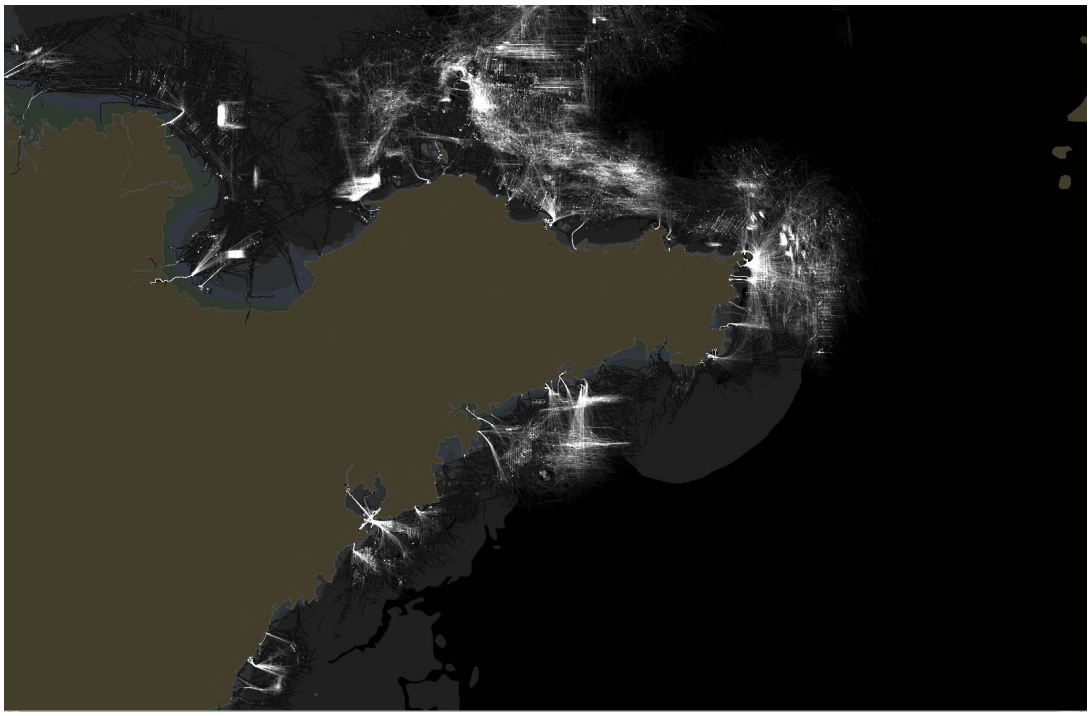

Figure 5-4 Class B AIS Vessels' tracks distribution for a random week

Source: Compiled by the author.

There are two types of AIS, Class A and Class B(ITU, 2001); According to the cargo input in vessels' AIS, vessels can be divided into passenger, cargo, non-transportation, dagerous, oil tanker; other parameters include vessels' draft, LOA, speed, etc. According to the software design, we can choose to get filtered display. Figure 5-4 is Class B AIS vessels (mainly fishing boats) track distribution in CSJ waters for a random week. Similarly Figure 5-5 is got by LOA setting, Figure 5-6 by speed setting.

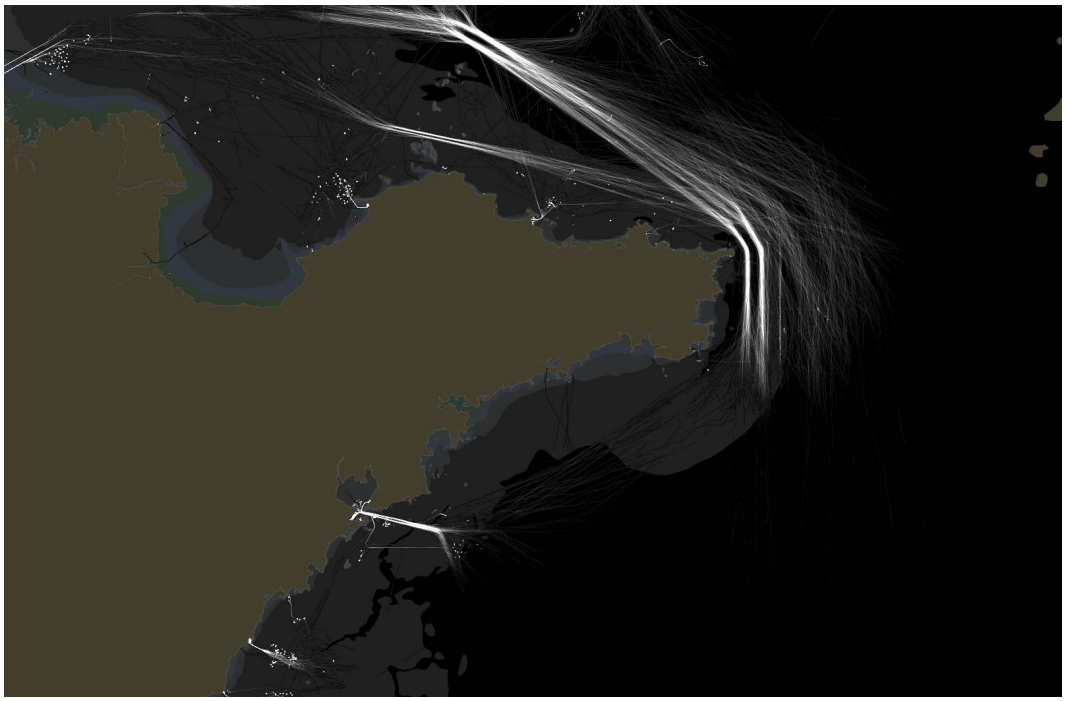

Figure 5-5 Vessels' (with LOA>180m) tracks distribution for a random week

Source: Compiled by the author.

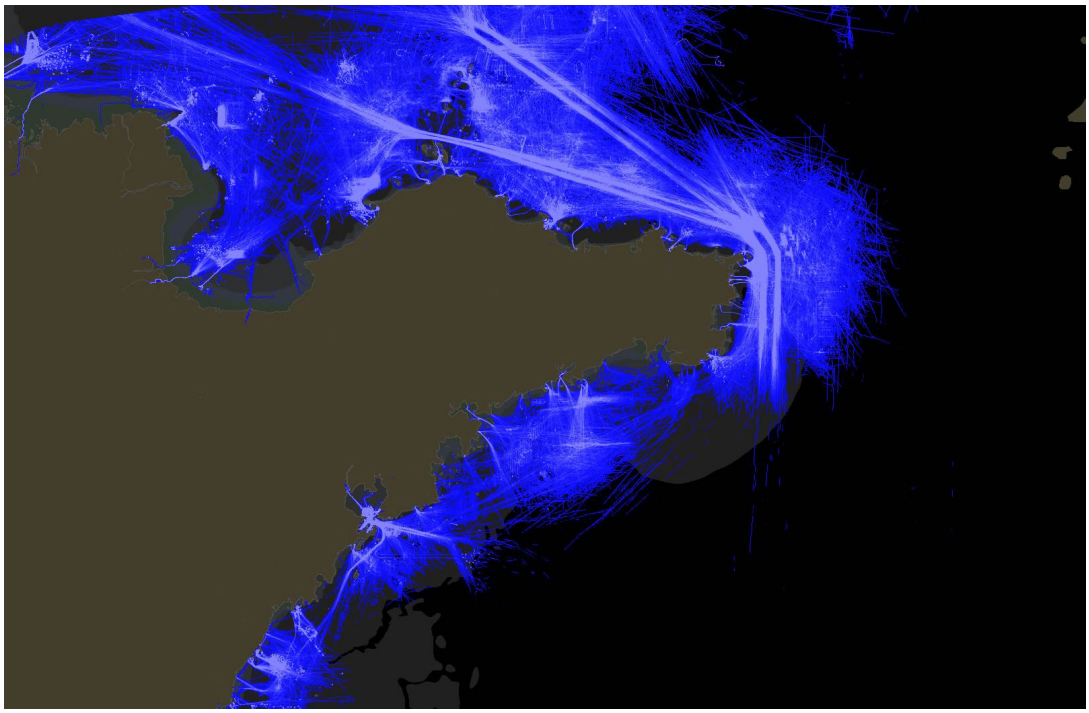

Figure 5-6 Vessels' (with Speed<10 kts) tracks distribution for a random week

Source: Compiled by the author.

5.2 Maritime Traffic Analysis Based on VTS

Maritime traffic analysis based on VTS includes the statistics of AIS targets, Radar targets. It can eliminate the limitations of maritime traffic analysis based on AIS. The only problem here is the effect of Radar clutter to the statistic result. Since majority of China VTS centers are equipped with ATLAS system, I will use it as an example for illustration. In this system, all traffic data is stored in Multi tracker server. This data can be extracted and analyzed by software. The following software is developed on Java platform on the basis of ATLAS VTS 9770 for traffic flow analysis.

5.2.1 Traffic density statistics

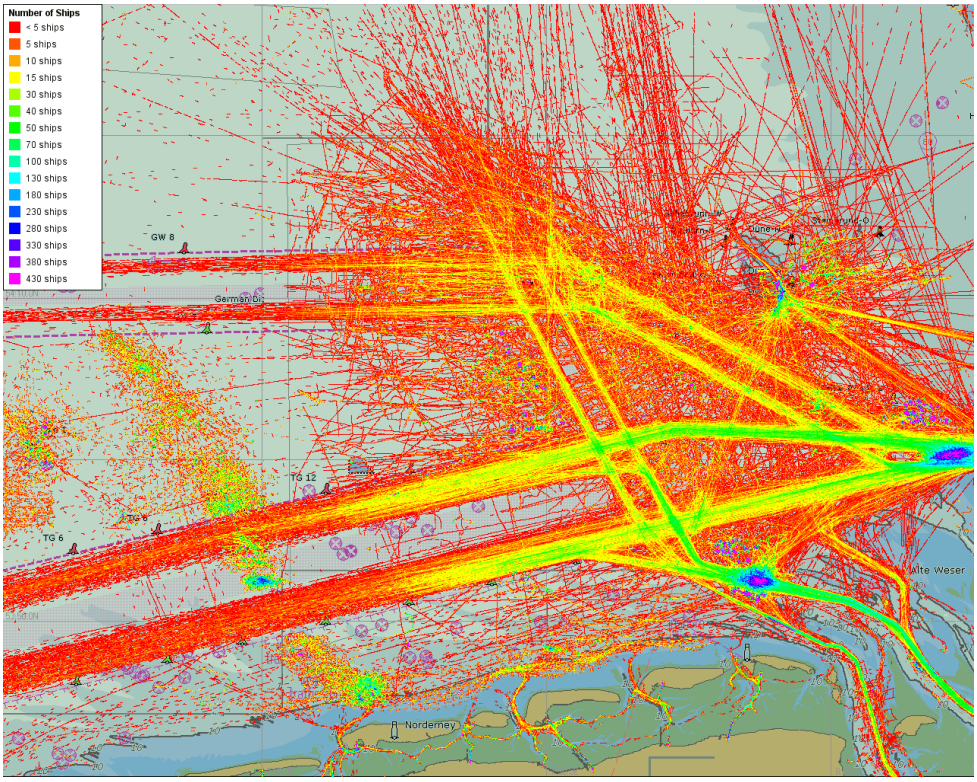

Figure 5-7 Vessel traffic density distribution

Source: ATLAS operators' manual

Vessels' tracks can be displayed on ECDIS. The vessels' traffic density is indicated by different colors. This is especially useful for congested waters like CSJ VTS area. Figure 5-7 is an example taken from ATLAS manual. In this picture, red color suggests less congested routes, green color indicates moderate density, blue/purple/pink stands for high congested area.

5.2.2 Section statistics

Similar as the AIS software introduce in 5.2, VTS system can also realize section statistics for a predefined section. Figure 5-8 is an example. In the picture, different passage lines are shown by different colors.

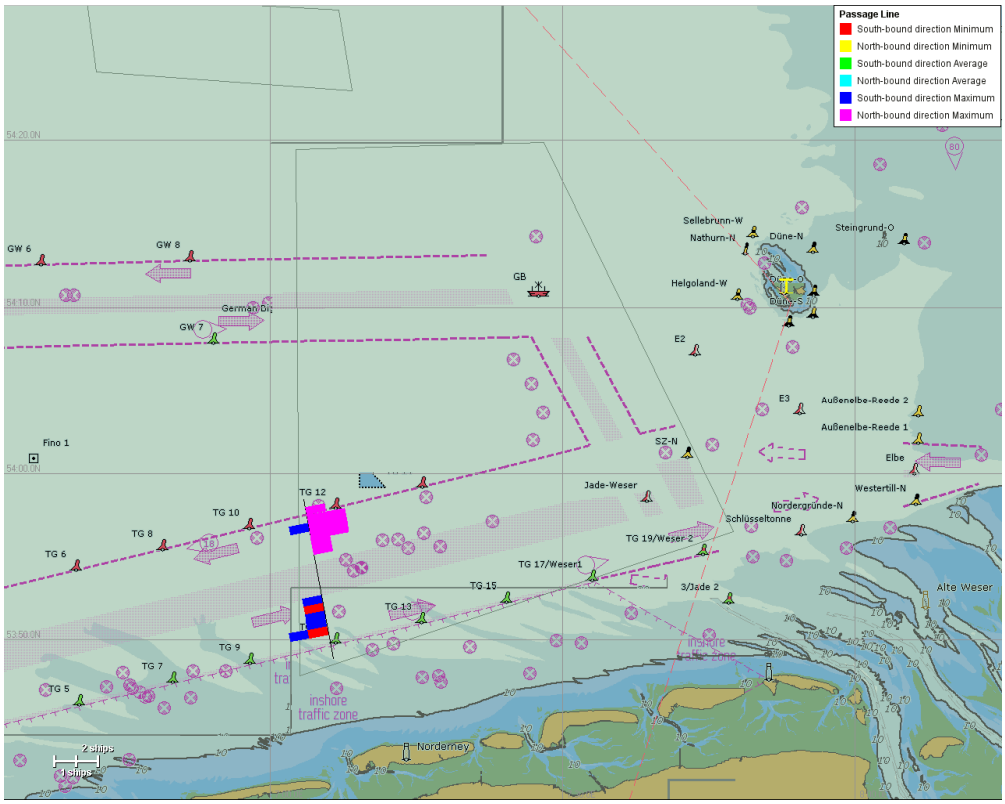

Figure 5-8 Section statistics from VTS

Source: ATLAS operators' manual

5.2.3 Vessels' parameter statistics

Different parameters such as course, speed, draft, LOA, breadth, etc. can be set for statistics. Figure 5-9 is an example showing speed distribution.

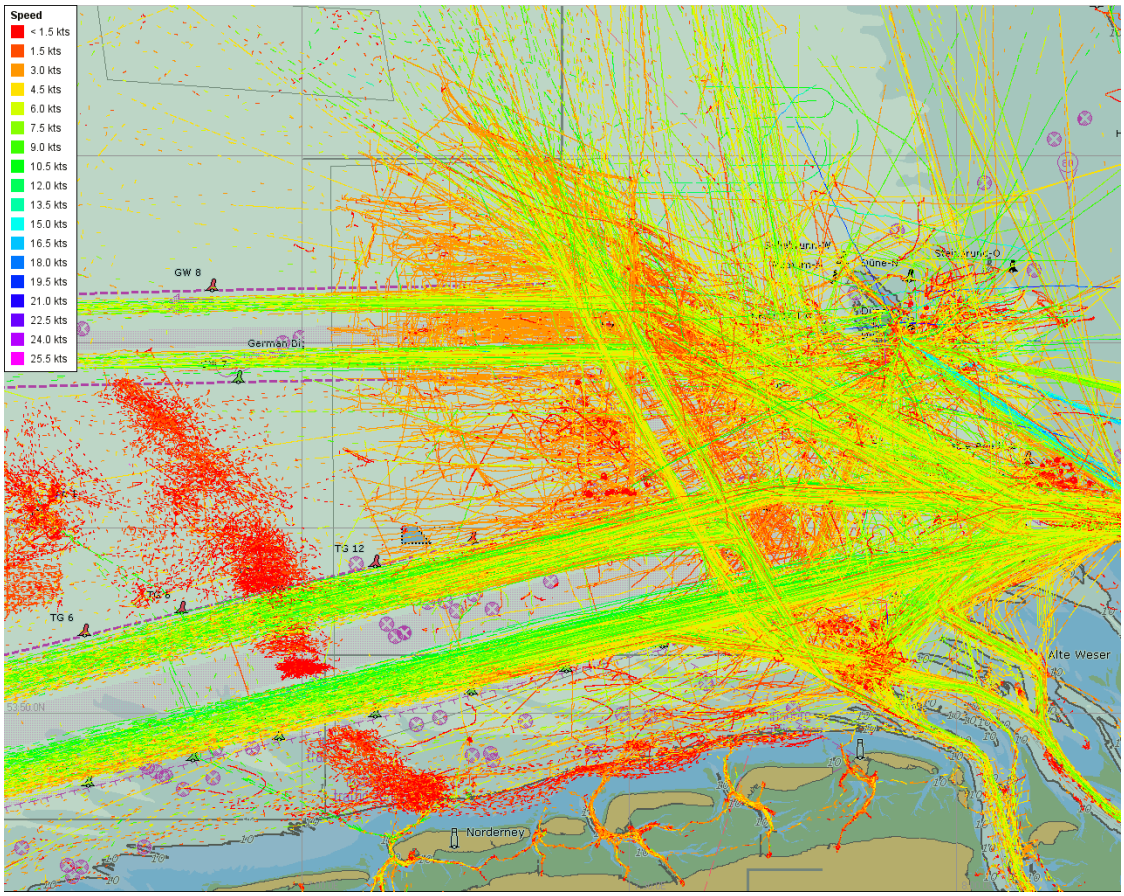

Figure 5-9 Speed distribution in VTS area

Source: ATLAS operators' manual.

5.2.4 Near-Miss statistics

After set CPA and TCPA, the statistics of encounter information (when the CPA, and TCPA of two approaching vessels are less than preset data) can be collected and displayed on the chart as illustrated by Figure 5-10.

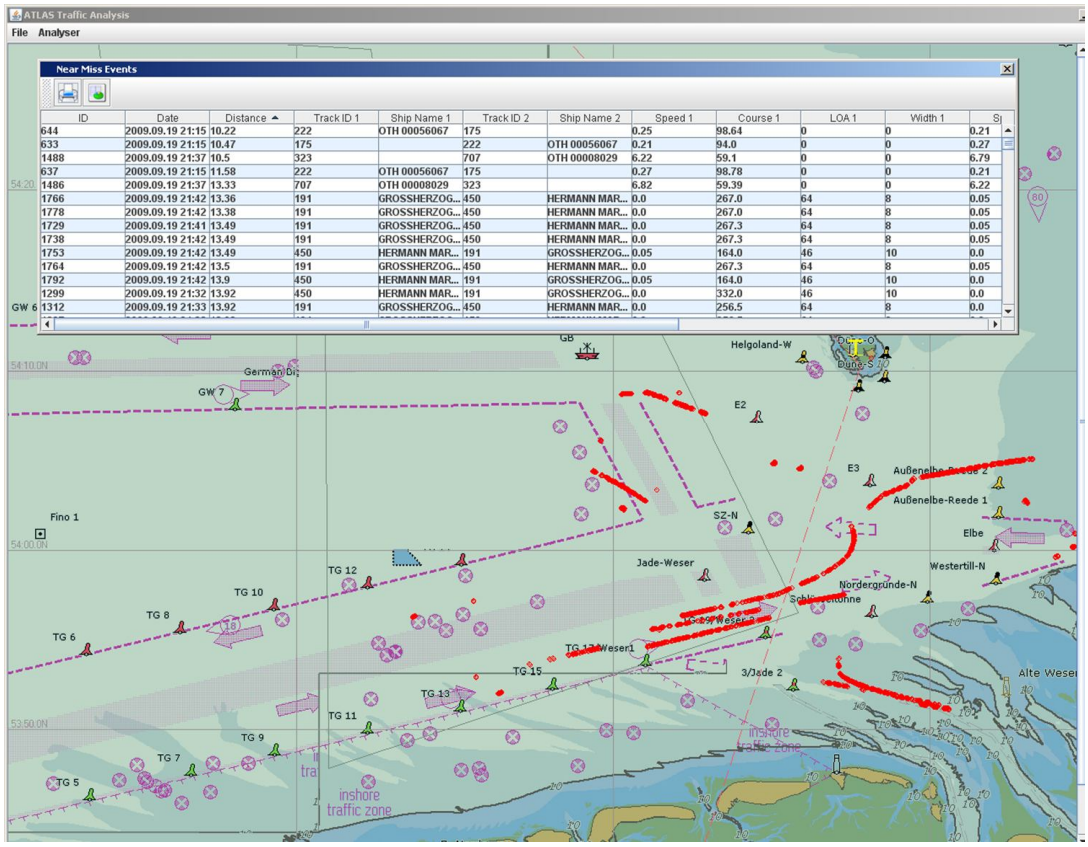

Figure 5-10 Near-miss statistics

Source: ATLAS operators' manual.

5.3 Maritime Traffic Analysis Based on VTS

In the Management Information System (MIS) database, massive static and dynamic data is stored. Maritime traffic analysis can also be based on this data. still I use ATLAS MIS 9800 as an example to show how to realize precise analysis. In order to reduce the workload of VTS operators, CSJ VTS set automatic identification line, state transition line to achieve automatic statistics of visiting vessels. By Structured Query Language (SQL), customized query and statistics report can be obtained. The following is the example of how to design "Ship dynamic report". Figure 5-11 is the report form produced by the system.

```
/*
  $From date*=FDATE%D;
  $To date*=TDATE%D;
  $Ship name=SNAME%s;
  $Call sign=CLS%s;
  $Ship type=ST%i[select SHTID,SHTNAME "Name" from shiptype order by SHTNAME];
  $Last port=FP%i[select alid,alname "Name" from arealine where alkind=14 order by alname];
  $Next port=NP%i[select alid,alname "Name" from arealine where alkind=14 order by alname];
  $INITIALIZE{select sysdate-1,sysdate from dual};
*/
select svid "VRC",SDGROSSTON "Grosstonnage", nvl(sdlocalname,sdname) "Ship name" ,sdcallsign "Call sign" ,a.SAREALSTARTTIME "First transit time" , fp.alname "From port", tp.alname "Next port", shtname "Ship type"
from shipdata,shipvisit,shipaction a, arealine fp,arealine tp, shiptype,
( select sasvid, min(said) said
  from shipaction
  where SAACTIONSTATE=7 and SAACTIONKIND in (3,4)
  group by sasvid
) tr
where svid=a.sasvid and sdid=svsdid
and a.said=tr.said and fp.alid(+)=svfromport and tp.alid(+)=svnextport and sdshiptype=shtid(+)
and :FDATE<=a.SAREALSTARTTIME and a.SAREALSTARTTIME<=:TDATE
$DECODE{$CLS$,,,and sdcallsign like upper('$CLS$')||'%'}
$DECODE{$SNAME$,,,and ((sdname like upper('$SNAME$')||'%') or (sdlocalname like
```

```
'$SNAME$'||'%'))}
$DECODE{$ST$,,,and sdshiptype=$ST$}
$DECODE{$FP$,,,and svfromport=$FP$}
$DECODE{$NP$,,,and svnextport=$NP$}
order by a.SAREALSTARTTIME
```

Vessels' Report Form

Relieved Officer _____ **Relieving Officer** _____

First transit time	*Ship name*	*Call sign*	*Ship type*	*LOA*	*WIDTH*	*GT*	*From port*	*Next port*	*SPEED*	*Voyage*
12/07/2012 07:48:17	远胜36	BLAS6	散货船	180	29	22491	扬州	TIANJIN	11.86	
12/07/2012 07:49:09	万信21	BLFY2		180	26		连云港	鲅鱼圈	9.52	Next port:BA YU QUAN
12/07/2012 07:51:29	吉航97	BVFM5	多用途船	104.89	15.8	3727	鲅鱼圈	宁波	9.33	Next port:NING BO
12/07/2012 07:51:57	马瑞尼奇	9HWU9	散货船	224.94	32.26	39736	新加坡	大连	12.83	Next port:DALIAN,CHINA
12/07/2012 07:58:50	中达油268	AP4GD_8	油船	53	9	498	上海	滨州	7.97	Next port:SHANG HAI
12/07/2012 07:59:37	威龙9	BMYW		99	15		秦皇岛	广州	9.91	Next port:GUANG ZHOU
12/07/2012 07:59:59	宏隆8	BLAR8		13	16		上海	天津	9.52	Next port:TIAN JIN
12/07/2012 08:01:05	泰荣9	BKWT4	杂货船	127.92	18.6	6577	韩国	曹妃甸	12.05	Next port:CAOFEIDIAN
12/07/2012 08:08:03	新景盛12	BJNR	散货船	98	16	2879		丹东	9.33	Next port:DA LIAN
12/07/2012 08:12:17	向凯	BPMD	集装箱船	164.9	22.86	14505	鲅鱼圈	上海	11.27	Next port:SHANG HAI

Figure 5-11 Vessels' report form produced by the MIS system

Source: ATLAS MIS 9800 with designed software.

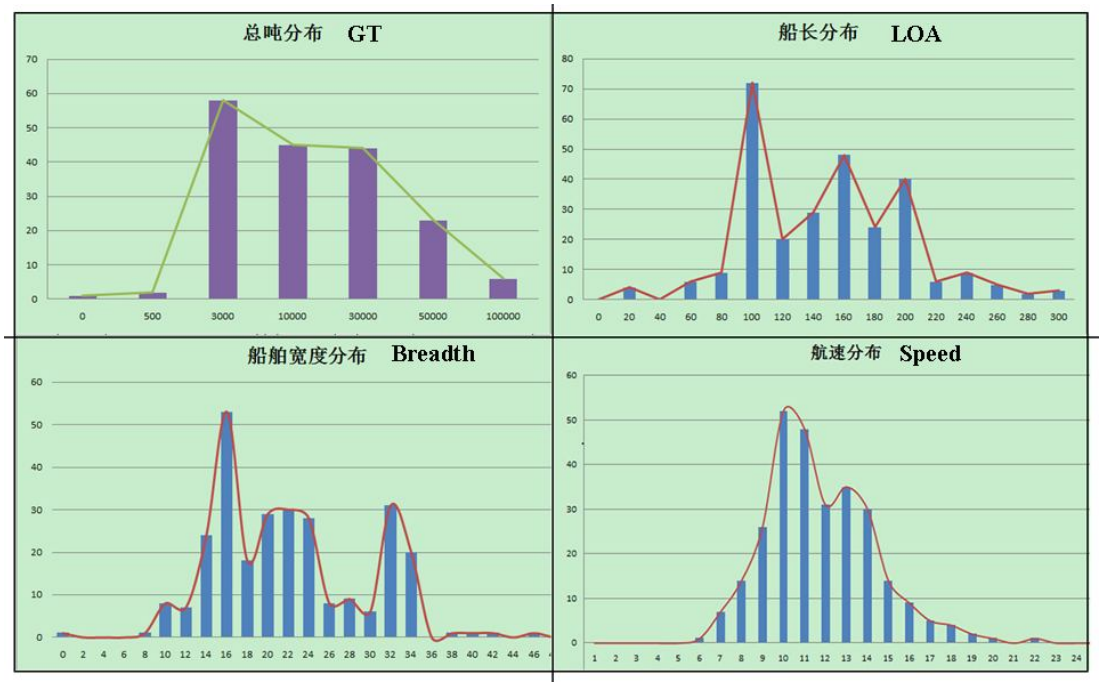

Figure 5-12 Parameter analysis based on MIS database

Source: Source: ATLAS MIS 9800 with designed software.

On basis of MIS database, analysis can be further done to different parameters such as GT, LOA, Speed, etc. Figure 19 is the example.

Chapter 6 The Configuration of Promulgation System of Traffic Information

6.1 System structure

The System integrates information collection, data processing, information promulgation into one system with support from hardware and software of VTS center. Figure 6-1 is the structure diagram.

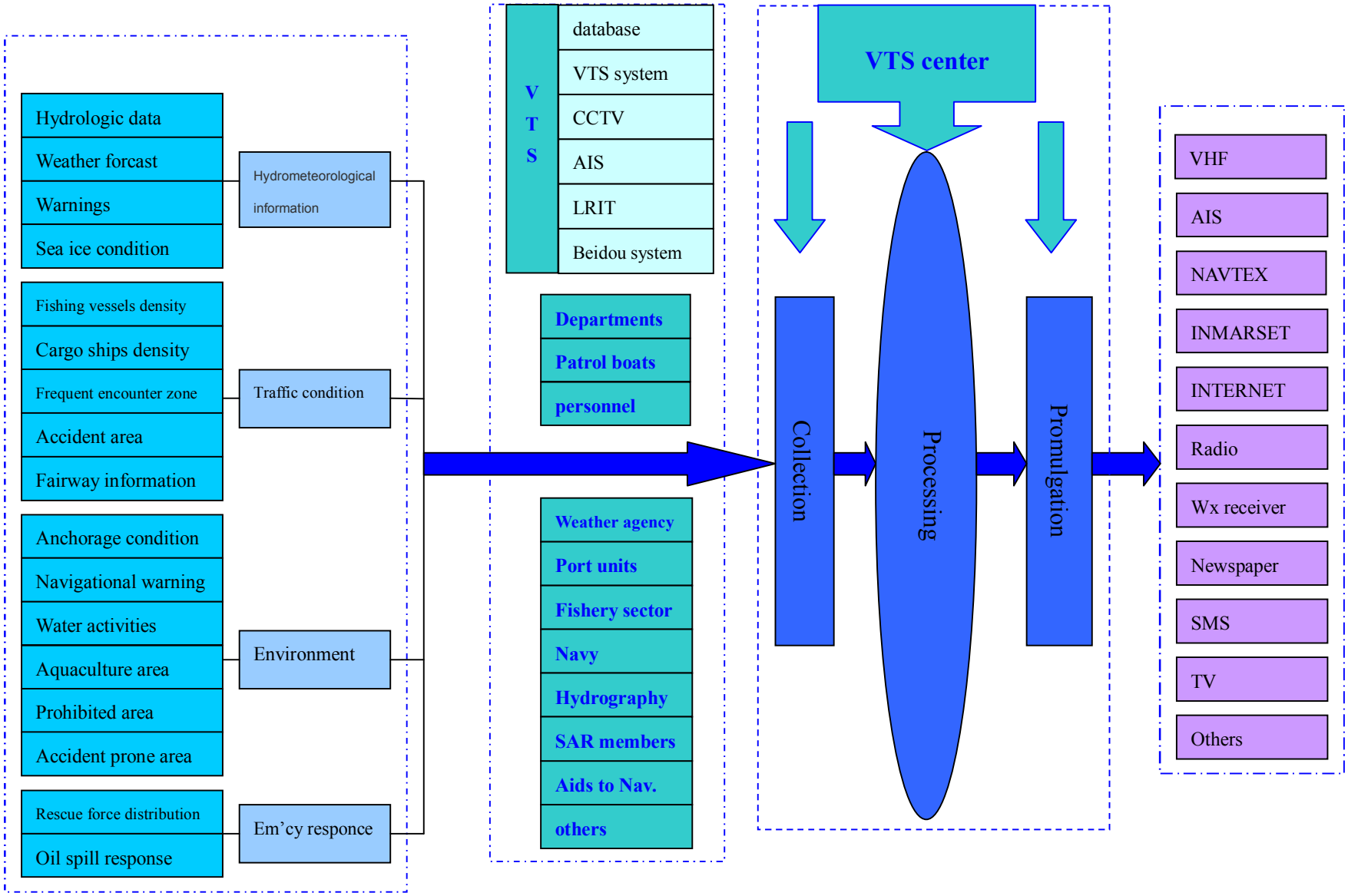
Hydrologic data
Weather forcast
Warnings
Sea ice condition
Hydrometeorological information
Fishing vessels density
Cargo ships density
Frequent encounter zone
Accident area
Fairway information
Traffic condition
Anchorage condition
Navigational warning
Water activities
Aquaculture area
Prohibited area
Accident prone area
Environment
Rescue force distribution
Oil spill response
Em'cy responce
V T S
database
VTS system
CCTV
AIS
LRIT
Beidou system
Departments
Patrol boats
personnel
Weather agency
Port units
Fishery sector
Navy
Hydrography
SAR members
Aids to Nav.
others
VTS center
Collection
Processing
Promulgation
VHF
AIS
NAVTEX
INMARSET
INTERNET
Radio
Wx receiver
Newspaper
SMS
TV
Others

Figure 6-1 Structure diagram for the promulgation system
Source: Compiled by the author.

Different types of Maritime safety information are included in the dashed box to the left of the Diagram. The different means of promulgation are included in the dashed box to the right. Inside the dashed box in the middle left are equipment, units and departments for information collection. The information collected will be collected by VTS center. After analysis and processing, the information output will be sent to different users through different means they prefer.

6.1.1 The collection of Maritime safety information

VTS center is the pivot of Maritime safety information. On the one hand, VTS center is equipped with advanced information collection systems such as VTS, AIS, VHF, CCTV, etc. On the other hand, because of its special functions VTS center can obtain information from other departments of MSA, harbor units, fishery agency, and navy. The information collected through different source is reliable. It can be categorized into hydro meteorological information, navigational conditions information, information related to vessels' safe navigation / anchorage / operation, emergency response information (such as the distribution of resources), etc.

6.1.2 Maritime risk assessment

Risk assessment is using scientific procedures and methods to identify the intrinsic or potential hazards and the severity for safety analysis and assessment (Schroder, 2012). It is indicated quantitatively by index, rank or probability value (ChinaItlab, 2007). Risk assessment provides scientific basis for safety management to formulate

basic protective measures. Identification of hazards, risk analysis, risk control options are the procedures to conduct Formal Safety Assessment (FSA). (IMO, 2002) That also applies to the purpose of this study. On the basis of maritime traffic analysis discussed in Chapter 5, we can use CSJ waters as sample to predict maritime risks and provide preventative measures. Then our maritime safety management will change from experience-based to prior control which includes prior identification, prior prediction and prevention. However, the experience is also quite useful. During my research, I went back to CSJ VTS center and invited VTS operators especially those with many years' working experience. Some opinions or experience can be regarded as expert judgment as mentioned in IMO MSC-MEPC.2/Circ.5 (2006) which states that,

> *It not only contributes to the proactive nature of the methodology, but is also essential in cases where there is a lack of historical data. Further historical data may be evaluated by the use of expert judgment by which the quality of the historical data may be improved.*

Based on the qualitative analysis, Table 6-1 is made as an example for demonstration purpose. It uses vessels types, Traffic conditions and Navigational conditions together with number of vessels to define risk level and provide risk control measures.

Table 6-1 Maritime risk assessment example

Risk factors		Index/no. of vessels	Risk level	Risk control measures
Vessel type	Passenger	≥3	High	Measures when Risk level is moderate or higher: a. concentration of fishing boats and
	Dangerous	≥8&＜15	moderate	
	Large vessel(LOA>200)	＜4	low	

	Fishing boats	≥45	High	restricted visibility, Strength INS; b. Strengthen Pax vessel surveillance; c. when traffic density is high, provide TOS.
Traffic conditions	Traffic density within unit area	≥12	High	
	Traffic flow Per hour	＜9	Low	
Environm. conditions	Visibility	＜500 m	High	
	Wind force (BF)	＜5-6	Low	
	Sea conditions	moderate	Low	

Source: Compiled by the author.

Maritime risk assessment is the basis for safety management and scientific decision-making. It is a proactive way to prevent marine accident. The result of the assessment can be important reference for shipping companies, vessels and VTS centers to formulate preventative measures or to arrange watchkeeping forces.

6.1.3 Marine traffic data processing

Marine traffic data processing is the most important element of the System. Based on marine traffic theory, it uses various kinds of advanced information processing technology (such as the maritime traffic analysis software based on AIS or VTS introduced in Chapter 5) to achieve precise decision-making information which will be further categorized for sending to vessels or shipping companies. Figure 6-2 indicates the promulgation design of traffic information for vessels, and Figure 6-3 for shipping companies.

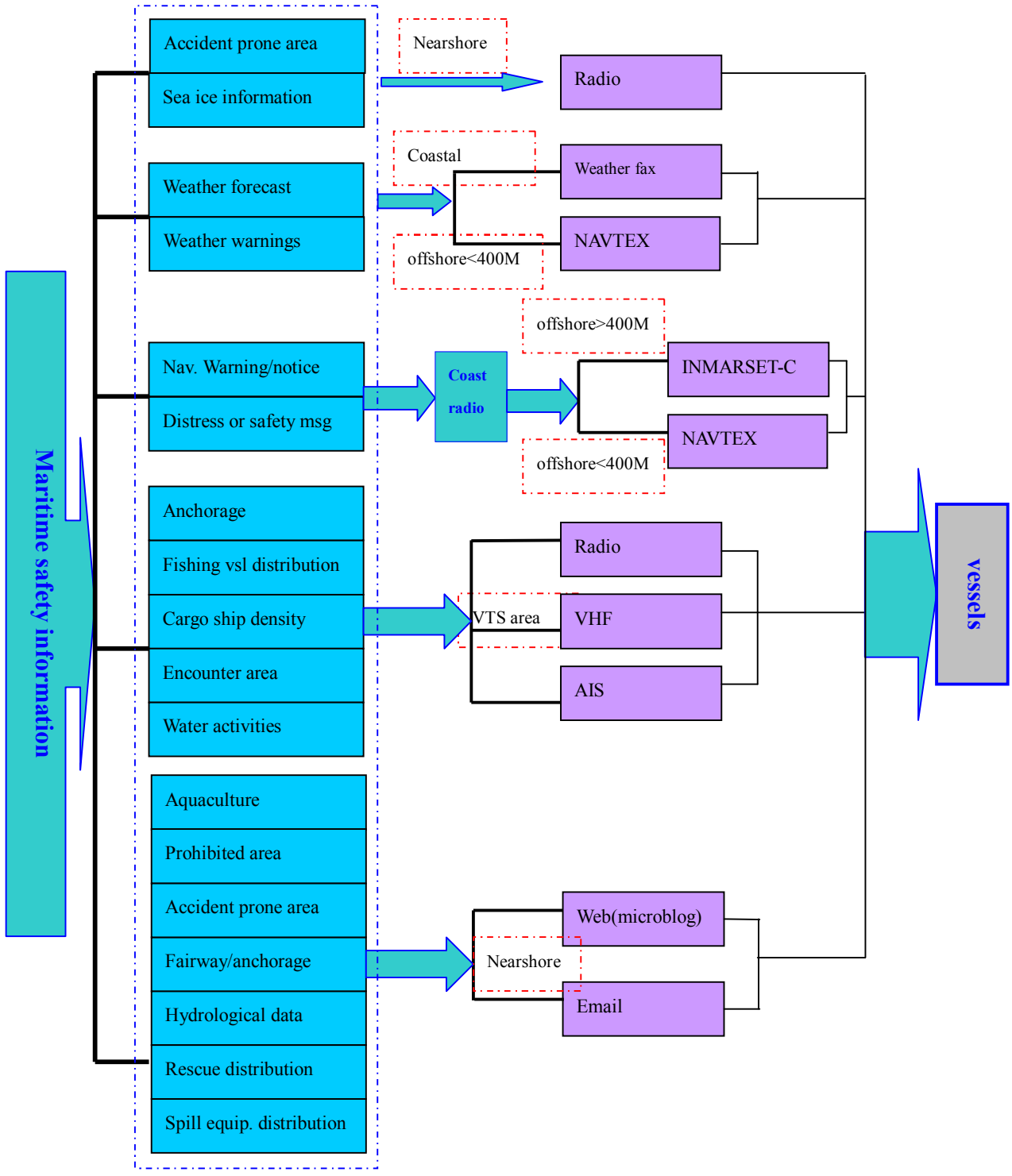

Figure 6-2 The Promulgation design of maritime safety information for vessels

Source: Compiled by the author.

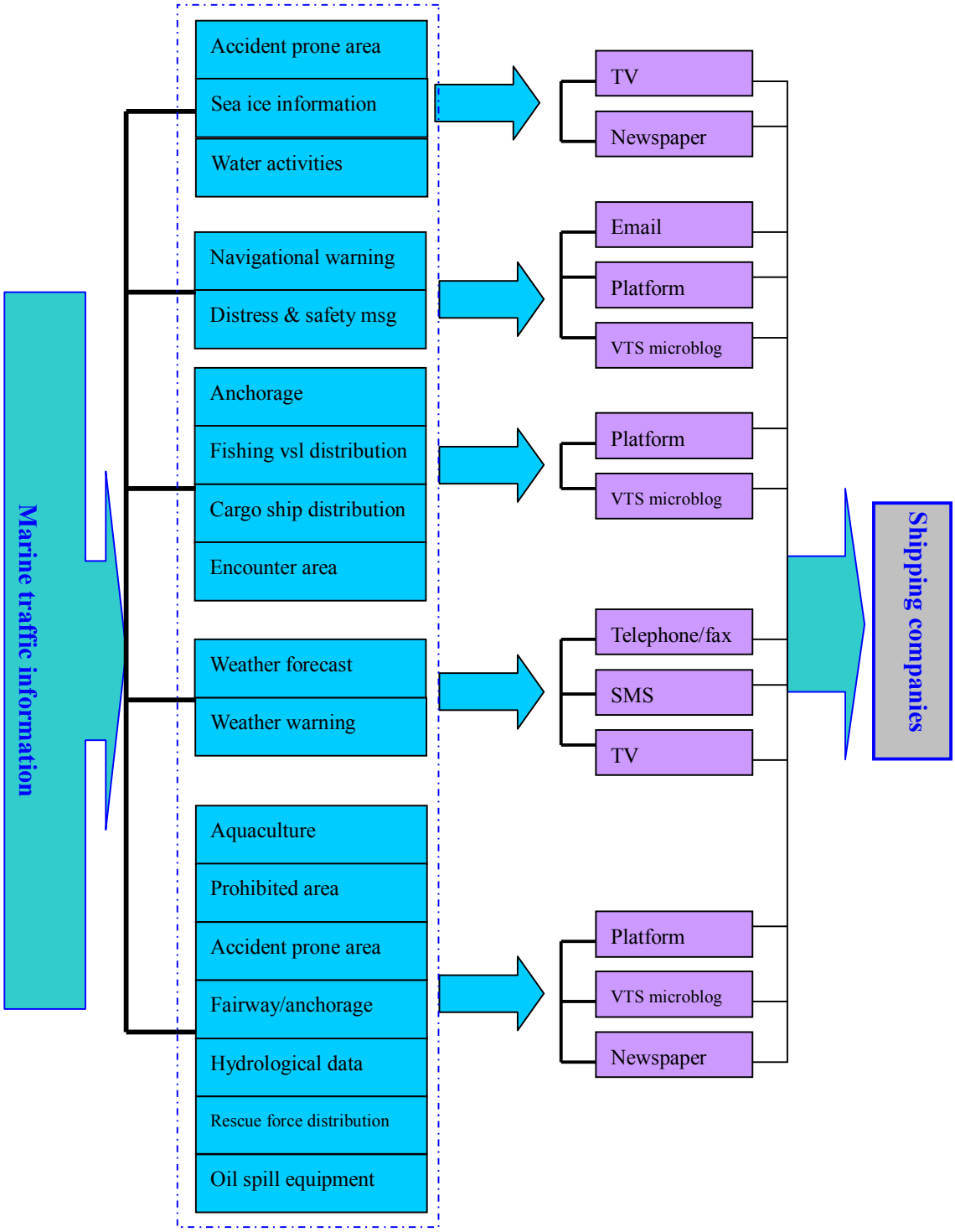

Figure 6-3 The Promulgation System design of maritime safety information for companies

Source: Compiled by the author.

6.1.4 The promulgation of Maritime safety information

6.1.4.1 Means of promulgation

For vessels are equipped with different communication equipment according to their tonnage, types and sea areas of operation as required by international conventions. So in order to ensure that vessels and their companies can receive Maritime safety information that VTS center promulgates, questionnaire survey was carried out to investigate their information demands and means of promulgation (as discussed in section 3.3 of this paper). The survey shows that transit vessels prefer to receive information through VHF, AIS, NAVTEX, Inmarsat; Shipping companies favor means of promulgation by Internet, Email and SMS to receive necessary information. I believe that a good Maritime safety information release system not only should have complete and practical Maritime safety information release equipment and system, at the same time should also make full use of the equipment and the advantages of the system for different information users through their preferred means of promulgation. The promulgation design for vessels and companies are illustrated by Figure 6-2 and Figure 6-3 respectively.

6.1.4.2 VTS personnel requirement

For the establishment of the System, there are some requirements for VTS personnel (hereafter referred to as “messenger”). Messengers are responsible for: (1) gathering various Maritime safety information; (2) analyzing and classifying information according to user groups, means and time of promulgation; (3) promulgation according to the System design. To perform this job satisfactorily, messengers shall fulfill the following requirements: VTS watchkeeping experience; familiar with the

operation of different systems; Some statistic knowledge; fluent nautical English level.

6.1.4.3 Content of information for promulgation

The content of information for promulgation is also investigated through the questionnaire survey. The result from vessels' survey indicates that: about Hydrometeorological information demands, 97% surveyed vessels consider weather forecast for next 24 hours is important, weather forecast for next 48 hours 93%, adverse weather pre-warning 99%, ice information in Bohai Bay in winter 93%; about traffic conditions information demands, 96% of surveyed vessels consider cargo ships density distribution and tendency important, fishing vessels density distribution and tendency 98%, ships' encounter area information 97%, distress and accident information 99%; about navigational environment information demands, 99% of surveyed vessels consider navigational warning/notice important, water activities 97%, accident-prone information 99%, aquaculture information 96%, anchorage information 97%, anchorage usage in adverse weather 98%; about emergency response information, 98% of surveyed vessels consider rescue force distribution information important, oil spill response resource distribution 96%. The result of companies' survey is illustrated by Figure 6-4. The importance for different Maritime safety information is not to be further discussed.

It can be seen from the survey that more than 90% surveyed vessels or shipping companies valued the importance of Maritime safety information, which means that vessels' and companies' demands for Maritime safety information are quite urgent. The content of information for promulgation is exactly based on the survey result.

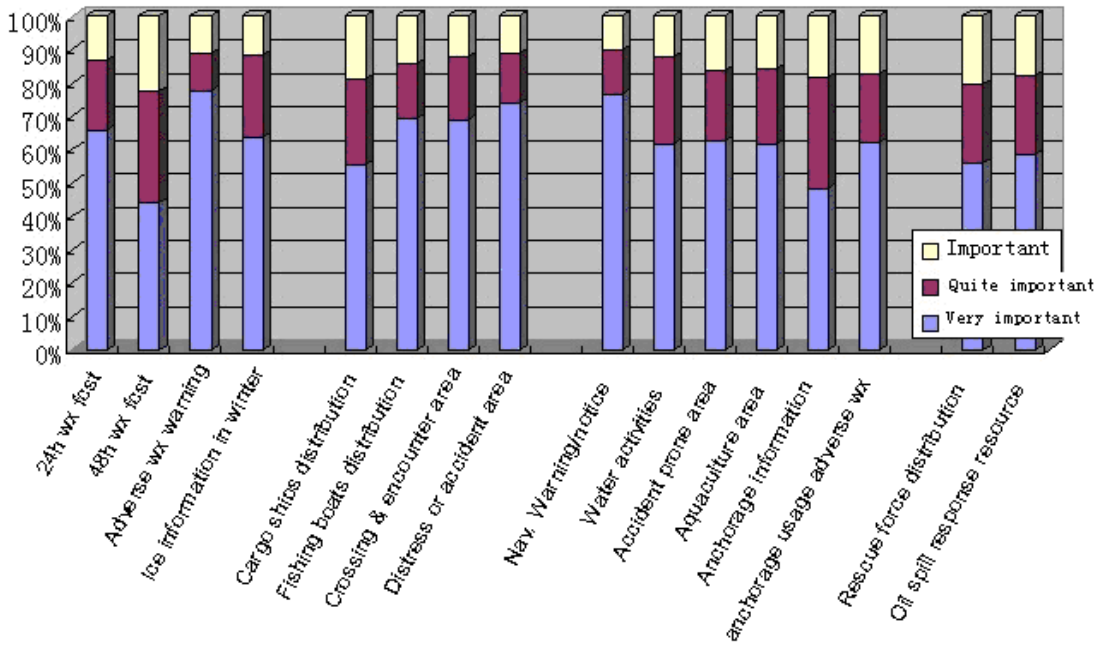

Figure 6-4 Ranking of importance for different Maritime safety information (Companies' feedback)

Source: Compiled by the author using the survey data.

6.1.4.4 Time of promulgation

Questionnaire survey from vessels indicates that: with regard to the use of VHF radiotelephony for transmission, 79% of surveyed vessels expect once every 4 hours, 7% expect once every 8 hours, 4% every 12 hours, 3% every 24 hours, 7% others; about the use of AIS, Weather receiver, SMS for transmission, 83% expect to receive information on arriving reporting line, 11% expect to receive on arriving the precautionary area, 6% expect to receive other area in VTS coverage; about the use of official website and microblog for promulgation, 78% expect the information to be updated every 8 hours, 17% expect updating of information every 12 hours, 3% expect every 16 hours, 2% every 20 hours.

Questionnaire survey from companies indicates that: most of the surveyed companies expect the information on the official website and microblog to be updated everyday. Among them 44% expect VTS centers to update information at least twice every day, 32% expect four times every day. About the exact time of promulgation or updating of information on the website and microblog, 90% companies expect at 8 o'clock every morning.

Because the questionnaire survey is designed with consideration to the actual traffic conditions of CSJ water for investigating only vessels that frequently pass CSJ VTS waters according to the database record of 2012, and companies that have vessels transiting the CSJ VTS waters, so the effectiveness of the result of survey only applies to this waters especially about the promulgation mode, time and frequency. In order to meet users' demands, CSJ VTS is recommended: to send Maritime safety information by VHF radiotelephony every 4 hours; to send Maritime safety information by AIS, SMS when vessels are arriving 24 nm reporting line and depending on the circumstances VTS to send when vessels are arriving the precautionary area; if official website and microblog are used for promulgation for vessels and companies, one time shall be at 8 o'clock every morning.

6.2 The application the promulgation System in CSJ VTS center

6.2.1 Operational mode

After two major reconstruction and innovation projects in recent years, CSJ VTS system and related subsystem have been upgraded in an all-round way. Especially in 2012, Satellite AIS, LRIT have been introduced into CSJ VTS. The hardware facilities can fulfill the requirement of the establishment of the promulgation system.

With the questionnaire survey, the necessity of the System, the information demands of different users, means and time of promulgation have been investigated. On the basis of the survey, a configuration of the System which can meet the requirements of users is formulated as shown in Figure 6-5.

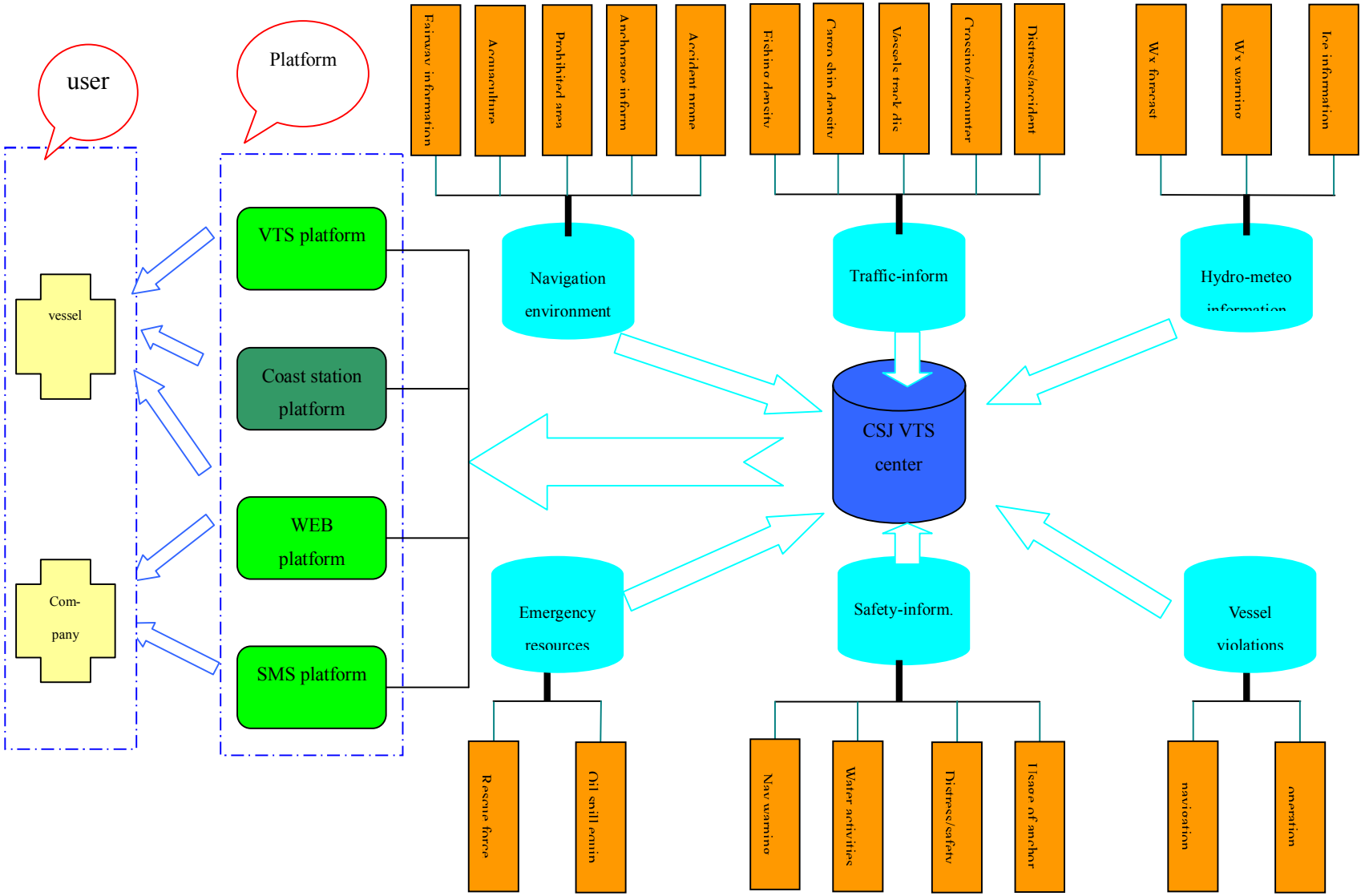
user
Platform
vessel
Com-
pany
VTS platform
Coast station
platform
WEB
platform
SMS platform
Navigation
environment
Traffic-inform
Hydro-meteo
information
CSJ VTS
center
Emergency
resources
Safety-inform.
Vessel
violations
Fairway information
Aquaculture
Prohibited area
Anchorage inform
Accident prone
Fishing density
Cargo ship density
Vessels track dis
Crossing/encounter
Distress/accident
Wx forecast
Wx warning
Ice information
Rescue force
Oil spill equip
Nav warning
Water activities
Distress/safety
Usage of anchor
navigation
operation

Figure 6-5 The configuration of CSJ VTS Promulgation System

Source: Compiled by the author.

From Figure 6-5 it can be seen that the System include 6 information databases, namely basic navigational environment information database, Maritime safety information database, hydro meteorological information database, emergency response information database, maritime safety information database, vessels violations information database. Those 6 databases cover all types of information that are required by vessels for safe navigation evidenced by the urgent information demands identified through questionnaire survey.

6.2.2 Platforms of promulgation

According to the requirement of China MSA, all VTS centers shall be built into a command center, coordination center and information center (China MSA, 2011). VTS center shall use all available means as described in Figure 6-5 to collect information. Then after processing of such information, categorize it into different information databases. The Promulgation System includes four platforms of promulgation, namely VTS system platform, WEB platform, SMS platform and Coast Station platform. The messengers are responsible of sending out the categorized information through these four platforms to different users.

6.2.2.1 VTS system platform

This platform mainly uses VHF and AIS to send to vessels Maritime safety information for example information from maritime safety information database such as distress and safety information, water activities information, military exercises

information, anchorage usage information in adverse weather. VTS operators can send the information according to the traffic and environmental conditions, at the request of vessels, or when it's deemed necessary. The promulgation through VTS system is the most important form of INS which serves a vital role for ensuring the maritime safety in CSJ waters.

6.2.2.2 WEB platform

WEB platform is most appropriate for sending information with big data load or poor intelligibility for example: information from basic navigational environment information database such as fairway and anchorage conditions, prohibited areas, boundary of aquaculture, accident-prone areas; vessel traffic density distribution from Maritime safety information database; Weather forecast information from hydro meteorological information database; rescue forces or oil spill response equipment information from emergency response database. Vessels or shipping companies can browse the website of CSJ VTS to obtain their concerned information. In addition to the information listed above, some other regular information can be provided which includes VTS User's Guide and relevant regulations, news about CSJ VTS etc. In order to promote communications between vessels and shipping companies, VTS website can invite comments from users which are effective for continuous improvement of VTS services.

Since normally vessels access to web information is mainly through Satellite station or personal cell phones, the data traffic may be only limited to some Kilobytes (KB). So VTS center can develop cell phone edition of WEB promulgation which consists of only text message for the convenience of vessels or shore management personnel to have access to the information.

6.2.2.3 SMS promulgation platform

The information from hydro meteorological information database such as weather forecast, adverse weather pre-warning and sea ice information in winter needs to be sent to users timely so as to assist their decision-making. Since this kind of information is normally short and has quite high requirement on timeliness and precision, further more it has great significance for safe navigation of vessels, Short Message Service (SMS) can be an effective way to transmit information. In order to ensure seafarers' cell phones will receive such information when they are within CSJ VTS waters, we can cooperate with telecom service companies to realize that. As for shipping companies, we can establish a database for storing the cell phone numbers of shore management personnel of shipping companies. Then use computers to group/individual send SMS when necessary. Shipping companies will relay such information to their vessels in CSJ waters.

6.2.2.4 Coast station platform

Navigational warnings are broadcasted by NAVTEX at fixed frequency or by INMARSAT. To include coast station platform is to guarantee the completeness of our means of promulgation. CSJ VTS center only prepare navigational warning (or notices) messages and then send it to coast station for promulgation.

Chapter 7 Conclusion

This research attempts to explore the possibility of expanding VTS center's function as information center. Because there have been many advanced systems equipped in VTS centers which can collect various types of Maritime safety information. However, such information is not properly categorized and fully utilized. Except the information used in INS, most information stays within the focal center.

> *In the current situation, ships in the VTS area cannot make optimal use of the resources available as their actions are based on limited information and local optimizations. This leads to a situation in which, when resources are insufficient, safety may be seriously impaired.*
>
> (Westrenen & Praetorius, 2012)

In order to find out the needs of vessels and shipping companies, a questionnaire was designed for the investigation of the information demands of vessels and shipping companies and the possible means and modes of promulgation. Based on the survey result, the author proposes the establishment of the Promulgation System of Maritime Safety Information which not only can integrate various hardware systems in VTS center for information collection, but also can promulgate such information to various users after information processing.

The System will ensure that comprehensive marine information will be collected through various systems in VTS center. Then the information collected will be analyzed and assessed by different software to identify potential risk in VTS area. After that the System will send out Maritime safety information by most effective means of promulgation to vessels and shipping companies to assist their decision making such as passage planning. So it is more appropriate to call it Vessel Traffic Information Service (VTIS) centre. By the promulgation system, the following objectives can be achieved:

(1) To enhance the safety of navigation.

(2) To protect the marine environment.

(3) To facilitate the movement of vessels.

(4) To support SAR and oil pollution response operations.

(United Kingdom Hydrographic Office, 2013)

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Appendix A：Maritime Safety Information demand questionnaire (for companies)

I. Personal Information	
Experience in shipping business	①<1year ☐ ② 1~5years ☐ ③ 5 ~10years ☐ ④ 10 ~20years ☐ ⑤ >20years ☐
Department of company	①NSM office ☐ ②operation ☐ ③technical ☐ ④marine division ☐ ⑤crewing ☐ ⑥other_____
Time in present department	①<1year ☐ ② 1~5years ☐ ③ 5 ~10years ☐ ④ 10 ~20years ☐ ⑤ >20years ☐
II. Company Information	
Company type	①shipping company ☐ ②ship management ☐ ③crew management ☐ ④fishing company ☐ ⑤other _____
Number of vessels	① 1-10 ☐ ② 11-20 ☐ ③ 21-30 ☐ ④ 31-40 ☐ ⑤ 41-50 ☐ ⑥ >50 ☐
III. Maritime Safety Information Demands	
1.The necessity of the establishment of Promulgation system	
Do you think it necessary?	①very necessary ☐ ② necessary ☐ ③not necessary ☐ ④ not matter ☐
What information do you need? (multi-choice)	①hydro meteoro. ☐ ② vessel traffic ☐ ③navigational (safety related) ☐ ④emergency response ☐ ⑤other_____
2. The importance of specific Maritime Safety Information investigation	
2.1 Hydro meteorological information demands	

Weather forecast (24h)	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐
Weather forecast (48h)	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐
Adverse weather warnings	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐
Sea ice information in winter	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐
Other information:	
2.2 Vessel traffic information demands	
Cargo ship density distribution and trend	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐
Fishing vessel density distribution and trend	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐
Encounter/crossing information	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐
Distress/accident information	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐
Other information:	
2.3 Navigational information demands	
Navigational warning/notice	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐
Water acivities	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐

Accident prone area	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐
Aquaculture distribution	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐
Shelter effect of anchorage	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐
Anchorage usage in adverse wx	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐
Other information:	
2.4 Emergency response resource information demands	
Rescue force distribution	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐
Oil spill equipment distribution	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐
Other information:	
2.5 Other information demands	
Vessels' violation information	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐
Other information:	
3.What means do you prefer for receiving information? (please choose two feasible ways and write down in the order you favor)	
1. Internet 2. Email 3. Radio 4. TV 5.SMS Other:	

Your answer: _____	
4.The frequency of daily promulgation?	
You want the information updating	① once ☐ ② twice ☐ ③3times ☐ ④ 4times ☐
Time of updating (ZD=-8) at LT	①0800 ☐ ②1200 ☐ ③1600 ☐ ④2000 ☐
IV. The application and prospects of the Promulgation system	
In which aspects do you thind the utility of the system is reflected:	①to know the traffic condition and to improve navigation efficiency ☐ ②to know accident prone area and to facilitate passage planning ☐ ③to know emergency resource distribution,help to navigation safety ☐ ④To provide new ways of interaction between ship shore, improve the efficiency of company management ☐ ⑤ to better serve people livelihood, help communication ☐ ⑥other_____
What do you think of the prospects of the application of the system	①will enhance maritime safety, worth promoting ☐ ②will help maritime safety, but little sense to promote ☐ ③will have some effect for safety, worth promoting ☐ ④will have some effect for safety, but little sense to promote ☐

	⑤no obvious effect, not worth promoting □ ⑥other_____
Where in your opinion can be expanded or improved and your comments and requirements	

Sign_____

Company_____ (stamp)
Date_____

Appendix B：Maritime Safety Information demand questionnaire（for vessels）

I. Personal Information	
Years as seafarers	①<1year ☐ ② 1~5years ☐ ③ 5 ~10years ☐ ④ 10 ~20years ☐ ⑤ >20years ☐
Rank onboard(now)	① captain ☐ ② chief mate ☐ ③ second mate ☐ ④third mate ☐ ⑤ratings ☐ ⑥ fisherman ☐
Years for the rank	①<1year ☐ ② 1~5years ☐ ③ 5 ~10years ☐ ④ 10 ~20years ☐ ⑤ >20years ☐
II. Ship’s Information	
Ship types（with more experience)	① Dry bulk ☐ ②container ☐ ③ oil tanker ☐ ④dangerous cargo ☐ ⑤Passenger ☐ ⑥ fishing boat ☐ ⑦ other_____
Ship’s size (with more experience)	①≤200GT ☐ ② 200 ~500GT ☐ ③500 ~3000GT ☐ ④3000 ~10000GT ☐ ⑤10000 ~100000GT ☐ ⑥≥100000GT ☐
Communication equipment on bridge (multiple)	① AIS ☐ ② VHF ☐ ③ SSB ☐ ④NAVTEX ☐ ⑤ INMARSAT ⑥other_____
Ship’s age (average)	① ≤5years ☐ ②5~10years ☐ ③10~12years ☐ ④12 ~18years ☐ ⑤18~20years ☐ ⑥≥years ☐
The sailing method you often use when transit CSJ waters	①use TSS traffic lanes ☐ ②use Inshore traffic zone ☐ ③avoid TSS area but use reporting regime ☐ ④ not use

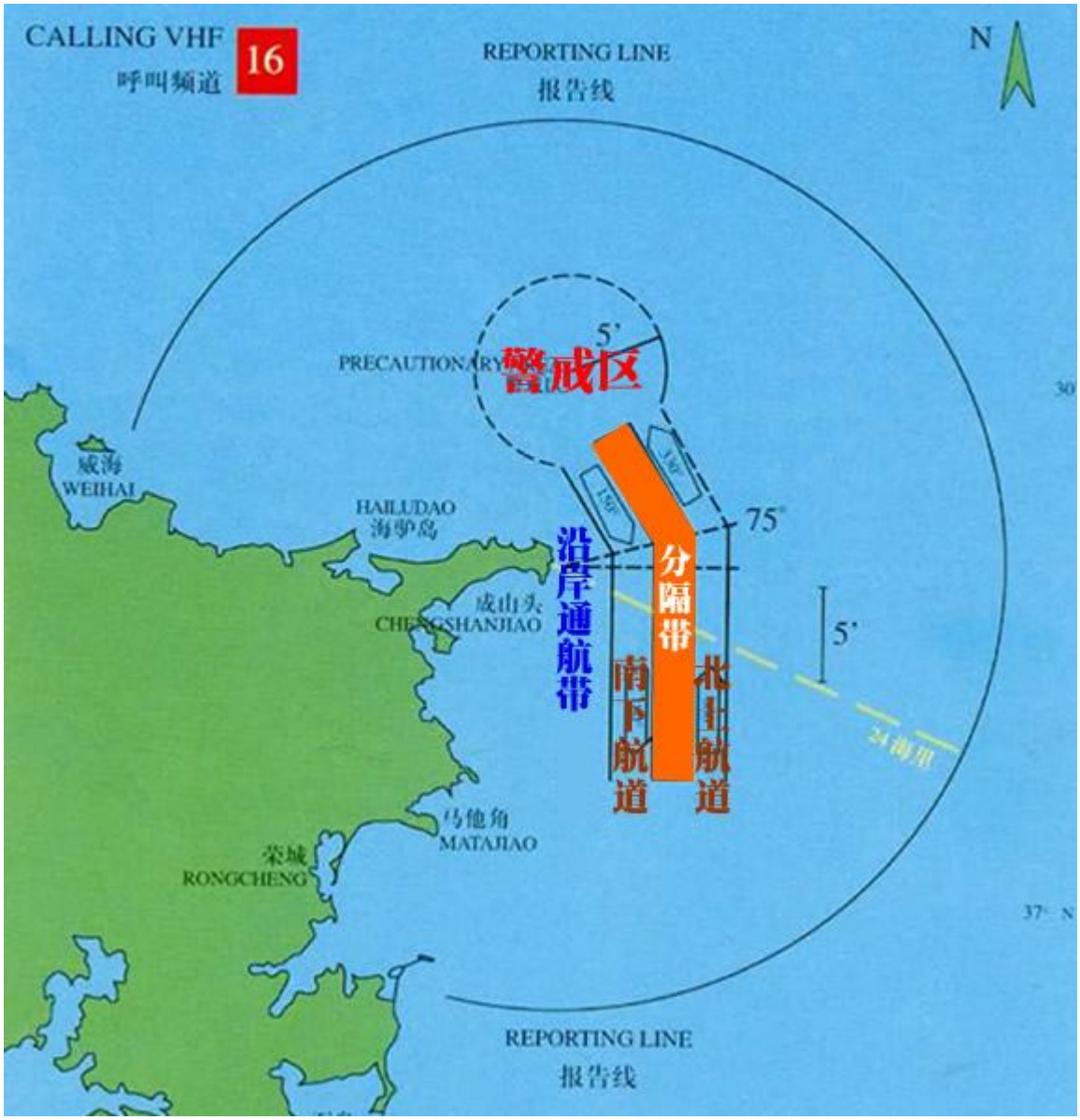
	reporting regime ☐ (please plot your regular sailing method on the attached map)
III. Maritime Safety Information Demands	
1.The necessity of the establishment of Promulgation system	
Do you think it necessary?	①very necessary ☐ ② necessary ☐ ③not necessary ☐ ④ not matter ☐
What information do you need? (multi-choice)	①hydro meteoro. ☐ ② vessel traffic ☐ ③navigational (safety related) ☐ ④emergency response ☐ ⑤other_____
2. The importance of specific Maritime Safety Information investigation	
2.1 Hydro meteorological information demands	
Weather forecast (24h)	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐
Weather forecast (48h)	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐
Adverse weather warnings	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐
Sea ice information in winter	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐
Other information:	
2.2 Vessel traffic information demands	
Cargo ship density distribution and trend	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐
Fishing vessel density distribution and trend	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐

Encounter/crossing information	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐
Distress/accident information	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐
Other information:	
2.3 Navigational information demands	
Navigational warning/notice	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐
Water acivities	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐
Accident prone area	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐
Aquaculture distribution	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐
Shelter effect of anchorage	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐
Anchorage usage in adverse wx	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐
Other information:	
2.4 Emergency response resource information demands	
Rescue force distribution	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐
Oil spill equipment distribution	①very important ☐ ②quite important ☐ ③important ☐ ④not important ☐

Other information:	
2.5 Other information demands	
3.What means do you prefer for receiving information? (please choose two feasible ways and write down in the order you favor)	
1.VHF 2.AIS 3.SSB 4.NAVTEX 5.INMARSAT 6. Fishery meteorological receiver 7.Internet 8.SMS other: _____	
Your answer: _____	
4.The frequency of pormulgation	
4.1 When using VHF radiotelephony for promulgation	
You want the frequency to be **once** every:	①4 hours ☐ ②8 hours ☐ ③12 hours ☐ ④ 24 hours ☐ ⑤other_____
4.2 When using AIS, weather transceiver, SMS for promulgation	
You expect to receive the information	①on arriving reporting line ☐ ②on arriving TSS precautionary area ☐ ③other_____
You want the frequency to be once every:	①4 hours ☐ ②8 hours ☐ ③12 hours ☐ ④ 24 hours ☐ ⑤other_____
4.3 When using Internet for promulgation	
You want the frequency **per day**	① once ☐ ②twice ☐ ③three times ☐ ④ four times

	□
Updating time (ZD=-8) LT	①0800 □ ②1200 □ ③1600 □ ④2000□
IV. The application and prospects of the Promulgation system	
In which aspects do you thind the utility of the system is reflected:	①to know the traffic condition and to improve navigation efficiency □ ②to know accident prone area and to facilitate passage planning □ ③to know emergency resource distribution,help to navigation safety □ ④To provide new ways of interaction between ship shore, improve the efficiency of company management □ ⑤ to better serve people livelihood, help communication □ ⑥other_____
What do you think of the prospects of the application of the system	①will enhance maritime safety, worth promoting □ ②will help maritime safety, but little sense to promote □ ③will have some effect for safety, worth promoting □ ④will have some effect for safety, but little sense to promote □ ⑤no obvious effect, not worth promoting □ ⑥other_____

Where in your opinion can be expanded or improved and your comments and requirements	



Please plot your regular route when transiting Chengshan Jiao VTS area