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WORLD MARITIME UNIVERSITY

Dalian, China

**STUDY ON THE DEVELOPMENT OF VTS IN
CHINA**

By

HAN KE

The People's Republic of China

A research paper submitted to the World Maritime University in partial
Fulfillment of the requirements for the award of the degree of

MASTER OF SCIENCE

(MARITIME SAFETY AND ENVIRONMENTAL MANAGEMENT)

2015

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DECLARATION

I certify that all the materials in this research paper that are not my own work have been identified, 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: **Study on the Development of VTS in China**

Degree: **Master of Science**

The research endeavors to study on the development history of VTS in China and in the world, the conditions of international advanced VTS centers and the trend of development of VTS centers in future, and the basic condition of VTS in China, including 2 case studies.

The main problems exist in the functioning and development of Chinese VTS centers are also analyzed in 5 aspects, including the legislation of VTS in China, the nature and responsibilities of VTS centers in China, the staffing construction in VTS centers, VTS function of marine environment preservation and the conditions of research on new trends of VTS development in China.

There are 4 proposals advised by the author to improve the condition of VTS in China, including that the legislation of VTS should be improved in China, the administrative system of VTS centers should be reformed, the personnel scheme should be improved and that more attention should be paid on research work.

KEYWORDS: VTS, VTS centers, History, China, Proposals, Legislation.

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List of Abbreviations

AIS	Automatic Identification System
ECDIS	Electrical Chart Display and Information System
EU	European Union
GMDSS	Global Maritime Distress and Safety System
IALA	International Association of Lighthouse Authorities
IAPH	International Association of Ports and Harbors
IMO	International Maritime Organization
IMPA	International Maritime Pilots Association
MCS	Maritime Communication System
MIS	Maritime Information System
MOT	Ministry of Transport of People's Republic of China
MSA	Maritime Safety Administration
NGDCN	Navigation Guarantee Department of the Chinese Navy Headquarters
NGO	Non-Governmental Organization
NPC	National People's Congress of People's Republic of China
OPA 90	Oil Pollution Art, 1990
PRC	People's Republic of China
UK	United Kingdom
USA	The United States of America
USCG	United States Coast Guard
VHF	Very High Frequency
VTM	Vessel Traffic Management

VTMIS	Vessel Traffic Management and Information Service
VTs	Vessel Traffic Service

Chapter1 Introduction

1.1 Background

Shipping has been the main transport mode of world trade for several centuries. And the basic requirements of shipping are keeping safety of shipping, increasing of navigating efficiency and preventing the marine environment from pollution. For the purpose of implementing these requirements, there are a large number of navigation aid facilities installed on coastal waters of states in the world. Especially in recent decades, accompanied by the swift growth of world trade volume, there are many maritime traffic accidents occurring in port waters and narrow waterways due to the dense traffic density. In order to decrease the frequency of maritime traffic accidents and improve the traffic efficiency as well as preserving the marine environment in these waters, VTS have been established on many ports in the world including Chinese ports.

The shipping industry has developed rapidly in China since the Chinese economic reform, and there are 8 ports of China in the top 10 most throughout ports in the world in 2014(Chinaports, 2015). There is a huge pressure for Chinese ports to prevent maritime traffic accidents in their waters, and VTS are established on ports to improve these conditions. On the other hand, the Chinese government attached importance to calling to account responsibilities on production safety accidents which caused casualties, and the news media and ordinary people in China also paid huge attention to casualties, which made the competent authority of maritime safety---China MSA with powerful pressure on the decreasing of maritime traffic and pollution accidents in waters under the jurisdiction of China. Besides that, the

Chinese government now is making efforts to transfer China from a large shipping country to a strong shipping country, which takes the modernization and informatization of maritime administration as one of these specific objectives(Wang, 2010, p39). Those elements referred to above would promote the construction, development and making effort of VTS in ports of China.

1.2 Research methods and contents

1.2.1 Main contents

(1) The definition and service items of VTS by the IMO and Chinese laws and regulations, the basic requirements for VTS by the related international conventions, and the development history of VTS in the world.

(2) The basic conditions of VTS in China, including the development history of VTS in China, the legal status and administrative ownership of Chinese VTS centers, the scale, distribution and construction plan of VTS in China, different types and functions of VTS centers, the financial support of construction and maintenance of VTS centers, the training and manning of VTS staff, the acceptance inspection and assessment scheme of VTS centers, and the information diffusion scheme of VTS to public.

(3) The conditions of international advanced VTS centers and the trend of development of VTS centers in future.

(4) The main problems exist in the functioning and development of Chinese VTS centers.

(5) Proposals to the development of VTS in China.

1.2.2 Research methods

- (1) Based on the data collection to evaluate and analyze the basic conditions of VTS in China.
- (2) By case studies to discuss comprehensively the root problems and bottlenecks of the development of VTS in China.
- (3) By comparing the international advanced VTS centers and the predicted trends of the development of VTS to propose measures to improve the development of VTS in China.

Chapter2 The History of VTS Development throughout the World and development trends of VTS

2.1 The definition of VTS

The IMO Resolution A.857(20) which was adopted in 1997 defined that VTS means a service implemented by a Competent Authority, designed to improve the safety and efficiency of vessel traffic and to protect the environment. The service should have the capacity to interact and to respond to traffic situations developing in the VTS area.

The resolution also defined the VTS services that the information service should at least be comprised and other services including navigational assistance service, traffic organization service and allied services could also be included(IMO, 1997, P3-4).

2.2 The history of VTS development and its relevant supporting organizations and regulations

Centuries before, the development of shipping industry gave rise to the need for ships to navigate safely and efficiently, which further promoted the authorities throughout the world to provide aids to navigation in and around their ports and coastal waters. Shore-side beacons and lights appeared earliest, which was followed by the appearance of buoys. These aids had been improved greatly over these years, and after World War II it became the common view of the shipping industry that audio-visual aids were insufficient to service the fast growing of maritime traffic volume effectively and efficiently, which hastened the appearance of maritime traffic monitoring actions by using shore-based radars and combining with communications to enhance safety and efficiency in port areas. Douglas, Isle of Man established the first radar based Port Control Station in 1948.

Later in the year, the port of Liverpool and Rotterdam established radar sites. After that a number of shore-based radar sites appeared in Europe. These early systems minimized maritime traffic accidents and increased traffic efficiency greatly.

However, in the 1960s and 1970s some major maritime disasters including Torrey Canyon and Metula occurred, which attracted the public's great attention to the marine environmental protection. To respond to the keenly expectation of public on environmental protection, the shipping industry took plenty of measures on marine pollution prevention, including that the IMO adopted Resolution A.578(14)--Guidelines for Vessel Traffic Services, which was replaced by the Resolution A.857(20) in 1997, which described the operational procedures and

planning for VTS, defined that the objectives of VTS is enhancing safety of navigation, improving the efficiency of maritime traffic and protecting the marine environment, and is now the internationally recognized source policy documents for VTS. And the responsibilities of IMO and States were added in the SOLAS, 1974.

As the number of VTS increased throughout the world, the concept of operation has led to various categories of VTS, including coastal, port and harbor, and rivers as well as inland waterway services(IALA, 2012, p16-18).

With the development of VTS, as a NGO, the IALA considered the requirements of VTS and carried researches in the long term, and associated them with the effort of IMO, IMPA and IAPH, established VTS Committee within its organizational setup to carry out the work of VTS development throughout the world, and published VTS Manual every 4 years, the latest edition is the VTS Manual 2012.

2.3 Conditions of advanced VTS centers in the world

2.3.1 A brief introduction to the conditions of VTS authority

In the Annex of IMO Resolution A. 857(20), it is stipulated that the competent authority means the authority made responsible, in whole or tin part, by the Government for safety, including environmental safety, and efficiency of vessel traffic and the protection of the environment(IMO, 1997, p3).

From the main countries throughout the world, there are mainly 2 types of VTS

centers according to the administrative authority of VTS centers. The first type are represented by the USA and Japan, the competent authority of VTS centers in the USA is the US Coast Guard(USCG), and in Japan is the Japan Coast Guard which is set by simulating the US Coast Guard, the VTS centers in the 2 countries are administrated by military branches, and their primary objectives is to keep safety of maritime traffic and maritime environmental protection. The another type is represented by Western European countries including the UK, Germany and France. The competent authorities in these countries are port authorities or NGO such as search and rescue organizations or pilot stations, besides the objectives of keeping safety of maritime traffic as the first types of VTS centers, the VTS centers also make effort to coordinate the port operations and raising their efficiency and emphasizing the safety of piloting ships(Zhang, 2011, p33).

The types of administration on division of VTS centers are as follow:

Country or area	Type	Competent authority
The USA	Government management	Coast Guard
Canada	Government management	Coast Guard
Japan	Government management	Coast Guard
Europe	Business administration	Port Authority
China	Public administration	China MSA

Table 2.1Types of administration on VTS centers

Source: Zhang, J.L. 2011.

2.3.2 Case study of VTS centers in the USA

In 1990, the US Congress issued the Law of Oil Pollution Act, 1990(OPA 90) as a national law. In Regulation 4107 of the OPA 90, it is stipulated that the USCG could establish, maintain, operate, enlarge and refresh VTS centers. Besides that, the OPA 90 also stipulated that certain types of vessel should join the VTS mandatory, types of which are voluntarily to join the VTS services before. Vessel Traffic Service Regulations in the Code of Federal Regulations in the USA stipulated that the safety and efficiency of navigation of vessels in navigation available areas of VTS areas should be promoted.

The demands of the VTS center for recruitment of staff are in 3 aspects: ability, skill and knowledge, and the competence of staff is also emphasized. An integrated scheme for competence management was established, and the work of staff recruitment, training, allocation and development is operated on the basis of that scheme.

As an division of military branch, VTS centers in the USA are constituted of 2 different systems--monitoring system and non-monitoring system, both of which are supported by comprehensive technologies and functions. The services provided by VTS centers in the USA are monitoring and providing navigation advice actively, especially in dense vessel traffic channels and restrictive channels, preventing ships from collision and grounding in port waters, providing navigation assistance service in port channels and inland water channels to raise the efficiency of ship transportation. From the prospective of public management, some shipping companies are asked to provide coordination to the operation of VTS centers in the USA(Ma, 2013, 29).

2.3.3 Case study of the UK

the Port Law issued in 1964 in UK stipulated that the port authorities should establish dynamic scheduling regulations, which includes relevant regulations on port VTS systems. Besides the Port Law, there are many complementary regulations issued by port authorities in the majority of ports in UK, for instance the London Port Regulations. In 2004, the Regulations of Vessel Traffic Monitor and Report was issued by UK and stipulated that the VTS centers should be administrated by component authorities via legal notices, which are published in the World VTS Guidelines.

The component authority of VTS centers in UK established comprehensive assessment criteria and procedures to recruit and select VTS operators. Among the criteria, the primary factor considered is personal quality. The candidates should be tested on the following 13 items: assessment of the situation, the ability to deal with multiple tasks, judgment and responsibility, communications skills, creation and decision making ability, digital ability, the ability to receive multiple targets imported to the system, the decision making ability to take emergency measures, assessment ability to dynamic targets, the ability to perform responsibilities under pressure, team work spirit, the three-dimensional ability and communication skill. And the tests are not limited to these 13 items.

The VTS centers in the UK are coordinated by the UK VTS Association, which seeks to develop and establish itself as a professional body within the maritime community for qualified Vessel Traffic Service personnel in the UK, and aims to encourage and

promote the highest standards of knowledge, competence and qualifications among personnel responsibility for VTS and Local Port Services, and establish and maintain appropriate educational and professional standards of Membership and other objectives related are also aimed at(Tang, 2013, p47-49).

2.4 The trends of VTS system development

2.4.1 Introduction to VTMISS

In the early years of the 1990s, the concept of VTMISS was generated from the research and development program “COST 301”, which was conducted by the EU. The objective of the program was to discuss how to improve the function of VTS system, and one of the conclusions was to improve the utilization of VTS information. And subsequently in a group discussion on the Fourth Frame Program, the VTMISS was further be discussed and be defined as:

- (1) VTM--Vessel Traffic Management. VTM is the action taken in certain area and certain circumstance, for the purpose of furthest keeping vessels traffic safety, preserving the marine environment and furthest improvement of the efficiency in these water areas.
- (2) VTMISS--Vessel Traffic Management and Information Services. VTMISS are services provided with the demands of public and private companies to promote the vessel traffic management.

Currently the concept of VTMISS has been accepted by the governments and relevant companies in EU countries, the USA, Canada and etc.

In 1998, EU described the definition and meaning more clearly in a report. According to the description of the report, VTMISS is a system that centered with the targets data, platformed with the computer network, connected by data communication, for the purpose of keeping maritime traffic safety and preserving marine environment, provides services for all marine users, according to uniform data exchange criteria and service commitment, provide vessel traffic information services. VTMISS is a concept or a virtual system other than a specific system. The VTMISS emphasizes information service, which would be available by various specific systems. The VTMISS system could be as big as including VTS, AIS, weather report, ships data, dynamic conditions of port and etc, or as small as system only with tide data information available(Zhang, 2014, p105-106).

The VTMISS system is mainly constituted of 6 sub-systems. They are VTS, Global Maritime Distress and Safety System(GMDSS), AIS, Maritime Information System(MIS), Electronic Chart Display and Information System(ECDIS) and Maritime Communication Service(MCS). Those 6 systems are all mutually interaction within the VTMISS system(Zhang, 2014, p107-109).

2.4.2 Introduction to VTM

There are some challenges to VTS existing in the global shipping environment, including that the volume of vessel traffic are increasing, the pressure on navigable waters are increasing, the dependency on an interconnected global supply chains are increasing and the rapid development and availability of modern and more efficient technologies.

The dependencies that may however easily be hampered or complicated for instance by conflicts of interest or insufficient inter-operate ability between the many stakeholders involved. Considering the international nature of maritime transport, such issues may not be solved on a national level or by technology alone. Various stakeholders have already taken advantage of such offerings by implementing local or regional co-operation arrangements. However, these activities are generally driven on case-to-case basis and mostly not in a uniform manner.

The authority is increasingly becoming dependent on the performance of other cooperating or contracted parties. Consequently, new cooperative arrangements - on top of what is already in place--may be needed, in particular those affecting the marine environment and the safety, efficiency and security of maritime traffic. And these arrangements should meet the need of a sustainable marine environment, and to guide all marine activities(or named managing risks) and for harmonization, both on board and ashore, of vessel traffic handling and information exchange(arranging efficiency), and of Coastal States and ports, to protect their investments and environment (controlling space) (Huang, 2014, p3-6).

The VTM is defined as the strategic provision of measures and services to enhance the safety, efficiency and security of marine transportation and protection of the marine environment. These services and measures may be available globally and need not be limited to specific areas internationally. And a new name was proposed to VTM as Maritime Transport Collaboration and Harmonization(MATCH). MATCH is defined internationally as ‘MATCH is the functional framework of harmonized arrangements, measures and services supporting the collaboration between stakeholders within the maritime domain, to enhance the safety, security, and

efficiency of shipping and the protection of the marine environment in all navigable waters' (Huang, 2014, p8-9).

The relationship of VTM and VTS are as follows:

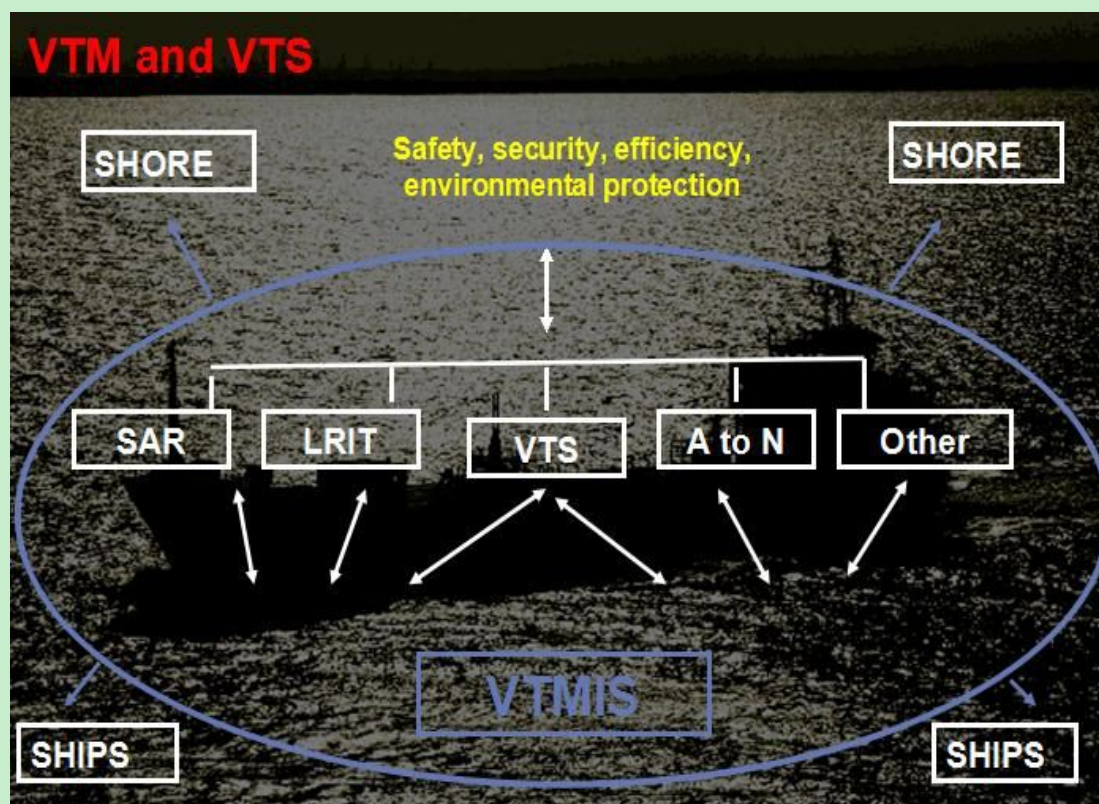


Figure 2.1 The relationship of VTM and VTS

Source: Huang, X.Z. 2014

Various initiatives in the maritime domain are currently underway aiming at the optimization of processes within or related to the maritime transport chain (e.g. Single Windows and e-Navigation). Within these initiatives, the VTS Authority is

seen as a central stakeholder. It is, therefore, expected that VTS--as a service, depending on responsibilities at the national level--may have to face and deal with new challenges and requirements arising from current or future activities, which may not be directly related to its primary role.

The aims of E-Navigation focus on the berth-to-berth navigation, and the concepts of MATCH provide the functional framework for all activities within maritime transport domain. These two concepts can be complementary to each other. In other words, E-Navigation is harmonization of the means for collecting, distributing and presenting information related to maritime safety, security, efficiency and environmental protection (Zhang, 2011, p33-35).

Chapter3 A Brief Introduction to the Conditions of VTS in China

3.1 The history of VTS in China

Generally speaking, the development of VTS in China could be separated into 4 phases:

- (1) The first phase started from the 1970s, during which the possibility of establishing shore-based radar aids and VTS in China was discussed by competent authority. Ningbo VTS, which is the first VTS by applying radar monitoring method, was established in the spring of 1978.
- (2) The second phase was the wide range construction stage. In this phase, by assessing that the Ningbo VTS had exerted huge effect, there are 4 ports including Qinhuangdao, Qingdao, Dalian and Lianyungang that started to establish VTS centers. However, the cognition of VTS functions and in China in this phrase was still elementary, the designation theories and methods still remained to improve, the operation and management system and legal system building were still immaturity.
- (3) In the 1990s, the phase of overall construction VTS centers in China began. There were 10 coastal and port VTS centers in China within 8 years, and the 5 VTS centers established before were all refreshed or enlarged. In this phase, the

designation and theories of VTS developed to some extent, the management system was modernized and relevant regulations and guidelines in China was adopted.

(4) From the 21st Century, with the development of informatization and the improvement of management levels of competent authorities, the hardware and software of VTS centers in China are trying to keep up with the advanced level internationally(Tang, 2013, p14-15).

3.2 The legal states of VTS centers in China

3.2.1 The definition of VTS in China

In 1997, the Safety Monitoring and Management Regulations of Vessel Traffic Service System of People's Republic of China(PRC), was issued by the MOT of China, which defines the VTS system as 'the system that for the purpose of safeguarding the vessel traffic safety, improving the vessel traffic efficiency and preserving the marine environment, set up by competent authority to implement traffic control and to provide information consultation services(MOT, 1997, p3).

3.2.2 The administrative ownership of VTS in China and its legal basis

In China, the VTS centers are administrated by Branches of Maritime Bureaus located in the ports, and those Branches are administrative organizations for law enforcement and administrated by the Direct MSA which are basically divided by the jurisdiction of provinces, and belong to the China MSA, which is as a component of MOT of China. In short, as a department of the Branch of Maritime Bureaus, VTS

centers in China are administrated by China MSA.

In Chapter 4 of Maritime Safety Law at Sea of PRC, it is stipulated that when ships and facilities navigate, berth and operate in Chinese coastal waters, they should abide by the relevant laws, administrative regulations and codes issued by the PRC. And in Chapter 1 General Principles, it is stipulated that the China MSA is the competent authority to implement consolidated monitoring and administration of safety of vessel traffic on coastal waters of China(NPC, 1984).

The Safety Monitoring and Management Regulations of Vessel Traffic Service System of PRC and Operation and Management Regulations of Vessel Traffic Service Systems of PRC was issued by the MOT.

3.3 The present conditions of VTS in China

By the end of 2014, there had been 33 VTS centers and 120 radar stations approved by China MSA and commenced officially, which are the biggest in number throughout the world, and there are several VTS centers in the status of preparing and test run, such as Zhuhai VTS and Jinzhou VTS. There are 6 VTS centers distributed in the middle and lower reaches of the Yangtze River, and 27 in the coastal waters, including 4 water channel VTS(NGDCN, 2015, p1). The distribution of VTS centers in China are as follows:



Figure 3.1 The First Picture of the Distribution of VTS Centers in China

Source: the author

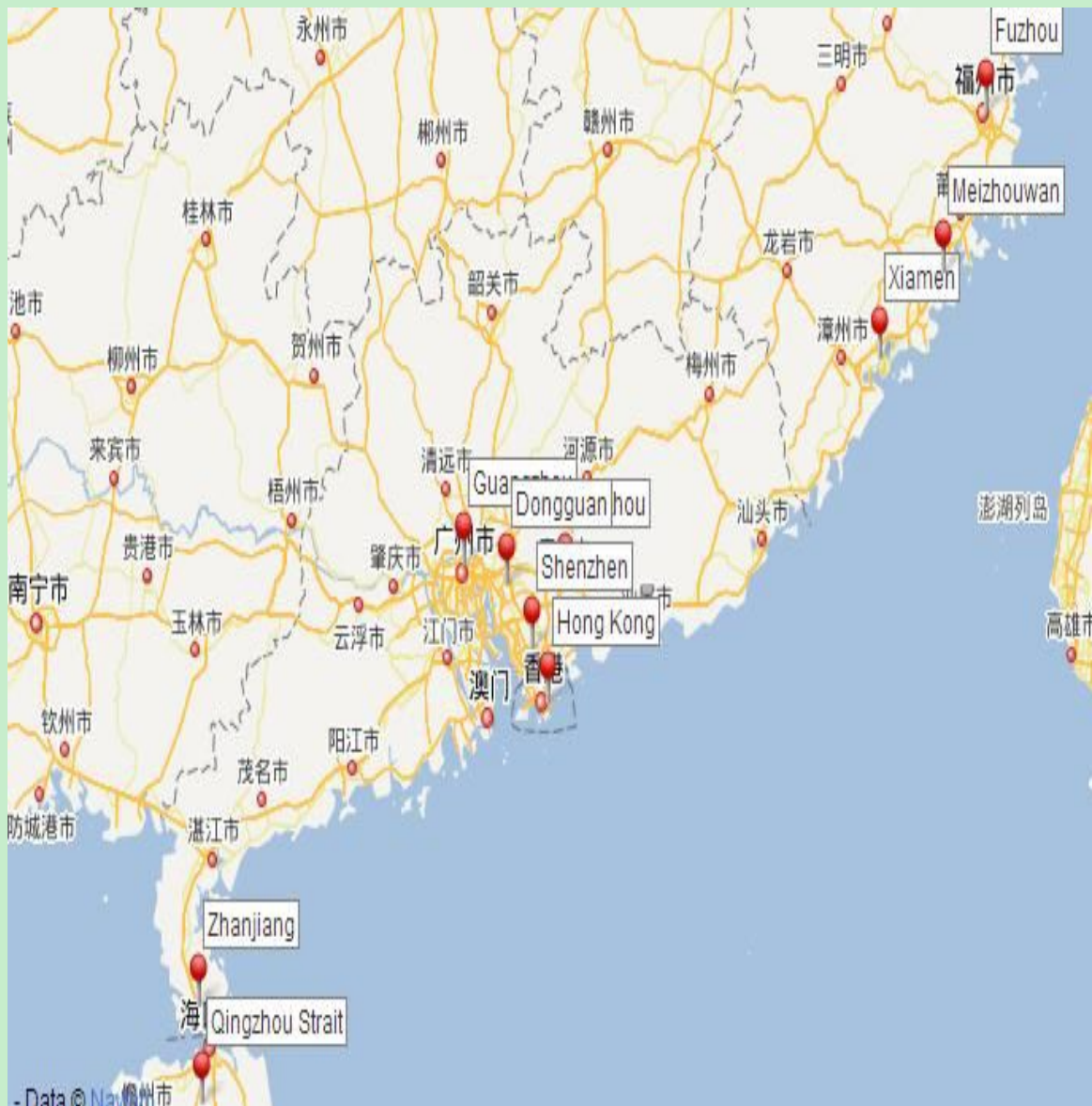


Figure 3.2 The Second Picture of the Distribution of VTS Centers in China

Source: the author

There is a VTS training center located in the office building of Wusong VTS center with the function of training, assessment and certification of VTS supervisors and operators, which is administrated by China MSA, and there has been about 2000 VTS supervisors and operators from VTS centers throughout the country have been trained and certificated in the VTS training center since the establishment of the

training center in 2008. Among the thousands number of VTS supervisors and operators, only a small number of them are persons holds master's certificates, besides that, only 20% of the VTS supervisors and operators holding senior officer's certificates, most of them lack navigation practice experiences on board(Tang, 2013, p12).

3.4 The function and responsibilities of VTS in China

3.4.1 Functions of VTS in China

Currently all the VTS systems in China are with the function of data collection and data assessment. Due to the condition that the primary objective of VTS in China is the safety of vessel traffic, and meanwhile gives consideration of traffic efficiency and maritime environmental protection, the function of VTS in China are mainly information service and navigation assistance service. However, owing to the different navigation environments and vessel traffic mode in different ports and water channels, most VTS centers in Northern China mainly provide information service and meanwhile give consideration of navigation assistance service, and in Southern China most VTS centers provide traffic organization service.

Most VTS centers in China are primarily operate by means of monitoring traffic flow of vessels navigating, berthing and anchoring in VTS areas, and only few of VTS centers implement vessel traffic control. Generally VTS centers regulate that all merchant vessels equipped with VHF communication devices should report to VTS centers. However, some VTS centers regulate that only passenger ships, ships

carrying dangerous cargo and/or ships whose gross tonnage are greater than a certain number should report to VTS or other criteria, for instance, Qingdao VTS regulates that all vessels whose length are more than 50 meters should report to Qingdao VTS in its VTS areas. Majority of VTS centers in China have implemented mandatory vessel dynamic report scheme.

3.4.2 Responsibilities of VTS centers

According to the Safety Monitoring and Management Regulations of Vessel Traffic Service System of PRC and Operation and Management Regulations of Vessel Traffic Service Systems of PRC and the institution setting of VTS centers, the function of VTS centers in China includes not only the services for vessels, but also the management and control to the activities related to maritime traffic safety. In recent years, there are 2 viewpoints about the orientation of VTS centers. The first viewpoint is that the property of VTS centers is an public service institution, and the second viewpoint is that as a division of law enforcement agency (China MSA), the basic orientation of VTS centers is public administration and law enforcement. From the prospective of actual practices of VTS centers in China, the primary objective of establishing VTS centers is to satisfy the demand of law enforcement agencies to control and manage the maritime traffic and vessels' dynamic operations. In other words, as a component of public administration management institution, the proportion of service in the functioning of VTS is less than that of public administration.

In the operation of VTS, especially in the process of vessel traffic organization services, there are 2 types of information made by VTS centers--instruction and

advice. Although the advice is pointed out by VTS centers that they are suggestive, the vessels who disobey these advice are usually punished, and these punishments are supported by the Maritime Safety Law at Sea of PRC and the Safety Monitoring and Management Regulations of Vessel Traffic Service System of PRC(Ma, 2013, p13).

3.5 The daily management of VTS centers in China

3.5.1 The construction and assessment of VTS centers

In the first phase of development of VTS in China, the VTS centers and radar stations were all financed, constructed, managed and assessed by China MSA. With the fast growth of Chinese economy in the coastal areas and shipping trade demand, as well as the pressure of reducing production accidents of local governments, there were some VTS centers that financed by local governments or companies operating these ports. After the construction of VTS centers and radar stations, those facilities were transferred to Branches of MSA to check and accept. After the acceptance, these VTS centers would be owned and operated by the corresponding MSA agency.

According to the Assessment Methods of Vessel Traffic Service System, which was issued by China MSA in 2001, before the formal operation of a new VTS center, the VTS center should be assessed by China MSA. Those VTS centers in operation should be audited by China MSA every year, if a VTS center failed to pass the audit, there would be a 6 months long rectification period for the VTS center, and if the VTS center still failed to pass the audit, the VTS center would face the risk of

stopping the service(China MSA, 2001, p1-2).

3.5.2 The management of Branch of MSA

As discussed above, the VTS centers operate under the administration of Branches of MSA, and the running fund, personnel promotion and demotion, the daily operation condition assessment of VTS center and information publish to public and press are all administrated by Branch of MSA. In short, as a department of Branches of MSA, VTS centers are managed and financed by them.

3.6 Cases study of VTS in China

3.6.1 Case study of Dalian VTS

The construction of maritime traffic management system in Dalian was started from 1986, and 2 years later the Huangbaizui Radar Station formally established and operated. In 1997 the name of Huangbaizui Radar Station was changed to Dalian Maritime Traffic Management Station. And in 2003, Dalian Maritime Traffic Management Station center merged part of the business of Dalian Signal Station and Duty Office of Dalian MSA, established Dalian VTS with 3 radar stations. After that, with 3 times of reinforcement, currently there are 1 center with 4 sub-centers and 10 radar stations within Dalian VTS system.

There are several regulations implemented in Dalian VTS area, including the Dasanshan Channel Traffic Separation Scheme inside Dalian Port and Ships'

Routeing inside Laotieshan Channel.

Dalian VTS center is responsible for the safety of maritime traffic and the preservation of maritime traffic order in its area, and responsible for the daily duty of Search and Rescue centers of Liaoning Province and Dalian City, and also responsible as the daily duty office of Liaoning MSA and Dalian MSA.

There are 8 sub-systems which constitute Dalian VTS system, they are radar surveillance sub-system, AIS sub-system, VHF communication sub-system, VHF direction finder sub-system, ship data processing sub-system, meteorology monitoring sub-system, CCTV surveillance sub-system and data recording and playback sub-system(Dalian VTS, 2013, p6).

Dalian VTS is a synthesizing type VTS with 2 sub-centers as port VTS centers(Dalian port and Lvshun new port) and 1 water channel VTS centers(Laotieshan Channel), they are named Dalian Port VTS and Laotieshan Channel VTS respectively.

There are nearly 4400 square kilometers with more than 300 berths in the water area of Dalian VTS center. And according to the data record of VTS centers from 2010 to 2012, there were about 160, 000 ships that reported to and monitored by Dalian VTS, including 51,000 key monitoring shiops and 82,000 ships passed through Laotieshan channel(Ma, 2013, p15-17).

Passengers, ships carrying dangerous goods, ships engaged in towing or restricted in her ability to maneuver, foreign ships and other Chinese ships longer than 20 meters are asked to report to Dalian Port VTS when they are in that area. And passengers,

other ships not less than 300 gross tonnage and other ships less than 300 gross tonnage but join the VTS service voluntarily should report to Laotieshan Channel VTS when they are in that area(Dalian VTS, 2013, p8).

According to the table below, it is obvious that the workload of Dalian VTS center to provide services was huge and the number of some types of services such as traffic organization increased rapidly.

	Transit	Information service	Navigation assistance service	Traffic organization	Dangerous situation avoidance
2010	71179	241271	1816	47262	1062
2011	78189	138633	497	64455	1027
2012	70180	376785	1767	160367	5422

Table 3.1Amount of VTS services provided by Dalian VTS center

Source: Ma, J.2013

The area of Dalian Port VTS and Laotieshan Channel VTS are as in Figure 3.3 and Figure3.4. :

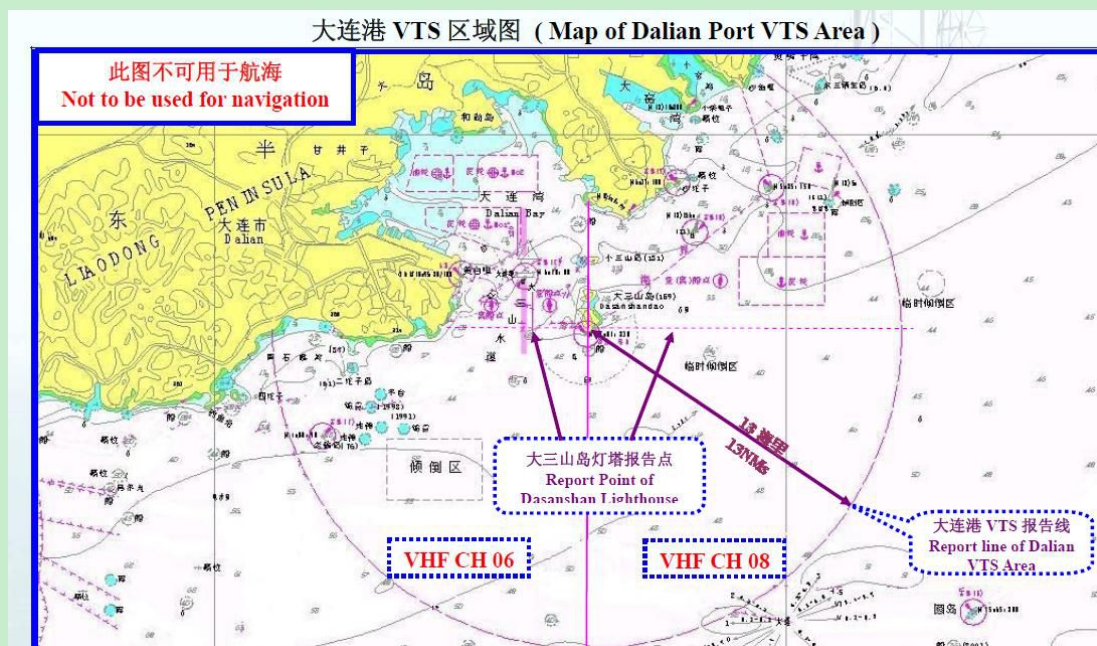


Figure 3.3 Dalian Port VTS area

Source: Dalian VTS Guide for Users

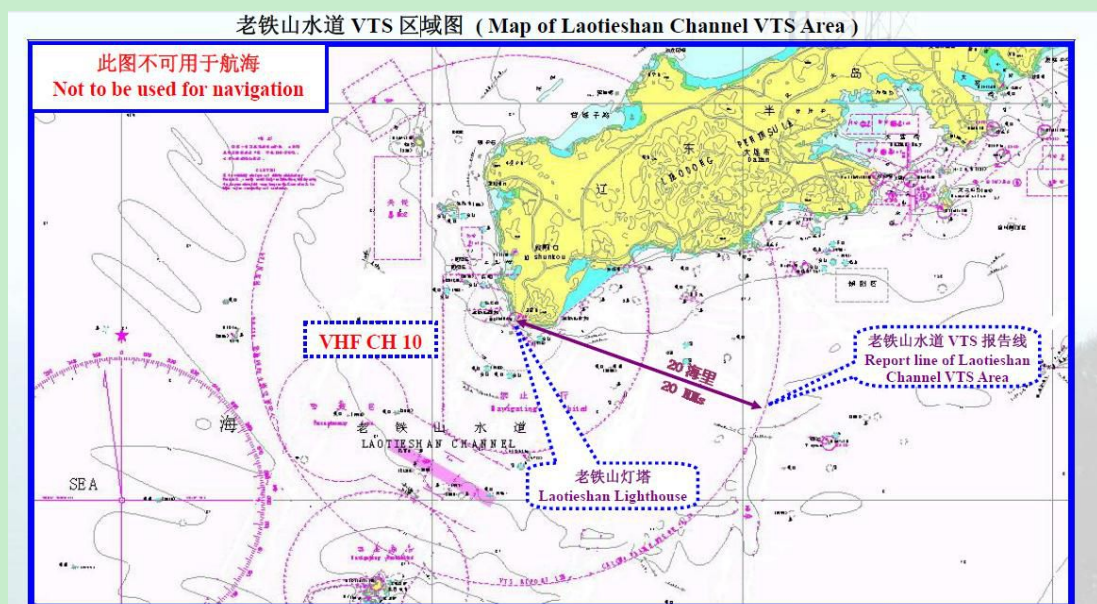


Figure 3.4 Laotieshan Channel VTS area

Source: Dalian VTS Guide for Users

3.6.2 Case study of Qingdao VTS

Qingdao VTS started to be constructed in 1994, and started test run in the next year. The VTS formally started to operate in 1999 after the approval from China MSA. The operation system of Qingdao VTS center is the ATLAS VTS9730 system which is imported from Germany. The Qingdao VTS system is constituted of Qingdao VTS center, Qingdao radar station and Huangdao radar station.

There are information service, navigation assistance service and vessel traffic organization service provided by Qingdao VTS. Vessels whose length are not less than 50 meters and other vessels needing VTS services should report to and monitored by Qingdao VTS in its water area.

Qingdao VTS system is constituted of 4 sub-systems. They are radar surveillance sub-system, VHF communication sub-system, VHF direction finder sub-system and vessel data processing sub-system.

The general functions of Qingdao VTS include:

- (1) Recording and managing static data of vessels and pilots.
- (2) Recording data of vessels entered and leaved from Qingdao VTS area.
- (3) Generating vessel navigation plan in Qingdao VTS area.
- (4) Recording and managing the dynamic data of vessels' navigation.
- (5) Recording and managing pilot operations, escorting and towing operations in Qingdao VTS area.
- (6) Dynamic managing on anchorages and berths.

- (7) Managing and recording the operations of anchoring, berthing and construction in Qingdao VTS area.
- (8) Recording the vessels detained and mortgaged.
- (9) Recording vessels' act of violation of regulations and accidents within Qingdao VTS area.
- (10) Recording the services provided by VTS operators to ships.
- (11) Managing the relevant actions related to navigation warnings and notices to mariners.
- (12) Recording conditions of navigation obstruction.
- (13) Recording and analyzing vessel traffic data.
- (14) Providing relevant data for vessels' tracking(Qingdao VTS, 2010, p6).

The personnel allocation of Qingdao VTS center are 38 persons, they are allocated as the following table:

Sequence Number	Title of Job	Number of Staff
1	Director of Qingdao VTS center	1
2	Vice director	2
3	Director of Watching Room	1
4	Business Director of Watching Room	1
5	Equipment Director of Watching Room	1
6	VTS Supervisor	4
7	VTS Operator	20
8	Manager of VTS Equipment	1
9	VTS Business Statistic Operator	1

10	Equipment Operator	6
Total		38

Table 3.2 Personnel Location of Qingdao VTS Center

Source: Zhang, D.G. 2009.

There is a questionnaire about the satisfactory extent of 35 VTS operators in Qingdao VTS center made in 2013.

	Night shift allowance	VTS allowance	post	prospect	Individual development	Exchange scheme
Satisfy	17	5	19	12	5	3
General	9	0	4	11	8	6
Unsatisfy	7	27	11	10	17	26
Hard to say	2	3	1	2	5	0

Table 3.3 Questionnaire of satisfactory of Qingdao VTS operators

Source: Li, C. 2013.

The Qingdao VTS area is the water area stipulated in the Qingdao Water Ship

Reporting Scheme, the area is marked as follows:



Figure 3.5 Qingdao VTS Area

Source: Qingdao VTS Guidelines for Users

The service capacity of Qingdao VTS in 2012 is shown in the following table:

Monitoring vessels	110, 350 ship times(the same unit as follow)
Escort for key vessels	1789
Berthing of super-large vessels	688
Investigate ships' violations	33
Issue early warnings	103
Approval of international navigation vessels enter port	8985
Receive ship reports	203,160
Provide information services	101,582
Traffic organization services	693

Table 3.4The service capacity of Qingdao VTS in 2012

Source: Li, 2013.

Chapter4 The problems of VTS in China

4.1 The legislation of VTS in China

Currently, there are only two national level laws related to the operation of VTS system in China--the Safety Monitoring and Management Regulations of Vessel Traffic Service System of PRC and Operation and Management Regulations of Vessel Traffic Service Systems of PRC. And the two regulations are both issued and implemented since 1998, with nearly no amendments occurring. Besides that, there is little relevant content about the public service of VTS.

In the past decade, the legal construction and administrative system in China have improved largely, laws such as Port Law, Administrative Penalties Law, State Compensation Law and other laws. The applications of new technologies to navigation. For instance, the AIS have bring big changes to the operation and management of VTS, and the facilities of VTS system have improved largely especially with the application of Internet and data exchange function.

The internal and external circumstance of VTS also has changed enormously, there are many big size vessels and small vessels co-exist in VTS areas, the density of vessel traffic flow also grew quickly. In the external circumstance, the expectation from public and press to the VTS are becoming higher and higher, they expect that VTS centers could not only provide services for ships and shipping companies, but also could provide information for the public and other administrative entities(Tu, 2013, 31-32). Besides that, the legislation level of the two regulations related to the

operation of VTS are relatively low compared with to the main countries with VTS centers.

And the Chinese government is transferring its governing philosophy from management to service. Therefore, the legislation of VTS in China should improve.

4.2 The nature and responsibilities of VTS centers in China are not clearly defined

4.2.1 The orientation of VTS centers in China

IMO and IALA emphasize that the nature of VTS is to provide services for the operations of vessels. And worldwide, most countries set the primary objective of VTS system as providing effective and timely information about the operation of ships, to satisfy the demands of ports and vessels on public service. However, the primary objective of VTS centers in China is to satisfy the demands of law enforcement agencies on monitoring and managing vessel operations due to the fact that as a division, VTS centers are financed and administrated by MSA. The proportion of public service in the function of VTS system is very small in China.

Besides that, because of the fact that the nature of VTS in China is not clear, the function of public service of VTS centers is affected. The public service is not generated by image, it needs corresponding resources to support. Therefore, due to the low position of VTS centers, the resource allocation of public service of VTS centers is still at low level, which would impede the improvement of public service

level of VTS centers in China.

4.2.2 Responsibilities of VTS centers in China

In China, during the process of VTS operation, VTS centers would provide advice and mandatory instructions. According to relevant IMO documents, in the process of making traffic organization decision, especially when ships are in conditions of engine broken, bad weather condition and navigating with difficulties, VTS could implement traffic organizations.

VTS could establish mandatory report scheme, traffic admission scheme related to the priority of operation, speed limits which should be complied with and ships routing, or other actions deemed as necessary by VTS centers.

When VTS are instructing vessels, the instructions should be result-based, and the specific measures should be determined on board. However, due to the fact that VTS are divisions of law enforcement agencies, the instructions sent by VTS centers usually are mandatory, if disobeyed, the vessels would be punished.

Because of the fact that VTS centers are financed and administrated by MSA, the audit and effect assessment of operation conditions of VTS centers are completed by China MSA, not VTS users or other organizations, it would cause the phenomenon VTS centers to pay much attention to how to satisfy the demands of China MSA, rather than the demands of VTS users.

Besides that, if casualties occur in VTS area of China, the duty VTS supervisors and

operators when the casualties occurred would be investigated by MSA. If there are serious casualties or casualties caused serious impact to public, the staff of VTS center would be investigated by procuratorate and may be accused for crime of dereliction of duty due to the nature of VTS centers, which occurred several times in China(Ma, 2013, p44).

Due to the fact that there are dual tasks for VTS centers to provide VTS services and to perform maritime law-enforcing activities, usually it is difficult for VTS staff to find the balance point correctly. The VTS meeting organized by China MSA in 1999 pointed out that both public service and law-enforcement are the key tasks of VTS centers in China. However, in practice, VTS staff may perform those tasks which would have been performed by VTS service but take many time and resource actually by means of law-enforcement methods. This phenomenon would result that administrative management would be the primary task of VTS centers and the VTS services would be performed by the purpose of avoiding administrative responsibilities(Tu, 2013, p28-29).

4.3 The staffing construction in VTS centers

According to the data from the Report of Assessment of VTS Operations in China, which was made by China MSA in 2012, there were 5 VTS centers which did not satisfy the criteria on staff of VTS center made by China MSA(China MSA, 2012, p12).

The main problems in the staffing of VTS centers in China are:

(1) The competence of staff is at low level. It lack staff with navigation experiences in VTS centers, and the training level is also low.

(2) The service awareness of VTS staff downplays. Because of the traditional management scheme in China, sometimes the VTS operators take tough stance and force to issue instructions when communicating with VTS users, and the demands of users usually be negligent, which may impact the whole service awareness of VTS centers.

(3) There is lack of VTS staff reservation scheme in China. The work of recruitment and training of VTS staff are not systematic, and there is no comprehensive VTS staff complementary scheme in China, as a result, the reservation of VTS staff could not be guaranteed(Ma, 2013, p29).

(4) Restricted by the promotion scheme of China MSA, just like the questionnaire about Qingdao VTS operators, there are few promotion channel for VTS operators in China. Besides that, the salary increase is restricted by the administration regulations of civil servant in China, which would cause that VTS operators to lack motivation to improve their working level.

4.4 VTS function of marine environment preservation

Despite the fact that the IMO Resolution A.857(20) defined clearly that VTS should be designed to protect the environment(IMO, 1997, p3), and the Safety Monitoring and Management Regulations of Vessel Traffic Service System of PRC also stipulated that preserving marine environment is one of the objectives of VTS, the function of preserving marine environment was made little effect by VTS centers in

China.

Otherwise there are emergency serious pollution accidents occurring in VTS areas in China, VTS centers paid little attention to the protection of marine environment in their routine operation. Traditionally most governmental entities pay attention to those actions related to the economic development and their related actions, the environmental preservation especially the marine environment preservation receive little attention from government entities and the public in China, which is the cause of the phenomenon. Another reason is that the connection between VTS center and on scene law-enforcement ships or other powers are not close enough, the management level of the coordination between VTS center and other law-enforcement divisions in MSA and on scene law-enforcement powers out of MSA are need to be improved.

4.5 Lack of research on new trends of VTS development

The concept of VTM and VTMIS are widely accepted in Canada, the USA and EU countries , and relevant researches have been performed actively. It is probably that they would be extensively used to merge the function of VTS system and play important role in future.

However, only little academies in China are researching in the field of VTM and VTMIS, too little attention is paid to the new technologies and new trends of VTS development in China.

Chapter5 Proposals on the development of VTS in China

5.1 The legislation of VTS should be improved in China

The legislation is the basic guarantee of VTS operation. Due to the fact that the two regulations relevant to the operation of VTS were adopted nearly a decade ago, and currently are not adapted to the development of VTS centers in China. The regulations should be amended immediately.

The new regulations should consider the new technologies applied to VTS system, and the increasing demands for public services from VTS users, and the responsibilities of VTS centers should be adjusted to adapt to the objectives of VTS centers.

Besides that, the training of VTS staff, and new administrative system of VTS centers should also be stipulated in the new regulations.

5.2 The administrative system of VTS centers should be reformed

As analyzed in Chapter 5, the dual nature of VTS centers impeded the function of VTS to provide public services.

According to the author's opinion, the law-enforcement function and the public service function of VTS centers should be separated in to two different departments. A new department which is responsible for law-enforcement of maritime traffic including punishing ships who disobeyed relevant laws and regulations should be established within MSA, and VTS centers should responsible for public services only.

Besides that, a communication scheme should be established between the new department and VTS center. VTS centers are responsible to provide proof of ships' unlawful acts and report these acts to the law-enforcement departments, and the law-enforcement departments are responsible to respond to these unlawful acts and assist VTS centers to maintain the orders of vessels traffic by means of on-scene patrol and other methods.

5.3 The personnel scheme should be improved

Restricted to the administrative system of civil servants management scheme in China, the promotion and salary increasing of VTS staff are the same as civil servants in other governmental entities in China.

In the author's suggestion, the VTS supervisors and operators should be treated as "special positions", because besides the demands of age and education background which are the same as other positions in Chinese governmental entities, the navigation experience, the focus of attention, the ability to adapt to work shifting environment and VTS system operating system experience are all required by VTS

supervisors and operators in addition. If the promotion and salary increasing schemes for VTS staff are the same as other governmental entities, the positions of VTS supervisors and operators would not be attractive enough to recruit competent staff who are with the ability needed by VTS centers. A separate promotion and salary increasing scheme should be established to satisfy the requirement of recruiting and storing VTS staff.

The training of VTS staff should also be enhanced. Compared with the staff ability of advanced VTS centers in the world, the ability of VTS staff in China should be enhanced. VTS staff in Turkey Strait VTS are all with master's certificates, and Singapore VTS staff are all with navigation experiences, and the training of VTS staff are complied with IMO and IALA standards and procedures. For various reasons, the communicative ability of using standard navigation communication languages of VTS operators in China are still at a low level , and needed to be improved(Tu, 2013, p41).

According to the current conditions of VTS staff ability in China, there are 4 items suggested by the author:

- (1) Joint training institutions should be established by competent authorities, academies, pilot stations and shipping companies, and persons should be trained by these institutions before entering into VTS centers. The content of training could refer to the IALA recommendation.
- (2) The fresh men of VTS centers should be trained by VTS staff with rich experience in these VTS centers, to promote the fresh men to adapt the VTS operation system quickly and correctly.
- (3) The ability of VTS staff should be assessed by interval, and knowledge refreshing training should be conducted if deemed necessary to VTS staff.

(4) VTS supervisors and operators on board field study should be held by intervals such as every year, which would increase the navigation experience and knowledge of navigation practice of VTS staff.

5.4 More attention should be paid to research work

Due to the lack of researches on new technologies and new trends of developments of VTS and the function of preserving the marine environment by VTS system, the research on new trends of development of VTS should be performed by VTS centers, academies, port organizations and shipping companies. And the concepts of new trends of VTS such as VGTMS should be widely accepted and understood by VTS centers in China.

Chapter6 Conclusion

With the rapid increasing of number of VTS centers and the fast growth of public demands to VTS system in China, and the relevant reformation of administrative system, operating ideas and relevant researches of VTS centers improve relatively slow, it is inevitable that problems about the operation and management of VTS centers in China would arise currently and in future.

Compared to the requirements of relevant resolutions from IMO and IALA, and the operation exercises of advanced VTS systems in the world, there are still many shortages in the operation process of VTS systems in China, and needed to be improved and enhanced.

With the continuous deep development of administrative system reformation conducted by Chinese government, and the objective of MOT to construct service-oriented MSA, it is imperative to constitute public service oriented mode VTS centers in China, as well as the adjustment of administrative relationship of competent authorities and VTS centers to adapt to the new situation of maritime traffic and service management ideas of the Chinese government in the new circumstance.

The recruitment and routine training and management scheme of VTS staff should

also be improved with the actual demands for VTS staff to recruit and maintenance competent VTS supervisors and operators.

The relevant researches on relevant technologies, developing trends and international regulations and guidelines of VTS system in the world should also be conducted and performed widely by relevant academies, companies and competent authorities of VTS system to guarantee that VTS systems in China would satisfy the demands of development of maritime traffic in future.

Due to the fact that the maritime traffic situations will keep on develop and change in the future, the strategies of VTS development in China would also be improved continuously to adapt to the new situation.

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