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## Research on the improvement of functions of Hangzhou Bay Bridge VTS

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**WORLD MARITIME UNIVERSITY**

Dalian, China

**RESEARCH ON THE IMPROVEMENT OF  
FUNCTIONS OF HANGZHOU BAY BRIDGE VTS**

By

**CAI HAIYANG**

**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)**

2014

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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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(Date):                10th July, 2014

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## **ABSTRACT**

Title of Research Paper: **Research on the Improvement of Functions of Hangzhou Bay Bridge VTS**

Degree: **Msc**

In China, the Vessel Traffic Service (VTS) plays a more important role in the strengthening of marine traffic management than providing traffic service to ships. Even when providing public information service, the VTS is often passive to provide these service, such as the other ships' movements, sea conditions and other required information, which largely affects the functions of VTS.

The paper is a research on the improvement of the functions of Hangzhou Bay Bridge VTS. The author mainly studies the status of Hangzhou Bay Bridge VTS, discusses the problems and presents some suggestions. There are a lot of problems to be solved in the practical work of Hangzhou Bay Bridge VTS, for instance how to make reasonable innovations in the public service model and how to expand the functions of Hangzhou Bay Bridge VTS in preventing ship-bridge collisions. Furthermore, we need to change the management system from passive management to active management, from decentralized management to systematic management, from traditional management to modern management and from qualitative management to quantitative management, and pay more attention to the timeliness and humanization of its public service. Only in this way can Hangzhou Bay Bridge VTS provide better service to Hangzhou Bay Bridge and Jiaxing port.

**Keywords: HZ Bay Bridge VTS, Service, Information, Function, Improvement, Problem**

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## **LIST OF ABBREVIATIONS**

AIS	Automatic Identification System
CCTV	Closed Circuit Television
HZ	Hangzhou
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
IMO	International Maritime Organization
INS	Information Service
JX	Jiaying
LRIT	Long Range Identification and Tracking System
MSA	Maritime Safety Administration
MSI	Maritime Safety Information
NAS	Navigational Assistance Service
TOS	Traffic Organization Service
VHF	Very High Frequency
VTIS	Vessel Traffic Information Service
VTMIS	Vessel Traffic Management Information System
VTS	Vessel Traffic Service

## **CHAPTER 1 Introduction**

### **1. 1 The background of the research**

Since the Chinese government emphasized its government functions in the Sixteenth Congress, the construction of a service-oriented government in China has been vigorously propelled and is now under continuous comprehensive renovation. The research of a service-oriented government and its related public service ability has become the forefront of this kind of research.

Corresponding to exploring the construction of a service-oriented government, the ports and shipping industries in our country are experiencing prosperous development. Most of Chinese ports' cargo throughput and passenger capacity have been rocketing, and the number of ships that entering and leaving the ports is increasing with each passing day. The growing navigation density and busy water transportation make it a very urgent task for Maritime Safety Administration, especially the Vessel Traffic Service (VTS), to efficiently assure the safety of marine transportation and improve the marine transportation efficiency.

At present, most of the world's ports are equipped with VTS. In China, VTS has been built in all major coastal ports and along the Yangtze river, meanwhile, the government has gradually established the Safety Supervision and Management

Regulation on VTS of the People's Republic of China and the Regulation on the Operation Management of VTS of the People's Republic of China to set a clear rule of the authorities and other organizations by the law. At the same time, each VTS center also has formulated its corresponding user guide to declare its various functions and service functions. Judging from the construction and development of the VTS in China in the past 30 years, we can conclude that it started late but develops very fast, and it is constructed with higher standards but has operated with lower standards (Chen, 2013).

However, due to the under positioning of VTS in China, the weak service consciousness of government departments and civil servants, the excessive monopoly and supply imbalance of public service, the VTS cannot satisfy the public demand for its function of public service. In addition, since the 12th Five-Year Plan began, the construction of VTS in China has been saturated and the functions of VTS can only meet the requirements of the traditional administrative management but cannot get used to the transformation of VTS into service-oriented Maritime functions. Consequently it is not good for the development of VTS under this bottleneck status.

Jiaxing (JX) Maritime Safety Administration is the competent authority and JX VTS Center is the operating center of Hangzhou (HZ) Bay Bridge VTS which mainly serves the JX port and HZ Bay Bridge. HZ Bay Bridge areas boast a developed economy and JX port is an important port in the Yangtze River Delta and the major feeder feeding port of Ningbo-Zhoushan port. In recent years, JX port has developed very quickly and the position of ocean economy in JX city is also increasing rapidly, which places greater demands for HZ Bay Bridge VTS to fulfill its serving functions.

And as an integral part of the port supervision and services and the guarantee of the safety of HZ Bay Bridge, it is of great significance to improve the public service capacity of HZ Bay Bridge VTS and expand its functions in bridge protection.

## **1.2 The significance of the research**

During recent years, the role that VTS plays in the protection of ship navigation safety and marine environment and promotion of local economic has got universal affirmation. And it has drawn wide attention on the research of the improvement of the VTS functions. It is of great theoretical importance to make an exhaustive study on the system, public service function and other functions of VTS and then to improve the service quality of VTS and perfect the modern marine traffic security management.

Under the major premise of urging the construction of public service-oriented government in China, we must adhere to the right orientation and master the right positioning of VTS to satisfy the demands from the public. And there is a lot of work to do to carry out scientific management of HZ Bay Bridge VTS, to offer good public service, to introduce the successful experience of domestic and foreign advanced VTS, to fulfill the VTS officers' potential ability and to expand the functions of HZ Bay Bridge VTS.

## **CHAPTER 2 Some Basic Conceptions**

### **2.1 VTS**

Along with the development of shipping, some countries realized that the effective way to solve the problem of traffic efficiency, navigation safety and environmental protection is to establish a system on the shore which can monitor the ships' movement in the working water and offer information, advice or instruction to these ships. This system can coordinate with the ships and effectively control the traffic flow, and then help the port obtain long-term and maximum benefits and minimize the risk of ships traffic accident and marine environmental pollution (Zhu & Chen, 2008, 30-33). This system is known as the Vessel Traffic service.

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).

### **2.2 Service**

What is service? According to Wikipedia, we can find the definition of service:

*A Service is a set of actions or solutions that are put in place or are performed to provide a repeatable and consistent set of outcomes, deliverables, and*

*performance for people, organizations, and systems that represent consumers or beneficiaries of such results.*

(Wikipedia, 2014)

In different areas, service has a different meaning. Then return to the service of VTS. The services provided by VTS are carried out by its competent authority to increase transportation system efficiency and protect the ships and marine environment. According to IALA Vessel Traffic Manual (2008), three types of services are offered by VTS, namely Information Service (INS), Traffic Organization Service (TOS), and Navigational Assistance Service (NAS). “Service” is the aim of VTS. However, in China, the service of VTS is not as usual as the compulsory service which also contains the meaning of management.

### **2.3 The capacity and level of VTS public service**

Public service capacity is whether the provider of public service can realize the demand of the receiver of public service, and after the provider realizes the demand, whether he/she can provide the public service timely, as well as the level of the public service can he provide. Properly speaking, public service capacity refers to the skill and technique mastered by the subject of public service to provide high-quality public services and products to meet the demand of the object of public service. The strength of the public service capacity determines whether he/she can really bear and deal with all matters of public service in the whole process.

Public service capacity of VTS should be equipped with advanced management and service concept and scientific and effective manning level. The level of VTS public

service is closely related with the effectiveness and quality characteristic of VTS public service. From the point of the VTS public service provider, the effectiveness of VTS public service, which reflects on the reliability and continuity of communication, the accuracy and comprehensiveness of the information and the level of discovering the risk and giving a alarm, directly shows the level of VTS public service. From the point of the VTS public service receiver, the level of VTS public service is measured by the receiver's perception and experience in the process. When the level of VTS public service satisfies the functionality and guarantees the timeliness, the receiver will demand greater civilization and comfort from provider (Zhou, 2008, 76-77). On the other hand, the efficiency of VTS public service is the comprehensive assessment of the process and the result of VTS public service. The efficiency is the external reflection of the level, and the level is the base of efficiency.

This paper discusses how to improve the functions of HZ Bay Bridge VTS. According to the above analysis, an important part is how to improve the efficiency of HZ Bay Bridge VTS in order to heighten the capacity and level of HZ Bay Bridge VTS.



## CHAPTER 3 The Present Status And Problems Of Hangzhou Bay Bridge VTS

### 3.1 The setting and operation status of HZ Bay Bridge VTS



Figure 3-1 Hangzhou Bay Bridge VTS coverage

Source: Hangzhou Bay Bridge VTS Guide for Users.

HZ Bay Bridge VTS is the auxiliary project of the construction of HZ Bay Bridge. It consists of two radar stations (Dengguangshan radar station and Xiangliang Port radar station) and a control center located in the office block of JX Maritime Safety Administration. HZ Bay Bridge VTS has two operating areas and contains the subsystem of Radar, Automatic Identification System (AIS), Closed Circuit

Television (CCTV) System, Long Range Identification and Tracking (LRIT) System, Weather, Very High Frequency (VHF) System and so on. The Netherlandish company HITT built the core technological equipment and is responsible for the future technological support. HZ Bay Bridge VTS began to be constructed in 2009, then received completion acceptance and was put into trial operation in June 24, 2011. October 22, 2012, it successfully passed the completion inspection and all major equipment of HZ Bay Bridge VTS are accord with the design request. After HZ Bay Bridge VTS began to officially run , it carries out monitoring of JX Port and HZ Bay Bridge 24 hours a day. As shown in Figure 3-1, the area within the red lines is the HZ Bay Bridge VTS coverage.

After running over one years, HZ Bay Bridge VTS has established its watch system and working procedures, and also formulated a lot practical oriented normative documents on the basis of the working characteristics of VTS. All the VTS officers have obtained the certificates issued by Maritime Safety Administration of the People's Republic of China and can well implement their duties.

### **3.2 The present condition of HZ Bay Bridge VTS**

In 2013, HZ Bay Bridge VTS focused on the safety supervision and management work to promote more standard and detailed management, in order to strengthen the capacity of accident warning and pre-control, marine environment protection and bridge protection. Both the management level and service level of HZ Bay Bridge VTS have significantly increased. Table 3-1 indicates the main service data of HZ Bay Bridge VTS in 2013.

Table 3-1 The service data of HZ Bay Bridge VTS in 2013

The service data of HZ Bay Bridge VTS in 2013	
Effective operation of VTS	365 days
VTS available rate	99.6%
Monitoring by VTS	18582 port calls
Monitoring by AIS	18252 port calls
Berthing and unberthing monitoring by CCTV	6195 port calls
Publishing the maritime safety information	12309 times
Providing navigational aids	1232 times
Traffic organization	1193 times
The security alert of HZ Bay Bridge VTS	6 times
Publishing the severe weather warning	44 times
Discovering and correcting the violation	57 cases

Source: Jiaxing MSA, (2013). Statistics of HZ Bay Bridge VTS.

In recent years, HZ Bay Bridge VTS has centered around marine traffic safety supervision and persisted in law-based administration, efficient and convenient principle, honesty and trustworthiness. It has fulfilled its responsibilities of serving for people and supervising scientifically, continued to optimize the VTS service function and enhanced its ability of maritime security to protect the safety of lives and property of people and meet people's requirements of the safety of sailing and smooth communication.

Firstly, deepen the service concept. HZ Bay Bridge VTS treats ships and

administrative counterpart as “the customer”, and firmly establishes the post service awareness of “supervise for one minute and serve for 60 seconds” to deepen the VTS service concept. Besides, it gives full play to the special role of VTS in assuring the safety of ship navigation and then to enhance the influence and visibility in serving ships, ports, shipping companies and HZ Bay Bridge.

Secondly, standardize the service. HZ Bay Bridge VTS follows the semi-military management model and standardizes the working environment to achieve standardized management and service. And by using the standard marine navigational vocabulary, HZ Bay Bridge VTS carries out standard duty language to improve the image of the VTS service.

Thirdly, expand the VTS service. HZ Bay Bridge VTS always tries to supervise more effectively and serve more excellently. So it makes full use of the existing resources and innovates more new service carriers, such as newspapers, internet, micro blog and Wechat, to distribute safety information. The diversify of the service means HZ Bay Bridge VTS can provide more safety guidelines to ships.

Fourthly, perfect the supervisory mechanism. HZ Bay Bridge VTS puts itself under the supervision of the mass initiatives by means of employing special supervisors, holding supervisors meetings and taking a survey of satisfaction and then to improve the working methods.

Fifthly, enrich the connotation of the service and actively participate in social activities. HZ Bay Bridge VTS keeps to communicate with some developed countries' and other advanced domestic VTS in order to optimize the mode of the

supervision and service and elevate service quality. At the same time, HZ Bay Bridge VTS starts to develop the Open Day and the “Bridge Guard” brand-building. Besides, it actively participates in the public welfare activities to create a good atmosphere in serving the society and to improve its high visibility and influence.

Lastly, build linkage mechanism with field inspection. HZ Bay Bridge VTS has established exchanges and co-operation mechanism with General Station of Exit and Entry Frontier Inspection and Department of Ocean and Fisheries. These three units often carry out law enforcement activities periodically and they give full play to their jurisdictions and functional superiority to make joint efforts in inspection and management of JX Port and HZ Bay Bridge. Moreover, HZ Bay Bridge VTS termly holds forums with HZ Bay Bridge Administration, HZ Bay Bridge Development Company, the upper and lower terminals, pilot station and other relative departments to analyze the situation and troubleshoot the risks. On the basis of the forums, an emergency drill is held by HZ Bay Bridge VTS and some related departments to enhance the quick-reaction capability each quarter.

### **3.3 The main problems of HZ Bay Bridge VTS and the cause analysis**

#### **3.3.1 Unclear function position**

For a long time, in the framework of the maritime administrative functions, there are two different understandings of the functions of VTS, that are supervision and service. Furthermore, in the actual performance of the duties and functioning, not only HZ Bay Bridge VTS but also all VTS in China focus on supervision. And the different understanding of the orientation brings about the different requirements of

resource allocation, seeking the efficiency and requirement of the public service level.

**(a). The ambiguous position of the functions makes the working model different under different functions of supervision or service**

When performing the function of “service”, VTS shall emphasizes the important characteristic of non-profit public welfare. It requires VTS to offer help when the activities may make the shipping market failure in the VTS monitoring area. And with the help, the shipping market can take measures itself to avoid or cut down the loss in advance (Li, 2013). Therefore, the main task of VTS to perform the “service” function is to ensure the effectiveness of those safety information and navigation aids. And only when VTS is offering service does it need to monitor the movement of the ship, and the monitor ends after service is completed. Although the VTS officers are required to attend VHF 24H a day to receive the application for navigation aids or ship reporting at any moment, they do not need to attend the VTS monitor interface 24H a day. Because they are not responsible for the finding of the hidden danger in VTS monitoring area at all times. Accordingly, in this case, the requirements of the actual working model of VTS are relatively simple; the division of each VTS officer’s operations area is relatively extensive, the standard of the resource allocation is relatively lower, and the requirements of the comprehensive quality and numbers of VTS officers are also relatively lower.

When performing the function of “supervision”, VTS then shall emphasizes the administrative characteristic of being mandatory. It requires VTS to find and interfere the activities that make the shipping market failure happens. As a result, it needs to

follow a control of the ship movements continuously and completely. The VTS officers must fix their eyes on the screen 24 hours every day to find any hidden risks and take measures to remove them. Obviously, the requirements of the actual working model of VTS are more complex and high-leveled. The division of each VTS officer's operations area must be more refined and the standard of the resource allocation, especially the comprehensive quality and numbers of VTS officers, also shall be higher than performing the "service" function only. In addition, supporting documents of the related laws and regulations shall be formulated to insure the effects of the "supervision", i.e. the effectiveness of the interfering of market failure.

**(b). The ambiguous position of the functions has direct adverse effect on actual working**

Firstly, it affects the further display of the functions of HZ Bay Bridge VTS and is the root cause of the bottleneck of the effectiveness of VTS function. This long-standing problem has caused the shortage of the unified corresponding standard of the resource allocation. As a result, the problem that constructing with high standards but operating with low standards has long existed in the VTS in China including HZ Bay Bridge VTS. HZ Bay Bridge VTS has been treated more as the supplementary means of JX Maritime Safety Administration. Therefore, it mainly focuses on supervision. However, it does not pay great attention to the high requirements needed to perform the supervision function, for instance neither the numbers of the VTS officers nor the capacity of them can satisfy the heavy tasks, so the working quality can only be based on lower standards and cannot be assured. Moreover, under the background of constructing service-oriented Maritime Safety Administration, the navigation environment of JX Port and HZ Bay Bridge waters is also becoming more

and more complicated. Increasing problems, such as monitoring blind areas, navigation obstruction by fishing vessels, small-scale ships' navigation in fog and so on, all add difficulty and pressure to performing the function of supervision. The lower standard supervision will cause the "bottleneck" become smaller and smaller and then further affect the effectiveness of HZ Bay Bridge VTS.

Next, it restricts raising the service level of HZ Bay Bridge VTS. The purpose of giving full play to the VTS service level is to export the public product with specific quality characteristics, i.e. VTS public service. Nevertheless, the VTS public service is by no means provided without foundation, which is based on the supporting of corresponding resources (Zhang, 2011). Therefore, the ambiguous position of the VTS functions makes both the supervision and service functions remain on the lower basis of the resource allocation and accordingly the VTS service level remains on the low-level of corresponding resource allocation. It has affected the heightening of the VTS service level over a long period of time.

Finally, it largely increases the risks of VTS officers' performance of their duties and is not good for the development of the work force. Although the risks of the job are no doubt affected by officers' sense of duty, objective factors caused by the ambiguous position, such as mismatching between unscientific division of the VTS monitoring areas and allocation of human resources, may also turn to be the hidden factors of risks.

### **3.3.2 Imperfect VTS agency and staffing**

The agency and staffing of HZ Bay Bridge VTS are not scientific and divorced from



practical working demands. In 2013, the Maritime Safety Administration in China turned to be one government sector instead of a public institution. And JX Maritime Safety Administration also adjusted the agency and staffing according to the government's approved document. HZ Bay Bridge VTS is still working with the maritime rescue coordinating center, control center and navigation department, but the staffing of HZ Bay Bridge VTS cannot meet the requirements of the number and specialty and is far away from the actual operational requirement. According to the requirements of the China MSA, the two operating platforms of HZ Bay Bridge VTS need to be equipped with 14 officers excluding the equipment's maintenance staff. However, the government only approved 10 officers including the maintainer, only accounting for 14.3% of all the officers of JX Maritime Safety Administration.

Making light of the staffing of VTS still affects the belongingness of the VTS officers and the stability of the team. HZ Bay Bridge VTS is now working together with those departments and sometimes the officer is seconded from other post and is not entrusted into a specific position. And these officers do not have strong sense of belonging which is not good for the development of both themselves and the VTS.

### **3.3.3 Unsound HZ Bay Bridge VTS management**

Just like most VTS in China, HZ Bay Bridge VTS was constructed with higher standards but now operates with lower standards. In order to start running earlier, it hastily drew up the internal and external regulations and systems before the institutional framework had been clearly set, the working procedure had been formed and the officers had been reasonable allocated. The number of the operating platforms and the division of the operating areas are determined in haste without

wide consultation and full assessment. And until now it never has had a chance to update and improve this situation, which affects the quality and effectiveness of the supervision and service of HZ Bay Bridge VTS.

The marginalization of the VTS management is another important reason. The management and check-up of VTS become a mere formality and some policies and measures cannot be put in place. Under the main functions of maritime superintendency, the VTS is always in a supporting role. Although the significance of HZ Bay Bridge VTS has been generally recognized and VTS has attracted more and more concern, the departments at all levels are perfunctory about the formulating and implementing of various VTS management systems and they pay more attention to the formality than the actual effect.

In addition, the maintenance of the VTS cannot get the full weight it deserve, so the hardware basic of VTS is not firm. The manpower, material resources and capability required to assure daily maintenance are all not enough. There is only one maintenance officer in HZ Bay Bridge VTS and he is also the VTS officer. Therefore there is a crisis that if some of the VTS equipment was broken it would not be repaired in a short time. On the other hand, there exists a great warp of the maintenance budget, and the planning of the budget is not scientific. Part of funding is even diverted into other purposes. Furthermore, the logistics support of the VTS operation is insufficient, which affects the positivity of VTS officers and the efficiency of maintenance.

#### **3.3.4 Working mode lacks of humanity**

*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, 2014)

The means and method of the maritime safety information broadcasting are too simple. HZ Bay Bridge VTS generally broadcasts safety information on the fixed VHF channel and the amount of information is very large. Therefore, many ships have to spend a lot of time listening to some repeated information to avoid losing new message. Quite a few ships hope the safety information broadcasting service can be more user-friendly. Besides, the requirements of ships' reporting of movement are too complicated which place a burden on ships.

In addition, the utilization of the extranet to provide service is not good enough, for instance its content is single, timeliness is weak and interaction is limited. At present, the content published online are mainly the notice for navigators, navigation warning, and sometimes these information are delayed. Moreover, it is hard for ships to search for the information they need as there is no handy search engine. The main purpose of publishing information online is to make government affairs public but it does not really take users' demand into consideration. The practicability of these information is not strong and cannot play the subsidiary role of the single VHF broadcasting.

### **3.3.5 Lacking of staff inspiration**

VTS officer is a special and tough position which needs to be on duty 24 hours a day

and it is also detrimental to health. The daily work of VTS officers is quite boring and many of their duties are on the night shift. The VTS officers have few time to communicate with other departments and do not have strong sense of pride and recognition in their job. Although JX MSA has drafted preferential policies to increase the VTS officer’s allowance, these policies have not been effectively implemented. Therefore, most of the VTS officers in HZ Bay Bridge VTS do not put all their hearts and souls into work and do not actively give advice and suggestions to the improvement of the VTS. In 2012, Zhejiang MSA wanted to recruit certain chief officers or maters with rich navigation experience, but only less than two-thirds applied. The main reason is that this post does not have good prospects and is too boring and tired.

The VTS officers in HZ Bay Bridge VTS are not sufficient and most of them are young people. The lacking of reasonable staff exchange mechanism and training makes most of them feel less prospective and have no passion in their works.

Once worked in HZ Bay Bridge VTS, the author carried out a questionnaire survey among the VTS officers with job convenience. The questionnaires were sent to ten VTS officers and all of them were taken back. The statistics is shown in table 3-2.

Table3- 2: The questionnaire survey of the VTS officers

	allowance for night-shift	post allowance	current position	prospect plan	personal development	job rotation mechanism
satisfied	2	3	4	3	2	1
just so-so	4	3	0	1	2	2

not satisfied	3	4	5	5	6	7
not sure	1	0	1	1	0	0

Source: Compiled by the author based on questionnaire survey.

All the questionnaires were anonymous. And judging from the result, we can find that most of the VTS officer are not satisfied with this job.

## **Chapter 4 Countermeasures and Suggestions of Improving HZ Bay Bridge VTS Functions**

### **4.1 Measures to improve the capacity and level of VTS public service**

#### **4.1.1 Change the position of HZ Bay Bridge VTS to flexibly and effectively fit the social and economic environment**

According to the new theory of public service, public service has the characteristic of universality. And with respect to universality, the core position of government departments is to differentiate and rationally choose the “planner” or the “producer”. That is to accept public service as their duty and to recognize that they should not monopolize the providing of public service. There exists a misunderstanding in the administrative management of traditional government: the government plays both the part of above-mentioned “planner” and the “producer”. With the establishment and improvement of the market economy in China, the function of government is no longer all-around management but it shall turn to be limited management to build a service-oriented government (Min, 2008, 27-28). The same is VTS department.

Under this background, more important task is to change the management concept of HZ Bay Bridge VTS and to change the position of VTS by solving practical problems. Only when ensuring manpower, material resources and capability to match

the functions of HZ Bay Bridge VTS, can the problem of the ambiguous position be solved radically.

#### **4.1.2 Strengthen functional support**

##### **4.1.2.1 Further promote the building of legal system**

As law enforcement departments, the public service provided by Maritime Safety Administration shall be also based on Chinese laws (Xu, 2011, 46-48). Therefore, only with a perfect legal system, can VTS assure validity, democratization and effectiveness of the public service, and can VTS officers and ships coordinate together under related legal and regulatory framework.

Carry out post evaluation of laws and regulations of HZ Bay Bridge VTS. A matching legal system environment is needed to adjust to the change caused by the transform of the VTS position. So it is important to strengthen the legislative work of VTS and carry out post evaluation of existing laws and regulations on the basis of problems and new phenomena. And to put forward suggestions of revision and improvement through comprehensive investigation and evaluation of policy measures, effectiveness of implementation and influencing factors.

##### **4.1.2.2 Strengthen technological transformation and maintenance**

Because of changes of the navigation environment in HZ Bay Bridge VTS areas and the aging of VTS equipment, blind areas of VTS are increasing which affects the reliability of VTS monitoring and daily work efficiency. Other problems such as the

cross-interference to VHF communication, failure in receiving safety information due to poor signal quality and added times of movement report because of losing signal when passing through the bridge, not only affect the work efficiency of VTS but also arouse a lot of bad feelings at the ships. Accordingly, it is significant to strengthen the technological transformation and maintenance, thus constantly improve the hardware environment of HZ Bay Bride VTS and raise the public service level.

#### **4.1.2.3 Enlarge publicity to improve the soft environment of VTS**

Land users in shipping context include ship-owners, 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, 2013). To bring the effect and function of VTS into full play, not only the high service level of VTS is required but also the cooperation and interaction with served objects. So it needs to establish and perfect the long-term mechanism of publicity and training. Thereby, both VTS and the served objects can fully recognize their rights, obligations and liabilities. To achieve this goal, firstly we can expand the training of bridge officers to ensure that they well coordinate with VTS officers. Secondly, we can innovate the publicity and training mode. For instance, we can introduce the promotion and training into the knowledge update training of seafarers, ask VTS officers to give lectures in maritime universities and add the opening days of VTS to strengthen the public’s cognition of VTS and the awareness of voluntary compliance with related regulations. Thus, the influence and popularity of HZ Bay Bride VTS can be raised and a friendly external environment for VTS can be built.



#### **4.1.2.4 Improve the logistics support capacity**

The logistics support of VTS must be enhanced. The working and living environment of VTS shall be improved to ensure the reasonable rest of VTS officers. Besides, we should improve the logistics support of manpower and resources to increase the efficiency of immediate responses and to ensure the technical support of VTS equipment.

#### **4.1.3 Improve the management mechanism of VTS and strengthen the process management**

##### **4.1.3.1 Perfect the responsibility mechanism**

To define responsibilities of all levels of VTS operation and establish the system of post responsibility. Ensure the carrying out of post responsibility by building and perfecting the self-discipline system, prevention mechanism, safeguard mechanism and punishment mechanism. Once the system and responsibility are defined, everyone need to comply at any time.

##### **4.1.3.2 Strengthen the assessment mechanism**

In order to avoid making the assessment a mere formality, random inspection and supervision mechanism of the assessment result are needed. And the cross-inspection mechanism with other VTS is also necessary. Only by effectively carrying out the assessment mechanism, can the problem be found and then solved, and eventually the quality of VTS operation can be really improved.

#### **4.1.3.3 Optimize the coordination and cooperation mechanism**

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 operation is face-management and field inspection by other departments is the point-management. Only the face and the point are effectually combined, VTS can bring out more comprehensive efficacy. As a result, we need to strengthen the coordination between VTS and other departments and build internal joined force mechanism. It is important to improve the information flow procedure and enhance the communication and coordination. Each department performs its own functions but also cooperate perfectly and then to improve the entire effectiveness.

#### **4.1.3.4 Build the talent management and motivation policy**

##### **(1). Implement people-oriented principle and respect talented**

We shall not only consider the long-term interest and development of VTS, but also take into account of VTS officers' interest and future occupational planning to make them get a clear understanding of their developing direction and enhance their sense of belonging. There are several suggestions: firstly, enhance the motivation mechanism to largely explore VTS officers' enthusiasm and creativity. To give reward to those who make achievements by various forms. The selection of excellent individuals and the chance of studying and training shall be given to more VTS officers then to create the atmosphere that every department is supporting VTS. Besides, increase the publicity of role models to praise the good spirit and working style. In this way, VTS officers can recognize the importance of their work and

immerse themselves in the career. Of course if the salary and the night-work allowance can be raised, VTS officers will have a stronger sense of achievement.

**(2). Make further efforts to improve the training system and performance appraisal mechanism**

VTS officers need to constantly receive the latest professional training to increase their comprehensive professional qualities. Then it needs to define the standards and content of the appraisal to objectively and dispassionately assess the actual work of VTS officers. The one whose capacity cannot be competent at his/her job will receive more trainings and the one whose capacity is higher than the requirements will be raised to a higher position. Everyone can be encouraged to exert more potentials and enthusiasm. In the meantime, the discipline mechanism shall be carried out strictly. The action which affects the work or bring a negative effect is to be criticized and corrected. And the malversation is also strictly forbidden. It is very important to create an honest, upright and positive working environment.

**(3). Perfect the competition mechanism**

Act is driven by motive power. Most people have positive aspects and they have aggressive attitude (Xu, 2012, 18-19). Therefore, healthy, positive and fair competition can be held within VTS to give capable personnel more chances and to make VTS officers encourage themselves and to constantly improve themselves. It is also good for the development of the whole VTS department.

**(4). Optimize the working environment and improve the working conditions**

It is essential to strengthen the logistic support for VTS officers to assure their rights and interests such as studying, working, rest, training and entertainment. With good logistic support, VTS officers' initiative can be further enhanced.

#### **(5). Build and perfect the job rotation system with other departments**

The VTS officer who has engaged in this work for a certain number of years can be rotated to other positions. If one person does the same job for too many years, one will feel tired, and this mechanism can keep VTS officers' vigor to ensure VTS function in another way.

#### **4.1.4 Build the brand of VTS to expand influence**

Jiaxing is a beautiful city and HZ Bay Bridge is also famous around the world, but most people knew little about JX MSA and VTS. Consequently, HZ Bay Bridge VTS shall recognize that it needs to optimize the policy and public opinion and constantly expand the promotion of itself. In order to increase public awareness of MSA's service and to set up a good social image, HZ Bay Bridge VTS needs to strengthen the displaying of its positive contribution to the development of JX's port economy and the important role in safeguarding maritime safety and HZ Bay Bridge.

For the sake of expanding the influence, HZ Bay Bridge VTS can expand ways to communicate, for instance setting up QQ group, micro blog and public service account of Wechat. And then VTS can publish information such as weather, sea conditions, maritime laws and regulations, notices of meetings, navigation environment etc. by these channels. Related ports and shipping companies can get

information at the first time and then to make adjustment accordingly. Both the VTS and its counterparts can improve work efficiency and the VTS public service level will be largely enhanced.

Next is to believe in the power of brand. Nowadays, brand strategy has been beyond the economic market and many nonprofit institutions such as the government agencies, hospitals and universities have generated brand strategies to create a better image (Ma, 2013). The purpose of brand establishment in governmental public domain is to improve public management and service level of governments as well as promote the public image of governments, whereas the final purpose is to enhance the satisfaction of the public. Generally speaking, in public domain, due to the abstraction of public service, the satisfaction of the public is often reflected by relevant evaluations made by the public on carriers which provides public service (i.e. the specific governmental department providing public service, such as various governmental windows for affairs). Hence, the establishment of public service brand is developed through building the image of public service carrier. As a result, VTS public service brand establishment can effectively improve VTS public service level and comprehensively enhance the window image of VTS public service. As for VTS, under the context when the infrastructure construction (hardware) of VTS projects tends to be saturated and the effectiveness of VTS meet its "bottleneck", the future development of VTS is mainly reflected by the level of public service (software) provided by VTS. In fact, Maritime Safety Administration in China has already realized the importance of "software" construction of VTS. The "four-type Maritime Safety Administration" brand establishment which was launched in 2012 is in fact an initiative to construct "software".

HZ Bay Bridge VTS proposed the “Bridge Guard” brand last year, whereas it did not take advantage of the good opportunity to expand its brand influence. VTS officers should strengthen the consciousness of service brand and regulate the process and improve the service quality, in order to make ships realize that it will be a benefit rather than a burden for them to join in VTS. In this way, VTS can be publicized automatically, besides, relevant people and ships can be motivated to join the VTS system. The frequent and basic work of VTS is to provide information service, traffic organization service and navigational assistance service. Therefore, the improvement of VTS public service can effectively expand the influence of VTS. The well establishment of service brand can win strong credit from the service target of VTS. With constant influence, the society will know more about the Maritime Safety Administration and recognize its favorable service image. In this way, more social benefit can thus be created.

With the operation less than 2 years, HZ Bay Bridge VTS has already formed a cultural atmosphere of “transmission, assistance and leadership”. The relationship among VTS officers is well handled, and the qualities of them are generally high. In the dull work and life of watchmen, VTS culture is also an important factor to retain talents. The coexistence and communication between leaders and VTS officers are harmonious and delightful; besides, experienced VTS officers transmit practice experience, assist life affairs and lead work process for new officers. Such mutual harmonization among people is also a kind of culture formed by HZ Bay Bridge VTS. In the next working step of HZ Bay Bridge VTS, human-based management and cohesion construction are also very important as well as the basic element to improve public service capacity.

## **4.2 Expand the application of VTS in bridge protection**

Since the official operation of HZ Bay Bridge VTS, it has made positive contribution to maintenance of navigation safety in the water areas within the bridge zone. However, with the swift economic development of JX Port, vessel navigation density in the water area within the bridge constantly increases, and security risk of the bridge has notably risen. Therefore, new requirement is proposed in order to vary security protective measures of the bridge. As a result, we should expand the functions of VTS, strengthen and implement security protective measures of the bridge via informationalization means, further reinforce the interaction among departments, establish and improve comprehensive and long-lasting security management mode and jointly build a solid defensive line of bridge against clash, in order to feasibly enhance the security protective capacity of HZ Bay Bridge.

### **4.2.1 Existing security protective measures of the bridge**

Currently, the security protective measure taken by HZ Bay Bridge is “joint service of operation and management”. All joint service departments shall perform their joint liabilities. As one member department, JX MSA is responsible for the electronic cruise as well as the onsite cruise by maritime cruise boats of the water area within the bridge. According to the arrangement, at present, the security protective measures of the bridge cover hardware equipment and relevant supporting systems, which are mainly constituted of three categories, including security monitoring system, onsite protective equipment and facility, security protective system etc. Figure 4-1 shows the existing security protective measures of the bridge.

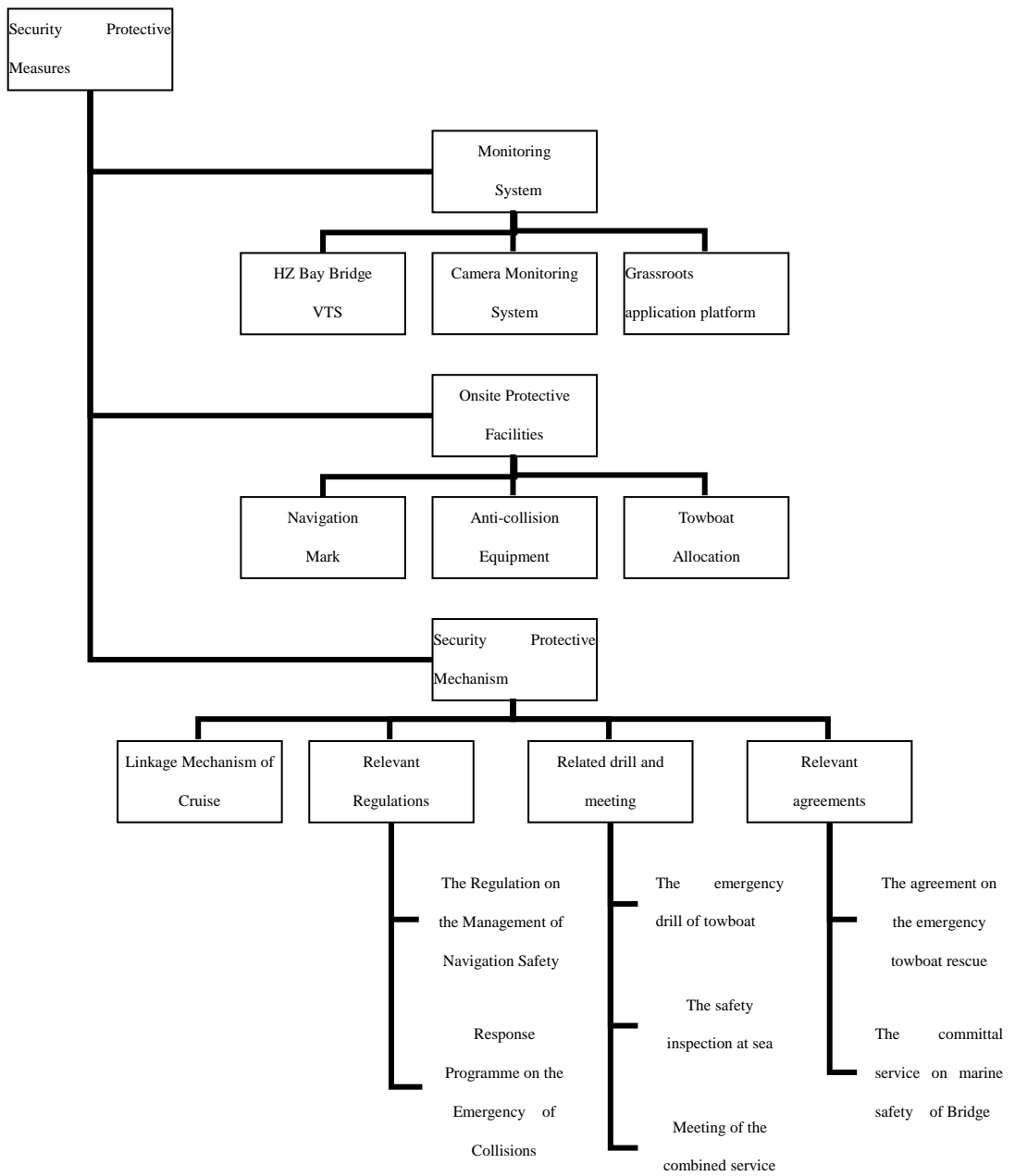


Figure 4-1 Existing security protective measures of the bridge

Source: Compiled by the author.

#### 4.2.1.1 Security monitoring system

##### (a). HZ Bay Bridge VTS



At present, HZ Bay Bridge VTS sets two operating platforms, one of which is specially used to monitor HZ Bay Bridge. Meanwhile, the VTS data base has the function of counting the number of ships crossing the bridge.

**(b). Camera monitoring system for sea surface**

The camera monitoring center to which the HZ Bay Bridge Development Co. Ltd is subordinated sets the VTS monitoring client-side, in order to monitor the sea areas on the two sides of the bridge. There are totally 36 sets of monitoring cameras on the two sides of the bridge (including 26 sets cameras in non-navigation channel, 6 sets of zooming-controllable cameras in the northern and southern navigation channels and 4 sets of infrared thermal imaging cameras), six sets of high altitude cameras on the tower top of navigation channel bridge and 12 sets of cameras on the continent of the two sides. The dynamic record on the ships navigating or berthing in the navigation-forbidden water area on the two sides of the bridge can monitor the number and direction of ships in the water area in real time, but it may be influenced by fog.

**(c). VTS maritime grassroots application platform**

VTS maritime grassroots application platform is a remote access platform developed from the VTS operation platform. The grassroots departments can access the designated server via the Internet to obtain the real-time traffic picture which is same as the VTS operation platform, meanwhile to inquire the targeted ship's basic information. Different from traditional AIS system, this platform can assist on-site law enforcement officers in grasping the specific position of objects without AIS, so

to strengthen the targetry of cruise in specific water areas.

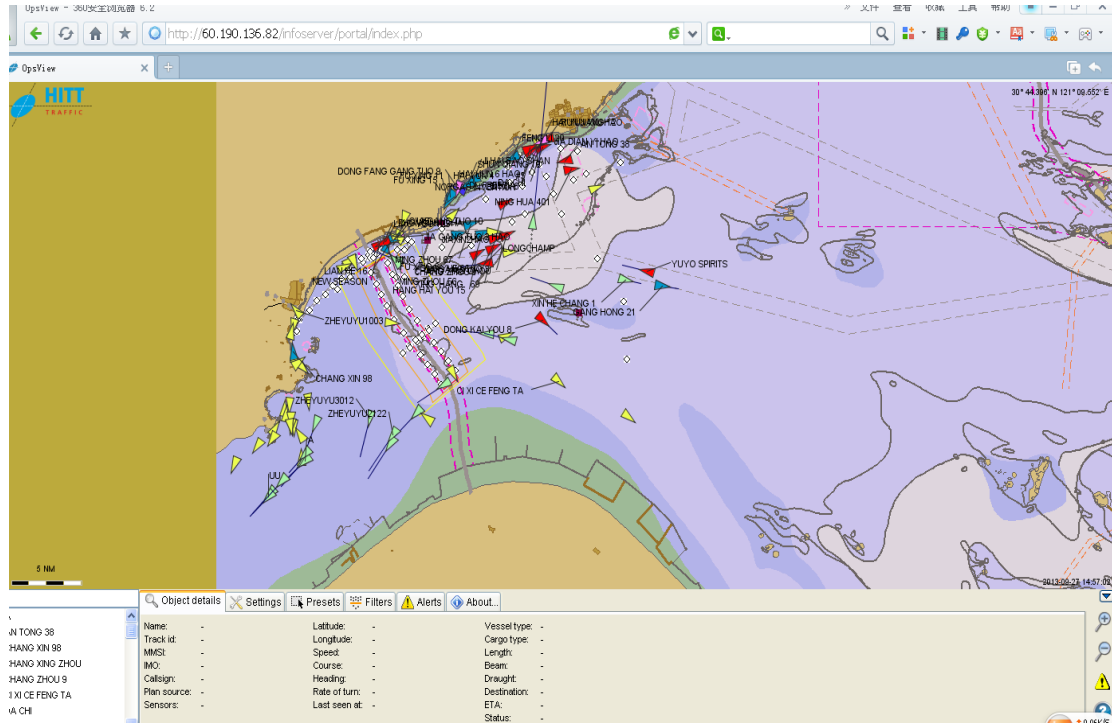


Figure 4-2 The interface of VTS maritime basic application platform

Source: Obtained from HZ Bay Bridge VTS center.

#### 4.2.1.2 Onsite protective equipment and facility

##### (1). Navigation mark in the water area within the bridge zone

There are totally 88 navigation marks in the water area within the bridge zone, including 38 buoy lights, 22 bridge and culvert marks, 14 alarm light beacons, 10 anti-test light beacons, three radar transponders and one isolated danger mark. JX Beacon Station is responsible for the daily maintenance of navigation marks, including changing and installing beacon lights as well as environmental and renewable energy, checking, cleaning, maintaining and coloring navigation marks

and equipment, measuring the position of navigation marks and technical performance as well as supervising, protecting and monitoring those navigation marks. According to statistics, currently, the normality rate of navigation marks reaches 99.6%, the normality rate of navigation mark maintenance reaches 99.8%, the repair rate of navigation rate is more than 80%, whereas the internal abnormality rate is less than 0.05%. Those navigation marks provide great aid to navigation.

### **(2). Anti-collision equipment in non-navigation channels**

HZ Bay Bridge is currently equipped with anti-collision equipment in non-navigation channels, which are funded by HZ Bay Bridge Company. They are mainly distributed in channels where the north and south navigation channels are nearby. They provide protection to navigation dense areas; however, anti-collision equipment has not covered the water area of the whole non-navigation channels.

### **(3). Towboat allocation in water area within the bridge zone**

According to the Regulation on the Management of Navigation Safety of HZ Bay Bridge, the berth of ships at wharfs near the water area of the bridge (less than 3000m) shall be forced to use towboat. Currently, there are six towboats within JX Port Areas (one of them was officially authorized in Oct. 2013). The main engine power of five towboats is 3200 KW, and the rest one is 3600 KW. According to statistics, from January to June of 2014, the six towboats assisted 1789 ships in berthing, 3955 times in total. Those towboats assisted 1580 times in berthing or unberthing in the water area near the bridge, which occupied 40% of the total.

#### (4). The allocation of the maritime cruise boats

There are two maritime cruise boats in JX MSA, as shown in table 4-1 and Figure 4-3.

Table4-1 The maritime cruise boats of JX MSA

Ship Name	Type	Material Quality	Main Power	Design Speed
Haixun 0781	40 metric type A	steel	2×447KW	14.2 knots
Haixun 07801	12 metric type A	fibre reinforced plastics	2×405KW	36 knots

Source: Compiled by the author.



“Haixun 0781”



“Haixun 07801”

Figure 4-3 The maritime cruise boats of JX MSA

Source: Compiled by the author.

#### 4.2.1.3 Security protective mechanism

##### (1). Linkage mechanism between onsite cruise and electronic cruise

Based on geographic information system and business data system, electronic cruise is a modern supervision model of marine safety which integrates various modern supervision platforms including VTS, AIS system, CCTV system etc. It can supervise the dynamic activity of ships, effectively check the data of vessels and positively provide marine safety information service.

Command center and enforcement detachment are specific implementation departments of electronic cruise. The electronic cruise implemented by command center conducts comprehensive supervision on the administrative area (water area of the bridge) during key periods, provides information service of water security, remotely corrects activities of ships which violate laws or regulations, and transmits onsite violation correction command to enforcement detachment when necessary. The enforcement detachment conducts simulative cruise or dynamic supervision within the key water area of the authorized sea zone via the existing informationalization equipment, in order to improve the pertinence and effectiveness of the cruise.

**(2). Relevant regulations**

Table 4-2 shows relevant regulations on the protection of HZ Bay Bridge.

Table4-2 Relevant regulations

Name	Framework	Reference
The Regulation on the Management of Navigation Safety of HZ Bay Bridge	5 chapters, 32 articles Including: General, Navigation, Berthing and	The Maritime Traffic Safety Law of the People's Republic of

	operation, Security, Supplementary Provisions	China Convention on the International Regulations for Preventing Collisions at Sea, 1972
Response Programme on the Emergency of Ship-bridge Collisions.	6 articles Including: the aim, the extent of application, responsibility and emergency response	The Contingency Plan on Public Emergency at Sea of JX

Source: Compiled by the author.

### (3). Relevant drill and meeting

Table 4-3 shows the relevant drill and meeting held to assure the protective measures.

Table4-3 Relevant drill and meeting

Items	Content	Participants
The emergency drill of towboat (each quarter)	The salvation of the ship risks in bridge areas	1. JX Maritime Administration 2. HZ Bay Bridge Development Co. Ltd 3. JX Port Service Co. Ltd
The safety inspection at sea (each quarter)	The inspection of the navigation aids, warning	1. JX Maritime Administration

	signs, anti-collision box of the main piers and other anti-collision facilities	2. HZ Bay Bridge Development Co. Ltd
The meeting of the combined service (every half year)	Problems and deficiencies in maritime safety management	1. JX Maritime Administration 2. HZ Bay Bridge Administration

Source: Compiled by the author.

#### (4). Relevant agreements

Table 4-4 shows relevant agreements signed among several parties to protect the bridge.

Table4-4 Relevant agreements

Names	Content	Parties in the agreement	Implementation of the agreement
The agreement on the emergency towboat rescue of HZ Bay Bridge	The emergency rescue in bridge waters	1. HZ Bay Bridge Development Co. Ltd 2. JX Port Service Co. Ltd	JX Port Service Co. Ltd
The committal service on marine safety of HZ Bay	1. patrolling the bridge waters (once a week)	1. HZ Bay Bridge Development Co. Ltd 2. JX Haian	JX Haian Technology and Trading Service Co.

Bridge	2. depth sounding of the bridge channel 3.patrolling the warning signs and anti-collision facilities 4.submitting the safety conditions and the sounding data (the end of a month)	Technology and Trading Service Co. Ltd	Ltd
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Source: Compiled by the author.

#### **4.2.2 Problems encountered by HZ Bay VTS in present bridge protection**

##### **4.2.2.1 The change of objective environment proposes new requirements to VTS**

###### **(1). Increasing ships that cross the bridge bring pressure to VTS**

With the swift development of the port economy in JX and the employment of newly added port in Haiyan, the density of ships that cross the HZ Bay Bridge is constantly increasing. According to VTS database of JX (which was established in June, 2012), from July, 2013 to June, 2014, the number of ships that went across the navigation channels of HZ Bay Bridge is on the rise, among which the number of identifiable vessels (equipped with AIS) that went across the bridge has increased notably. The



numbers are shown in Figure 4-4. Such a dense transportation proposes higher requirements to the daily supervision of VTS.

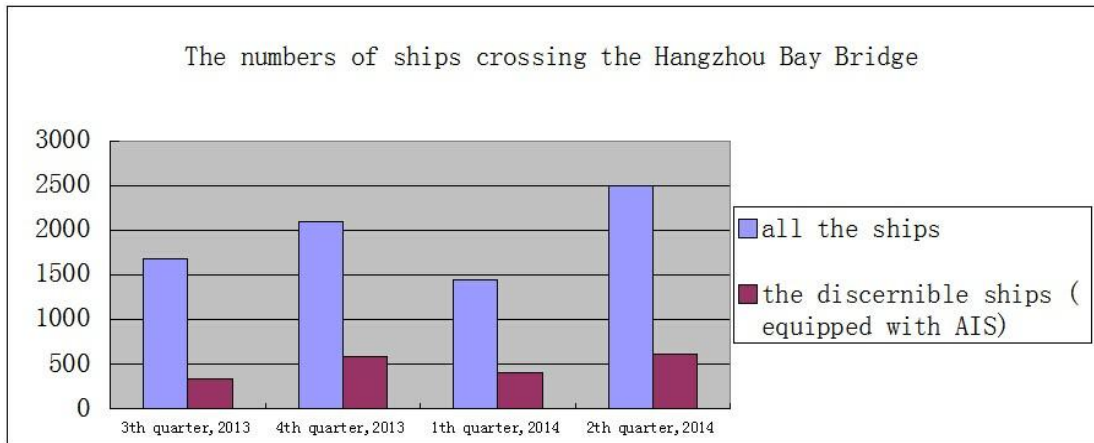


Figure 4-4 The number of ships crossing HZ Bay Bridge

Source: Compiled by the author using statistics data of HZ Bay Bridge VTS

## (2). Numerous unidentifiable ships brings difficulties to VTS

From January to June of 2014, the monthly average number of vessels that crossed the north navigation channel of HZ Bay Bridge was 233, among which 122 vessels can be displayed by AIS information, occupying 52.3%; the monthly average number of vessels that crossed the south navigation channel of HZ Bay Bridge was 465, among which 62 vessels can be displayed by AIS information, occupying only 13.3%. Figure 4-5 and figure 4-6 show the numbers of ships crossing the north and south navigation channel in the first half year of 2014, and we can find the numbers of the unidentifiable ships are very large. Via interview it was known that most of them that went across the bridge were passerby ships, among which the majority of them were ships carrying sand. The time rule of ships that went across the navigation channel was generally three hours before the flood slack. Due to sight factors, cameras set on

the north and south navigation channels cannot conduct effective supervision. As a result of no AIS or information errors of AIS, VTS could not provide effective security information service as well. Those deficiencies will result in hidden risks for the security of the bridge.

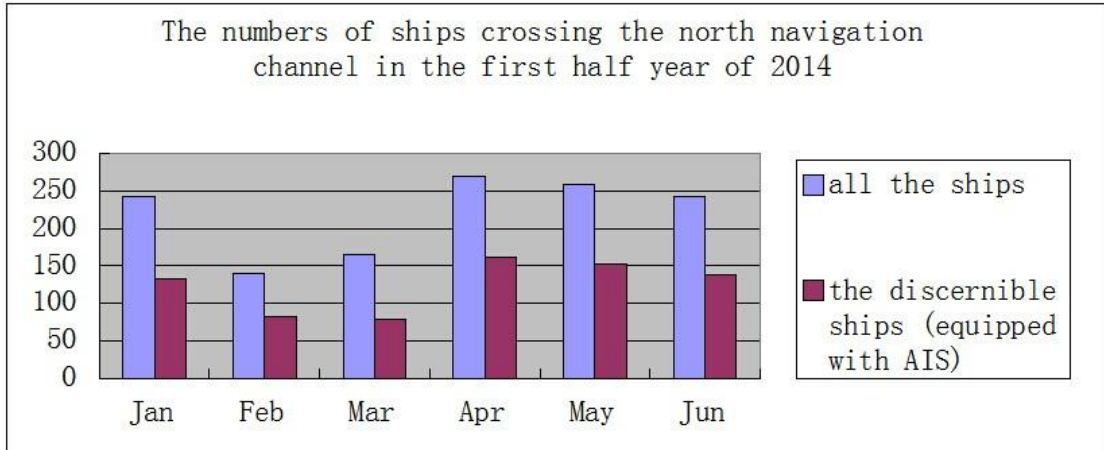


Figure 4-5 The numbers of ships crossing the north navigation channel in the first half of 2014

Source: Compiled by the author using statistics data of HZ Bay Bridge VTS

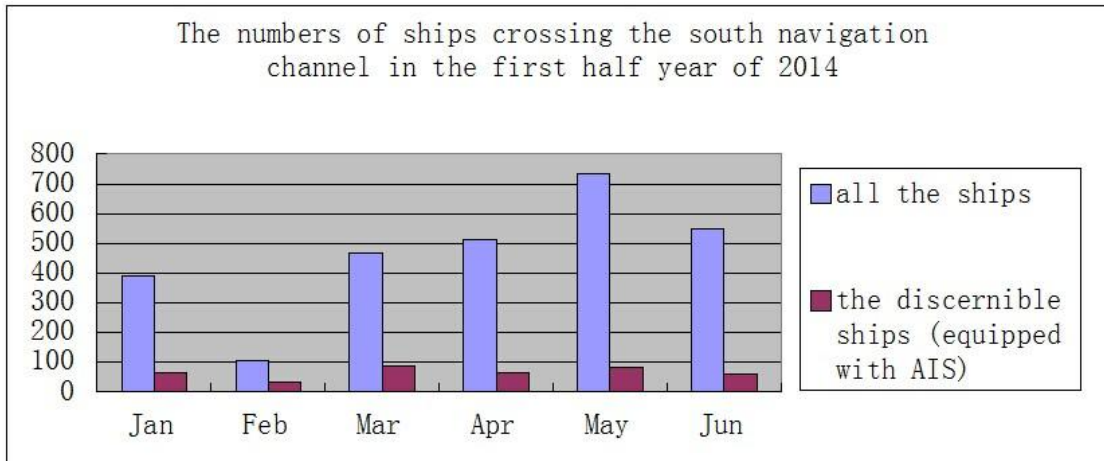


Figure 4-6 The numbers of ships crossing the south navigation channel in the first half of 2014

Source: Compiled by the author using statistics data of HZ Bay Bridge VTS

### **(3). Ships which go across non-navigation channels bring hidden dangers to security of the bridge**

After the bridge was completed, the original broad navigation water area is restricted to two passageways-the navigation channels in the north and south. It is difficult to forbid some small ships (most of them are fishing boats) which want to cut corners to arbitrarily go across non-navigation channels. When the safe space between the bridge pier and these ships is not enough, the latter will easily sink or capsize. On Sep.12, 2010, “Zhesheng 89003” was collided near F03 bridge pier of HZ Bay Bridge, which resulted in the sinking of the ship, and three persons fell into water (Jiaxing MSA, 2010). Fortunately, the bridge was not seriously damaged.

#### **4.2.3 The subjective interaction between VTS and onsite supervision protection is lacking**

##### **4.2.3.1 Onsite enforcement boats cannot positively update dynamic plans of ships**

In the first half of 2014, enforcement detachment implemented 152 cruises and patrols in the water area of the bridge, 110 order safeguards in the north and south navigation channels of the bridge, and inspected 122 vessels which went across this water area. The accumulative navigation time was 219.7 hours, and the total distance was 2054 nautical miles (Jiaxing MSA, 2014). With the popularization of VTS maritime basic application platform, onsite enforcement boats can effectively conduct targeted cruise and supervision. However, since there were no effective methods which can positively update the dynamic plans of ships, there is still

possibility to improve the orderly arranged cruise and supervision.

#### **4.2.3.2 The arrangement of rescue power such as towboats is not enough to fulfill the emergency needs**

In JX Port, the tidal range is large, and tide is turbulent. The number of towages within the area is small, whereas the demand quantity of berth assistance is large. The berth assistance by towages is operated tensely. When ship accident happens, towages are in turn needed to provide rescue. However, slow emergency reaction which is resulted from lack of emergency towages or impossibility of towage unberthing due to tide, may appear.

#### **4.2.3.3 The dense traffic in the north navigation channel of the bridge and the pilot anchorage may cause risk**

The east part of the north navigation channel is a dense area for navigation. The connecting part of bridge-crossing channel and port entrance channel forms two right angle turns here. Besides, Zhapu Joint Inspection and Pilot Anchorage locates on the south of this channel, and the influence among ships are relatively strong. When maritime transportation accidents happen or the operation of ships is limited, it is easy to cause threats to the security of the bridge. Zhapu Joint Inspection and Pilot Anchorage is just 0.7 nautical mile far from the bridge. The depth of water is 7-12 m. The substrate of the water is generally sludge, which results in unfavorable anchoring effects. If ships meet accident of dragging or the main engine is out of control in this anchorage, the time for taking measures is quite limited. In case that towboats are needed for rescue, it will cost 30 minutes for towboats get the engine ready and reach

this water area, and almost no time is left for rescue.

#### **4.2.4 Comments and suggestions**

Targeted at the current security protective measures for bridges and the problems of VTS in present bridge protective work, the author advises to start from the following three aspects to achieve the informatization, automation and intelligitization of safety supervision for water area of the bridge.

##### **4.2.4.1 Develop automatic early warning by collective broadcast**

Based on the current VTS system, the three-level (reminding area, warning area and navigation-forbidden area) automatic early warning by collective broadcast for bridge can be developed so as to achieve the objective of automatic release of security information for ships at water area of the bridge, moreover, it can also optimize the labor resource allocation for supervising the water area of the bridge in the heavy traffic flow organization, liberate labor and innovate the new mode for maritime safety supervision.

##### **(a). Automatic early warning by collective broadcast**

Set the warning line and user-defined triggering conditions in VTS system. When the user-defined vessel enters the reminding area (the specified position), warning area (within 3000m away from the bridge axis) and navigation-forbidden area (within 1200m away from the bridge axis), the sound-light alarm and corresponding VHF collective broadcast will be triggered automatically so as to guarantee the reminding

service of security information.

Triggering conditions: 1. according to the berthing and unberthing plan in VTMIS as well as the navigation routes, whether the ships will cross the bridge is predicted and judged. 2. According to the berthing and unberthing plan in VTMIS as well as the navigation routes, whether the vessel tends to berth near the water area of the bridge (within 3000m) can be predicted and judged. 3. When ships want to berth against the tide downstream the north navigation channel at high tide, judge whether it has the hidden danger of hitting the bridge based on the ship track line and predicted positions.

Broadcasting content: if ships have AIS or are recorded in VTS database, ships' names will automatically join the collective broadcast.

Rules: 1. when ships enter the reminding area, the sound-light alarm will be triggered to arouse VTS officers' attention. 2. When the non-navigable water areas also designate warning area and navigation-forbidden area, the priority of warning area is higher than navigation-forbidden area.

#### **(b). Tracking objects without AIS**

When the ship enters the three-level automatic early warning for bridge, in the case without AIS, the system will automatically judge whether it is error tracking. If it is not error tracking, the sound-light alarm will remind the VTS officer and enter the manual intervention stage.

### **(c). Security reminding of non-navigation channels**

Set warning area at the non-navigable water areas. When the tracking object (which is automatically judged by system) satisfies the triggering conditions, it will implement valid reminding of security information, including the sound-light alarm for VTS officers.

#### **4.2.4.2 Establishment of VTS database sharing platform**

At present, the VTS maritime basic application platform is limited to the synchronous transmission of ships' real-time dynamics, and the interflow of data like the berthing and unberthing plan and historic records of entering and leaving port has not been realized. It is suggested to build a VTS database network access platform which integrates the current application platform to truly achieve data interflow (Yang, 2012). And the following three functions are expected to be realized: 1. the relevant internal departments of MSA can take the initiative to update and grasp the ships' movements within the area under administration through accessing this platform. 2. Maritime onsite law-enforcing department can record the real-time on-site law-enforcing dynamics through accessing this platform, and the VTS center can realize the real-time inquiry. 3. The rescue vessels can acquire the ships' distribution and their relevant plans as well as realize the reasonable and dynamic distribution of rescue vessels by accessing this platform.

#### **4.2.4.3 Safety precautions for dense traffic areas**

##### **(1). Application of racon (radar transponder)**

In the case of ships entering the port for the first time or ships unfamiliar with navigation channels of the bridge that may suffer course deviation while crossing the bridge, it is advised to set racon at northern and southern navigation channels of the bridge to assist ships to navigate and avoid risks. As the location of racon is distinctively fixed and completely different from other objects, its location and distance can be simultaneously measured on the ship's radar screen based on recall signals so as to facilitate ships crossing the bridge to correct navigation direction and guarantee the security of bridge crossing (Zhang, 2012, 29-30).

**(2). Strengthen linkage of departments and properly strike ships crossing the bridge unlawfully**

It is necessary to further strengthen the management of onsite cruise, grasp the onsite cruise of key periods and water areas, positively implement night staggered cruise, vigorously renovate the illegal navigation behavior, actively explore the comprehensive management mode of the cruise with VTS and electronic cruise, and constantly purify the navigation environment (Lou, 2010, 42-43). Firstly, the onsite guard and security maintenance shall be carefully implemented to enhance the cruise work quality. Secondly, effective and vigorous onsite cruise for key water areas and periods shall be actively implemented, and the reorganization of key ships' navigation behaviors in key water areas shall be carried out properly so as to constantly purify the navigation environment. Thirdly, the new mode for cruise combined and supplemented by electronic cruise, maritime patrol boats and law-enforcement vehicles shall be deepened.



## **CHAPTER 5 Conclusion**

In this paper, based on the research of HZ Bay Bridge VTS, the author mainly has discussed the problems existing in HZ Bay Bridge VTS, proposed the suggestions to improve the public service capacity and level and analyzed the feasibility of expanding the function on bridge protection. The following is a summary of my conclusions:

- (a). It is important to make a reasonable position of HZ Bay Bridge VTS.
- (b). It needs to strengthen functional support, such as legal system, technological support, soft environment and logistics support, to lay a solid foundation of VTS service.
- (c). It is necessary to improve and perfect the management mechanism.
- (d). It is a matter of cardinal significance to building the brand of VTS.
- (e). It is essential to expand the function of bridge protection by establishing Automatic early warning system by collective broadcast and VTS database sharing platform, as well as strengthening the safety precautions for dense traffic areas.

In conclusion, this paper is developed by combining the work needs with actual investigation. It lays particular stress on investigation reports, but the theoretical research is based on the practice. Due to the author's limitation of theoretical and professional knowledge, the author cannot implement more profound and thorough

analysis on how to improve the VTS public service ability and function, and the proposed suggestions are relatively macroscopic. Moreover, suggestions for the specific operation based on the actual features of HZ Bay Bridge VTS are defective. However, with more and more people concerning this problem in the field of maritime and shipping industry. the author believes the prospect of VTS development in China, including HZ Bay Bridge VTS, will be promising.

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**Appendix A: The questionnaire for HZ Bay Bridge VTS officers**

Name: \_\_\_\_\_(can be empty)

1. How long have you been working in HZ Bay Bridge VTS: (                    )

2. Do you satisfy with the allowance for night-shift: (                    )

A: Satisfied      B: Just so-so      C: Not satisfied      D: Not sure

3. Do you satisfy with the post allowance: (                    )

A: Satisfied      B: Just so-so      C: Not satisfied      D: Not sure

4. Do you satisfy with your current position: (                    )

A: Satisfied      B: Just so-so      C: Not satisfied      D: Not sure

5. Do you satisfy with your prospect plan: (                    )

A: Satisfied      B: Just so-so      C: Not satisfied      D: Not sure

6. Do you satisfy with your personal development: (                    )

A: Satisfied      B: Just so-so      C: Not satisfied      D: Not sure

7. Do you satisfy with the present job rotation mechanism : (                    )

A: Satisfied      B: Just so-so      C: Not satisfied      D: Not sure

8. Your suggestions to improve the functions of HZ Bay Bridge VTS:

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