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A study on the application of information system in patrol vessel management

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A Study on the Application of Information System in Patrol Vessel Management

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Declaration

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

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

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Title: **A Study on the Application of Information System in Patrol Vessel Management**

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Abstract

Patrol vessel, as an important enforcement tool Marine Systems, played an irreplaceable role in the maintenance of China's maritime rights and interests, to strengthen maritime supervision, improve maritime law enforcement capacity has made an outstanding contribution. Patrol vessel equipment are increasingly complex, high-tech, and difficult to manage. A more effective system of maintenance and repair is needed in order to experience the repair and maintenance of the main fault. The crew's experience based on their patrol boats for maintenance, can easily result in unstandardised management, and thus reducing the life of the equipment. Moreover, to a certain extent, it will become a safety hazard. With the rapid development of maritime industry, the number of patrol boats will continue to increase. In the face of so many patrol vessels, a streamline equipment management system is greatly demanded to refine coast guard boat equipment management measures, and the use of IT for patrol boats equipment management is necessary to maintain the ship in good technical condition, which is particularly important.

In this paper, the author collected a large number of data and conducted field research related to maritime agency for patrol vessel equipment management, in order to have a basic understanding of the information technology support system requirements. The author proposes an information system into the ship's daily

management, with the use of computers, networks, communications and basic information database and other means to establish the transmission of information between ship and shore and sharing scientific statistical system for data, analysis, and thus systematicly and comprehensively guide the daily work of maritime patrol vessel equipment management.

This paper mainly includes 3 aspects:

1. Through summarily and analysisly to maritime systems Coast Guard boat equipment management system, aided by information technology, the author presents a new management model to promote information technology and the management of deep integration Coast Guard boats, cruising to meet bailout integration, intelligent decision support, and to improve the equipment management level.

2. Through the research and analysis, this paper studies the actual use of patrol vessels, as well as maintenance and other daily management, combined with the development of information technology. The author proposed ship management, hardware and software, training, and system functions in four areas of information technology needs.

3. The author discusses the information technology support system structure in detail, and proposes a system features modular design, database design and other specific embodiments. The system makes equipment as the core, combines the maintenance work involved in the procedures, requirements, standards, related technical data, equipment operation data, spare parts, materials, and personnel. Through an organic database system, the author makes recommendations to manage the ship affairs, maintenance and other work to ensure standardised and scientific operation.

KEYWORDS: patrol vessel, information system, management, application, IT

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List of Abbreviations

CCS	China Classification Society
CDMA	Code Division Multiple Access
CWBT	Ship Repair and Maintenance System
GPRS	General Packet Radio Service
IT	Information Technology
LAN	Local Area Network
MPV	Maritime Patrol Vessel
MPV	Maritime Patrol Vessel
MPV	Maritime Patrol Vessel
MSA	Maritime Safety Administration
SQL	Structured Query Language

Chapter Ⅰ Introduction

1.1 Background

China Maritime Safety Administration (MSA) is responsible for the exercise of state water safety supervision and preventing pollution from ships, vessels and marine facilities, navigation safeguard management and administrative law enforcement and other management functions (China MSA, 2012). The management function has strong policy and technical requirements, and therefore, maritime management efficiency is directly related to social satisfaction and administrative relative person of interest, the service-oriented maritime construction, and the state and the government's image, which is significant.

In order to further enhance maritime regulatory standards to meet the whole society needs of safety and environmental protection, and constantly enhance maritime service economy and social ability, China MSA propose to develop a "Marine Systems" and clearly put forward the goods of the "second five" development in December， 2011. The plan aims to basically complete full coverage, all-weather surveillance, rapid response, modern water traffic safety management system by 2015, focusing on coastal areas, inland waterway network and non-water network coordinated regional development, and continuously to improve maritime safety supervision, emergency protection and public services in order to achieve "effective supervision, rapid relief, quality service". Maritime patrol vessels, as important

enforcement tools in the maintenance of China's maritime rights and interests, can contribute to strengthen maritime supervision and improve maritime law enforcement capacity. These patrol vessels have played an irreplaceable important role, therefore, the level of maritime ship equipment management directly affects the performance of their duties to the maritime sector capacity, as well as whether China MSA's the second five development goals can be successfully completed. A profound understanding of the maritime sector in the maritime patrol boats has an important role of supervision. During the "Eleventh Five-Year" period, the government invested heavily in the construction of patrol boats to strengthen the focus on weak areas and blank area. All the coastal Maritime Bureaus have basically have a certain number of small, medium and large maritime patrol vessels. With the "Twelfth Five-Year "'s continues focus on continuous building patrol vessels, patrol vessels are equipped with improved structure, especially focus on building large tonnage, high-powered patrol vessels. To the "Twelfth Five" the goal of "total moderate, reasonable structure advanced performance, standardization, management practices," will be achieved. With the rapid development of maritime career, the government will continue to increase the number of patrol boats. In face of such large patrol boats, it is particularly urgent to rationalize the equipment management system, refine patrol vessel equipment management measures to keep the ship in good technical condition, and establish scientific, standardized and realistic maritime systems to guarantee the maintenance and repair works," with long-term management mechanism.

Maritime Patrol vessel (MPV) equipment increasingly complex, high-tech, and it is difficult to manage, the existing management system and more effective maintenance and repair in order to experience the repair and maintenance of the main fault, that the crew's experience based on their patrol boats for maintenance,

can easily result in management are not standardized, reducing the life of the equipment, while a certain extent, will become a safety hazard, thence, the management system can not meet the coast guard boat equipment management standardization and technological requirements. With the spread of information technology and the rapid development of the shipping industry, maritime administrations have a profound understanding of the application of IT technology to patrol boats through the establishment of ship maintenance management information system. The use of computer, network communications and basic information database and other means can help with the ship's daily management (Ma, 2007, p.42-43). The establishment of information transfer between ship and shore can share scientific statistical system for data, analysis, and provide a comprehensive guide to the system routine patrol boats device management. In the maritime management, information technology has become an integral part of the overall planning of the digital management, and boat information management.

Currently, the information management system of patrol vessels has been carried out in some MSA branches applications. The economic benefits generated by the maritime authorities have increased greatly, which can be seen to be supplemented by the use of information technology management. However, the management of patrol boats remain to be standardized, refined and scientific.

1.2 Research purpose, content and meaning

1.2.1 Research purpose

Along with the economic development, the construction of smooth and efficient, safe and green transportation system is urgent. It relies on their own development and

transformation of traditional technologies to improve maritime regulatory capacity, or it has little room to rise. The maritime agency has fully recognized the important role of the information technology and proposed to build “smart Maritime”, in order to give full play to science and technology information in maritime administration. In order to establish a comprehensive perception, China MSA widely interconnected and intelligent application of information technology systems, integration of information resources, information resources to enhance the depth of mining and utilization levels, and promote information technology and marine management and deep integration of services, layout grid to meet regulatory, law enforcement service standardization, cruise rescue integration, decision support intelligent marine construction needs, improve maritime service quality, regulatory efficiency, management efficiency, supporting the “four-type maritime” (innovation, responsibility, service, learning) construction.

Through the use of information technology, the author promotes the formation of ship-shore patrol boats with integrated information network, to maximize the use of information technology in order to regulate the daily management, and reduce human factors during repair, over repair and misuse repair. Gradually, it can help to improve equipment reliability , thereby reducing management costs by relying on science and technology driven maritime administration. Continued upgrades for maritime scientific development can form a strong scientific and technological support to achieve modern management.

The purpose of this thesis is to adapt to the trend of maritime information, streamline patrol vessel equipment management system, and the use of information technology of the carrier, in order to explore effective patrol vessel repair and IT support binding mode. The author proposes means of information technology support, establish and

improve the patrol vessel equipment and technology information databases, to establish scientific and standardized management workflow patrol boats and working standards, maintenance and other work to ensure the rational, normative and scientific operation. To further improve the maritime sector crew and ship management efficiency, a comprehensive information system should be adopted to improve maritime and coastguard boats level of emergency response capabilities.

1.2.2 Research content

Based on the above object, the thesis covers:

(1) Summary of the marine patrol vessel equipment management system; to study IT management patrol vessels assisted the new model; to explore IT and patrol vessels daily management in depth;

(2) Research and analyze patrol vessel on actual usage, daily management and maintenance, etc. Combined with the trend of information technology, research the information needs of patrol vessel management;

(3) Research IT support system architecture. The initial proposed system features modular design, database design and other specific embodiments.

1.2.3 Research meaning

This topic is an integral part of the “Wisdom Maritime” system, so it has far-reaching significance:

(1) Help to straighten out the patrol vessel equipment management system. Effective equipment maintenance and repair work are to promote the standardization and scientific equipment to improve patrol vessel safety, and reliability;

(2) Help to change the “emphasize purchase, weaken maintenance”, “emphasize usage, weaken management” work tendencies. To a certain extent, it can effectively prevent or repair missed equipment, reduce maintenance and support costs of patrol vessels;

(3) Help to enhance the image of China MSA. The reliability of patrol vessel equipment should be guaranteed. The maritime sector in response to emergencies can be the first time to reach the scene for traffic control, to carry out search and rescue operations, and to protect people’s lives and property.

Chapter Ⅱ Patrol Vessel Equipment Management System

2.1 Overview of the same type of ship domestic and abroad overview

2.1.1 The domestic patrol vessel overview

Domestic maritime vessels mainly include patrol vessels whose primary purposes are patrol and law enforcement, emergency rescue, etc. Patrolling enforcement, namely high frequency random ship duty, as patrol waterways navigable environment, and promptly correct the situation ship various illegal; disaster relief, namely towing stranded, sunk or lost navigational capability and fire in the difficulty boat or persons in distress, and served as site search and rescue coordination, command and participate in search and rescue ship. Disposal may lead to pollution of the marine environment, and have tasks such as site guard. Maritime ships experienced from scratch, and gradually develop the formation of large, medium and small, reasonable structure, superior performance pattern. According to incomplete statistics, China MSA has more than 1200 ships, including patrol vessels, buoy boats, tracking ships, special vessels, etc. With a number of large-tonnage maritime patrol crafts built and columns compiled into use, it can gradually strengthen cruise blue waters of the maritime sector's ability to defend national sovereignty, enhance water safety supervision of law enforcement forces. In the earlier period before 2000, maritime patrol vessels have wind low-grade, with slow speed, and the degree of automation is not high, but the majority is small and medium ship. With the rapid

development of China's shipping and marine engineering, since 2001, patrol kiloton gradually put into use, and such large vessels are equipped with advanced communications and navigation in general and law enforcement forensics equipment. They are capable of carrying helicopters, and have high speed and strong wind resistance, with all-weather search and rescue cruise and stereo monitoring capabilities.

Table 1-Main parameters domestic maritime patrol (China MSA) vessels

Ship name	Patrol vessel NO. 31	Patrol vessel NO. 21	Patrol vessel NO. 089	Patrol vessel NO. 091	Patrol vessel NO. 08906	Patrol vessel NO. 08901	Patrol vessel NO. 08919
length(m)	112.8	93.23	61.2	45	31	26	15.76
breadth(m)	13.8	12.2	9.2	7.6	6.5	4.4	3.39
depth(m)	/	5.4	4.5	/	/	/	/
draft(m)	4.38	/	3.0	2.5	2.25	0.8	0.7
displacement(t)	3000	1500	463	/	/	/	/
Maximum speed(knot)	22	22	21.5	16.5	12.5	26	50
Main engine power(kW)	2×5800	2×4500	2×3435	2×900	2×323	2×410	2×526

Source: Compiled by the author based on the data from China MSA

2.1.2 Overview of pacific Rim countries concerned maritime search and rescue ships

1. America

United States has implemented water safety regulatory authorities and search and rescue missions for the Coast Guard, with a relatively complete types of vessels, mainly patrol boats, icebreakers, patrol boats, training, sailing, boat buoy, engineering vessels, tugs, etc. Until 2008, the number of the implementation of

port and marine waters was near about 2000, of which approximately 235 vessels are longer than 19.8 meters; approximately 1,800 vessels are longer than 19.8 meters. The main patrol has 106, divided into 37. 5 meters, 33.5 meters, 26.5 meters 3 levels (Chen, 2008). The main force patrol boats are fitted with dinghy cast recovery system, in the mother ship sailing state under the dinghy be able to quickly cast and safety recycling, convenient perform maritime search and rescue tasks. The U.S. Coast Guard's patrol search and rescue boats are basically the use of standardized ship type, and the notable feature are conducive to inspection, maintenance and management.

2. Canada

The current tasks of Canadian Coast Guard are navigation, waterways management, marine environmental emergency, ice, marine transportation and communication services and search and rescue. Therefore, the institution arranges more types of boats, mainly icebreakers, Fisheries and Marine Research Division test ships, maritime services boats, patrol boats, hydrographic survey vessels, hovercraft and small boats and versatile training vessels.

Table 2-Canadian Coast Guard vessels primary parameters

Ship name	SIR WILFRID LAURIER	JOHNPTULLY	W.E.BICKER	GORDON REID	VECTOR	ARROW POST
Ship kinds	Lightweight icebreaker ship	Offshore investigation ship	Fisheries investigation ship	Patrol vessel	Offshore investigation vessel	Patrol vessel
length(m)	82.91	69	58	49.95	39.74	28.97
breadth(m)	16.15	14.5	9.5	11	9.64	8.8
displacement(t)	5025	2021	1285	879	557	/
Maximum speed(knot)	15.5	13	11	16.5	12	12
speed(knot)	11	11	8.5	12	10	10.8

Source: Compiled by the author based on the data from Canada Coast Guard

3. Japan

Japan is similar to the U.S. Coast Guard of their duties, primarily responsible for on alert along the coastline, patrolling, law enforcement and other tasks. It functions equivalently to our navy, border police, maritime police, maritime surveillance, maritime, fisheries, customs other departments take some of the functions of law enforcement is a diverse team.

2.2 The general situation of Maritime Systems equipment management system

As important enforcement tools in the maritime system, patrol vessels' performance

will directly affect the behavior of law enforcement, so the maritime sector in the daily management of the equipment should make great efforts to establish a new system, and to improve management means to increase rates of routine inspections. With the incoming water monitoring system and constantly changing economic development, generally speaking, the management structure of patrol vessel equipment is divided into two phases (Yu, 2007).

2.2.1 From 1993 to 2005

With the deepening of China's economic reform and the development of maritime surveillance systems for the maritime industry, the Ministry of Transport should play a protection role by putting forward higher requirements, and improve equipment management, usage, support, and repair work. The government is to play a safeguard supporting role in the foundation of a global work, but also the basic guarantee for completion of the required prerequisites. In 1993, the Ministry of Transport requires safety supervision systems all over the country to carry out in-depth device management, use, maintenance, repair inspection and assessment activities. Since then, the coastal maritime surveillance system equipment safety supervision bureau, which is predecessor of MSA, in accordance with "manage, use, maintenance, and repair" inspection assessment standards, itemized refine, improve work management system, patrol boats equipment management basically embarked on standardization and normalize tracks (Lian, 1997, p.203-206). Until 2005, China MSA proposed "effective maintenance and repair" inspection and unified the assessment standards.

2.2.2 From 2005 to present

In order to guarantee routine maintenance and repair work, from hardware and

software co-development, and continuously improve maritime regulatory capacity requirements, with the purpose of further strengthening and standardizing maritime vessel management system, and gradually establishing and improving the ship "normalization and institutionalization, standardization," the long-term management mechanism is to improve the overall quality of the crew and the technical level, and fully exploit the ship's efficacy and potential. In 2005, China MSA made new standards for patrol vessel management, use, maintenance and repair on the basis of 1993 inspection and assessment criteria in order to form a " Maritime Systems ship manage, use, maintenance and repair special work inspection standards." The standards are divided into unit management and ship management. Unit management consists of organization safeguard, clear goals, develop plans and rules, a sound system and strengthening the management, etc. Ship management includes the records, ship preventive maintenance plan, ship repair, ship container, ship appearance, mechanical and electrical equipment, and ensure safety, etc. Each of the two parts will be quantified by percentage. 2006 is the first year of Maritime ship "effective maintenance and repair" standardize the management of long-term implementation. By carrying out "effective maintenance and repair", the special work aims to further establish and improve the maritime ship "effective maintenance and repair." The rules regulations work standards are to ensure that every position has its responsibilities. There are devices where exist work items operating procedures. To realize the "normalization and institutionalization, standardization," of the ship management mechanism, we should guarantee that the ships are in good technical condition, and the water of major emergencies handling capabilities for water safety oversight and maritime are secure and reliable.

In order to strengthen the management, in 2006 the Ministry of Maritime Bureau Marine Systems organized experienced ship management personnel, and worked out

the “Marine Systems Working Ship Management Measures.” Management Measures for maritime systems work ship in basic management, technology management, maintenance, ship repair, ship calls and security management have put forward the guiding principles forma macro perspective. The management approach is also directly under the proposed assessment methods of MSA ship management effectiveness, and has strong operability and macro-guidance. For the standardized Marine Systems “log” and “engine logbook” record, maintain the solemnity of legal documents. In early 2006, China MSA completed the preparation of the “China MSA logbook” and “China MSA engine logbook.” In April 1, 2007, these regulations came into effect. In order to establish a unified complete marine systems ship performance catalog table and promote the image of China MSA, China MSA has prepared a “Maritime Systems Boat List”.

Since then, according to the arrangement of “effective maintenance and repair” special work, each MSA carries out self-inspection of ships and units of work of self-examination. Patrol vessel equipment management gradually moves into the “scientific, normalized, institutionalized, and standardized” ship management mechanism.

2.3 Technical requirements of patrol vessel equipment management

2.3.1 Specific technical requirements

Patrol vessels are in accordance with China MSA and the China Classification Society (CCS) of the relevant rules and regulations for the construction and survey need to meet the following technical specifications and regulatory requirements (Yu, 2007, p.14):

1, China Classification Society “Maritime High Speed Classification and Construction Rules” 2005 edition;

2, China Classification Society “Rules for Steel Ships” 2009 edition and the modified notification;

3, China Classification Society “Domestic Voyage Ship Construction Rules” 2009 edition and the modified notification.

4, China Classification Society “Domestic Voyage Ship Classification Rules” 2006 edition and the modified notification;

5, China Classification Society “Coastal Boat Classification and Construction,” 2005 edition

6, China Maritime Safety Administration(MSA), “Ships and offshore installations statutory inspection rules” (Domestic Voyages Technical Regulations Statutory Surveys of Ships) (2004) and its modification notification;

7, International Maritime Organization, “International High-speed Craft Safety Rules, 2000.”

2.3.2 Technical requirements of equipment management patrol vessel on the maritime sector

Patrol vessel, as an important maritime sector, requires fixed assets, equipment and more funding. Its importance is self-evident. China MSA has made special rules and regulations, requirements specification in order to strengthen state-owned assets supervision and administration, maintenance, security and integrity of state assets, to improve efficiency in the use of state-owned assets, and to promote the healthy development of maritime industry. China MSA issued a document named “Patrol Vessels effective maintenance and repair work inspection and assessment standards” in 2005. Patrol vessels “effective maintenance and repair” work has become a high

priority at all levels of leadership and supervision of business, and is closely related to the higher authorities regularly check of the normal work. The main technical requirements are specified as follows:

1) Ship management departments should fully grasp the technical condition of the ship and conduct technical classification scheme file . Reasonable, accurate, scientific ship maintenance and repair as well as safe and economic use should be guaranteed.

2) Technical condition of the ship classification is assessing the status of marine technology unit standards and statistical methods, according to the hull, mechanical and electrical, communications and navigation, outfitting, soundness and safety equipment. Its classification criteria are as follows:

(1) A class vessel - good technical condition, can ensure safe navigation and the normal operation. The specific conditions are as follows:

a. Hull, main electrical and mechanical equipment and special equipment meet the technical condition of the ship inspection specifications and obtain proper ship inspection certificate. The certificate is no legacy items and reservations;

b. Main engine and auxiliary engine can reach the rated power and speed, fuel consumption and embellish material parameters of the main conditions to reach the rated level;

c. Special equipment design performance without compromising;

d. Major safety, emergency device indicates accurate function normally.

(2) B class vessel-- Technical condition is still good, can basically meet the conditions for safe navigation and operation. The specific conditions are as follows:

a. Technical condition of the ship comply with ship inspection specifications, able to

obtain the corresponding certificate, but the certificate has a deadline to resolve the remaining items.

b. Ships with sectional defects which can be solved in the planning repair.

(3) C class vessel--Poor technical condition, problems may be resolved via large repair. The specific conditions are as follows:

a. There are big flaws in the hull, mechanical and electrical equipment and special equipment. By taking certain measures, you can obtain the appropriate inspection certificate, but the certificate has more significant reservations;

b. The main technical parameters of the ship can not reach the rated requirements, restricted navigation area, load shedding, deceleration, main engine uninstall and so on.

(4) D class vessel-- technical condition serious adverse, no longer have the safe navigation conditions. The ship was forced to suspended.

Belong to A and B class ships is the intact ship, the number of intact vessels compare registered boats in the total number of vessels is the intact rate ratio.

Ship intact rate=number of intact vessels/total number of registered vessels

3) The annual ship seaworthy days is the annual days minus the planning repair days and then minus the abnormal suspended days. If the “annual ship seaworthy day” is divided by the difference between the “annual days” and “planning repair days”, the “ship seaworthy rate” will be produced.

Ship annual seaworthy days=annual days-planning repair days-abnormal suspended days

Ship seaworthy rate= ship annual seaworthy days/ annual days-planning repair days X 100%

4) Achieve the required service life can still be normal navigation, ship operations should be kept to a minimum C class technical condition.

5) Reach or approach the specified service life and plans to scrap the ship, which can not be counted as intact rate assessment.

6) Annual “ship intact rate” should be no less than 90%. A single ship “ship seaworthy rate” should be no less than 95%.

2.4 Management status domestic patrol vessels

Ship equipment, as the main object of patrol vessel management, are scientific management which to pursue marine equipment life cycle reach the objective of minimum cost and maximum performance (Wang, 2010, p.147-149). Patrol vessels as the official ship, have a short running time, and are usually used in emergency. They require high speed, however, the merchant ships require economic speed to reduce fuel consumption and ensure uninterrupted long time run. Therefore, there is obvious difference between patrol vessels and merchant ships, which determines patrol vessel’s management mode can not copy from commercial transport ship management methods, and it must be designed to meet the requirements of its own operating characteristics. Because of this reason, regional MSA make useful attempts in the aspect of patrol vessels equipment management, and work to form their own advantages and characteristics of the management system (Li, 2009). The following several management system are currently processed.

2.4.1 CWBT cycle maintenance mode

CWBT is the abbreviation of the ship repair maintenance system. This system is formed by Shanghai MSA and the Shanghai Ocean Shipping Company. It is based on China's traditional ship repair management, and has absorbed foreign advanced management knowledge. Based on China's actual conditions, the shanghai MSA aims to develop and form a kind of modern ship repair management model (Xiong, 2002, p.43). CWBT is a preventive repair system whose design thinking is: classifying and coding definition ship equipments according to system; making repair and maintenance work in accordance with the maintenance cycle or importance grading, classification; writing device card for each device, set up card information, and prepare maintenance plans, in accordance with the maintenance schedule book circulation, thus achieving the ship maintenance and management of each equipment (Wang, 2002, p.9).

From the 1980s, the maritime sector refers to the CWBT management method, and carried out cycle maintenance mode on patrol vessel equipment management, which made afterwards repair become beforehand maintenance (Liu, 2005, p.4-5). It overcomes the crew team instability, mobility, and has changed the unstable state of the equipment management, reduced the failure frequency and maintenance funds, as well as promoted the maritime ship equipment management, and protected the maritime center to work smoothly.

Therefore, the implementation of CWBT patrol vessel on the ship's management model is not only an effective way to improve the level of maintenance management, but also an important means of establishment of ship maintenance and repair work and scientific, standardized and institutionalized, operation for long-term management mechanism.

2.4.2 Establish 5S management as the center of patrol vessel management system

The 5S is initially originated in Japan as a family management, which is a management approach mainly for the land, the object of family arrangement and adjustment. Later, Japanese companies absorb the management and apply in internal, meanwhile, gradually absorb some other management factors, and ultimately form the 5S management mode (Wang, 2010, p.147-149).

The 5S are arrangement (seiri), rectification (seiton), sweep (seisou), clean (seiketsu), literacy (shitsuke). Japanese use roman spelling of these five words whose are initial letters are “S”. Therefore, it is called “5S”(Wang, 2010, p.147-149). It is by means of strengthening field work environment management, controlling personnel, equipments, methods, and other production necessary factors, in order to create a safe and comfortable workplace environment, to improve work quality, efficiency, and equipment utilization, enabling employees to train good work habits, and thus improve enterprise management level. It is an advanced and effective equipment management mode (Qi, 2007, p.29-31). The core of 5S is to form good quality, from focus on the details of everyday work, train work habits, thereby reduce the incidence of major accidents, and operating costs, thus to improve the production efficiency (Fang, 2003).

The 5S management steps are as follows:

First step: arrangement. Inspect patrol vessel work area; distinguish essential items and non-essential items; clear non-essential items.

Second step: rectification. Classify items storage area; assort items according to necessary goods in region; determine storage method.

Third step: sweep. The workplace is cleaned of unwanted stuff, keeping the workplace clean.

Fourth step: clean. It is the core of 5S. The major content is making the previous three steps regular so as to maintain fore profit.

Fifth step: literacy. Develop good work habits, and enforce standards strictly; cultivate team spirit and the sense of team operations; keep meticulous, rigorous, serious work style.

After several years of operation, the patrol vessels 5S management model has achieved some results. The patrol vessel management has been further standardized, and equipment failure was significantly reduced. A group of highly qualified patrol vessel equipment management personnel have been trained to improve work efficiency and enhance the management level.

2.4.3 Patrol vessel management mode NSM rule

According to ISM code, China MSA produced NSM rule. The rule absorbed the ISO9000 quality assuring “process control” principle, through generalize shipping company activities of safe operation of shipping and safe operation of the ship, to establish the safety management system of the companies and the ships in order to achieve the principle of “work for “programmed work, standardization activities, documented behavior”. All personnel will participate in the control process, system management. Risk control is the main features of the rules, and safety and pollution prevention is the goal. For example, Fuzhou MSA introduced NSM rules into maritime ship equipment management, and explored a lot.

Understand job responsibilities and refine equipment operating procedures; specify

the development and maintenance requirements, and strengthen internal audit and external supervision; clearly define the ship maintenance, and strictly implement the assessment criteria, to ensure that the ship's management is complete. The operator can observe evidence and make process control carried out, so that each executor really understand why to do, who to do, when to do, where to do and what to do (Zheng, 2007, p.12-13).

2.4.4 Disadvantages of above three patrol vessel management modes

Demerits of CWBT are as follows:

i Patrol vessel has short running time, and single ship equipment. The main engine and auxiliary engine start frequently which are different from CWBT standards

ii CWBT run time based on the implementation of preventive equipment maintenance plan. If strictly refer to CWBT maintenance standards, patrol boats will greatly extend the maintenance cycle, and the device can not be guaranteed at all times in good condition.

Disadvantages of 5S management:

5S management system focuses on work details and its effect relies on the quality and technology level of management personnel. What is more, the lack of scientific and rigorous operation makes it easy to miss repair or excessive repair.

Disadvantage of NSM management:

The scientific and technological content are not enough for management. Only depending on personal management would not bring long-term development.

2.5 Summary of the chapter

This chapter focuses on the equipment management system of patrol vessels. Through introducing the currently existing management systems and models, and comparing the requirements of technical requirements, the author holds the opinion that the current management model is still unable to reach and meet the technological requirements, and is unable to adapt to the daily supervision of maritime search and rescue and emergency requirements.

Chapter Ⅲ Maritime Patrol Vessel Equipment Management Informatization Requirement Analysis

China is a shipping country, but the maritime management level of our country and our position in the international maritime community are disproportionate, and the gap between the developed countries and that of our country is very big. It is mainly because of the lack of information management, thus it's necessary to imformationize the sea patrol boat equipment management in order to enhance the capability of maritime control.

Through research and analysis of the actual usage, daily management and maintenance situation etc. was concluded that the requirement of maritime patrol vessel management informationization of one maritime bureau mainly includes the following aspects.

3.1 Ship management requirements

Meet the requirements of the maritime ship management. The system is able to cover the management of shipping maintenance, and spare parts for combustion and fuels. The interface should be simple, user-friendly.

Provide flexible ways of granting rights. Grant the rights based on ships and shores respectively. Focus on users, and set permissions by the position of the user. As for special users, special privileges should be endowed.

The ship and the shore could transmit data synchronously, and information could be shared.

Supply technical support information for the convenience of managers referring to relevant technical parameters, maintenance notes and maintenance period etc.
The equipment run well.

Have the function of instant recovery and automatical back-up, and integration should work effectively.

3.2 Requirements of software and hardware

Requirements:

All the boats which apply the modern ship management informationization need to be equipped with the corresponding hardware, printers and other peripheral equipment, as well as platform software of operating system and database management system (Li, 2007).

According to the actual situation of the existing computers and hardware, the equipment management department shall purchase, upgrade and expand the application server, in order to meet the need of relevant departments to run the modern ship management information system.

Configure wireless communication equipment (such as CDMA/GPRS), in order to meet the needs of data exchange between sea and shore (Gao, 2005).

3.3 Training requirements

At the beginning, strengthen the training of operating personnel and management personnel in order to make them familiar with the system operation steps. Formulate scientific a training plan, and train the senior crew on board and managers with knowledge of modern ship management and computer operation, in order to make them become the compound talents proficient in ship management and technology, and can operate computers.

3.4 Function requirement

Functional requirement of the system refers to the expected provided service after using this system. Stable system performance, complete functions, easy operation and reasonable response speed are needed so as to run in local area network environment or stand-alone environment (Li, 2010). From the perspective of functional requirement, this system is required to satisfy the requirements in the following aspects.

3.4.1 System management

The system management function is set to equip the system with the most basic data, to make the system available to ensure the availability of the application function of the system and to maintain the performance of the system (Wang, 2009, p.43). The

main function includes system information and configuration, user authorization management, user password system configuration, re-login system, personal office assistant defining, process configuration, database backup and restoring, marine department switching, alarming and other necessary functions.

3.4.2 Maintenance plan management

All plans regarding maintenance will be recorded, including content such as marks, data and time of completion etc.

1）Annual plan

The annual plan is automatically generated by the system according to the implementation and maintenance cycle of the previous year. The annual plan can be adjusted on board after the approval of the captain. It should be reported to shore-based authorities. Shore-based authorities examine and approve the ship's annual maintenance plan, and then the ship will carry out the annual plan. The content includes:

Main content: the maintenance project in the annual plan must be included. Automatically generate the ship's annual maintenance schedule.

Dividing into two departments, the engine and the deck, submit the examination and approval according to the required procedure.

Provide completion status of the annual plan, according to the time period, person in charge, equipment etc. After finishing the monthly maintenance work, update the status of every item in the annual plan.

2）Monthly plan

The system could maintain the base table and disassemble it to generate the plan according to the annual plan. The content includes:

The project should be finished in the current month.

The maintenance project should be finished in the current month.

Finish the unfinished projects of the last month.

The monthly plan of the engine department and the deck department will be made and carried out respectively, then will be examined and approved according to the requirements. Monthly statements will be made accordingly, such as the engine department maintenance monthly statement, and the deck department equipment maintenance monthly statement. Completion status will be illustrated according to certain projects.

The actual execution time could be in advance or postponed, but leaders of concerned department should be informed first, meanwhile additional notation should be attached to the changed program.

3.4.3 Equipment management

Equipment management is the key function of the system, and the data associated with it could be handled associatively. Equipment management has operational functions such as query, modification, addition, deletion and printing.

3.4.4 Information synchronization and sharing on board and ashore

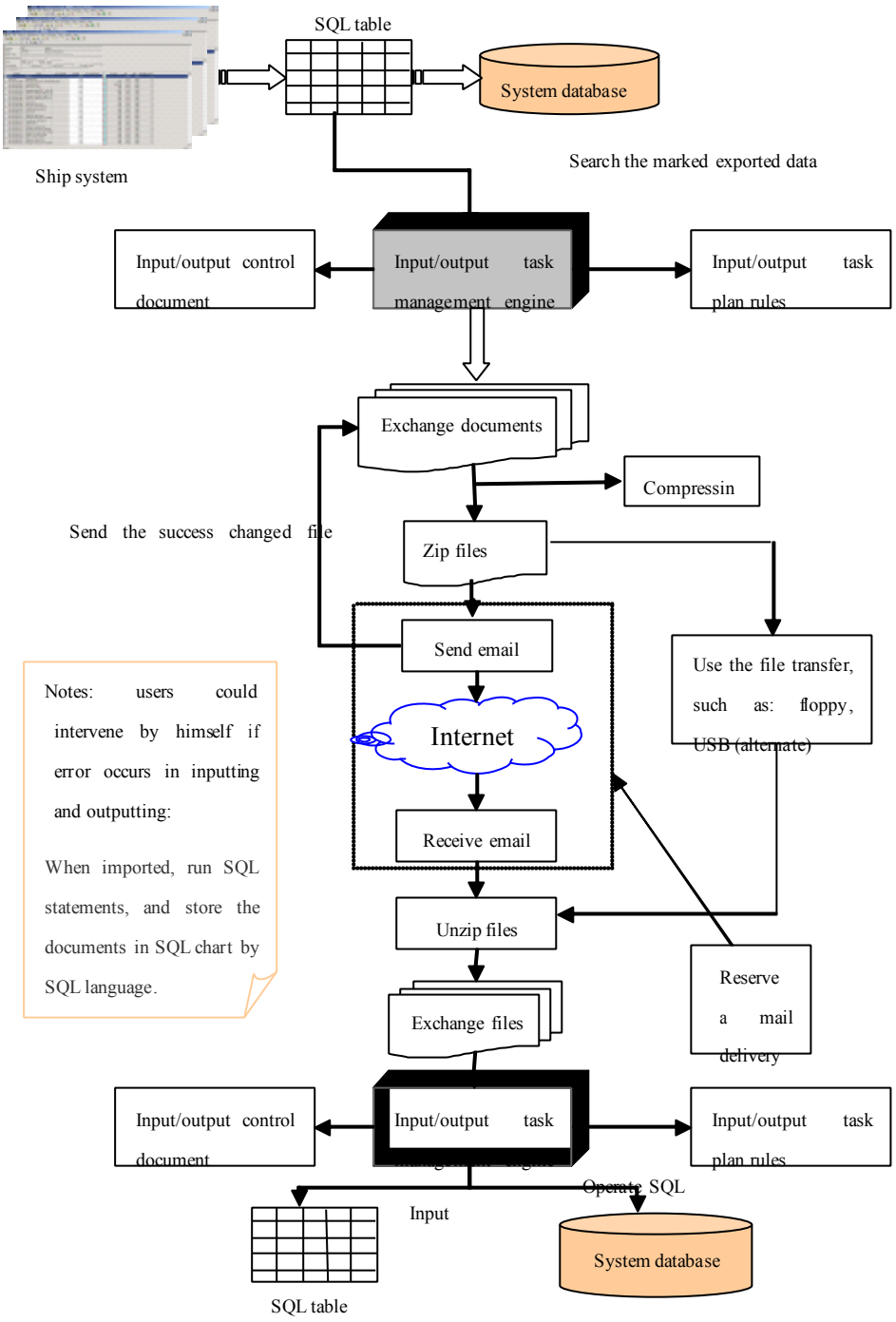

Figure 1-Flow Chart for Ship-shore data transmission data synchronization

Source: Edited by author based on the system

Use the data transmission channels between the ship and the shore to make sure that the information or data could achieve synchronous delivery, while both the two parts could get instant information on status of the equipment and the maintenance work (Man, 2000). Moreover, the ship could get immediate approval and appointment from the shore, and the data will be shared synchronously. The flow chart is as figure 1.

Use the data replication and data synchronization technology and collect all the data of modern ship system management on board. This kind of data storage and data update scheme is easy to manage, and it can enhance the security of data storage, which is convenient for crews to do query, statistics and analysis works.

Data transmission channel could select: 1) the GPRS/CDMA - IX; 2) maritime satellite B, M, Mini - M station; .3) Mobile storage devices. The mobile storage equipment could easily import/export data, and save money, but the instant availability of the information cannot be guaranteed. The transmission data through the GPRS/CDMA - IX or maritime satellite is instant and efficient, besides it's portable, but in early period it has to be largely invested (Zhang, 2003).

3.4.5 Alarms

It is probable to set up alarms to remind managers to arrange the work in time when it is time to check the ship certificates and maintain and repair the equipment. Don't forget any repair or check. Also it is probable to set the safety stock quantity of spare parts, tools and measuring instruments. When the actual quantity is lower than the safety stock quantity, the system will automatically alarm (Li, 2006).

3.4.6 Report management

Report management includes: report data input, format adjustment, printout, historical data query, statistical analysis, and so on. It can customize the system report, and establish all kinds of system forms of the users' unit conveniently, which can be defined by the users, needless to modify the program.

3.5 Summary of this chapter

This section makes a detailed analysis of ship management information system in terms of the ship management, software and hardware, training as well as system function, in order to provide the basis for the next step of information technology construction.

Chapter Ⅳ Architecture of Information Technology Support System

4.1 The system architecture

4.1.1 Ship management mode

The long boat department is responsible for the management of the ship maintenance plan, the spare parts and the ship repairing. Each basic unit of the department in charge of the ship machine is responsible for the examination and approval.

4.1.2 System architecture model

The information system of sea patrol boat management is a very complicated system. It includes the ship and shore base, and adopts interactive process control, and its complexity of performance is as follows:

1) This system focuses on the management of the maintenance of ship equipment, not only to consider the management business process, but to deal with the routine management data, unlike other systems which simply dealing with some business such as production, purchase, sales and stock, etc.

2) When the ship is sailing at sea, in a state of “adrift”, it is difficult to transfer and share the data with the shore base through the “LAN” in real time. But it requires the bank to exchange the data and process management in “quasi real time”. The shore base can carry on the query to the ship management business and the approval, in order to keep track of the condition of the ship maintenance anytime.

3) Ship shore data exchange channels have two ways. One is through the CDMA 1X, the satellite and other wireless transmission ways; another is to transfer data via mobile storage, such as U disk, etc.

4) Shore base management system” and “ship management system” need to be in harmony for an organic unit, and they are both mutually independent and restricted.

Therefore, the management information system of the sea patrol boat architecture model contains more than one vessel terminal system (ship terminal management), and the office/basic unit management system (shore terminal management). The design and operation of the whole system regards the modern ship management of the sea patrol boat as its core. All ship management system data is a subset or part of the supervision management system (Yu, 2002).

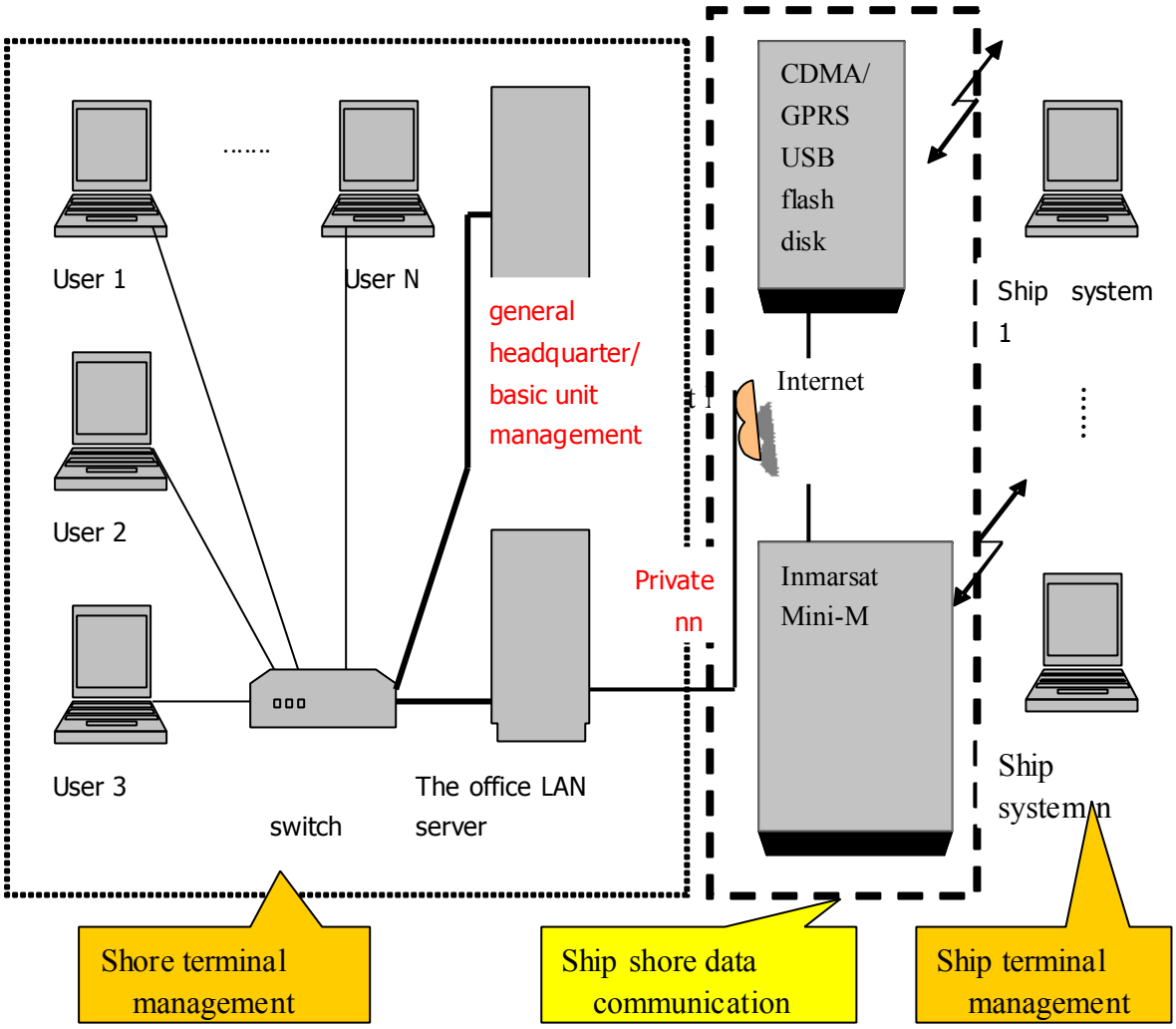

Figure 2-Structure Diagram of Sea Patrol Boat Management Information System
Source: Edited by author based on the system architecture

4.2 Main structure of the system

The information system of sea patrol boat management must consider equipment as its core (the system's overall function structure is shown in the above), combining

the related process, requirements, standards, technical data, equipment operation data, spare parts, materials and personnel through the database organically, and systematically to manage all the affairs (Yu, 2006); record the work in details; provide powerful query and statistical analysis function, with data synchronization functioning between the organs and vessels so that the authorities can timely understand and master the operation of their vessels and implement command scheduling; make sure the ship maintenance and its other work are operating in a planned, standard, and more effective way.

The Coast Guard boat equipment management mainly expands around the following designs:

1) The system develops an annual, monthly plan according to pre-set equipment maintenance cycle (in accordance with the instructions or the requirements of the cycle) and last date of completion, after the approval in accordance with the regulations.

2) The system automatically creates maintenance work orders according to pre-set equipment maintenance cycle (in accordance with the instructions or the requirements of the cycle), except the early-warning time, annual, monthly plan, voyage and other factors. After that, the chief engineer or person in charge inputs what has been done into the system and deposits it in the history library, preparing for query, statistical analysis, and report generation.

3) The application, approval and depletion of spare parts/ materials link up with the equipment maintenance. After the completion of equipment maintenance, used spare parts/ materials are deducted automatically, and the equipment and work order

number which used up the spare parts/ materials are indicated.

4) After the completion of maintenance and inputting to system, the maintenance of the equipment automatically moves to the next cycle. The workflow system is shown above.

4.3 System features modular design

The system design should be in accordance with the guidance and basis of actual demand, combining with modern ship management ideas and management features. The purpose is to systematically make an analysis of all aspects of ship management process as well as their relationship, focusing on equipment maintenance work in order to arrange system functions scientifically and reasonably. The system can be classified into shore -side management system and ship terminal management system. “Shore-side management system” uses fleet management capabilities to coordinate and monitor the work condition of the ship, and command handling emergency situations. “The ship terminal management system” has the basic functions of the management of marine equipment. It has strong planning skills and high degree of automation. Then it can effectively reduce the labor intensity of ship staff and improve work efficiency (Yao, 2010).

4.3.1 System Management Module

The system management of Patrol Vessels IT Assistant Management System can be divided into two parts. The first part is the system functions management. It mainly offers the system administrators to set up and maintain the system, including the definition of system encoding rules, maintenance of the system code, grant and

revoke privileges of system user and other functions. The second part is the management of the system basic data. It mainly offers the maintenance of the basic data which is global or affects all subsequent operations.

1) System login

The system requires the user to enter the login user name and password. The system defines to whom ship belongs, attribution of the department, position and etc. under each valid user name. So when the user logs into the system, then the corresponding rights have been identified. The user will only see the related business. Unrelated business are all masked.

2) System information and configuration

This function allows the user to customize the following key messages: company name, company abbreviation, the database server name, database name, working database, and test database. This function allows the user to flexibly set some global information of the system and reflect real-time during the operation of the system

3) Process management

This system firstly conducts the extraction and modeling for all processes of the system. Then the system conducts the definition and design of work flow based on business process model. The system specifically designs the business process management center. All processes are unified maintenance in this management center.

4) Ships authorization management

It is used to authorize the ships under appropriate persons in charge. This function can divide the ships in accordance with the person in charge. Different people

manage different ships. When the person in charge login in the system, he can only check the ships under his own management.

5) System parameter setting

It is mainly used for setting some systems used parameter which is relatively fixed, but may change. Such as language settings, the certificate alarms, version and other parameters set.

6) User rights management

User rights management is based on the user group management. Firstly set the user group, and authorize the user group the appropriate permissions. One user belongs to a group, and has the appropriate permissions. User permissions are controlled in the buttons of each window.

7) System alarms

To avoid the fact that equipment maintenance work orders, spare parts inventory of materials, certificates and other important information cannot be missed due to human negligence processing opportunity, the system designs alarm function for important information. In the alarm function, the system combined timer technology with WINDOWS tray technology. The system conducts sampling in a certain period. Once there is information to be handled with maturity, it is immediately pushed to the WINDOWS procedure tray.

8) Personal office assistant

The module system binds the function that each system user might use. When a user logs into the system, personal office assistant search engine will automatically start searching information. If there is information for the users to handle, personal

assistant will immediately pop-up the features list that user needs to complete as soon as possible, and navigate users directly to the specific function, concisely and practically.

4.3.2 Equipment Management Module

1) Basic data of equipment management

Basic data of equipment management is mainly about the public information used in equipment. Such as standard working definition, counter type, job categories, equipment categories, condition data items, installation location and so on. Generally first define these basic data at system initialization, then select when the system is running to avoid manual inputting Chinese character on board.

2) Equipment data maintenance

The module includes units master file, component maintenance work, spare parts used by equipment, associating upward with the basis of data of equipment management, downward with the basis of other modules' generation.

3) Equipment maintenance conditions

This module conducts maintenance in connection of the data items of various components. Then enter the maximum, minimum, and standard values for each data item, so that users can maintain comfortably.

4.3.3 Maintenance Module

Equipment maintenance is one of the core functions of the system in accordance with the plan. Maintenance module puts equipment (components) in the center. It

uses the form of labor list (repair list) to implicate users to do right maintenance at the right time based on the plan or timer.

Maintenance work is divided into two kinds of periodic system and timing system. The former is formulated according to the plan and the latter according to the timer (the actual running time of the device). Some disposable or unplanned maintenance work can fill in the temporary work list. Some similar work can be combined together to form a "combination-work", and be printed on one work list. Work may be assembled in accordance with persons in charge, job categories, and so on. It should be promptly reported to the system, after maintenance work completed, in order to save the maintenance history of the work, spare material consumption, and measurement conditions. Then maintenance plan for next time should be formulated on this basis.

4.3.4 The Spare Parts/Material Management Module

Spare parts/material management module is responsible for managing all the spare parts, materials and tools in the ship, specifically maintaining the subscription, application, check and out-put and in-put of warehouse information record of spare parts material, as well as the corresponding increase or decrease of inventory quantity in ships, including the following four aspects of management:

1) Basic Data Management

Inventory basic data management is the fundamental and advanced maintenance in inventory management, namely in need of strict and accurate input at the initialization time. It is the foundation of the inventory management operation of other modules. Manufacturers and suppliers are also the basic equipment data; spare

parts and special tools are associated with the equipment. Type definition for ins and outs, inventory categories, allocating reason category and manufacturer/supplier are all maintained by the company; tool details of location definition, spare parts material are maintained by each ship itself.

2) The loading and unloading management

It is at the core position in the whole inventory management/warehousing management, referring to most of the material management of spare parts and tools. This module will only affect the number of ship spare parts, materials and tools. This module involves deducting spare parts, materials and tools after the work order completion report.

3) Inventory verification

The person in charge of the spare parts in each ship will modify the real quantity in its storage location after checking. The chief engineer is responsible for the inventory materials and tools. Input: the actual number of spare parts in the location; Output: the inventory transaction and its subsidiary, inventory number changed accordingly.

4) Application management

The person in charge of each department is responsible for the input of the code and quantity of the spare parts need application, but it can also be generated automatically (the spare parts safety stock minus the number of existing), by setting up department claim sheet. The ship will call out the application list and sign for the check after receiving the spare parts material.

4.3.5 Ship-repairing Management Module

Ship-repairing management module includes: the annual repair planning, review and approval, the monthly repair planning, review and approval, ship-repairing project planning and its examination and approval, ship-repairing engineering single inquiry, ship repair project summary and its query and statistics, information management of repairing manufacturer , qualified repair vendor evaluation, repair contract registration and its query and statistics, ship repairing engineering project management, ship registration and its audit and settlement management etc.

4.3.6 Seafarers Management Module

The crew management module is mainly used for the maintenance of staff information, including the crew level, basic information and personnel work experience, etc. Some modules in the system will invoke the module information as long as they use the personnel information.

The crew module has basic registration information, record registration, approval, learning records, comprehensive query, analysis, statistics and various outputs involving user's requirements such as tasks related with process control, and the cadres of crew management work. The crew management module function structure is shown in figure3.

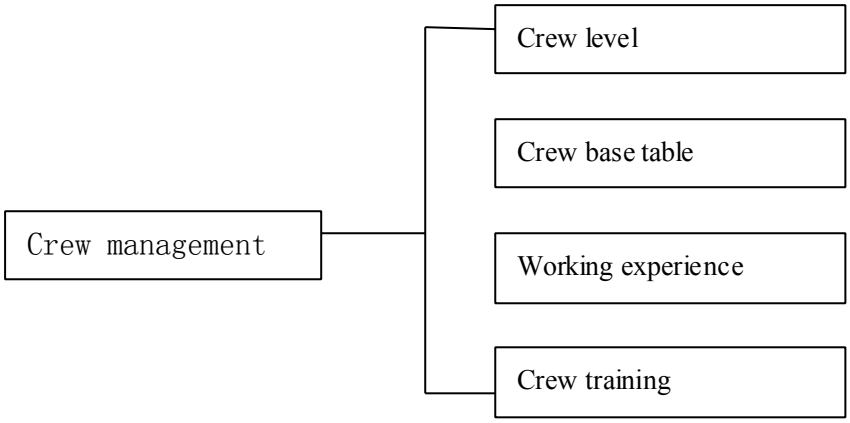

Figure 3-Crew Management Module Function Structure

Source: Edited by author based on the crew management module

1) Level of crew

Crew level is an important basic project of the crew, so the rank is maintained as a menu item.

2) Crew base table

Use for staff basic information input and review.

3) Crew working experience

As each staff has different positions in different periods, and many module principals have replaced names with their positions. Records with personnel experience will be convenient for query and the appraisal of staff responsibilities.

4) Crew training

Register crews training project, content, time and number. Be able to generate statistics for the crew training report.

4.3.7 Mode of Costs Management

Costs management which can complete the functions of basic costs management of

ships is an independent function mode of the system, and it mainly contains the classifications of costs, input of costs information, costs inquiring, costs statistics, annual plan of costs and details of costs etc.

Figure 4: tree-diagram of functional structures on mode of costs management is as follows:

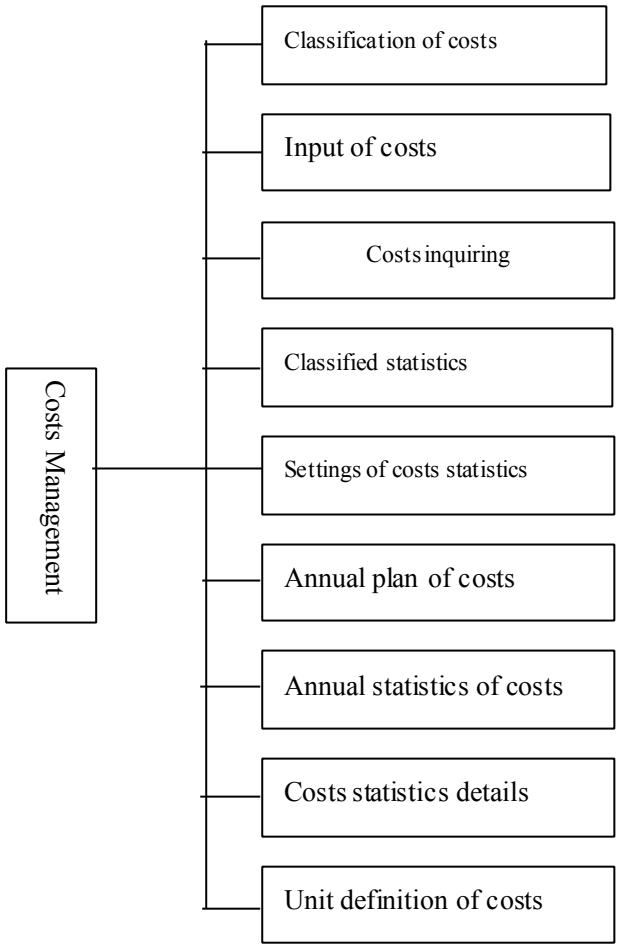

Figure 4-Tree-diagram of Functional Structures on Mode of Costs Management

Source: Edited by author based on the costs management module

Brief introductions of the main functions of costs

1. Classifications of costs

It primarily completes the management of classifications on costs, which can classify costs depending on specific situations of units, and it is mainly used for costs inquiring in accordance with classifications. Classifications of costs may have multi-level definitions. The later data can be completed by either macro-statistics or micro-statistics.

2. Input of costs

The function of input of costs plays as an entry of basic information, which primarily completes to input basic factors of costs, making some preparations for later inquiring of costs. In order to solve the difficulty of exchange rate between domestic currency and foreign currency, it decides to convert to domestic currency to complete the settlement and statistics at last.

3. Costs inquiring

It is primarily used to inquire the former costs data which has been input and which can be inquired by every installed prerequisite.

4. Annual plan of costs

This system supports to make plans for its presidia units in order to make budgets of units. When making an annual plan, we can start with every presidial units and classifications of costs details.

5. Annual statistics of costs

Management of costs can best embody its value of management that it can complete the function of automatic statistics on costs by itself. This system has provided function of costs statistics in detail, which can complete the statistics according to its

presidial units.

6. Unit definition of costs

This function is used to define those primary-level units and information of ships it controls, and they contain the basic information on management. However, in the course of definition, units of costs is not only limited to those ships which have installed and operated patrol vessels IT assistant management system，but also to any ship, primary-level unit and department it controls. For those ships of which numbers and names have little connection with the ship information patrol vessels IT assistant management system used, the definition can be flexible.

4.4 Design of system corpus

4.4.1 General principals of corpus building

This corpus is based on equipment (components) as its core, materials related to equipment (components), maintenance, stocks, tools, drawings and equipment operation counter as entities, and utilizes advanced corpus technologies to build ship equipment corpus with full materials by the way of scientific and reasonable conclusion, classification and coding on its equipment and related components. According to the regulations and rules of maintenance and factors of equipment maintenance such as names, cycles, types sand chargers, a primary corpus on maintenance of ships can be built. Then a timely, precise and reliable, effective and shared environment about equipment management of sea cruisers is built, which can improve the shared recourses and service. Some principals should be obeyed when to build a system corpus:

1. Normalization

2. Standardization

3. Uniqueness

4.4.2 The Content of Overall Construction of Database

The overall construction of Database includes three aspects: (1) combing data resources and consulting, collating and concluding all the marine technology data and graph paper; (2) dividing data resources and confirming the division of data resource boundary, type and database structure; (3) establishing data resource and building the system of ship equipment, maintenance service and spare part coding respectively.

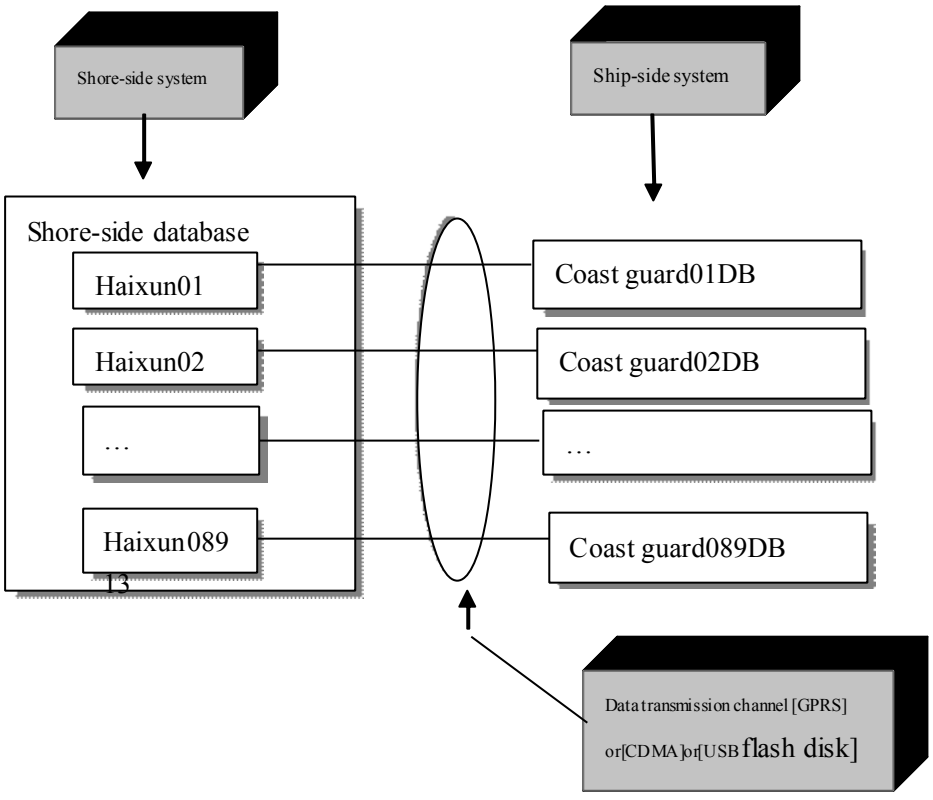

Figure 5-Ship-side and shore-side system database schema
Source: Edited by author based on the construction of database

As is shown in figure 5, every ship-side system has Stand-alone database. Its substance includes the ship equipment maintenance data, ship-repair basic data, spare parts or material inventory data, shipping data, history records and other supplementary data. Every ship-side system database is a subset of the set of organ system database.

4.4.3 Database Design

System operation selects efficient and reliable back-end database management system :(Structured Query Language) SQL-Server2000. The database has the features of practicality, reliability and easy maintenance, and supports higher versions of database migration (such as SQL-Server2005). Database design process is conducted in strict accordance with the requirements of software design specification process, and it is the real database table design in terms of the logical design, physical design, and the association designs even the forward engineering design. The design process fully utilizes the features of a relational database, fully considers the integrity and security of the data, and applies a more advanced data model design tools-ERWIN4.0 in the period of overall design, providing a clear data mainline for follow-up development and ensuring the association among the various database tables and reasonability and science of the database design.

This system used E-R model in the process of database design (herein refers to entity-relationship model: entity-association model), and that means transforming the real-world model into an information world model (Jing, 2005).

1) Database logical design

Logical database design mainly reflects functional logic of system, as the first half of the entire database design, including the required entities and relationships, and the

work of entity standardization etc. Logical database design determines the overall performance of the database and its applications as well as the tuning location. If the database logical design is not good enough, then all tuning methods for improving database performance results are limited. The database normalization theory must be observed in order to make the database design methods perfect. Normalization theory provides theoretical guidance and tools for logical database design, reducing data redundancy while saving storage space and accelerating the speed of adding, deleting and correcting.

2) Physical design of database

Physical database design is the second half of the design. It implement a given logical structure to a specific environment, the logical data model to select a specific work environment. The working environment provides a data storage structure of and access method, and this process is the database the physical design.

4.5 Summary of this chapter

This chapter makes detailed analysis of IT support system framework of the Coast Guard boat equipment management. The framework is based on Coast Guard boat equipment management mode, providing a detailed analysis of the IT support system framework model, the main structure of the system, the main function modules design of the system and database system design.

Chapter Ⅴ System Implementation

5.1 Realization of the annual and monthly plan

In brief, the origin of the maintenance work of maritime patrolling boat is plan management, and thus it is in a core position in the whole system that it associates with the basic data module such as the parts maintenance, components standard works, and on the other hand, it provides the data source for maintenance subsystem which provides important data for carrying out maintenance work and plays a connecting component of based data and maintenance work.

The plan is comprised of preventive maintenance plans, planned maintenance, and routine maintenance. The relationship between them is as follows: preventive maintenance plan is higher than the planned maintenance and routine maintenance, and if it has arrived at a conclusion by long term ship maintenance practice. In the actual management, preventive maintenance is usually carried out on the important and complex equipment and its cycle is longer than planned maintenance and daily maintenance; Planned maintenance is stipulated in the maritime ship management rules and maritime shipping “MUMR” inspection standards for periodic maintenance. When doing the monthly plan, if the preventive maintenance programs are in the same monthly plan maintenance and the preventive maintenance projects have finished, it should consider that the relevant maintenance work is done

automatically and it needn't have to repeat the maintenance plan, and start timing. In other words, there is a kind of advocate complementary relationship between maintenance and repairing work, and routine maintenance is a level lower than the planned maintenance and preventive maintenance plan which is usually according to the responsibilities of routine management.

The work order is generated by monthly plan directly, so during the formulation of the monthly plan one should not only consider the smooth implementation of annual plan project, but also ensure the implementation of all levels of maintenance work methodically. At the same time, monthly plan should include the regular system work and timer trigger time system, and thus the plan arrived out can be more scientific, continuous and forward-looking, which is more convenient to ship personnel management from the height of the global arrangement and deployment of ship equipment maintenance work.

The plan management relates to database contain component maintenance job, component, standard job, annual plan state, annual plan, monthly plan state and monthly plan.

5.2 Realization of maintenance work order

The technology implementation of maintenance work order generation is the key to the whole system. As a result of major equipment maintenance requirements and different levels, equipment maintenance cycles and different ways, how to estimate timing system work cycle according to the operation of equipment, which require work order both consider plan demand of timing work order and condition-based maintenance requirement. In the system design, one should take into account the

characteristics of the ship management maritime regulations and foreign advanced "condition-based maintenance" requirements, in order to protect the work order algorithm flexible.

For timed system equipment set a timer that is based on the work:

1. Work maintenance cycle = timer current time – timer last maintenance time

In order to scientificly calculate how much time each day to the equipment, the system introduces the concept of an average calculation frequency.

2. Average calculated frequency = cumulative value after repair/(current date – start date after repair)

3. Work cycle = timing system working frequency/(frequency conversion days * average calculated frequency)

Among them, the average frequency of default calculated automatically calculated by the system, systems can be based on historical data, to determine the frequency of the recent operation of equipment, it can predict how much time the device runs per day, the average frequency is dynamic calculation. Of course, and the system also provides the interface to manually change the update timer.

This function relates to database tables include： work order, work order job, month plan, month plan state, component, component counter, component maintenance job, component maintenance job counter, etc.

5.3 Development and implementation of shore base version

Because shore base requires both able to manage a single ship, but also to manage the multi-ship, therefore, the system design should not only consider

single-ship-to-shore database of data transmission problems, but also consider the shore base in carrying out multi-boat joint inquiry question of statistics. As well as the underlying data changes in data transmission after mass changes in the business with a single ship sent only for single vessel problems, making the whole system complexity increased dramatically. Some foreign management also try to avoid this problem.

The shore base version of the development is a complicated systematic project, beginning in the system design taking into account the unified management of multi-ship. Version from a single ship-to-shore base version is much more than "quantitative cause qualitative change" issue, but both independent and mutual influence of the organic whole.

The specific design approach is based on data from the shore base maintenance, and the use of "mass" approach to change data updates to each ship; single-ship business data by the ship management, shore base management system for single-vessel operating results of all business data append ship internal encoding by the program, exported back to the corresponding vessels.

5.4 Import and export technology implementation

The technique is core technology to ensure data consistency ship and shore, and this feature requires the sufficient reliability and high efficiency, as well as a smaller amount of data exchange. Shore base version with a version compatible with single vessel characteristics guarantee from the ship to the shore base and export base for export to the ship's shore data. The system uses the import and export SQL statements, each time only import / export since the last import / export system after

running the SQL statements generated. The main design points are as follows:

1. Using appropriate compression algorithm for each SQL file import and export packages compressed in order to reduce the amount of data transmission.

2. Set each exported each SQL file packet size

3. Using appropriate calibration algorithm SQL files received verification, to ensure the correctness of import and export documents.

4. When SQL file package import the system, the SQL file should be submitted integrally. If due to various reasons the import job fails, the entire import process should rollback so as to reduce possible system impossibility errors, thereby to ensure the consistence of the ship and shore data.

5.5 Component counter updates

This module implements the actual running time depending on the device update part timers, and accordingly estimates the average working time system to calculate the frequency and the anticipated date of the next maintenance. At the same time, generate new timing system work order according to timing value. When users enter the appropriate timing value, the system automatically calculates the total value of the timer component and the average calculation frequency. Calculated average calculation frequency allows the user to manually modify the light of experience. After saving, the system automatically estimate the word cycle of the timing of the work.

1. Total numerical value=start value + zero value +current value

2. Average calculated frequency = (current value + zero value – start value)/(current date – start date)

3. Work cycle = frequency X Frequency conversion Days/average calculated frequency

This function relates to the database tables include: component counter, component counter log, component maintenance job, work order, work order job, etc.

5.6 Summary

This chapter describes the process of the whole system to achieve several key features of technical conditions, such as annual and monthly plans, maintenance work orders generated technical realization, shore base version of development and implementation, etc. Through the necessary analysis, the author points out several technical obstacles to be overcame, and proposes a more comprehensive solution.

Chapter Ⅵ Application of information technology in patrol vessel management

6.1 Application situation of information technology(IT) in patrol vessel management

Currently, Guangxi MSA, Jiangsu MSA and Shanghai MSA have already launched pilot project patrol vessel IT Assistant Management System. The system learns modern domestic and foreign ideas and experience, combined with the management of maritime boat equipment specific needs. According to the actual conditions patrol vessels custom development, based on a shared database, each running on ships and shore-based computers, including crew management , maintenance, repair, spare parts, materials, fuel, lubricating oil, certificates, statements and other management functions is as one of the modern ship machine management information system (Luo, 2009, p.29-30). The system is a distributed system, divided into a series of vessel endings and shore-side terminal. Pilot operation, the system's function has been effectively utilized in improving the Coast Guard boat equipment management level, and the quality of the crew. The ship "effective maintenance and repair," information technology process management has played a significant effect.

6.2 Advantages of IT system

1. The system achieves ship management automation (Shi, 1982), and it has a complete ship data base, automatic generation plan, implement spare parts and materials application, consumption, inventory number of automatic generation and statistics, early warning, prompt, which really realizes automated management.

2. The system processes ship management standardization, which involves patrol vessel "management, use, maintenance, repair" as a whole process. It reaches the highly integration and standardization of systems and data, as well as ship equipment process management and goal management perfect combination.

3. The system processes scientific ship management. For example, the system through the network technology can achieve the ship terminal and shore terminal information seamlessly connection; shore terminal can control vessel repair and maintenance real-timely, and able to carry out targeted timely guidance to the boat repair, testing; effectively avoid omissive repair and excessive repair caused by human factors (Mizumoto, 1993).

6.3 Patrol vessel implementation of information technology systems evaluation

According to the current situation of the operation of the pilot units, after the implementation of the system, the patrol vessel equipment management become more scientific. What is more, it changed traditional mode of patrol management, usage, maintenance and repair work, and it promoted the improvement of modern management level; ensured patrol vessel equipments intact, enhanced the emergency response ability, improved nation maritime sector social influence. At the same time, after the application of patrol vessel IT assistance system, crew and shore management personnel obviously reduced labor intensity; promoted work efficiency;

produced some economic.

6.3.1 Change patrol vessel traditional management mode

Traditional patrol vessel management mode is mainly an experience management which totally depends on experience and personal initiative to develop daily work. Deficit, risk factors and difficulty to control the process are the disadvantage of traditional management mode.

For example, in order to make, implement, audit equipment maintenance work plan, traditional management mode needs to arrange monthly plan according to annual plan, then report for approval. After implementation, manager should input complete work situation via handwriting. Because of much labor intensity, there is usually occurring negligent omission.

However, ship IT assistance management system based on cycle maintenance, utilize computer intelligent management, through inputting basic data in creating database process. In management process when manager clicks relevant module, system would form work plan and prompt in the light of input data.

After finishing work, system would report completion, avoid omission repair and omission maintenance so as to regular crew equipment maintenance work behavior.

6.3.2 Extend the life of equipments

Patrol vessel IT assistance management system should be in accordance with pre-set maintenance principles and requirements of automatic planning and organization of

work. Expire without arrangements for the work should be done, the system can timely, relevant management personnel automatic reminders, so it can make the whole orderly conduct maintenance work, so that avoid leakage repair, undetected cases.

Statistical analysis can assist the relevant management personnel statistics equipment maintenance work in a variety of data, and it has the ability to conduct a preliminary analysis of the situation, to detect and deal with the problems of marine equipment. Only easily damaged equipment, for example, before running the system general life of piston rings is about two years, after that, general life of the equipment life can be increased to 2.5 years. From the comparison of equipment life between before and after the usage of the system, it shows that the system can improve the technical level of the ship's equipment, to extend the life of marine equipment.

6.3.3 Improve patrol vessel equipment management level

Patrol vessels IT assistant management system make technical data of equipment manual combine with daily work experiences thereby set basic technical data, make MUMR of the working principles and requirements set working standards. Afterwards, according to the work cycle of different equipments automatically, the system form work plan and detailed work tasks. The various equipment's technical data, and operation procedures, maintenance work main points, maintenance experience and skills can be easily searched in the system.

Spare parts and materials can be brought into the system concerned with the consumption of the situation, and can automatically generate statistical report forms. Ship cost management to achieve classification statistics and response timely the

cost of each ship.

Therefore, in the process of building a database system it requires all of the information related to the ship management and management objectives should be input system completely. This will help crew to launch maintenance work of ship equipments, avoid ships dispersion, crew mobility, ship and shore separated lead to management work not in place. Managers through the application situation of the system grasp the ship equipments management, use, maintenance and repair implementation, forming effective ship management oversight mechanisms; so that they can regulate ship management.

6.3.4 Enhance synthesized quality of maintenance management personnel and crew

After using patrol vessels IT assistant management system, the synthesized quality of maintenance management personnel and crew have improved a lot. Especially information technology equipment operational levels improved significantly; by the means of using the system; the majority of the crew are quickly mastered the methods of operation; gradually skilled in the daily operations at the same time. Effective maintenance and repair work on the ship's requirement has been further in-depth understanding, and take the initiative to simplify system operation recommendations.

6.3.5 Shaping the maritime sector a good social image

Through the implementation of patrol vessels IT assistant management system, equipments are usually in good condition. Sail rate has been further improved and

it enhances emergency response capacity to emergencies, improves the regulatory and maritime search and rescue capabilities in order to reduce traffic accidents and loss of life and property. Through effective supervision, impartial law enforcement, and investigate violations, it protects the legitimate interests of law-abiding, reflecting the maritime regulation and the executive power and credibility, and creates a fair and equitable and harmonious development of the good environment in which the Marine in maintains social stability, builds a harmonious society and promotes local economic development to play a greater role in shaping the maritime sector a good social image.

6.4 Summary

This chapter briefly describes the information technology in the patrol vessel application, analyzes the advantage of patrol vessels IT assistant management system, and evaluates the effect after the application of the system.

Chapter Ⅶ Conclusion

7.1 Summary

To maximize the supporting and leading role of scientific information, in recent years, the maritime authorities have increased its investment in information technology. As a basis for resource management system, the informatization of marine ship management has been incorporated into the maritime informatization in "12th Five-Year Plan", and also been recognized as an important research content. Maritime Ship management informatization is an very complex system engineering, it needs further integration of information resources to enhance the development and utilization of information resources. It promotes the merging the information technology and marine ship management in order to meet the marine construction requirements of unification cruise and salvation, intellectualization of aid decision making, and improvement of equipment management level. This thesis mainly focus on the research of the equipment management system of patrol boats. On the basis of that, it puts forward some supplementary management strategies by information technology. The main work is summarized as follows:

1. By the description of background, objectives, content and significance to identify the feasibility and urgency of the management of marine patrol ship by IT. This thesis demonstrates the management situation of the same type ship abroad, analyzes

the development process and technical requirements of maritime patrol, and briefly describes the current status of the management of MPV, develops a foundation of introduction the management of MPV by IT system.

2. Based on the research and analysis on actual utilization condition of MPV, daily management, as well as maintenance, combined with the development of IT, it proposes the requirements of ship management, hardware and software, training, and system functions.

3. This paper discusses in detail the structure of IT support system, and introduces the main function modules and databases. Based on the device, this system organically combines the technical data of procedures, requirements, standards which involved in maintenance work, and the databases of pare parts, materials and personnel, so as to ensure the rationality, standardization and scientific of maintenance and other work.

4. It describes the several technical issues of key functions in the implementation of the whole system, such as the generation technique of yearly and monthly plans, maintenance work orders, shore-based version of the development and implementation, etc. Through the analysis of the function system, it puts forward a more comprehensive solution.

5. It evaluates the current running system, and recognizes the effectiveness of the application of the system in the improvement of management level of MPV, enhancement of the quality of the crew and so on.

7.2 Future work

The maintenance and repair work of MPV is a complex systems work, this article only discusses the MPV equipment management system and IT support systems architecture. In addition, there are some further studies needed to be researched in deep, especially in the following areas:

1. Some functions needs to be extended, such as: Although report manager module can be exported, the external data reports can not enter into the system. Furthermore, many of the functions of EXCEL are also banned. So we should add the function of import of external data and reports. This will open various functions of EXCEL(Raj, 1998).

2. Achieve fault detection function (Zhang, 2001). Installs instrumentation on critical equipment for data acquisition to enable the system achieve fault detection by its own devices(Wang, 2001), and develop a maintenance program to guide shore-based and ship-based maintenance

3. Establish relevant management regime. According to the current operating conditions and skill level of personnel, it develops a management regime to ensure the stability and standardized operation of the system, and to avoid improper work of the system to affect efficiency due to inappropriate operation or errors .

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