

MANAGEMENT INFORMATION SYSTEM FOR DREDGER EQUIPMENT

CAO Xiang-bo¹, LIU Nian-jun², ZHOU Jin-ju³, MAO Wei-yi⁴, Zeng Yan⁵

ABSTRACT

This paper briefly introduces the overall operational environment, technical system, constitution and running of the Management Information System for the Shipping Machinery Equipment associated with the Guangzhou Dredging Company. It focuses on the coding principles for the dredging spare parts and facilities, all life-span management requirements for the important spare parts and the remote data interchange between the ships and offices onshore. The application of the key performance indicators both for the dredging equipment and the enterprise management will also be looked at. How the sharing of this information is achieved, online processing of affairs and the computerizing of the integrated statistic analysis that ultimately establishes the advanced information management system for the dredging spare parts is also discussed in this paper.

Keywords: dredging equipment management, key performance indicators, all life-span management, coding principles for spare parts, remote dynamic data interchange

BACKGROUND AND PURPOSES OF THE MANAGEMENT INFORMATION SYSTEM OF DREDGER FACILITIES

The management of the shipping machinery and facilities that includes the management of shipping equipment and spare parts as well as the overhaul and technical alteration to the various aspects of the enterprise's operation, needs lots of foundation data and information. It also plays an important role in securing the smooth operation of vessels and improves their throughput and efficiency. With the company's development and the internationalization trend in the dredging market, the management of the shipping machinery and facilities is in dire need of improvement to a level of modernization using updated managerial methods and highly skilled managerial personnel in the equipment department and other relevant sections.

In order to move forward with the standardization of the management and be able to master important technical and economic information a basic information construction of the shipping machinery has been built. This will help with issues such as the ships' operation condition, downtime and any malfunctions, maintenance status and lubrication conditions, holding and consumption of spare parts, replacement frequency and quality tracking of the main parts, as well as the throughput and the Key Performance Indicators (KPI) for the main components. It also realizes the sharing of the management data of the shipping machinery and forms the three-leveled managerial system: ships—machinery department – directors of the company, to process the administration and control of the equipment by utilizing advanced managerial ideas and the latest IT and digital communication techniques.

¹ Senior Engineer, Guangzhou Dredging Company, Tel: 86-020-89084997, Fax: 86-020-89004453, Email: caoxb@chec-gdc.cn

² Senior Engineer, Guangzhou Dredging Company, Tel: 86-020-89084883, Email: liunj@chec-gdc.cn

³ Engineer, Guangzhou Dredging Company

⁴ Engineer, Guangzhou Dredging Company

⁵ Guangzhou Zhengtai Data Ltd.

The objective of this project is to set up an advanced computer-aided management system for the shipping equipment utilizing Intranet/Internet techniques and the wireless radio telecommunication technique combined with advanced microcomputer management. The result of this is a three-leveled managerial platform: ships—machinery department – directors of the company, being built. It is high-performance and extendable system. It also functions as an economic and technical analysis platform. Through this system the management of shipping equipment could be realized with the sharing of the information, the online processing of activity, integrated statistic analysis of the various kinds of information, improved security and efficiency of the equipment. It can also provide a scientific and accurate information basis for the enterprise's decision-making. Ultimately this should guarantee the smooth operation of the daily business.

By standardizing the basic data relating to the shipping equipment and spare parts, the system establishes an advanced operation platform and management system for the shipping equipment. Furthermore, based on an analysis of material and capital flow, an economic and technical analysis system can be completed. On the one hand, it could enhance the level of modernization for the shipping equipment management and fulfill the enterprise's demand for high quality managerial skills. On the other hand, it could control various non-production costs and help to form an optimal and reliable management and decision-making system which can support the high-speed development of the enterprise.

SYSTEM CONSTITUTION

This system adopts the Browser/Server construction, which is in accordance with the J2EE frame. Following is a sketch map (Figure 1) of the topological system construction:

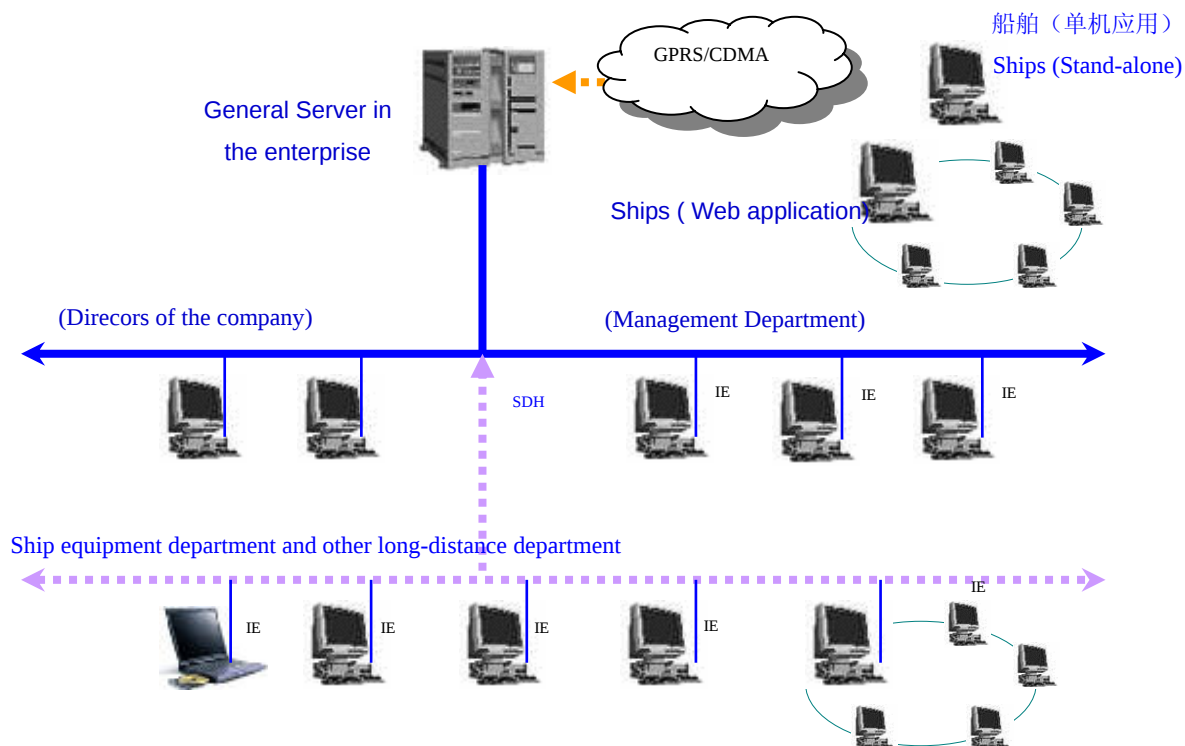


Figure 1. Sketch map of the topological system construction.

The management for the shipping machinery equipment consists of 3 levels (Figure 2):

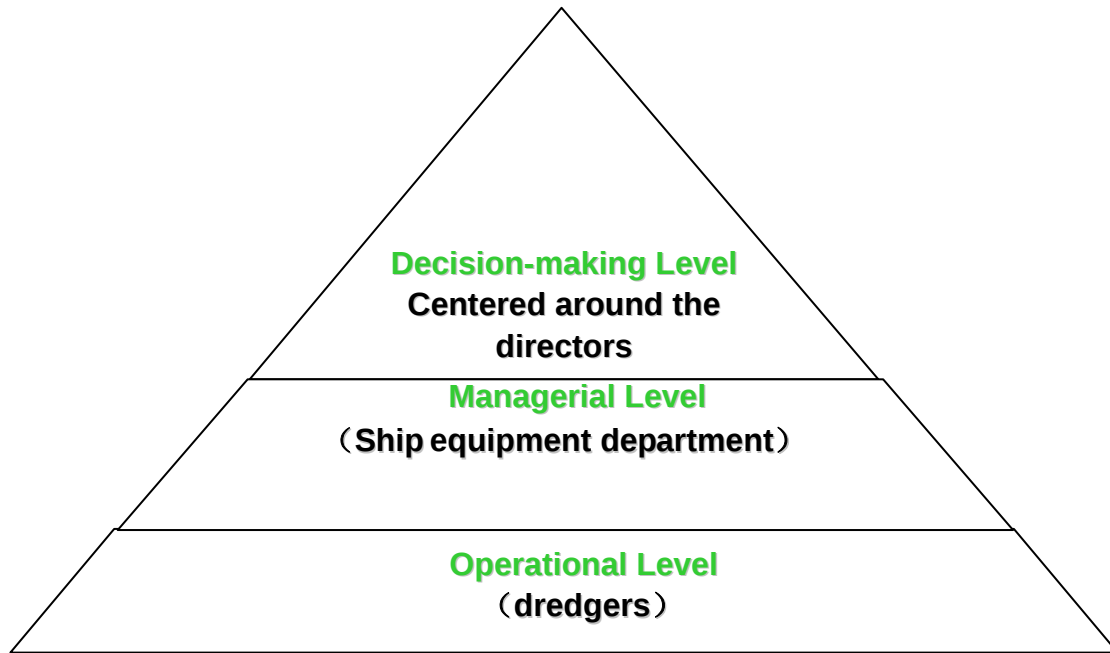


Figure 2. 3 levels of the system.

Two systems are used to realize the dynamic data exchange:

On-board system: Information collection for the main business

On-shore system: Information collection for the basic management and on-shore storage

The running of the system can be divided into 3 situations:

Firstly, the system that is running inside the general intranet of the head office (For the Directors of the company and the managerial department). Use can be made of the already established intranet and stand-alone internet server together with the following: the necessary operational system, data base system, application server, web server and management information system for the ship machinery. The computers within the intranet, with appointed authority, could run the Management Information System for the shipping machinery equipment through an IE explorer.

Secondly, running in the branches of the company (such as the ship machinery equipment section), both by intranet and stand-alone system. This situation can be treated as a remote visit to the server in the head office. The computers of the branches could visit the general server through a SDH special line. Similarly, they could operate the MIS of shipping machinery equipment through the IE explorer.

NOTE: The above two situations can be assembled as on-shore systems.

Thirdly, the situation of running the MIS on-board: the computers on-board could communicate data with an “on-shore system” through a stand-alone “on-board system”, which can be used to build the on-board intranet. To fulfill this purpose, one absolute-running set of MIS for shipping machinery equipment should be equipped on board (including the data base service, application service and WEB service).

The “on-board system” could exchange data with the general server in the office (“on-shore system”) by utilizing CDMA, GPRS or other wireless data exchange method, so as to realize the synchronous data exchange for both “on-board” and “on-shore” systems.

MAIN FUNCTIONS OF THE SYSTEM

Two parts are designed for the absolute data sharing in daily management of the system: the “work management module” and “information resources module” (Figure 3). The work management module, containing both the daily jobs and technical and economic management business, provides the designing and application service using a B/S structure frame. Based on the work system, the information resource module is a sharing system for the assets’ information and opens to internal users of the enterprise. Besides these two modules, the system also offers an extendable supporting module— an “assistant management module”.

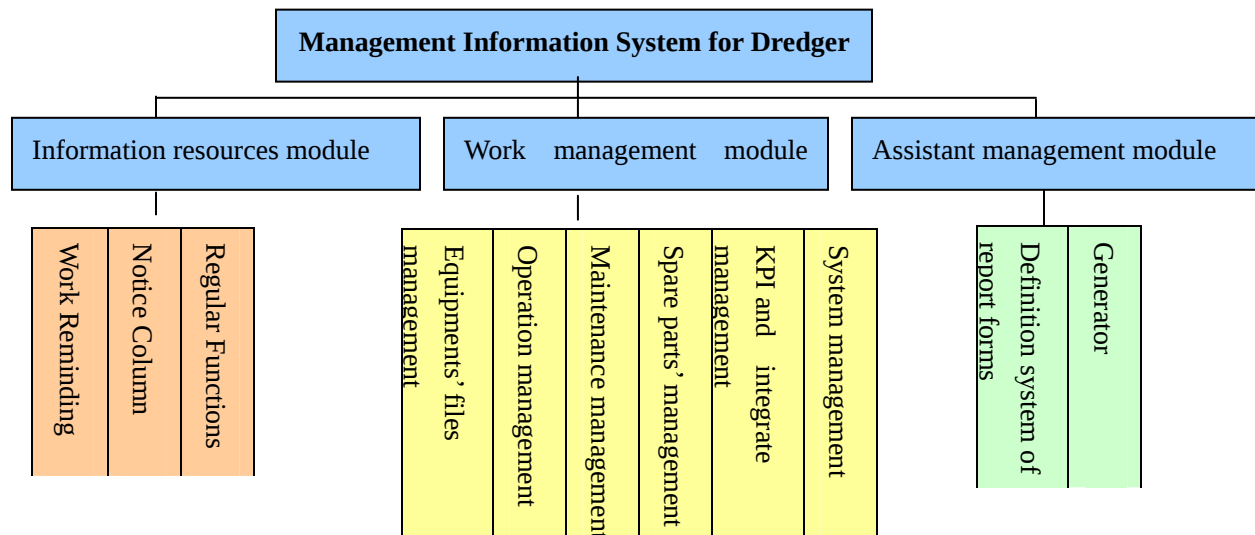


Figure 3. Sketch of main functions.

Information Resources Module

This is a sharing system for asset information and opens to internal users of the enterprise.

Work Management Module

This is the main functional module in the system. It divides the four steps of the shipping machinery management (management, utilization, maintenance and reparation) into five associate sub-systems, namely equipment file management, operation management, maintenance management, spare part management, and integrated management.

1. Equipment file management: focuses on the file management of each vessel. Via the standardization of the basic information of the ships and their equipment, the multilayered structure—firstly, the ship, then the equipment system, thirdly the equipment, fourthly the components and finally the spare parts, has been established. It could create an overall account for the equipment on each vessel as well as the whole enterprise, constitutes dynamic files for the equipments’ life-span, and makes a good foundation for strengthening the operation management, maintenance and reparation.
2. Operation management: manages the operation of the shipping equipment, including the condition of the equipment, ship safety examinations and equipment tests. Through the management of the equipments’ condition the supervisor could dynamically master the operational status of the main machinery, the efficiency and running costs and make sure that the operation of the equipment is under complete supervision.
3. Maintenance and reparation management: includes the maintenance management, reparation management and lubrication management of the shipping machinery. By combining this with the ship behavior triggers the technical standard information system for the maintenance of the equipment that has been established. Moreover, the maintenance and reparation pre-warning system could help to achieve an incorporated and optimized arrangement for the in-situ, in-dock and emergency reparation processes and accessory replacement. Finally, it highlights the importance of a maintenance plan, and secures the prompt control of the equipment maintenance.
4. Spare part management: based on the standardization of the technical information for the spare parts it achieves a unified management of the whole procedure. This includes the spare parts supplier, purchasing application and ordering of spare parts together with on-shore and on-board storage of spare parts. It introduces the concept of a virtual warehouse which helps to realize the sharing and utilization of spare parts. By linking the issues made from the store and the storage balance with each other, a pre-warning system between the on-board spare parts storage and on-shore spare parts storage can be set up.
5. Integrated management: main functions are the focusing on the integrated statistical analysis of the overall system and carrying out performance management based on key performance indicators (KPI).

SYSTEM CHARACTERISTICS

The system is divided into four steps for shipping machinery management (management, utilization, maintenance and reparation) and into five associated sub-systems, namely equipment file management, operation management, maintenance management, spare part management, and integrated management. It covers the whole procedure for the shipping machinery equipment management, and forms an integrated system. The business and position centered functional design fits the “manage by type and clarify the individuals responsibility” managerial mode very well.

Securing the Exclusivity of the Equipment and Spare Part Codes, the Code Principle of the Equipment and Spare Parts Specially Established with Reference to the International CWBT Rules

Equipment Code Principle

Coding of the equipment is the method used for the operation and maintenance management of the equipment.

The coding of the equipment system (Table 1) adopts a method for combining the ship’s code (sextuple-digital

system arranged by the enterprise planning department), together with the CWBT code, so as to guarantee the exclusivity of the equipment's code.

Instead of the quintuple-digital code of the CWBT, our codes extend to sextuple-digital. The fifth digit of the original CWBT code, which includes the figures 0-9 and the characters a-z are changed into double-digits, from 00 to 99.

Table 1. Equipment code.

Code	□	□	□	□	□□
Digitals	First digital	Second digital	Third digital	Forth digital	Fifth & sixth digitals
Definition	Main system	Sub-system	Groupware	Parts (equipment)	Serial number, position
Format	Capital letters	Figures	Figures	Figures	Figures
Current range	A~U	0~9	0~9	0~9	00~99
Designed capacity	26	10	10	10	100

Notes: “0”&“00”in the code means the whole.

For instance:

Equipment code 010108M11116 means the cylinder head of the 16th cylinder located in Main Engine 1 of “Guang Zhou Hao”

Among them: 010108——“Guang Zhou Hao” (name of the ship)

M——Main Engine (Main system)

1——Main Engine 1 (Sub-system)

1——Main part of cylinder (Equipment group or groupware)

1——cylinder head (parts)

16——the sixteenth cylinder head (serial number)

Coding Principle of Spare Parts

Purpose

- (1) To ensure the exclusivity of the codes
- (2) Can clarify the levels, and facilitate any increase or reduction of equipment
- (3) Must possess a lot of space for expansion
- (4) Is convenient for the independent operation of the spare parts system

Classification method for spare parts

The spare parts with the same functions will be sorted into one group. In order to keep the exclusivity, the various

types of equipment are divided according to their “brand”. The system distinguishes the different series of products under the same brand.

Analogously represent different groupware for the equipment and different components of the groupware.

As for the accessories relating to parts, figures 000-999 are prepared for them.

Table 2 .Instance for the coding principle.

Equipment Classification (00-99)	Equipment (00-99)	Brand (00-99)	Type (00-99)	Group Ware (00-99)	Parts (00-99)	Accessories (000-999)	Spare parts code
Prime mover							0100000000000000
	Diesel Engine						0101000000000000
		Selzer					0101070000000000
			8LZA40S				0101070300000000
				General cylinder head			0101070301000000
					Cylinder head		0101070301010000
					Cylinder head GP1		0101070301020000
						Plug on the cylinder head	0101070301020001

The KPI Management System of the Enterprise, Shipping and Equipment Has Been Established to Support the Continuous Improvement of the Whole Work and Provide a Stable Guarantee for the Enterprise’s Production

After fixing the Key Performance Indicators, the performance analysis of the shipping and machinery should be carried out based on the actual work conditions. This will strengthen both the macro-management and micro-management.

The Key Performance Indicator (KPI) for the system includes:

Appraisal of cost throughout the life-span: maintenance cost for each occasion

Equipment usability: actual utilization rate of equipment

Equipment operation performance: comparing the actual productivity with the designed productivity and analysis of the utilization rate

Appraisal of the equipment management quality: accidents, failures

Appraisal of the equipment reliability: analysis of the Mean Time between Failures (MTBF) as well as the Mean Time To Repair (MTTR)

Establish the Pre-warning System for the Equipment's Operation and Management (Maintenance Pre-warning Module, Spare Parts Management Pre-warning Module and the Vessel Certificate Pre-warning Module)

Maintenance pre-warning module: dynamically reflects the operation status of the equipment, improves the control of the equipment maintenance and strengthens the guaranteed power relating to the performance of the equipment

Spare parts management pre-warning module: insures the reasonable purchasing and storage of the spare parts.

Vessel certificates pre-warning module: provides a convenient management platform and methods suitable for the managerial employees who are in charge of the vessel certificates.

Establish the Standardized the Cooperation Platform for the Equipment Management

Consists of three levels (ships—ship equipment department—directors of the enterprise). MIS of shipping machinery and equipment is a fully-fledged and extendable management platform for shipping machinery and equipment. It integrates various affairs, such as foundation, technical and the economic management into one standardized and highly-efficient management platform. Operating on this platform could assist the managerial employees to organize and manipulate the system with high efficiency. Moreover, the fast examination and approval process through the web and the fluent business procedure for the complete management of shipping machinery will achieve a conducive and entire computer management pattern. It will also greatly improve management efficiency.

Establish the Maintenance Standard and the Integrated Maintenance Management System

Based on the characteristics of the dredging industry the complete maintenance standard system for the dredger machinery has been established so as to ensure the regulation of regular maintenance. The maintenance standard system effectively solves the problems that are complicated, nonstandard, difficult to amend and check etc. in the traditional compiling process for the reparation documents. This not only saves time but also makes the communication between the shipping engineers, managerial employee and the shipyard much easier. It also enhances the efficiency and controllability of the management for the reparation process and maintenance resources.

Establish the Synthesized Management System

This keeps the equipment files and reflects the changing situation of the equipment, tracks through the life-span of the equipment, its maintenance and reparation situation and affords basic information for the engineers.

Achieve a Dynamic Mutual Exchange between the “On-board System” and “On-shore System”

Through the CDMA, GPRS or other wireless data exchange methods, the “on-board system” could exchange data with the general server in the office (“on-shore system”). This will realize a synchronous data exchange for both the “on-board” and “on-shore” systems.

APPLICATION STATUS

This MIS of shipping machinery has been used in the head office of the enterprise and on the dredger “Wan Qing Sha” since April 24th, 2006. Up until now it has been working quite well. The data exchange between the shore and the vessel is fluent and the information communication fast and reaching the anticipated results.

The accurate data input by the operational level (shipping managerial employees and engineers) enables the all-round analysis of the economic and technical information. With this analysis, the managers can know how to handle various problems so they can provide assistance in decision-making. The directors of the enterprise could make use of the analyzed technical and economic information to determine the most feasible strategies, guild lines and decisions.

With respect to our own characteristics, this system adopts an updated management experience in order to set up a three-level shipping machinery management platform. This possesses a good foundation, high-efficiency and the potential to be extended. On the one hand, by integrating a lot of information on the shipping equipment and spare parts into one standard system, the advanced operation platform and management system for the shipping equipment could achieve the entire computer management pattern and greatly improve management efficiency. On the other hand, based on the analysis of material and capital flows the economic and technical analysis system has been completed. This could control various non-production costs and help form an optimal and reliable management and decision-making system which will support the high-speed development of the enterprise.

1. Standardize the basic information, and install a good foundation for the economic and technical analysis.
2. Employ advanced technical methods in order to establish a complete management platform for the management of shipping machinery, overhauls, technical alterations and spare parts.
3. Make use of the updated managerial ideas and construct the control and analysis platform for the shipping machinery.

This system has good stability and a high intellectual capacity as well as a clear and simple interface. It is convenient for operations and fast for transmitting information. Furthermore, it could obviously improve economic benefits (Cited from the *User Report of MIS of Dredger Machinery* of the Wan Qing Sha).

PERFECTION AND EXTENDING APPLICATION OF THIS SYSTEM

After installation on Wan Qing Sha, the system has reached the anticipated functions with good stability, high clarity and convenient operation. However, a great deal of work still needs to be done in order to reach perfection.

1. The system has been entirely employed on the dredger Wan Qing Sha, and is now being installed on the “Guang Zhou Hao”. What is going to happen next is to further optimize and perfect the overall system. Finally the system will be applied to the all dredgers of the CCCC Guangzhou Dredging Company. In this way, a mutual data exchange between those on-board and on-shore would gain information relating to the shipping machinery management. It would also provide scientific and accurate information for the enterprise’s decision making, and guarantee the smooth operation of the enterprise’s business.

2. The mass of basic information is one of the barriers in the application and utilization of the system. Taking Wan Qing Sha as an example, the coding of the equipment and spare parts requires looking up decades old handbooks and inputting more than 300,000 sets of data. This is time-consuming and requires some experts with a good level of English. Also the diversification of the vessels and complications arising from the big differences between their respective equipment and spare parts results in a lot of difficulties for data inputting. In order to speed up the implementation process, the coding input of the already used spare parts and the most important equipment will be dealt with first. The coding input of other parts will occur when repairing or replacing items.

3. The MIS of the dredger equipment is not only a technical project, but also a management project. That means, during the application process, the modernized management level needs to be improved in order to adapt to the increasing demand for technique and management development.