Research on life cycle of bulk port production environmental management information system

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Abstract. Comprehensive information platform for port environmental management is necessary to be developed, due to the serious dust pollution and low efficiency of primary environmental protection equipment in the bulk port, which should be combined with life cycle of bulk port production and on the basis of the clean and efficient production needs. The aim of this study was to solve the port environmental management information platform framework, model selection and system development. It provides technical support for the establishment of port environmental management information system, realizes the automotive and global control of the port environment, and a breakthrough of the port environmental management practice.

1. Introduction

Currently, the establishment of bulk port informatization is mainly focusing on the primary business and daily affairs. Some domestic important bulk port, such as Qinhuangdao port, Tianjin port and Shanghai port, have reached international advanced level in terms of the establishment of production management platform and electronic Commerce platform. However, there has been no research on the informatization construction relating to comprehensive management of port environment. In view of the increasingly stringent requirements for port environmental protection and the lack of informatization system for the comprehensive management of the port environment, this study, based on the present situation of the serious dust pollution and the low efficiency of the main environmental protection equipment (spraying system), puts forward the idea of developing port environmental management information platform, in combination with the whole life cycle of the port production, as well as the clean production and efficient production of the port. It is necessary to solve the port environmental management information platform framework, model selection problems, and system development.

Problems relating to primary environmental protection equipment (spraying system) in coal storage yard present with unreasonable water sprinkler time control and the non-standard measurement of sprinkler strength, which made a low wet dust removal efficiency, with no possibility to reach the optimal balance between environmental protection and energy saving and consumption reduction. For the actual needs of port environmental protection business, this paper was to investigate the development of port environmental management information system to realize the goal of intelligent port environmental management. Upon the completion of basic information data library, the port...
environment management software was developed, which provides technical support for port environmental management information system, thus realizing automotive and global control of the port environment, and a breakthrough of the port environmental management practice.

2. **Analysis of pollution links in the life cycle of bulk port production**

The loading and unloading process of the production operation of the bulk cargo port, see Figure 1.

![Figure 1](image)

1. Dust: dust caused by the fall when unloading; dust caused by the fall at the turning point of belt conveyor; natural dust deposited in the yard; dust due to the stacker-reclaimer operation; dust due to the shiploader operation.

2. Sewage: engine room oil sewage and domestic sewage produced by ships; sewage containing dust in the runoff from rainfall; dusty sewage produced by sprinkling, dusting and washing at wharf surface, yard, loading and unloading machinery; production and living sewage in auxiliary construction area.

3. Noise: traffic noise produced during train collection; mechanical noise produced by loading and unloading equipment.

4. Solid waste: production and domestic waste; solid waste produced by a ship.

3. **Requirement analysis**

The port environmental management information system, based on the GIS platform, can manage and monitor port information and environmental data in a graphical and intuitive way. The main purpose includes the following aspects:

1. Basic information management of port environment: to realize the archiving of the pollution sources in the port, to manage the rules and regulations of the port environmental management, to realize the release of the environmental bulletin of the port, to realize the management functions such as the environmental statistical reports.

2. Port environmental pollution source monitoring and early warning management: to achieve the basic data maintenance of the port environmental pollution sources, to collect and input data in each pollution monitoring points, to preserve and call the historical data, to check and call the preserved data, the real-time early warning for data beyond the standards.

3. Automatic spraying system in bulk cargo port: to resolve the problems of unreasonable spraying time control in bulk yard and no scientific system for the spraying strength measurement to reduce labor intensity of the workers while improving the dust prevention efficiency, so as to realize the automation and information management mode.

4. The use and management of port environmental protection equipment: to achieve the port environmental protection equipment classification file, environmental protection equipment operation and management, environmental protection equipment dispatch and other functions.

5. Port environmental monitoring and management: to achieve the port environment monitoring, to achieve feedback of the implementation of monitoring tasks and other management functions.
⑥ Energy consumption statistics of main equipments: to realize energy consumption statistics of all departments in port, and simple mathematical calculation and chart processing function for statistical data.

⑦ Other environment management requirements in port.

Overall design of the system

3.1 Overall structure of the system

Based on class module design and according to the business requirements and characteristics of environmental management information system, the data management program abstracts the functions of public business into one class module, so that the design of system bottom is shielded, and public function modules are integrated, as a result of a clearer system structure, a more convenient system management and an elevated working efficiency.

This frame abstracts the system business function into several base class modules, which are organized by the design and operation of interface to complete the basic business function of each individual development. Base class modules mainly include TAadapter, ThsDataSet and ThsModule, in which TAadapter has the primary function of connecting with database and providing unified database access method for dataset, ThsDataSet is to achieve dynamic acquisition of data and database update, and ThsModule mainly provides all functions and implementation methods of independent business units. It loads ThsModule that takes ThsDataSet as the base class via dataset listing properties and identifies the business case by key value and display value of the business class.

3.2 Logical structure

The frame of the whole system consists of data layer, server and client.

(1) Data layer design

The service layer provides the whole system with basic support service, including comprehensive database, GIS server (space database + GIS engine).

① Comprehensive database adopts SQL Server 2005 Chinese enterprise version,
② Space database adopts MapInfo series GIS map, which can be in database centralized storage as needed, or in documentation for distributed storage,
③ GIS engine adopts MapX desktop components and MapxTreme server components.

(2) Server design

Server is divides into WWW server and Web Service.

① Web Service server is built by Windows 2003 Server+IIS6.0+Service.dll to provide data access and communication interface for 4 C/S structure subsystem including system configuration platform, integrated information management platform, environmental monitoring center, project construction and management platform.
② WWW server is built by software Windows 2003 Server+IIS6.0, and ASP.NET as web script, to provide access interface for B/S structure subsystem of data inquiry, analysis and statistics platform.

(3) Client design

The clients has two modes according to the different subsystem: ① Subsystem platform for data inquiry, analysis and statistics uses the browser of operation system to visit WWW server. ② Other subsystem uses application program to visit Web Service server.

3.3 Physical structure

Due to the vast geographical areas and more management points in port, considering the users’ convenience, the system adopts combination design of B/S and C/S on the basis of public network. System configuration, integrated information management, environmental monitoring, project construction and management require frequent data exchange with the database, and a stable users group, thus C/S mode design is used. Data inquiry analysis can only extract data from database with a wide using range, thus B/S mode design is used. System physical structure in Figure 2.
4. Function design and development
The system mainly consists of port data management, environment monitoring, automotive spraying, area monitoring, risk plan, environmental protection equipment management and energy consumption statistics.

4.1 Port data module function
This module function includes pollution source files, rules and regulations, environmental protection bulletins, handling of pollution accidents, statistical reports on environmental protection and energy consumption.

4.2 Environmental monitoring module
The function of this module is divided into six parts, including water environment quality monitoring, air quality monitoring, sound environment quality monitoring, solid waste monitoring, radioactive material monitoring and historical data.

① Water environment quality monitoring, air quality monitoring, sound environment quality monitoring: the page provides the overall display through the monitoring point distribution map, including the location and name of the monitoring points, whose links is used to check the monitoring the data and statistical page. In the latest monitoring data view and data statistics page, users can interactively query the latest monitoring data, including monitoring time, monitoring site, monitoring person, auditor, monitoring project, monitoring value, standard value, unit, standard exceeding sign and execution standard, and in the lower half part of the page are monthly, quarterly, annual statistics and charts, which can be exported.

② Solid waste monitoring: the name, quantity, nature, agreement, source, whereabouts and other information of solid waste can be viewed.

③ Radioactive material monitoring: the monitoring data of the radiation monitoring point can be viewed, including monitoring points, monitoring items, standard values, monitoring values, units, collection time, evaluation standards, and the standard exceeding condition.

④ Historical data: through categories, monitoring items, monitoring time and monitoring point information, the historical monitoring data list of some monitoring items in a set time period can be queried.
4.3 Automatic spraying module
This module involves eight parts relating to automatic spraying module including "coal field production scheduling information collection", "environmental parameter monitoring", "running state monitoring", "model calculation", "decision support", "information inquiry" and "field monitoring" and "executive agency". The specific function description is as follows:
   (1) The system can carry out real-time monitoring and control operation on pump, valve and water tank; (2) alarm management function, such as alarm timely when failure occurs; (3) spraying control platform can be controlled manually, automatically, or intelligently. In case of the rain and snow, the system will automatically switch to artificial control spraying page; (4) the automatic control system of dustproof and water can automatically control water on the coal pile surface in open yard in different weather conditions and different yard areas, so that the influence of the dust on the environment during the storage and transportation of the coal yard can be effectively controlled.

4.4 Regional monitoring module
This module can view the task arrangement and task execution of all areas monitoring and can view the real-time situation in the monitoring area by "viewing monitoring video".

4.5 Risk preplan module
This module function is divided into two parts: risk source distribution and risk plan inquiry.
   ① Risk source distribution:
   The page provides an overall display through the risk source distribution, including the location and name of the risk source, and visiting risk preplan inquiry page through the link of the distribution map of monitoring points. At the bottom of the distribution chart, the information of the risk sources is displayed in the form of a data list, including the risk sources No., name and category, etc.
   ② Risk plan inquiry:
   The risk plan data can be also viewed, including the plan name, contents and attachment reference.

4.6 Equipment management module
This module is divided into two parts including environmental protection management and equipment.
   ① Environmental protection equipment management: the equipment maintenance planning, arrangement and execution records can be viewed, mainly including maintenance date, equipment name, maintenance plan, maintenance content, etc.
   ② Environmental protection equipment scheduling: the records of environmental protection equipment scheduling planning and task execution feedback can be viewed, mainly include scheduling tasks, equipment name, planning time, execution status, executor, execution time and other information.

4.7 Energy consumption statistics module
This module can check the energy consumption statistics of all departments, including the energy consumption data in current month and year, the energy consumption data list in a certain historical period, the energy consumption trend chart, and exporting the historical data to the Excel file.

5. Conclusion
In this study, the current situation of port environmental protection business are investigated and analysed, putting forward the problem that the port environmental management needs informatization urgently. Research has made breakthrough progress in port environmental management informatization. The application of this system will change the problem that the environmental protection work has not been systematized, global and informatization management under the traditional management mode, meanwhile the effectiveness and accuracy of environmental management are strengthened, and the technical content of environmental management in the port is improved. The construction of the system makes the port environmental management more scientific
and comprehensive, with an improved efficiency of environmental protection work, thus realizing the monitoring and early warning management of the environmental pollution source in the port. The system is of great significance for port environmental protection, by characteristic of mature technology and popularization value.

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