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Application and Development of Modern Safety Management System in Metallic and Non-metallic Mine

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Abstract

According to the demands of safety standardization in metallic and non-metallic opencast mines and the demands of safety production and management in mining enterprises, it analyses the elements of safety standardization system in mine and their PDCA running mode and proposes the establishing process of the system. Based on the philosophy of mining safety standardization and modern safety management, it develops "modern safety management system" which is mainly used in opencast mines using B/S mode, deeply analyses the function and advantages of the system, and finally elaborates its application way and effect briefly.

Keywords: metallic and Non-metallic mines; safety standardization; PDCA; modern safety management; system

1. Introduction

In recent years, mining has become the major development method of Chinese resources and the mining industry has developed continuously. However, safety production accidents in mine happen frequently posing a grave threat to human's lives and health security and bringing about substantial loss to the state economy. This phenomenon is particularly serious in coal industry. But as a mining industry, the safety conditions of metallic and non-metallic opencast mines also would not be neglected. Against the

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present severe situation of safety production in metallic and non-metallic opencast mines, State Administration of Work Safety (SAWS) formulated and issued the safety standardization criterion of metallic and non-metallic mines in 2006 (AQ2007.X-2006, which was called "norm" for short), and the "norm" was formally implemented on July 1st, 2007. The "norm" calls on metallic and non-metallic mines to carry out a series of work relevant to safety standardization in order to realize the normalization and systematization of safety management and improve the whole safety level in mining enterprises. Therefore, to create mining safety standardization system and to establish a modern safety management system with high performance, large information and strong maneuverability on this basis using the computer network and technology will have important actual significance in achieving scientific, systematic and standardized safety production management in mining industry[1-2].

2. Establishment of mining safety standardization system

2.1. Elements of safety standardization system in mine and their PDCA running mode

Safety standardization is the normalization and standardization of safety production work. Through establishing the responsibility system for safety production, formulating safety management system and operation instructions, carrying out investigation and treatment of hidden dangers, controlling and monitoring major hazardous sources, establishing prevention mechanism and standardizing production action, the purpose of safety standardization is to make each stage of production come up to the requirements of laws, regulations and standards in safety production, maintain human, machines and environment in good condition, realize continuous improvement and finally strengthen the standardization work of safety production in enterprises[3]. According to the contents of the "norm", there are fourteen first-degree elements and fifty-three second-degree elements in the mining safety standardization system. Each second-degree element specifies several questions that have great relevance to the improvement of safety performance, depression of human and property loss risk, and reduction of work stoppage in enterprises.

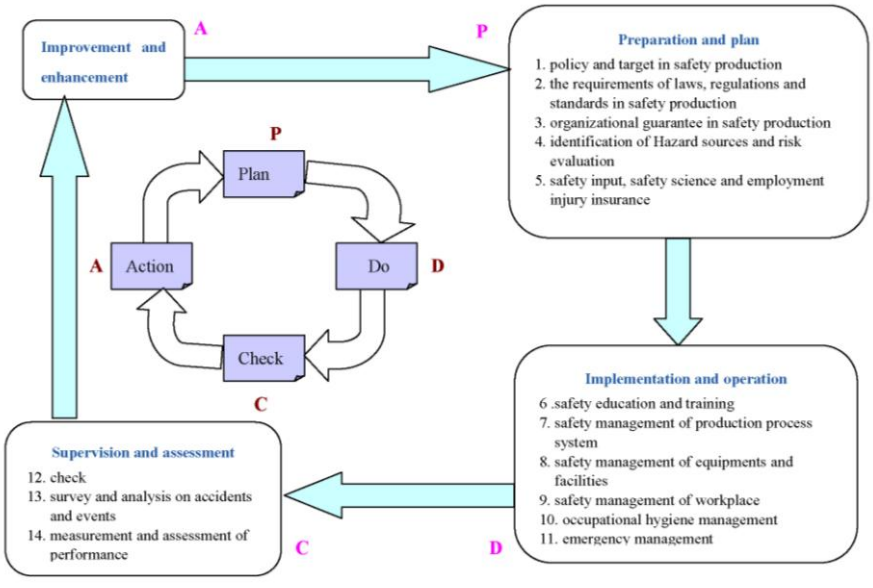

Fig.1. PDCA running model of safety standardization system in mine

The mining safety standardization system follows PDCA Deming model and it lays emphasis on process control based on systematic theory and requirements of continuous improvement. Every first-degree element connects to each other closely as a dynamic integration, forming a big PDCA cycle model(big closed loop); at the same time, the second-degree elements form a small PDCA cycle model(small closed loop) with the method of one ring linked with another through four sections which are called "plan", "do", "check" and "action"[4]. The PDCA running model of safety standardization system in mine is shown in fig.1.

2.2. The process of creating safety standardization system in mine

In accordance with the requirements of "Implementation Guidance for Opencast Mines" which is a part of the "norm", the first step of creating mining safety standardization system is to set out policy and goal; secondly, to found a work group; then according to the PDCA cycle theory, to analyze sections where elements can be involved step by step and set up corresponding management rules and scaling mechanism; and finally to form mining safety standardization system files which will be complemented, revised and polished regularly[5]. The process of creating safety standardization system in mine is shown in fig.2.

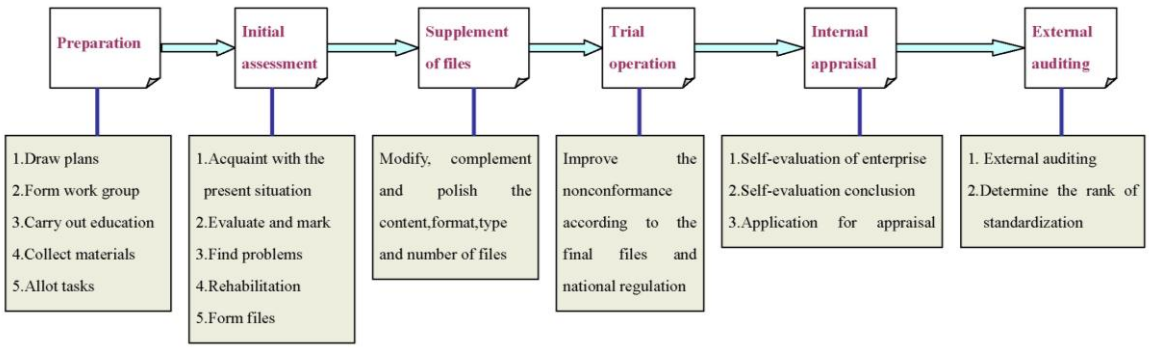

Fig.2. workflow of safety standardization in mine

3. Analysis of modern safety management system based on safety standardization

3.1. Analysis of the system demands

Mining safety standardization is a kind of fundamental management methods formulated by SAWS and carried out in every province, city and county step by step. While modern safety management in mine is a generic term of a series of activities which include planning, organizing, conducting, controlling and coordinating of safety problems in mining production activities by making use of the following technologies, such as safety scientific principle, safety control and information automation. But the central part of mining safety standardization and modern safety management is the same, which is mainly incarnated in four aspects, which are risk analysis, perfection of systems, process control and improvement of performance. And the ultimate purpose of them is to eliminate and control unsafe human

behaviors, unsafe physical condition and management bugs, and finally prevent the occurrence of production safety accidents.

In order to regulate the cosmos of mining safety management, prevent the occurrence of accidents and guarantee the workers' security in mining enterprises fundamentally, mines all over the country are focusing on the constriction of safety standardization. Improving the information level of mining enterprises is an important road to realize the modernization of mining safety management. Guided by the "norm" and according to the actual situation of mining enterprises, establishing a modern safety management system is not only the requirement for implementation of safety standardization by relevant state authorities but also the need of ensuring continuous improvement of safety production performance in mining enterprises.

3.2. Select of B/S application mode

As the information technology has developed rapidly, developing safety management information system in enterprises using computer networks and technology has become a trend. And there are two main kinds of application systems based on web, which are client/server mode(C/S for short) and browser/server mode (B/S for short). B/S mode is of great advantages compared with C/S mode. For instance, it simplifies the client so that users don't need to install applications on different clients as C/S mode does and they only need to install the universal browser software; it streamlines the development and maintenance of system; it enables users to the more simple operation of the system; it applies the dissemination of information online[6-7], etc. Considering the virtues of B/S mode, and combining the demands of the "norm" and actual needs of mining enterprises, the B/S mode was chosen in the development of "modern safety management system". The concrete application theory of B/S structure is shown in fig.3.

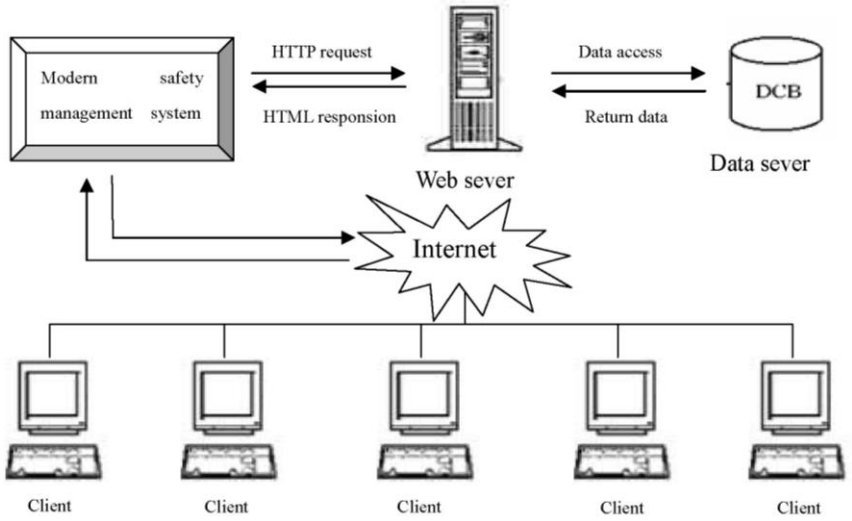

Fig.3. Application theory of B/S structure of "modern safety management system"

4. Function and application of the system

4.1. Structure and function of the system

The purpose of developing this system is to make safety management work covered by the fourteen first-degree elements of mining safety standardization be fully involved. Firstly, the "mining basic information" module and the "system management" module are set up; then the "mining safety standardization" module is established in accordance with the requirements of the "norm"; and "project acceptance" module, "license management" module, "notification and message" module, as well as the "early warning and cue" module are added based on safety standardization according to the actual needs of mining enterprises in order that the daily safety management work can be convenient and the data interface with super security supervision authorities can be realized[8]. Overall, the main function of modern safety management system can be represented as follows:

- (1) To manage users' information and provide different kinds of permissions for different users.
- (2) To establish complete safety management databases, including mining basic information database, hazard information database, safety education and training database, database of appliances for labor protection, database of occupational healthcare records for the staff, database of technological transformation project, safety precaution information database, database of investigation for hidden danger and record for peccancy, emergency resources information database, accidents information database,etc.Those databases can store various types of data information and relationship between them and provide reliable data sources for managers to inquire data and make decisions.
- (3) To provide data interface, which will import the existing staff information reports to the database directly and lead the daily hidden dangers and data examined and collected by safety checkers directly into the database so that the managers of different levels can have real-time mastery upon hidden dangers; the "license management" module is built to accomplish the addition and inquiry operation of company licenses(including mining license, business certificate, license for production safety,etc.), individual licenses(including certificate for barmaster qualification and safety certificate, certificate for people who has special work and other certificates for staff members)and special equipment licenses. Furthermore, in the end of validity of some licenses, the system can promote relevant managers to update and replace them as soon as possible.
- (4) To establish a system that is perfect in function, through which people can not only accomplish the inquiry job but also examine and approve problems on-line. Managers can upload and look over the relevant laws and regulations of mining industry, safety management rules in enterprises and different types of safety reports through the website; administrators who have authority can examine and approve all kinds of application that are submitted on the network .
- (5) To do dynamic monitoring on safety production and management work, issue and update internal safety information, plans and announcements in enterprises online, announce the results of routine safety inspection and carry out early warning and prompt of hidden dangers and defects as well as violation and offense behaviors, the return condition of "three-degree" education cards, the time limit of to licenses investigation and the accomplishment circumstances of technological transformation programs.
- (6) To form a information interaction platform, through which the staff can express their opinions and provide feedback of the mining production and construction, safety management and technical problems.

The whole functional modules of this system are shown in fig.4.

4.2. Implementation and operation mode of system

In order to achieve the design functions of system, Active Server Pages 3.0 and IIS5.1 are chosen in the development of system, Macromedia Dream Weaver 8 is used in web design and SQL Server 2005 is used as the database. The system makes use of SQL query in combination with ADO, as a result of which users can do adding, modifying and deleting operations on data.

According to the performance requirements of system, a computer with reasonable performance in mine should be chosen as server and good configuration and installation of the server and database should be done perfectly; then users can open any browser in the internal LAN in mine and input the home page at the address bar(IP address of the server + the main web directory or the virtual directory path where the website system is stored + the logging page), so the logging page can be brought out and the system began to run.

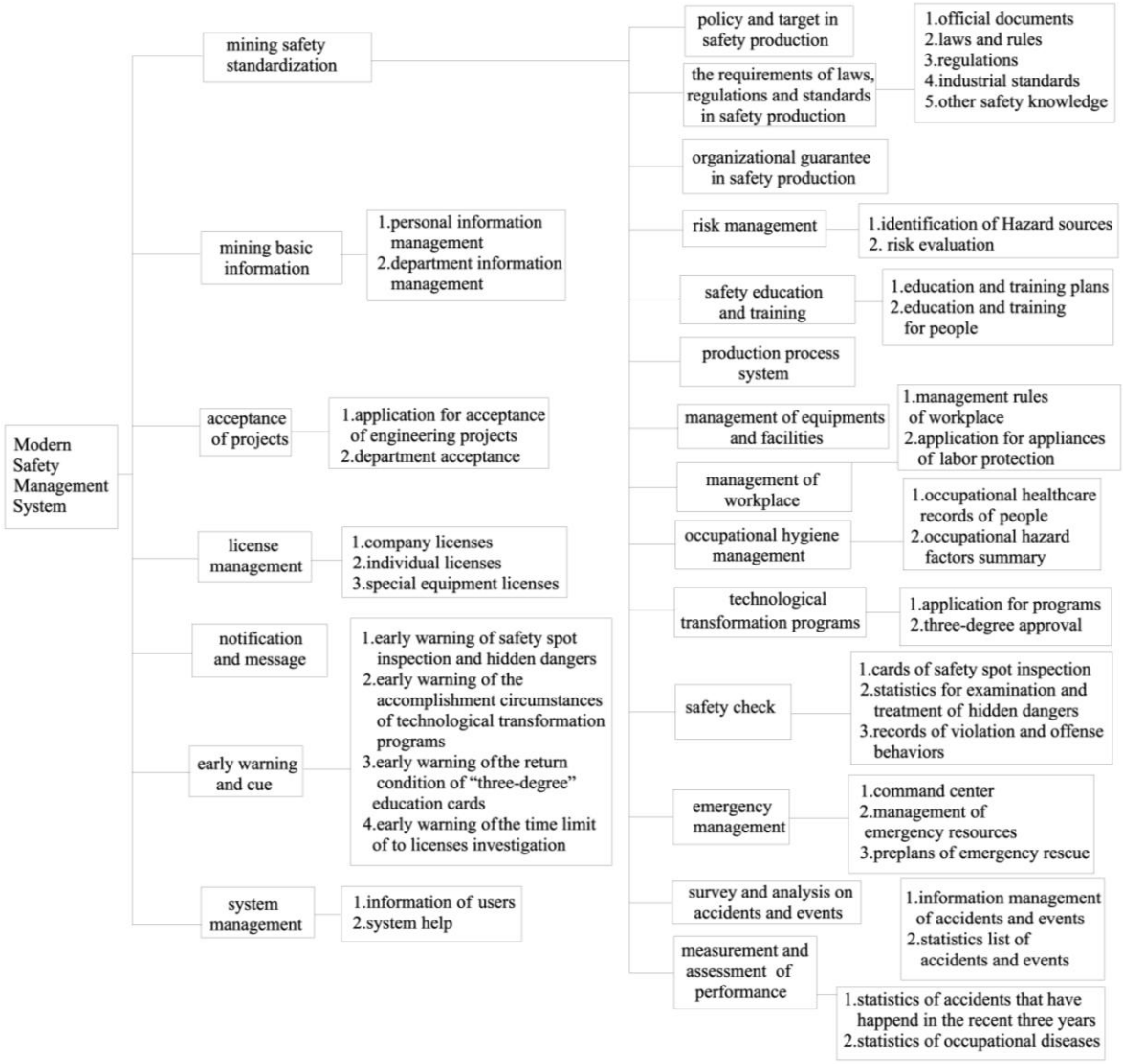

Fig.4. Functional modules of "modern safety management system"

4.3. Analysis on the application advantages of system

Compared with traditional safety management information system, the greatest advantage of "Modern safety management system" is its achievement on intellectualization, visualization and humanized management. The main strengths of system are shown in the following aspects:

- (1) the accuracy and integrity in data collection

The method of centralized management on computer is used when data are collected. On the one hand, the loss risk of all records due to the damage or loss of pads existing in traditional hand-written record or document management can be avoided and the integrity of data collection can be effectively safeguarded; On the other hand, human errors will be reduced and the accuracy of the data will be ensured through the computer records[9].

- (2) to realize resources sharing

Each module in the system has the function of information inquiry and browsing, the general staff can click on the relevant safety management information data and documents according to their actual needs; there is a "notice and message" exchanging module in which managers who have authorities can publish new notices and plans, and ordinary users can comment on the day-to-day management state in mine. Finally the safety management and technical experience can be exchanged and the safety knowledge can be shared.

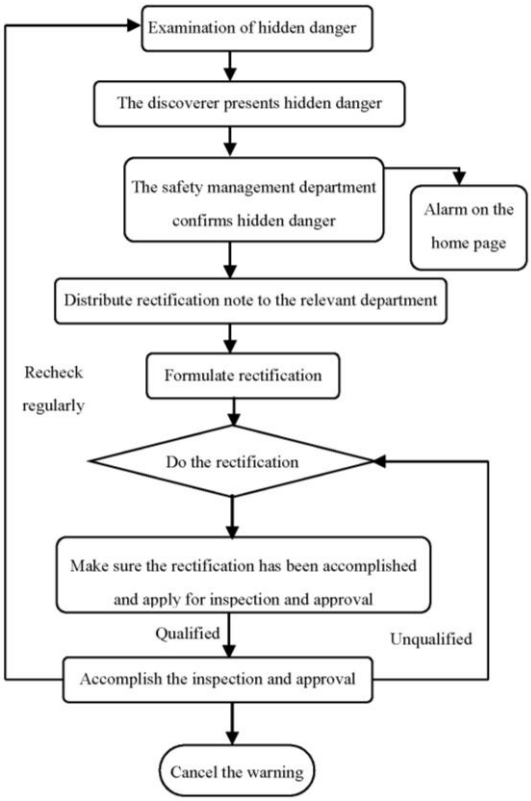

Fig.5. the handling process of hidden danger and defect

- (3)to realize visualization inquiry upon network

Network interface between data are provided in the system. The internet or LAN can transmit the monitoring data and analyzing reports to relevant departments so that the information will be shared. Leaders and safety managers in enterprises need not to go to the spot personally. They can consult the safety management information in the office at any time. So the time is saved and work efficiency is increased, and "safety information mastered by one hand" can be realized really.

- (4))to realize network approval and streamlining management

There are several project application modules in the system including application for technological transformation programs, appliances of labor protection, safety measures, inspection and approval of engineering projects, as well as discovery and rectification on hidden dangers, etc. They all use the method of "three-degree approval upon networks" .That is, firstly, the departments that have demands put forward their applications, then present the applications gradually following the "team and group-department- company director" mode through network, and finally acquire the approval results of department leaders who have approval authorities. The entire process follows the streamlining management model, the steps of which are strict and interlocked. This approval method makes full use of networks and it is so convenient that resources can be saved during the process. For example, the handling process of hidden danger and defect is shown in fig.5.

5. Conclusions

(1)The article analyzes the elements of safety standardization system in mine and their PDCA running mode and proposes the establishing process of the system according to the "norm", which provides a basis for the establishment and implementation of safety standardization system in metallic and non-metallic mine.

(2) The "modern safety management system" is developed based on safety standardization and the actual needs of mining enterprises. It solves such problems as the insufficiency of safety information, impeded channel for information transportation, unprompted feedback of information in the present safety management and provides a guarantee for essential safety in enterprises. The system can store a lot of data that are easy to be managed and the reliability, scalability and security of those data are so strong that people can obtain the firsthand information of safety management in enterprises completely, accurately and dynamically. So the real situation of safety production management in enterprises can be reflected. Thus relevant countermeasures will be adopted to make further improvement on the level of safety management in enterprises.

(3) The "modern safety management system" has been successfully applied in a metallic mine in Inner Mongolia autonomous region. As a result, the level of safety management in the mine has been improved greatly, the occurrence probability of accidents has reduced significantly and the performance of safety production has got its continuous improvement. So a good foundation has been laid for the realization of essential safety in the mine.

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