Research on the Intelligent Integrated Management System of Opencast Coal Mine

Xiaodong Hao, Hongwei Yang, Zihao Yin
China Iron and Steel Research Institute Group, Beijing 100081, China
yinzihao163@163.com

Abstract. This paper discusses the characteristics of the intelligent integrated management system of opencast coal mine in detail, and studies the six core system modules of production and manufacturing module, equipment management module, energy management module, safety management module and occupational health module, emphasizing the importance of the intelligent integrated management system.

1. Foreword
In recent years, the development of digitization, informatization, intelligent control and equipment manufacturing in China's opencast coal mine has lagged behind the reform and development of opencast process system. Before the 1980s, it was characterized by few varieties, low grades and incomplete sets, which had a big gap compared with the international level [1]. With the rapid development of opencast coal mine construction in China, the research and development, manufacture and control of opencast coal mine equipment has developed rapidly. The developing rapidly intelligent integrated management system of opencast coal mine is also developing rapidly and mainly takes materials, equipment consumption and coal transportation as main line in the mining process, with the focus on the sales and storage business. Through business restructuring, resource integration, and the network as the carrier, the existing decentralized and manual transfer work of opencast mines will reduce the operating costs of coal mine enterprises and speed up capital turnover by rapidly transferring workflow, capital flow and information flow, thereby improving competitiveness.

2. Characteristics of Intelligent Integrated Management System of Opencast Coal Mine
The integrated automation system of coal mine is another major advancement after the fully mechanized mining in China's coal mine. It involves not only the use of advanced information technology, automation technology, but also major changes to the coal mine management model [2]. The intelligent integrated management system of opencast coal mine enterprises is an important part of the comprehensive automation system of coal mines, mainly for supply chain and discrete industrial systems. It combines the characteristics and management mode of the opencast mine's own process engineering, especially according to the situation and target of each mine and the demand and price of the system function. It is necessary to select the appropriate system plan and tailor it.

The intelligent integrated management system has the following characteristics. 1) Highly integrated and intelligent management information system. The advanced management concept is used to improve and optimize the organization management and business process of opencast enterprises, forming an intelligent system of self-learning and self-decision; 2) Business data distributed layout mode. Based on the concept of manufacturing execution system, a distributed layout model matching the actual situation
of the enterprise is established, and each business is relatively independent internally; 3) Modular implementation architecture. According to the overall process, the integrated management system is divided into five modules: manufacturing, equipment management, energy management, safety management, and occupational health; 4) Unified transmission network platform and unified software and data warehouse. In terms of hardware structure and software configuration, it is ensured that each subsystem module in the information mine has a unified transmission mode, a unified data expression form, a unified data processing format and a unified data management method[3]; 5) Gradually go online according to the stage to achieve efficient use of human, financial, material, mineral reserves and technical achievements.

3. Research on intelligent integrated management system of opencast coal mine

3.1. Opencast coal mine production and manufacturing module
Opencast coal mine production and manufacturing module includes procurement management, production contract management, production planning management, inventory management, marketing management, financial management and human resource management.

Among them: 1) Procurement management. The procurement work mainly provides mining enterprises with all kinds of materials needed for production and management. Procurement management is the process of organizing, implementing and controlling the procurement business process; 2) Production contract management. It includes six functional modules: contract processing management, contract merge management, contract plan management, material transfer management, contract issue management and contract tracking management; 3) Production plan management. In the operation of modern coal enterprises, the production plan plays an extremely important role. It embodies and time-modifies the production targets of the enterprise according to production contracts and production forecasts; 4) Production inventory management. Collect and process the production performance of each process in the mining area sent by the production management system, the inventory information of the finished coal, and the actual performance of the main production equipment, and realize the inquiry of these information; 5) Marketing management. The sales business is indexed and streamlined, and each single business is tracked and managed from negotiation to contract signing, delivery and receipt of goods, and receipt of payment. At the same time, complete the evaluation and record of sales business from the aspects of finance, contract and information record, make good analysis, and provide data support for future sales decisions, including: market management, sales contract management, sales measurement, sales testing, business reports. The sales contract is transmitted to the contract management module to generate the production contract. 6) Financial management. The relevant financial data is introduced into the integrated management system to realize the real-time interaction and timely sharing of the financial management system data and the information of the opencast coal mine. 7) Human resource management. The relevant data is connected to the integrated management system to realize real-time interaction and timely sharing of data and information of human resources business in the opencast coal mine.

3.2. Opencast coal mine equipment management module
Equipment management in the opencast mine includes equipment basic management, equipment operation management, and equipment maintenance plans to achieve overall equipment management in the mining area and improve the level of equipment management.

Among them: 1) Equipment basic management. It contains opencast mine equipment classification, equipment coding, equipment catalog, equipment account, equipment maintenance standard knowledge base; 2) Equipment operation management. It contains equipment shutdown, equipment operation statistics, real-time monitoring of equipment operation status, and equipment service life management; 3) Equipment maintenance plan. The maintenance plan is divided into weekly maintenance plan, monthly maintenance plan, annual maintenance plan and periodic task plan. The maintenance task is generated according to the maintenance strategy (configuration and maintenance in the basic data), and
the system automatically generates the corresponding periodic maintenance task. The maintenance task is confirmed by the maintenance personnel to generate the maintenance plan. The maintenance plan shall be supplemented by the maintenance personnel and submitted for review. The maintenance plan shall be implemented after the review is approved. After the implementation of the plan, the maintenance personnel shall record the maintenance achievements; 4) Equipment maintenance knowledge management system. It contains information collection, storage, analysis and mining, which can support intelligent fault diagnosis, fault analysis and self-decision.

3.3. Opencast coal mine energy management module
The energy management system manages energy equipment, energy media, fuel consumption, and process production in real time. Under the premise of establishing an assessment system, the assessment indicators shall be formulated, and the objective data automatically collected in the system shall be used for energy assessment to reduce manual interference and eliminate measurement objections. Energy management contains SCADA monitoring, EMS information management, data basic processing and archiving.

3.4. Opencast coal mine safety management module
The safety production management of opencast mines contains the following contents. 1) Training and education management. Obtain relevant personnel basic information, post information, various qualification certificates and training records from the human resources management system; 2) Security inspection management. The safety inspection records for production and security (comprehensive treatment, public security, fire fighting, transportation, armed, high-risk goods/radiation products) shall be classified and managed according to the inspection category, and the inspection categories shall be customized by the user; 3) Security risk management. Provide the function of registration of defects and hidden dangers corresponding to production, security (comprehensive, public security, fire, traffic, armed, high-risk products / radioactive products), as well as the entry of hidden danger rectification notices, and adding attachments; 4) Security incident management. Unified management of safety accident accounts occurring in the opencast mine; 5) Emergency plan drills; 6) “Three simultaneous” management of occupational hazards of hazardous chemicals; 7) Management of high-risk products and radioactive materials. Take a registered high-risk product or radioactive product as the unit, extract key data for entry, and hang the registration account attachment (production, operation, use, storage, transportation); 8) Security equipment management; 9) Safety management of engineering and maintenance projects; 10) Safety production evaluation management; 11) Hazardous source monitoring and management; 12) Management of key parts. Manage key parts and locations of the company by category; 13) Safety assessment management. Conducting account management for safety assessment ledger and safety assessment statistics; 14) Security personnel management. It provides functions for adding, modifying, deleting and inquiring for security personnel and group defense team, and can also add related attachments and pictures.

3.5. Occupational health module of opencast coal mine
Occupational health management in opencast mine includes: 1) Basic data maintenance. Labor prevention standards, health examination standards, rest-off rest standards, labor protection supplies categories, labor protection supplies levels, health examination categories, off-rest rest and occupational hazard categories; 2) Labor and defense supplies management; 3) Occupational health management.

4. Epilogue
In accordance with the "Opinions of The General Office of the State Council on Further Strengthening Coal Mine Safety Production Work" (The General Office of the State Council [2013] No. 399) on the "four modernizations" of coal mine construction and production mechanization, automation, informatization and standardization, fully promote the development of coal mines’ Intelligent construction in China is an inevitable choice to ensure the safe, efficient, economic and green
development of the coal industry. The intelligent integrated management system of opencast mine is the automation frontier of mining technology innovation and one of the foundations of research on smart mine. Accelerating the research and construction of intelligent integrated management system is an inevitable choice to ensure the safe, efficient, economic and green development of the coal industry, and is a reliable guarantee for the sustainable development of the mining industry.

References
[1] Zhou Tong, Zhen Xuan. Current situation and prospect of opencast coal mine equipment development in China. [J]. Opencast Mining Technology, 2014, 29(1):1-4,7(in Chinese).
[2] Tan Dejian. Status of Automation of Coal Mine and Its Developing Trend in China [J].Industrial Construction, 2010,36(9):126-129(in Chinese).
[3] Zhang Gang, Sun Yajun. Comparison and analysis of integrated automation system network platform at home and abroad [J]. Shandong Coal Science and Technology,2013,106(6),100-102(in Chinese).