



Special Issue Article: The First International Symposium on Mine Safety Science and Engineering Risk management and workers' safety behavior control in coal mine [☆]

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ARTICLE INFO

Article history:

Available online 9 September 2011

Keywords:

Risk management
Coal mine
Safety behavior
Control
Early-warning
Countermeasures

ABSTRACT

According to the risk management characteristics and the actual needs of safety production in coal mine, we thoroughly analyze the system of risk management method in coal mine and implement it in Geting Coal Mine. The system manages and controls the potential accident risks, hazard sources and human behavior risks. On this basis, the system of workers' safety behavior control technology in coal mine is further studied, the "three disobeying" is classified and managed, the "three disobeying" database and safety countermeasures database are established, and the application software – the system of risk management and safety countermeasures optimization in coal mine based on B/S mode is developed and applied, which uses intranet to analyze and supervise the "three disobeying", publish early-warning information, optimize management and control countermeasures; at the same time, the important prompting messages can be automatically sent to the mobile phones of relevant managers and the person in charge through public communication system in order to improve the real time capability and effectiveness of unsafe behavior control. The technological system and application software implemented in Geting Coal Mine has achieved good results.

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1. Introduction

Risk management, is the pre-analysis, prediction and control of risk, and it is a management work of reducing risk loss, generally including risk identification, risk assessment, risk control and risk transference. Risk identification is to determine the possible risk type; Risk assessment mainly refers to the qualitative and quantitative analysis and description of various risk types; risk control is to reduce the occurrence probability and loss of risk, while the key point is to alter all kinds of conditions involving

the behavior of risk accidents and loss expansion, for instance, the adaptation of safety protective measures, the reduction of the occurrence probability and its loss (Cao, 2006; Shi et al., 2005).

Due to the complicated production process and the harsh production conditions in coal mines, the problem of safety production in coal mine is more significant, complicated and difficult to solve compared with any other industry. Therefore, more attention should be paid to the risk management in coal mine production (Kang, 2010). The production practice and relevant studies in coal mine show that occurrence of safety accidents is mostly caused by the unsafe behavior of workers whose behaviors are restricted by their psychology, physiology and environment factors and cultural background (Sun et al., 2002). For the purpose of ensuring production safety, it is crucial that coal mine worker's safety control be controlled (Liu, 2003).

According to the above understanding and the actual requirements of safety production in coal mine, we investigate and implement the system of risk management method in Geting Coal Mine which has achieved good results (Li et al., 2009). Based on the previous study, this paper aims to thoroughly analyze the safety behavior control technology of workers in coal mine, formulate the complete technical system of risk management and safety behavior control of workers that will be carried out in the production site in coal mine.

[☆] The First International Symposium on Mine Safety Science and Engineering (ISMSS2011) will be held in Beijing on October 26–29, 2011. The symposium is authorized by the State Administration of Work Safety and is sponsored by China Academy of Safety Science & Technology (CASST), China University of Mining & Technology (Beijing) (CUMTB), Datong Coal Mine Group, McGill University (Canada) and University of Wollongong (Australia) with participation from several other universities from round the world, research institutes, professional associations and large enterprises. The topics will focus on mines safety field: theory on Mine Safety Science and Engineering Technology, Coal Mine Safety Science & Engineering Technology, Metal and Nonmetal Mines Safety Science & Engineering Technology, Petroleum and Natural gas Exploitation Safety Science & Engineering Technology, Mine Safety Management and Safety standardization Science & Technology, Occupational Health and Safety in Mine, Emergent Rescue Engineering Technology in Mine, etc.

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2. The risk management method in coal mine and its application

Risk management is a continuous, circular and dynamic process. Zibo Coal Mining Group Company Geting Coal Mine and Shandong University of Science and Technology corporately launch the research “the technology of risk management and warning control in coal mine”, and put forward the technology system of risk management and dynamic warning control in coal mine. Besides, supporting software is developed. In March 2009, the above research results are successfully applied to safety management and daily accident prevention work in Geting Coal Mine (Li et al., 2009).

“The technology system of risk management and dynamic warning control in coal mine” includes risk information collection, risk identification and management, the transmission, storage and analysis of risk information, early-warning prompt, safe and dynamic monitoring as well as safety management countermeasures. It is a management technology system, the objects of which involve the production process and environment, the safety work behavior of workers and managers as well as relevant technology and equipments. By means of real-time monitoring and analysis on the unsafe behavior of workers, unsafe state of machines and unsafe condition of environment, the risk information will be obtained. Through scientific risk management, a warning signal will be issued when the risk degree becomes severe, prompting the relevant departments to take effective measures to eliminate risk or control risk to the smallest degree.

The risk management system mainly includes two aspects, namely daily risk management and safety production scheduling management. While daily risk management involves four aspects that are daily safety inspection management, hazard source management, potential accident management and directing staff management, as is shown in Fig. 1.

During the implementation process, the daily risk management and inspection can be carried out through the corresponding safety checklist combined with the production process in coal mine. The dynamic analysis and monitoring of potential accidents can be realized by means of control chart. Therefore, the information can be recorded and timely solved; meanwhile, the daily risk information will be stored into the computer and automatically uploaded to the LAN (server). Risk management and warning can be fulfilled on the LAN, the relevant leaders and departments can inquire and analyze safe production information in their offices, check relevant statements and accept the early-warning prompt.

In this way, the safety management in coal mine can be developed timely, conveniently and effectively.

The above technique being implemented improves the efficiency of discovering and handling hidden dangers of accidents, and so it is with the informationized and digitized level of Geting Coal Mine safety management. However, the control technology of worker’s unsafe behavior is still not perfect and standard and the safety countermeasures under different risk conditions and optimizing methods still need further study. This paper will conduct further research on these questions, and do applications in safety practices of coal mine.

3. The control technology of workers’ safety behavior in coal mine

The general process of human behavior is: people accept external changes, and then the body reacts to it to adapt to the outside changes for the purpose of achieving the balance and harmony between environments (Sun et al., 2002), its behavior model is shown in Fig. 2.

The stimulus during production process affects human body that will make response to stimulation comprehensively or alone out of human instinct, skill and experience, leading to the security act for the purpose of safety. Otherwise, if the body does not make the right response to the stimulus, unsafe behavior will happen, and finally the security objectives will not be completed and casualties and property losses may be caused (Huang et al., 2002).

As to control of workers’ unsafe behavior, numerous scholars from home and abroad have done a lot of research and exploration from multi-angle perspectives ranging from security psychology research, behavioral science theory to behavior intervention techniques respectively. This article puts forward the management and control scheme from the perspective of risk management.

As is mentioned above, during coal production process, the control of workers’ unsafe behavior is a crucial part of risk management. Because the risk caused by workers’ unsafe behavior (formed by human error) is dynamic (Cao, 2006), so in order to carry on the management and control, we should not only consider its static performance but also its dynamic development changes.

3.1. Early-warning of workers’ unsafe behavior in coal mine

The workers’ unsafe behavior specifically refers to “three disobeying” in safe production of coal mine in China. According to

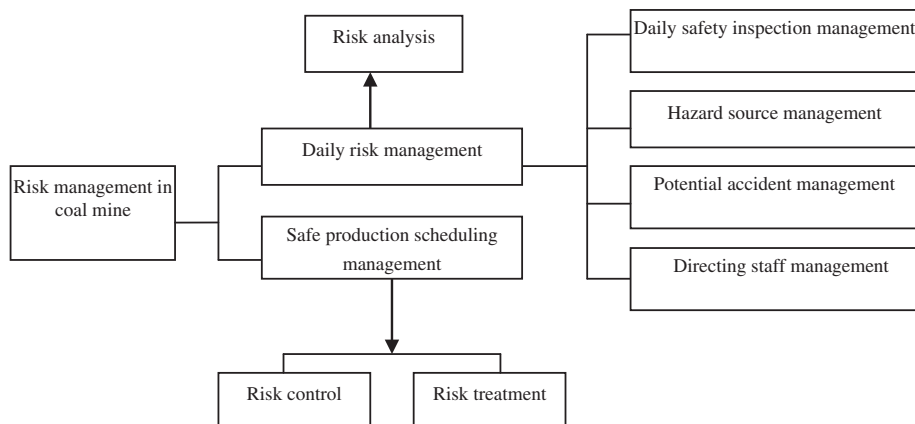


Fig. 1. The risk management system in a coal mine.

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