

Application of information technology in underground mine safety

Xuanyang Zhou

Anhui Lujiang Longqiao Mining Co., LTD., Hefei 231551, China

Abstract: Since the early 1980s of 21st century, the revolution of information technology has never stopped. The ubiquitous information technology in today's human life has become an indispensable part. For the operation of enterprises, information technology has been playing the role of a facilitator in solving human security problems. Since ancient times, people have been concerned and worried about security issues. Based on the background of modern development, the emergence of emerging technologies represented by the Internet has greatly improved many aspects of solving problems, ensuring people's life safety and quality of life. Based on the safety of underground mines, this paper explores the safety status quo of mining and the application of information technology.

Key words: Information technology; Underground mine; Safety

With the rapid development of information, its application to the world is becoming more and more intense, and it has become a fact that it is a lasting driving force for economic development and leads the progress of global science and technology. Information technology based on computer technology and communication technology is used to collect, organize, store and analyze data, and to transmit it. In recent years, information technology has not only been limited to promoting the development of financial markets or scientific and technological innovation, but has also affected other important industries including extractive industries. Due to its strong diffusivity and convenience, it can improve and upgrade all kinds of old-style equipment, so as to become more intelligent operation and can be widely used. The existence of digital forms can improve the accuracy of data transmission, but also accelerate the transformation of this process. It is therefore important to use innovative tools such as these to improve safety in underground mining operations. Through the use of innovative tools such as comprehensive monitoring to ensure that safety is in place, timely warning so that measures can be taken to prevent accidents, or rapid response in the event of an emergency, the desired goal can be achieved, and the level of safety in underground mining can be significantly improved.

I. Analysis of the current situation of underground mine safety

China's mineral resources are all over the country and in large quantities, but its development and use are faced with many challenges: first, the geographical location of the mine is scattered; Second, the mines vary in size; Third, there are many types of mines; Fourth, the mining infrastructure is relatively weak. As a result of the above problems, the safety situation of China's mining industry has been in an unstable state, especially in the past few decades, various types of disasters have occurred frequently, including ground collapse, landslides, etc. These events have seriously threatened social stability and people's quality of life. In order to prevent the occurrence of such disasters, it is necessary to strengthen the safety work in mines. At present, there are four main hidden dangers in mine safety in China: First, the geological conditions are complex and changeable, which increases the probability of mine accidents; Second, the lack of perfect monitoring system and advanced technical means; Third, the funds for investment in mine safety are limited; The fourth is the failure to solve the problem quickly, so that hidden dangers continue to accumulate. With the progress of human society, security issues have become an unavoidable fact. In the process of industrialization, people have to rely on natural resources to meet the needs of daily life, and in this process, the conflict between man and nature is inevitable. Therefore, improving the safety level of mine production has important practical value for both economic development and reducing mining costs. The use of modern information technology for mine safety management, has become a key means to enhance mine safety, reduce the possibility of mine safety accidents, reduce mining costs, improve economic benefits.

II. Underground mine mining characteristics

The mining activities of underground mines are mainly for the extraction of metals and non-metallic substances and the development of coal and oil. Except for oil and natural gas, which are usually drilled, the extraction of other resources depends on rock cutting or explosive methods and is completed by transportation. Although there are differences between underground and surface excavation, they have much more in common than their own. The biggest differences lie in the mechanical tools used and environmental factors. In contrast, the underground mining environment is more severe, with the following characteristics: first, the underground mine work flow is complicated and the line of sight is limited, the space is narrow; Secondly, due to poor ventilation, it is easy to cause toxic gas poisoning accidents; Third, because the visibility is limited, it is difficult for employees to accurately judge the geological situation, which will bring major risks to the safe operation of underground mines, such as misjudgment may lead to collapse, water gusher and other problems; Finally, once the goaf area is encountered, it is easy to cause the collapse of the ground, which poses a potential threat to the stability of the surrounding buildings, and may even induce underground vibration, endangering the stability of the entire system.

III. The types of disasters in underground mines

First, the disaster of the underground mine roof falling. This kind of accident is one of the dangerous events that are most likely to happen in the process of underground mining. Its main characteristics are rock stripping, large pieces falling off, collapse of poor geological areas, and so on. These risks are more likely to occur in mines with weak intercalations or poor ore stability and can lead to large-scale events that can cause major safety issues. Second, for some underground gold mines more than 1,000 meters deep, the high-pressure mining environment inside is prone to triggering large-scale geological explosive events (so-called “rockfalls”). The occurrence of this phenomenon is often accompanied by a huge roar and vibration, which will not only have a destructive impact on the buildings on the ground, but also may lead to serious safety problems such as collapse. Third, the underground mine surface collapse disaster. With the mining process, the influence of deep space and overdevelopment may lead to the movement of rock structures close to the ground, and then damage some buildings and routes on the ground, leading to the phenomenon of ground subsidence, and in extreme cases may cause the slide of the mountain. Fourthly, underground mine water inrush disaster. In the process of underground mine excavation, violation of regulations or abnormal excavation methods often lead to serious underground water inrush accidents. If there is stagnant water or goaf in the excavation area, or if there is underground undercurrent and other conditions, it may lead to sudden underground flood, which brings great risks.

IV. The application of information technology in underground mine safety

1. Construction of basic database

In order to create a mine database, it is necessary to collect and extract useful information from various related databases, and then summarize and combine it to form a unified mine database. The database should have the ability to update in time, and can adapt to the changing environment, so that the corresponding mine data can be transmitted to the central control room. In order to achieve this goal, the first need to build a real-time mine information database, the key to this step is to build an effective information acquisition system, which should be both rapid and accurate and highly automated. As the foundation stone of mine digital construction, such information system not only relies on advanced data processing technology, but also requires it to integrate the 3D model of the mine, so as to provide the ability of technical analysis and simulation mining; In addition, it should also be able to determine the location of the mine in the first time to ensure the safety and efficiency of mine operations.

2. Practical application of safety detection system

Ensuring personal safety is of Paramount importance to everyone, and we should be vigilant at all times to ensure our own safety. However, when conducting underground excavation operations, there are always potential risks and challenges; If we fail to take effective measures in advance to prevent accidents or equipment damage and other possible conditions, it will bring great risks and even fatal injuries to employees and facilities. Since these machines are often expensive and require significant investment of resources in research and development, they must be used with care and operated to avoid any possibility of injury. One of the ways to deal with such hidden problems is to build a set of long-term effective monitoring system, so that various kinds of crises can be detected and identified in time, and they are classified according to the severity of the treatment, and the implementation of refined control measures. With the help of information technology and human resources to achieve this goal, the probability of sudden disasters can be greatly reduced. In addition, by applying the functions of advanced spatial positioning (such as global navigation satellite) tracking systems, our early warning capabilities can be further improved to better cope with various unknown problems. In the past, people often relied on their own practical knowledge to judge the upcoming danger, but they could not completely predict all the potential problems, so they need to fully borrow technical advantages to provide reliable data support. With the continuous development of information technology, it is undoubtedly a wise choice to introduce it into the field of geological exploration. Through the use of related scientific and technological means to detect the state of surface and underground heat, and thus speculate the existence of potential underground gas, and then combine the collected data with the integration of information processing, communication and Internet and other technologies, to build a huge database. These data will be adjusted according to the changes in the actual situation, which helps to make accurate risk prediction of the security risks of mining enterprises. Therefore, an information-based safety monitoring system plays an important role in ensuring the stability of mines.

3. The practical application of safety management information system

After the establishment of the security system can not be lax, but also need to effectively manage the system. If the management is not in place, the role of the safety monitoring system will not be fully developed. Everything needs strict management standards. At present, the country is becoming more open, the economy is developing rapidly, and the problem of information security has become prominent. Therefore, a more secure management system is needed to ensure the security of national interests. China has developed the safety management information system, which can be applied safely and smoothly in all aspects. For the safety system, it is necessary to carry out effective management and take perfect measures to reduce the possibility of mistakes and accidents.

4. Monitoring the life safety of underground workers

It is very important to ensure the life safety of workers, and measures must be taken to safeguard their own safety during underground work. The safety of people’s lives is a bottom line of principle that cannot be touched. The government and relevant agencies need to do everything possible to protect the safety of underground workers by using advanced information technology to monitor their conditions in real time to ensure their safety. GPS and other measuring and positioning devices can be set up in underground mining areas to build a safety

monitoring system, which can send alerts to notify workers before a crisis occurs, thus reducing the probability of hazardous incidents. In addition, the mine can be monitored by satellite systems, mobile cameras can be installed, and the changes of the mine and the behavior of its employees can be continuously monitored, and the safety of employees can be always given priority. Once a safety monitoring system is in place and personnel are on duty at the control center 24/7, on-site rescue operations can be quickly directed. Without such a system, the scene would have been chaotic, unable to quickly launch rescue operations, and could have escalated the disaster. If a surface communication network is difficult or expensive, wireless communication can be used. The aim is to keep underground workers in contact with the main monitoring system, even in harsh conditions or under intense magnetic field interference, so that rescue plans can be launched immediately in the event of a mine disaster.

5. Application of safety management system

Perfect information management system and the management and maintenance of emergency rescue system are the basis for the effective operation of safety management information system. In addition to the management and control of mine supervisors, it can also be connected with other systems for assessment and response. Through timely evaluation, timely management of mine production, adjustment of ventilation, drainage, dust prevention, communication and other aspects, timely solution of problems, improve the overall safety of the mine. It is of great practical significance to study the safety monitoring of underground mines, especially to study the full application of information technology in underground mines. It is a long process from information collection to the establishment of a complete information base to the combination and perfect application of information technology with the actual situation of the mine. Only through continuous progress can the occurrence of mine safety accidents be effectively reduced. Improve the safety of underground mine mining and promote the sustainable development of the entire mining industry.

References:

- [1] Yan Zhuang. Deeply Cultivating the Mining Field and being the forerunner of Mine Safety Intelligent Technology -- An interview with Peng Ping 'an of Central South University [J]. Science and Technology Review,2023(7):72-76.
- [2] Lei Zhang. Discussion on the application strategy of electronic information Technology in Mine engineering safety monitoring [J]. Science and Information Technology,2020(7):1.
- [3] Yangyang Chen. Research and application of intelligent mining inspection control system in underground phosphate rock [D]. Wuhan Institute of Technology,2023.
- [4] Xuedian Liu, Bin Li, Changyong Qin, et al. Research on Application of Information Technology in Mining Machinery Management [J]. Modern Corporate Culture,2017(35):2.