

# Discussion on the Progress of Safety Risk Management in Underground Engineering in China

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## Abstract

China's underground projects are characterised by large scale, fast speed, long construction period, complex operation and difficult engineering safety. Various accidents have been reported, causing great economic losses. At the same time, the loss of life and property has also brought serious social impact. This report introduces the main progress of safety risk management in urban underground engineering in China.

## Keywords

**Underground Engineering; Safety Risk Management; Standardization and Rationalization.**

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## 1. Introduction

In the past decade, the number of tunnel engineering accidents in China has shown an upward trend. Generally speaking, tunnelling works may cause ground deformation, may affect ground buildings and road traffic safety, and fear irreversible losses. According to statistics, from 2008 to 2001, the risk safety management of underground tunnelling projects did not improve significantly. The causes of most liability accidents.

are essentially similar. Poor skills and poor management, including dangerous improvement performance. Unfavourable hydrogeological conditions, groundwater or heavy rainfall, and weak soil layers are the objective causes of tunnel engineering accidents. The collapse and damage of tunnels is the most important type of accident in tunnel engineering, accounting for 60% of the total accident record. In addition, explosions, pipeline damage and rock explosions are also common causes of underground engineering accidents. The injuries and mortality caused by accidents vary.

The Chinese government attaches great importance to the risk management of underground space construction. We will vigorously promote the standardization and rationalization of safety risk management in urban underground space engineering in China.

## 2. Progress in Security Risk Management

In the past decade, China has made great efforts in the management of urban underground engineering safety risk enterprises, the formulation of risk safety management laws and regulations, the strengthening of management system plans and related data technologies. Combine expert opinions, researchers' leaders and government departments to establish a sound risk safety management system by means of culture, management, technology, laws and regulations.

### 2.1 Establishment of Laws and Regulations

In the past decade, the main progress made in the construction of laws and regulations in China is as follows:

### 2.1.1 Construction of Urban Subway System

China's Ministry of Housing and Urban-Rural Development issued the Interim Provisions on the Safety and Quality Management of Urban Rail Transit Projects in January 2010. It clearly stipulates risk assessment, risk monitoring and emergency response measures, and emphasizes "strengthening safety and quality risk management throughout the construction of urban rail transit projects".

### 2.1.2 Railway Construction

The Interim Provisions on Safety Risk Management for Railway Construction promulgated by China in September 2010 stipulates that risk management will be extended from tunnel projects to various railway projects. In 2014, China Railway Corporation issued the Technical Specifications for Railway Construction Risk Management.

### 2.1.3 Traffic Works

The Ministry of Transport of China issued the Safety Risk Assessment Guide for Road, Bridge and Tunnel Design and the Safety Risk Assessment Guide for Road, Bridge and Tunnel Engineering in 2010 and 2011. On this basis, a risk assessment policy has been formulated.

## 2.2 Implementation of the Security Risk Management System

China's underground construction safety risk management system has been built from five aspects: organizational structure system, safety culture system, technology management system, disaster prevention and early warning system, and project insurance system. In the construction of urban rail transit, safety risk management has been applied to the construction of subway lines in Beijing, Shanghai, Guangzhou, Shenzhen, Nanjing, Chengdu and other cities. A land safety risk management system is slowly being established.

### 2.2.1. Engineering Overall Technical Management and Risk Control

Risk identification is carried out at the planning and audit stages. At the design stage, the source of risk must be avoided or mitigated. Attention should be paid to risk control and management during construction. Risk assessment and tracking should be strengthened in the post-construction stage.

### 2.2.2. Risk Assessment, Control and Prevention of Risk Sources

The security risk assessment and outline control system need to be fully implemented. Through risk safety identification, risk assessment, hierarchy management and expert prior inspection, security risks can be mitigated or roughly eliminated. At the same time, we will strengthen the management methods and measures of potential risks, and formulate corresponding emergency response measures to ensure that risks are controlled.

### 2.2.3 Implement the Safety Responsibilities of All Parties

Implement reasonable contract reward and punishment measures to strengthen the safety responsibilities of all parties involved in underground projects.

### 2.2.4. Process Monitor

Managers will pay attention to on-site actions during construction. Strengthen dynamic management, implement effective monitoring processes, and implement supervision measures and codes of conduct. On the basis of third-party monitoring, multiple dangerous sources can be tracked in real time. Carry out conditional acceptance of key points before construction to effectively control major risks. On-site inspection is adopted to dynamically control potential safety hazards. On the basis of the integration of design, construction and management, relevant institutions have been formed to improve the ability of space safety protection. Select appropriate and effective governance measures according to the level of early warning management.

## 3. Security Risk Management Faces New Challenges.

China has made great progress in safety risk control in underground projects, but there are still many topics in terms of personnel safety behavior and safety risk management technology innovation.

### 3.1 Challenge 1: Personnel Safety Behavior

In 2014, the number of civil workers in China reached 274 million. Among them, 61.09 million migrant workers in the construction industry, accounting for 22.3% (National Bureau of Statistics, 2014). The education level of migrant workers in the construction industry is low, and the level of safety awareness and knowledge is low. Therefore, by controlling various safety irregular behaviors of managers and workers, safety accidents in underground projects can be prevented.

### 3.2 Challenge 2: Innovation in Security Management Technology

According to the characteristics of underground space engineering, combined with experience, equipment and observation results, abnormalities can be detected in time, appropriate countermeasures can be taken to eliminate them before disasters and accidents occur, and losses can be reduced. The Building Information Model (BIM) can integrate security management and use security information sources to prevent the disappearance of security information. The BIM method can be used to realize the full-cycle risk safety management of subway projects.

## 4. New Strategy for Security Risk Management

### 4.1 Objects of Underground Engineering Safety Risk Management

Under the background of China's comprehensive deepening of reform and promoting the spirit of governing the country according to law, relevant laws and regulations are also being reformed and improved. Therefore, the overall goal of underground engineering risk safety management in China is that the policies and systems of safety risk management should be built and popularized in China. Reform the security supervision and management system and mechanism, improve the supervision mode, and strengthen the supervision force. Introduce market economy means to guarantee guarantee policies. Reform the employment policy and formulate a qualification licensing system. By 2020, the safety production situation of underground space projects across the country will be greatly improved, and major accidents will be effectively suppressed. By 2030, the safety management of underground works has been greatly improved.

### 4.2 Strategy

Based on the progress and challenges discussed in the previous sections, China's underground engineering safety risk management model is still at the primary or low level in some areas. The main task of policymakers and researchers is to actively guide the safety risk management model of underground engineering to the intermediate level of systematic and scientific safety risk management, and gradually change to the advanced level of safety culture.

## 5. Conclusion

This paper discusses the main progress of safety risk management of urban underground space engineering in China. The past experience of risk safety management in many developed countries shows that by adhering to the rule of law and scientific management for a long time, a highly systematic and scientific security risk management with a safety culture can be achieved. From the safety risk management system, a new plan for safety risk management for future underground construction in China is put forward. Only in this way can we fundamentally improve the risk and safety management in our country.

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