

Construction of Control Information System and Dynamic Safety Risk Management for Metro Construction

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Abstract. The index system of on-site and surrounding environment monitoring and on-site inspection has been established, and according to the information platform, 8 modules of subway construction dynamic safety risk management and control information system are developed, and the mobile phone APP function is integrated, which is applied to the whole process of subway construction risk management and control. The results show that on-site patrol and risk points dynamic tracking is the core work of the subway construction risk dynamic management; The use of risk management and control information system can improve the efficiency of risk management during the subway construction. The integration of mobile phone patrol APP can improve the timeliness of risk control.

1. Introduction

Metro is favored by more and more cities for its advantages of safety, less environmental pollution, fiducial point, large carrying capacity and low energy consumption[1]. Compared with other constructions, it has the prominent characteristics of complexity and uncertainty, especially in areas with busy urban or complex surroundings, the construction and operation of rail transit projects involve a large number of remove and their impact on the surrounding buildings, environment and line pipe[2]. If the decision-making is ill-conceived, it will cause great losses to society and country and make negative social impact in planning, design, construction and operation[3]. For this reasons, aiming at the risk points in the process of subway construction, this article structures the index system of scene and its surrounding environment on monitoring and inspecting. And develops the dynamic safety risk management and control information system of metro construction according to information platform, which integrates the function of mobile APP, and use it to the whole process of risk management and control in a subway construction. In this way, the safety management level of subway construction can be effectively improved.

2. Dynamic risk management of subway construction

Dynamic risk management is different from static risk management[4]. It's main characteristics are reflected in: ①Dynamic risk management runs through the whole process, not a certain stage, or a certain project node, which requires a cyclic system in the whole project cycle. ②Dynamic risk control requires dynamic tracking of risks, with the construction of the project, re-estimate re-discriminate, re-analysis, re-treatment and re-improvement to realize dynamic circulation. Metro dynamic risk estimate runs through the whole construction process, dynamic risk estimate is divided into two categories: Monthly risk assessment by the construction unit, and daily comprehensive assessment by the risk consulting unit in combination with monitoring data and patrol information of all parties[5-6].



Managers at all levels of participating units can consult, instruct, respond and feedback dynamic risks in the safety management information system at all times[7].

It can be seen that the focus of dynamic risk management in subway construction is to dynamically track identified risks and newly discovered risks, to really contain the hidden dangers in the bud. The process of dynamic risk assessment is shown in Figure1.

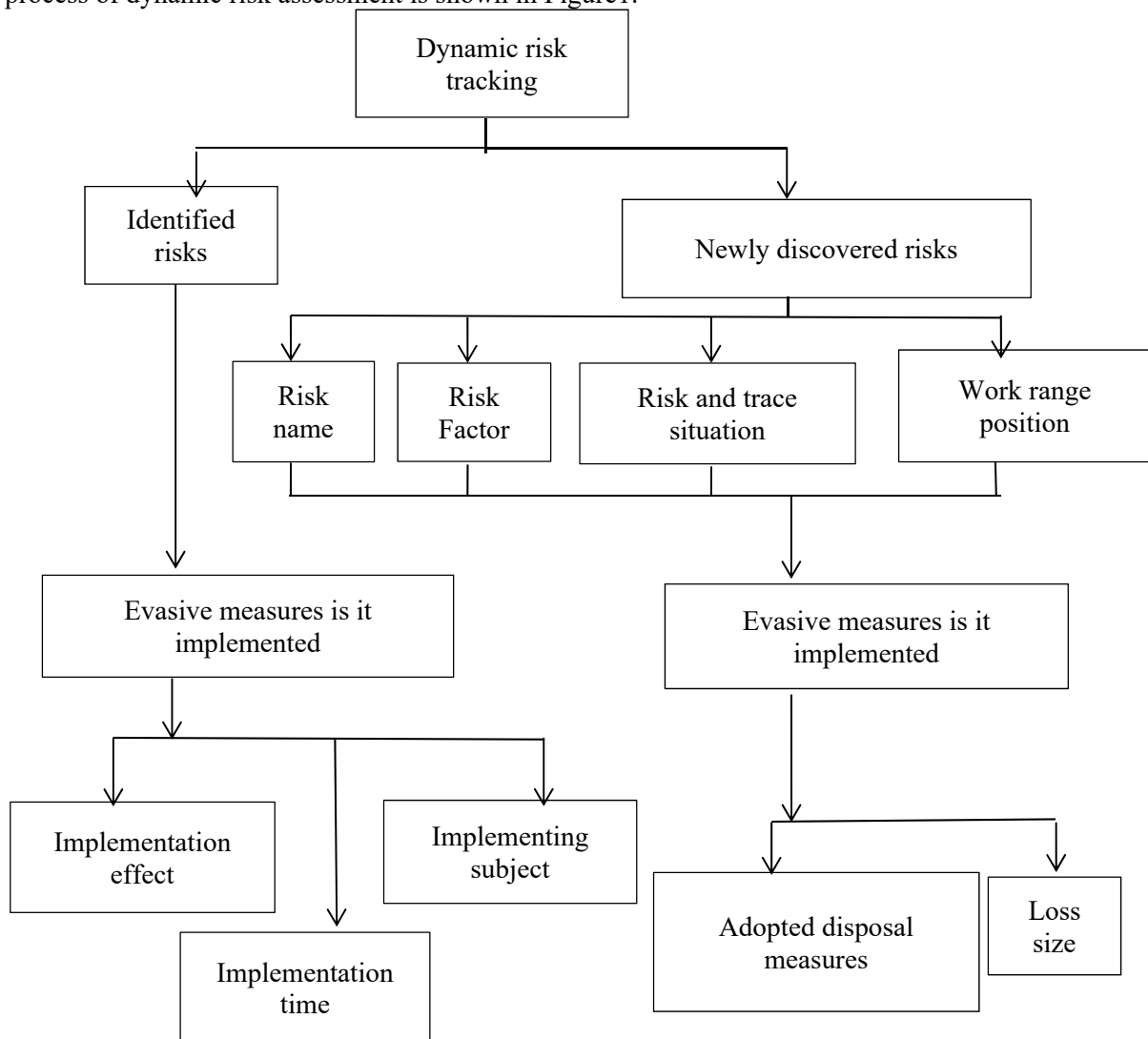


Figure1. Dynamic risk assessment process.

3. site inspection and dynamic tracking of risk points in subway construction

Site inspection and dynamic tracking of risk points are important parts in safety risk monitoring and management of construction site. Among them, the site inspection is mainly the investigation and understanding of the safety risk state of the construction site, the inspection of the key parameters of the construction progress and the inspection of the construction site. Through the site inspection, the safety risk state of the construction site can be grasped. As an important basis of dynamic risk assessment, combined with the analysis and prediction results of third party monitoring data, a reasonable decision is made. Dynamic tracking of risk points refers to the follow-up and observation of the development of major risk points, the supervision of the implementation of risk aversion measures, and the timely discovery and treatment of unidentified risk points.

Dynamic tracking of risk points is the biggest characteristic of dynamic risk management, which is different from conventional risk management.

3.1. site inspection

According to the actual situation of subway engineering, the index system of subway construction site and its surrounding environment monitoring and site inspection under different working methods is shown in Table 1.

Table1. index system for monitoring and inspection of subway construction site and its surrounding environment

Working method and content	Environmental monitoring content	Onsite inspection content
Ming /cover Excavation method	Surface subsidence, groundwater level, Porewater pressure	Whether there is surcharge around the foundation pit
Shield method	Structural uplift or settlement, horizontal displacement	There are three sealing conditions, unearthed temperature
Mining method	The arch roof settles, Horizontal convergence, surface settlement	The inspection in the cave has geological characteristics, Rock or soil
Peripheral environment	Building	Settlement, differential settlement
	Bridge / Bridge pile	Settlement and Inclination of bridge Piers and abutments
	Existing Railway line	The deformation of the Staggered platform, the lateral differential settlement of the track
	Underground pipelines	Settlement and differential Settlement, deformation curvature
	road	Subsidence of pavement and roadbed
	Rivers / lakes	Leakage of overlying soil, hydraulic Connection

3.2. Risk point dynamic tracking

In view of the actual situation of subway construction, considering the excavation of station foundation pit, the construction of main structure, the origin and arrival of shield and the influence of surrounding environment and structure of shield, the flow of dynamic tracking for major risk points is shown in figure 2.

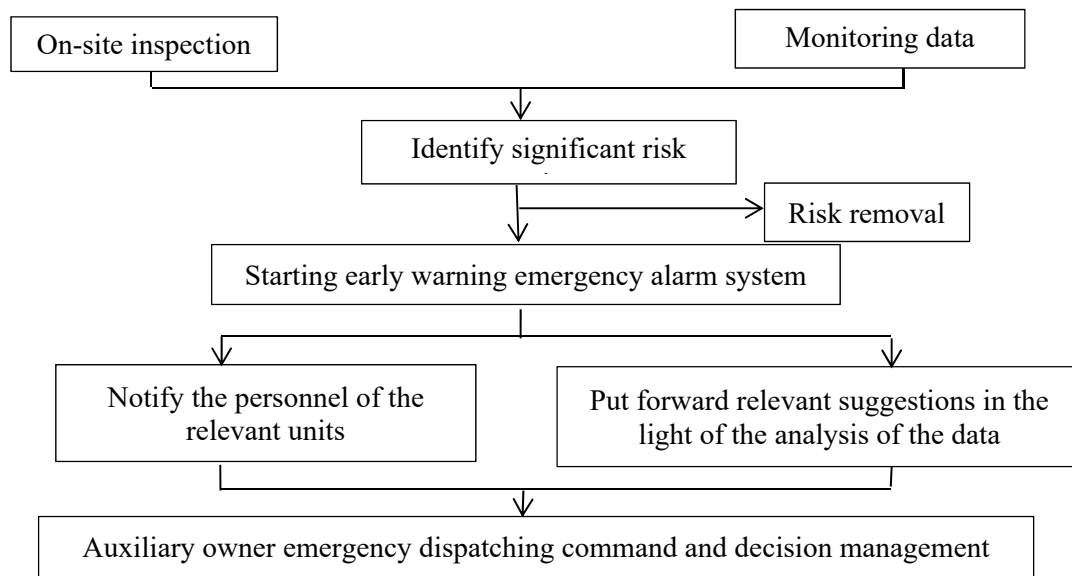


Fig2. Flow chart of significant risk point dynamic tracing

4. Development and application of subway construction dynamic safety risk management and control information system

4.1. The function

The function of the subway construction dynamic safety risk management information system is in every link of urban rail transit safety risk management, making full use of scientific methods and technologies including computer, networks, databases, etc. To collect, store, process, process and assist in decision-making of various information of subway construction projects can effectively improve the construction safety management level of subway construction projects, reduce the probability of risk accidents, improve the management efficiency, and ensure that subway construction projects can be carried out on time, with good quality economically safely and smoothly.

Through the research and development of the subway construction dynamic safety risk management and control information system, the project construction monitoring data and emergency rescue related data of the construction in process line stations are collected and stored, which can realize the management and statistical analysis of monitoring data, the management of grand risk points, the management of safe early warning, the evaluation of safety situation and the analysis and evaluation of experts, etc. It provides a collaborative work station for the construction units and all participating units to carry out safety management, strengthens the emergency disposal abilities, promotes the development of safety production management in a scientific, institutionalized and information direction, advances the control to disposal. A subway construction safety risk management and control information system developed has 5 modules and 12 functions, see table 2 for specific functions.

Table2. Function of dynamic safety risk management information system in subway Construction

Number	module	Function	Function description
1	Comprehensive information	Notices and announcement	The management of notification and announcement information can be realized by browsing
2		Early warning for disposal	the early warning information generated by the system is displayed of, It can be browsed and disposed of etc.

3	Risk management	Site inspection	To establish the problems found in the daily on-site inspections at various work stations
4		Analysis and prediction of expert	Realize a summary of the information formed by experts' analysis and prediction on risk management
5	Safety rectification and premanagement	Early warning management	Early warning and alarm information can be prompted through data summary report forms
6		Safety early warning disposal	Realize closed-loop management response, alarm elimination
7		Comprehensive early warning and patrol early warning	Displays the early warning in the daily patrol of the risk management unit or the third-party monitoring unit or the early warning jointly issued by multiple parties
8	Engineering data management	Construction unit	Construction unit progress weekly report, construction organization design
9		Supervision unit	Supervision unit on-site records, daily inspection records, supervision planning rules, etc.
10		Third party monitoring unit	Monitoring plan and monitoring plan of the third party monitoring unit, etc.
11	Emergency management	Emergency plan management	In the process of emergency rescue, to achieve the matching of plans, resource query, etc.
12		Expert team management	Mainly for safety risk consultation and emergency rescue and disposal technology experts

4.2. Application of mobile phone patrol APP for safety risk control

With the increasingly mature Android, Apple and other system technologies and the key information of rail transit project construction management as the data source, it is possible to timely grasp the safety status of the project construction and obtain emergency decision support through the mobile phone system. The functions of the mobile phone patrol APP developed mainly include daily safety patrol, early warning and prediction and timely acquisition and reporting of information such as experts, rescue materials, personnel in emergency statue.

5. Conclusion

Establishment of on-site and surrounding environmental monitoring and on-site inspection index system can make subway construction risk control modular, standardized, systematic, more targeted and better risk control.

Research and development and use of the subway construction dynamic safety risk management information system can mark the safety risk management records of the construction units and all participating units, implement the safety risk management responsibilities of participating parties, implement the process records of the daily safety risk management work of all participating parties, achieved trace ability, greatly improve the efficiency of risk identification, avoid a large number of office supplies use.

Development and use of mobile patrol APP is in favor of timely notification and emergency response information, and can assist engineering safety management personnel to carry out save management work.

Acknowledgments

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