

# Emergency Events Analysis in Metro Construction Project<sup>1</sup>

Gang Chen<sup>a,b,\*</sup>, Kefan Xie<sup>b</sup>, Qian Wu<sup>b</sup>

<sup>a</sup>*School of Economics & Management, Wuhan Sport University, Wuhan, 430070, P. R. China*

<sup>b</sup>*Institute of Systems Science and Engineering,, Wuhan Institute of Physical Education, Wuhan, 430070, P.R. China*

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## Abstract

This paper analyzes various emergency events in metro engineering construction project. The paper divides the emergency events in metro engineering construction project into three types: conventional emergency event, semi-conventional event, and unconventional event. The paper also gives an associating diagram of emergency events in metro engineering construction project.

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*Keywords:* Metro construction project; emergency events; unconventional events; Engineering

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## 1. Introduction

At present time, industrialization and urbanization has become the main contents of economic and social development in China. Metro engineering construction as one of the most important projects begins in many large-and-medium size cities right now, such as Beijing, Guangzhou, Shanghai, Wuhan, Dalian, and Hangzhou etc. However, the newly emerging industry is also followed with a number of security incidents. For instance, 21 people were killed in Hangzhou metro site collapse accident on November 15, 2010; 2 people were killed by collapsed accident in Xi'an Golden bridge station construction site on August 2, 2009; the subway lines 9 and 11 under construction caused a continuity of construction accidents which killed 2 people and injured 3 people. Similar emergencies occur frequently and have impact on engineering production safety which gets increasing concern by the local governments, builders and the citizens.

Some researchers pay attention to risk management of metro construction. For instance, Zwerling et al (1996)<sup>[1]</sup> study the patients who suffer injury in construction works .Zhang and Luo (2007)<sup>[2]</sup> analyze the environmental safety risk in metro construction. Kines et al. (2007)<sup>[3]</sup> study how to efficiently reduce serious injuries in construction industry. However, the researches about the emergency analysis process of metro construction are rare which means that the development of metro construction emergency is significant important in order to reduce damage caused by construction disaster.

In additional, engineering risk management in major events, especially emergency response has been studies more and more nowadays, which is under the situation that unconventional emergencies occur frequently and make

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\* Corresponding author. Tel.: +86 15327312350, E-mail address: [cg224@163.com](mailto:cg224@163.com)

great threat to people's life now. Lorincz et al. (2004)<sup>[4]</sup> develop emergency response methods by introducing sensor networks. Murray et al. (2006)<sup>[5]</sup> develop a set of general and supporting design principles and specifications for a dynamic emergency response management information system. Chen et al. (2008)<sup>[6]</sup> develop a framework to analyze coordination patterns occurring in the emergency response life cycle.

The paper proposes three factors of engineering emergency in metro construction project, event rarity, time urgency and consequence seriousness to analyze the emergency severity by classifying emergency into different scales. The rest parts of this paper are organized as follows. Section 2 introduces different types of metro construction emergency. Section 3 introduces evaluation methods to analyze emergency scale in metro construction project. Section 4 gives an example of metro construction emergency. Section 5 draws conclusions.

## 2. The types of emergency events in metro construction project

Emergency refers to the events that suddenly happens, causes or would cause casualties, property damage and environmental damage which has significant social impact or risk to security. Therefore, emergency has characteristics of sudden, urgency and harmfulness in general, which are usually reflected in economic and social life and metro construction as well. Based on this, metro construction emergency refers to the unexpected and risk occurrences which happen by the risk factors (Yuan, 1996)<sup>[7]</sup> leading to casualty, property damage, environment disruption and social negative influence in the process of construction.

Compared with common emergencies, metro construction emergency has several significant characteristics as follows: (1) dynamics. Once occurs, metro construction emergency can not be controlled in time but will develop to new trends contrarily. Therefore, its dynamics leads the response more timely to cope with metro construction emergency; (2) complexity. Many factors such as construction environment, builder, construction method and its management etc. will affect the project implementation in the metro construction process, which also make the emergencies extremely complex; (3) difference. Construction environment is the leading factor of metro construction emergency. Since that the construction environments are totally different in various projects and project stages, emergencies in metro construction have high difference among each other. Those three characteristics lead to more complication in assessment, grading and classification of metro construction emergency.

### 2.1. Types and their descriptions of metro construction emergency

There are many kinds of security incidents in the process of metro construction. The security events can be classified into different categories from different perspectives. For instance, in terms of impact scope and extent of emergency, metro construction emergencies are divided into extraordinarily serious accident, major accident, comparatively large accident and ordinary accident. Moreover, metro construction emergency can be divided into three types of emergencies based on frequency of occurrence: conventional emergency, semi-conventional emergency and unconventional emergency.

#### (1) Conventional emergency

Conventional emergency is an important type of metro construction emergency, which refers to the accidents that frequently occur and can be controlled in certain extent in the process of metro construction. Metro builders often develop appropriate contingency plans to cope with such conventional emergencies. Therefore, the impact of conventional emergencies on project and society can be controlled effectively. The focus of emergency response is to make relevant contingency plans and implement them with efficiency.

#### (2) Unconventional emergency

As opposed to conventional emergency, unconventional emergency refers to the emergency that has some precursor inadequate, with significant features of complexity and potential hazards of secondary derivatives, destructive serious, and can not be deal with by the routine management of emergency (Han, et al., 2009)<sup>[8]</sup>. Therefore, such emergencies are often difficult to control in the metro construction process. It should focus on the early warning and respond command in order to manage them.

#### (3) Semi-conventional emergency

Semi-conventional emergency has the characteristics which can be found both in conventional and unconventional emergency and is one of the most important components in metro construction emergency. Semi-conventional emergency refers to the emergency events that occur frequently, and have counter-measures to cope with which usually make poor performances or could not be implemented by the factors of disaster environment,

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