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Quantitative method on miners emergency response capacity

ZHANG Jiang-shi[1*a,b],HE Pan-pan[a],GAO Shu-shan[a],TAO Jia[a]

[a]*Faculty of Resource & Safety Engineering, China University of Mining and Technology, Beijing 100083, China*
[b] *State KeyLaboratory of Coal Resources and Safe Mining (China University of Mining and Technology, Beijing) Beijing 100083, China*

Abstract

A quantitative method is made to evaluate miners' emergency response capacity. Firstly, based on the safety engineering practices, an evaluation index system of individual emergency ability is established, and a hierarchical structure is set up, which includes security physiology, safety ability, individual psychology and sentiment in the top level. Secondly, Analytic Hierarchy Process is applied to determine each index's weight reasonably. Thirdly, fuzzy mathematical method is used to conduct the evaluation of single factor and the overall comprehensive evaluation respectively. Finally, for engineering practices, the method is used in a certain coal mine, and a set of appraise data is obtained, results shows that the quantitative method is help to select safety employers and reduce human-initiated mining accidents.

Keywords: safety engineering, miners, emergency response, quantitative method

1. Introduction

Improving miners' behaviours not only effectively prevent accidents, but also significantly increase safety performance [1]. So there will be of great realistic significance if we can evaluate miners' emergency response capacity truly and realistically which helps miners adapt post demands. Through analyzing human's safety behavior producing process of every link and each link's demanding emergency ability, and reviewing documents, this paper establishes an index system of individual emergency response ability based on safety behavior producing process, and it combines AHP with two hierarchical evaluation model to evaluate comprehensively , with this it obtains scientific and reasonable evaluation results.

As for the emergency response capability evaluation index system, many literatures are reviewed and analyzed. Liu Guojiang selects safety consciousness, knowledge and skills, emotional intelligence and physiological factors as the first grade indexes[2]. Liu Chao, Luo Yun and other people choose safety knowledge, safety capability, safety physiology and safety psychology[3].Zhang Jinggang, Tan Yunzhen and other people list professional quality, physical quality, safety consciousness and safety education[4].Wang Shuangying use safety technology quality, cultural quality,safety psychological(quality, cultural awareness and safety training[5]. Chen Liyan assorts cultural quality, professional ethics, situation cognition and decision-making, and work abilityand and so on[6]. From above it shows the division of index systems' first grade index has no theoretical basis and standards, and it mainly conducts with perceptual experiences. This paper selects security physiology, safety ability, individual psychology

* Corresponding author. Tel.: +86-010-62331115.
E-mail address: zjsh0426@163.com.

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and sentiment as first grade index. Compared with other index system, this system is more improving, and the classification is more standard.

2. Construction of Fuzzy Comprehensive Evaluation Model

Fuzzy Comprehensive Evaluation Method is a comprehensive evaluation method based on fuzzy mathematics principle [7, 8], this method uses fuzzy mathematics to make a whole evaluation about a subject is restricted by multiple factors. It has the features of strong in result and clear in result. It can well solve problems that are vague and difficult to quantify, and it is suitable for the solutions all kinds of uncertain problems.

2.1. Establishment of Evaluation Index System

The establishment of evaluation index system is an important part of the whole safety assessment work; it determines the scientific and objective degree of evaluation results. On the basis of investigation of large numbers of miners' emergency response ability and with reference to relevant materials document to analyze accident cases, the writer picks 4 first grade assessment indexes--safety physiology, safety ability, individual psychology and sentiment，and also select 14 second grade indexes. The constructed index system is shown below in figure 1.

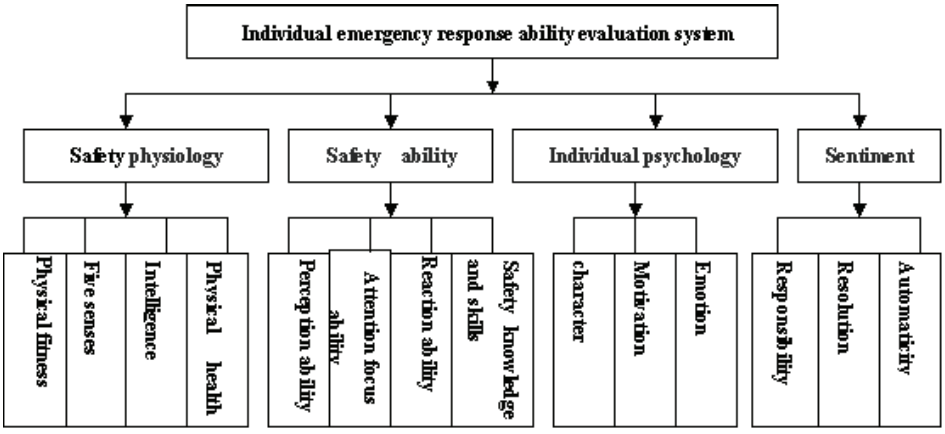

Figure 1 Individual emergency response ability evaluation index system

2.2. Establishment of Factor Set and Evaluation Set

Factor set is a collection of each factor affecting evaluation object. When there are many factors influencing assessment object, it will lead to the disappear of some small weight factors if using first grade fuzzy assessment model, at this time it's more reasonable to use secondary fuzzy comprehensive evaluation. Suppose first grade factor set affecting evaluation object as: $U = \{U_1, U_2,\ldots, U_n\}$. Suppose secondary single factor set affecting evaluation object as: $U_1 = \{u_{11}, u_{12}, \ldots, u_{1n1}\}$, $U_2 = \{u_{21}, u_{22}, \ldots, u_{2n2}\}, \ldots, U_n = \{u_{u1}, u_{n2}, \ldots, u_{nnn}\}$.

Comment set is a collection of m evaluation grades regarded as evaluation standard, denoted by $V = \{V_1, V_2, \ldots, V_m\}$. Comment grade must be chose properly, considering that three grades comment is too rough, and seven grades comment is too detailed, this paper selects five grades comment set as: $V = \{V_1, V_2, V_3, V_4, V_5\}$ = {very good, good, moderate, bad, very poor}..

Judgment matrix R is obtained by the relationship between U and V, Denoted by $R=(r_{ij})_{n\times m}$ (j=1,2，…, m）. Type: r_{ij} refers to the extent of u_i in U belonging to V, valuing the grade which factors belong to as 1, otherwise value it as 0. If it's uncertain to determine which grade a factor belongs to, any number between 0 and 1 can quantitatively describe fuzzy object by means of experience.、

2.3. Establishment of Weight Set and Determination of Index Weight