



# Predicting safety hazards and safety behavior of underground coal mines

Hongxi Di<sup>1,2,3,4</sup> · Asma Sbeih<sup>5</sup> · F. H. A. Shibly<sup>6</sup>

Accepted: 3 August 2021

© The Author(s), under exclusive licence to Springer-Verlag GmbH Germany, part of Springer Nature 2021

## Abstract

Most coal mine accidents are attributed to the miner's unsafe behavior. Regulating the safety attitude and thus enhancing miners' safety behavior are significant for accident prevention. Capturing the interrelations between risks is important to understand and promote coal mining safety thoroughly. Therefore, this paper proposes the intelligent accident predictive framework (IAPF) for monitoring and analyzing the safety hazards and safety behavior of underground coal mines. The most significant variables involved in occupational accidents and their association rules have been identified. These rules are composed of numerous predictor variables that cause accidents, describing their characteristics and environment. The accident model path analysis demonstrates that adverse effects, risk-taking behaviors predict and job dissatisfaction an increased number of injuries in mines. The IAPF model gives an outcome as an indicative risk score linked with the identified accident-prone situation, based upon which an appropriate mitigation plan can be established. The results show the most typical instant causes and the percentage of accidents with a basis in every connotation rule. The experimental results of IAPF show the highest prediction ratio of 97.5%, safety rate of 96.3%, security rate of 95.4%, and lowest accident rate of 22.6%, energy consumption ratio of 28.6%, carbon management ratio of 25.3% and hazard risk ratio of 20.2% compared to other methods.

**Keywords** Safety hazards and safety behavior · Underground coal mines · Prediction framework

## 1 Summary of predicting safety hazards of underground coal mines

Underground coal mining is mainly referred to as one of the most hazardous jobs in which there are common choking accidents, gas toxicity, building failure, rock

blasts, and gas explosions (Dash et al. 2021). According to the coal mine safety involving several accident coal mining accidents in state government (Nguyen et al. 2021). The high rate of accidents is the closing of several unauthorized underground mines and investment in technology improvement to control, predict, and eliminate hazards in violation of the government's strict safety standards in the

Communicated by Vicente Garcia Diaz.

✉ Hongxi Di  
hxd@ustc.edu.cn

Asma Sbeih  
asma\_sbeih@paluniv.edu.ps

F. H. A. Shibly  
shiblyfh@seu.ac.lk

<sup>1</sup> College of Management, Xi'an University of Science and Technology, Xi'an 710054, Shaanxi, People's Republic of China

<sup>2</sup> School of Management, University of Science and Technology of China, Hefei 230026, People's Republic of China

<sup>3</sup> Energy Economy and Management Research Center, Xi'an University of Science and Technology, Xi'an 710054, People's Republic of China

<sup>4</sup> HeNan Newvid Technology Co., Ltd, Luoyang 471000, People's Republic of China

<sup>5</sup> Dr Computational Neuroscience, Engineering and Information Department, Palestine Ahliya University, Bethlehem, Palestine

<sup>6</sup> Senior Lecturer in Information Technology, South Eastern University of Sri Lanka, Oluvil, Sri Lanka