



# Applying data mining techniques to explore factors contributing to occupational injuries in Taiwan's construction industry

Ching-Wu Cheng<sup>a</sup>, Sou-Sen Leu<sup>b</sup>, Ying-Mei Cheng<sup>c</sup>, Tsung-Chih Wu<sup>d,\*</sup>, Chen-Chung Lin<sup>e</sup>

<sup>a</sup> Department of Safety, Health and Environmental Engineering, Ming Chi University of Technology, 84 Gungjuan Rd., Taishan District, New Taipei City 243, Taiwan

<sup>b</sup> Department of Construction Engineering, National Taiwan University of Science and Technology, 43 Keelung Rd., Section 4, Taipei City 106, Taiwan

<sup>c</sup> Department of Civil Engineering, China University of Technology, 56 Hsing-Lung Rd., Section 3, Taipei City 116, Taiwan

<sup>d</sup> Department of Safety, Health and Environmental Engineering, HungKuang University, 34 Chung-Chie Rd., Shalu District, Taichung City 433, Taiwan

<sup>e</sup> Institute of Occupational Safety and Health, 99, Lane 407, Hengke Rd., Sijhih District, New Taipei City 221, Taiwan

## ARTICLE INFO

### Article history:

Received 24 October 2010

Received in revised form 6 April 2011

Accepted 8 April 2011

### Keywords:

Construction industry  
Occupational accidents  
Data mining  
Safety management  
Data analysis

## ABSTRACT

Construction accident research involves the systematic sorting, classification, and encoding of comprehensive databases of injuries and fatalities. The present study explores the causes and distribution of occupational accidents in the Taiwan construction industry by analyzing such a database using the data mining method known as classification and regression tree (CART). Utilizing a database of 1542 accident cases during the period 2000–2009, the study seeks to establish potential cause-and-effect relationships regarding serious occupational accidents in the industry. The results of this study show that the occurrence rules for falls and collapses in both public and private project construction industries serve as key factors to predict the occurrence of occupational injuries. The results of the study provide a framework for improving the safety practices and training programs that are essential to protecting construction workers from occasional or unexpected accidents.

© 2011 Elsevier Ltd. All rights reserved.

## 1. Introduction

### 1.1. Background

According to the International Labour Organization (ILO, 2003), approximately two million people die while at work every year. In the construction industry alone, at least 60,000 people die on construction sites and many hundreds of thousands sustain serious injuries or contract occupational diseases. These figures are, in fact, conservative estimates. Hamalainen et al. (2006) estimated that there were approximately 350,000 fatal occupational accidents and 264 million nonfatal work-related accidents around the world in 1998. Chi and Wu (1997) analyzed 1230 occupational injury incidents in Taiwan and found that most accidents occurred in the construction industry (662, 50.6%). Many recent studies (Chi and Chen, 2003; Chi et al., 2004; Liao and Perng, 2008; Lin et al., 2008) have also indicated the gravity of occupational injuries in Taiwan's construction industry. The occupational safety and health issues of this industry are thus worthy of further discussion.

According to the Labor Safety and Health Act (LSHA) of Taiwan, a major occupational accident is defined as "an accident that causes injuries to three or more persons or causes the death of at least

one person at the time it occurs" (LSHA, 1991). As noted above, the construction industry in Taiwan (and elsewhere) has a very high incidence of such major occupational accidents (Chi et al., 2005; Liao and Perng, 2008; Cheng et al., 2010b). According to the Yearbook of Labor Statistics published by the Council of Labor Affairs, the rate of fatalities per 1000 workers in the construction industry in Taiwan (excluding deaths from occupational disease and traffic accidents) was 0.13 in 2008, which is much higher than the fatality rate from accidents in other industries.

Many reasons have been proffered in answer to the question of why the construction industry has such high accident rates. These include: (1) the inherently hazardous nature of construction projects; (2) personnel factors; (3) environmental and equipment factors; (4) project factors; and (5) management factors (Sawacha et al., 1999; Fabiano et al., 2004; Tam et al., 2004; Chi et al., 2005; Cheng et al., 2010a,b). In view of the fact that virtually all types of work accident involve a combination of multiple factors, it is likely that no single factor can be identified to provide a complete explanation for the high incidence of serious work accidents in Taiwan's construction industry.

In these circumstances an alternative solution is to use modern information technology to identify key associations between relevant factors among the mass of complicated data on occupational accidents (Tsay and Chiang, 2005; Liao and Perng, 2008; Cheng et al., 2010a). Against this background, the present study undertook a detailed analysis of a large number ( $N = 1542$ ) of occupational

\* Corresponding author. Tel.: +886 4 2631 8652; fax: +886 4 2652 5245.  
E-mail address: [tcwu@sunrise.hk.edu.tw](mailto:tcwu@sunrise.hk.edu.tw) (T.-C. Wu).