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Data mining for occupational injuries in the Taiwan construction industry

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Abstract

There is a higher rate of occupational injury in the construction industry than most other industries on average. However, steps can be taken to reduce worker risk through effective injury prevention strategies. In this article, association rule mining is employed in identifying the characteristics of occupational injuries in the construction industry. Accident reports during the period 1999–2004 are extracted from case reports of the Northern Region Inspection Office of the Council of Labor Affairs of Taiwan. In addition to general factors, several factors related to weather conditions are included in this article. The results show that there are some patterns of occupational injuries in the construction industry. The effect of rain on the occurrence of fatalities is of great significance. Proposed inspection plans should be in accordance with the type of construction and environmental evaluation. The findings identified in this article provide a direction for more effective inspection strategies and injury prevention programs.

Keywords: Construction industry; Association rule; Occupational fatalities

1. Introduction

The construction industry is dynamic and hazardous due to the diverse and complex nature of work tasks, trades, and environment, as well as the temporary and transitory nature of construction workplaces and workforces (Kines, 2002). Therefore, the risk of occupational accidents in the construction industry is far greater than in a manufacturing based industry (Larsson and Field, 2002; Sawacha et al., 1999). In the construction industry, the tremendous losses of human and economic resources caused by occupational accidents have become a serious problem.

Some studies have investigated the causes of occupational accidents. In general, occupational accidents occur either due to a lack of knowledge or training, a lack of management, a lack of means to carry out

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the task safely, or alternatively, due to an error of judgment, carelessness, apathy or downright recklessness (Arboleda and Abraham, 2004; Sawacha et al., 1999; Toole, 2002). Others have discussed the factors contributing to both accident frequency and severity. Several characteristics, such as individual and organizational factors, have been considered frequently. However, little has been discussed about specific factors related to weather conditions.

Taiwan is situated between the Asian continent and the Pacific Ocean. The Tropic of Cancer (23.5°N) runs across its middle section and divides the island into two climates, tropical monsoon climate in the south and subtropical monsoon climate in the north. The north has rain all year round. In winter, when the northeastern monsoon system is active, the north is constantly visited by drizzle. In summer, much of the rainfall comes from convectional thunderstorm activity (McKnight and Hess, 2000). Because there is rain all year round, workers have to go to work under changeable weather condition. Workers may perform their work in drizzle, or they can be compelled by afternoon thunderstorms to break off. Since workers perform their tasks outdoors regularly on construction sites, and bad weather conditions often adversely affect the worker's state of mind and attention (Kartam et al., 2000), this kind of climate may constitute an indirect menace to safety on construction sites. Consequently, weather conditions are supposed to be an important factor contributing to occupational injuries.

Database technology is extensively applied in many domains, occupational accidents included. With the increasing use of databases, they should move from data processing aids to key strategic weapons for injury prevention. The large volume and high dimensionality of accidents databases leads to a breakdown in traditional human analysis. Data mining incorporates technologies for analyzing data in large databases and can identify potentially useful patterns in the data (Zhang and Zhang, 2002). In addition to an accidents database, a weather database is also used in this article. Considering that both databases intensify difficulties for human data analysis, data mining may be a solution to the problem.

Association rule mining is an important task in data mining. Association rules can be effective in uncovering unknown relationships, and provide results for forecasting and decision making (Tsay and Chiang, 2005). As weather condition is an unknown factor which is seldom discussed, association rule mining is employed in this article.

Accident analysis is used to identify factors contributing to occupational injuries and to develop strategies for injury prevention (Harper and Koehn, 1998). The analysis of aggregated accident data rather than single-case analysis is considered as the only way of discovering any unifying and common factors in accident events (Chi et al., 2004).

This article examines the characteristics of occupational injuries in the construction industry of Taiwan. Association rule mining is employed in evaluating the associations between different factors and in identifying the patterns of industrial occupational injuries. Contributing factors to 309 fatal occupational injuries have been identified with respect to individual factors, task factors, management factors, and environmental factors. This article focuses not only on general factors, as opposed to earlier studies, but also on some specific factors related to weather conditions. In addition, this article demonstrates how to identify local characteristics of occupational fatalities and facilitates injury prevention strategy development.

2. Factors contributing to occupational injuries

Several empirical studies have investigated occupational accidents in the construction industry. Much has been discussed about the factors contributing to occupational injuries. These factors include accident type (Chi et al., 2004; Jeong, 1998; Hinze et al., 1998; Larsson and Field, 2002; Arboleda and Abraham, 2004; Huang and Hinze, 2003; Hinze et al., 2005), worker's salary (Rabi et al., 1998), worker's experience (Chi et al., 2004, 2005; Jeong, 1998; Sawacha et al., 1999), worker's age (Chi et al., 2004, 2005; Huang and Hinze, 2003; Hinze et al., 2005; Jeong, 1998; Sawacha et al., 1999), cause of injury (Chi et al., 2005; Rabi et al., 1998; Arboleda and Abraham, 2004; Toole, 2002; Huang and Hinze, 2003; Hinze et al., 2005), source of injury (Chi et al., 2004; Hinze et al., 2005; Jeong, 1998), time of day (Huang and Hinze, 2003; Hinze et al., 2005; Kines, 2002), project cost (Huang and Hinze, 2003), company size (Chi et al., 2004, 2005; McVittie et al., 1997), and month of year (Huang and Hinze, 2003).