



# Structural equation model of integrated safety intervention practices affecting the safety behaviour of workers in the construction industry



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## ABSTRACT

Fatality rates at workplaces in the construction industry are high compared to other industries. Tremendous effort is required to strive towards zero accidents. Managing foreign workers with different cultural backgrounds at the workplace requires appropriate safety intervention practices to improve workers' safety behaviour. Based on the literature, the importance of safety intervention for changing unsafe to safe worker behaviour is known. For this reason, an integrated safety intervention model affecting workers' safety behaviour was developed and tested. This study was conducted by distributing a questionnaire survey to construction companies. The survey was randomly distributed, with a total of 198 responses received. Exploratory factor analysis (EFA) was conducted to confirm the three safety intervention constructs. Structural equation modelling (SEM) was performed to identify the most significant intervention-related safety practices, which are to be the focus in handling safety management. The results indicate that technical intervention has a positive influence by management and human intervention. In addition, an improvement in workers' safety behaviour can be achieved by focusing on the technical intervention with five important safety practices: workplace safety inspections, personal protective equipment (PPE) programmes, safety equipment availability and maintenance, safe work practices, and safety permits. These findings attempt to help construction management by identifying the appropriate selection of safety practices with specific interventions to improve workers' safety behaviour.

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## 1. Introduction

The dynamic environment of the construction industry at the construction site workplace is highly potentially harmful to workers. International statistics show that the majority of fatal accidents occur in the construction industry (Aksorn and Hadikusumo, 2007; Mohamed, 2002; Sawacha et al., 1999; Tam et al., 2004). Similarly, in Malaysia, according to occupational accident statistics in 2014, among all industries, 184 fatality cases were inspected by the Department of Occupational Safety and Health (DOSH). The highest number, 72 fatalities, representing almost 40% of total cases, was recorded in the construction industry (DOSH, 2014). Based on these statistics, the construction industry in Malaysia is still incapable of effectively tackling safety issues at the construction site workplace. Chi et al. (2014) find unsafe behaviour to be the main cause of accidents in Taiwan's construction industry. Similarly, Choudhry (2014), Sawacha et al. (1999),

and Zhang and Fang (2013) find that unsafe work behaviour is the most common cause of accidents at construction sites. Research in the area of safety management systems related to safety behaviour has become prominent in developing countries (Vinodkumar and Bhasi, 2010). A number of study findings have indicated that management commitment plays a vital role in handling safety at construction sites (Aksorn and Hadikusumo, 2007; Mohamed, 2002; Sawacha et al., 1999), finding that safety training is the most important safety management practice in terms of safety performance components. However, different countries probably have various important safety practices to focus on to improve worker safety behaviour. As Geller (2001, 2005) states, the research question refers to developing a guideline for use by safety personnel in determining the appropriate safety behaviour interventions for safety controls. Wirth and Sigurdsson (2008) argue that there is limited information in the safety literature on how to integrate miscellaneous safety intervention controls. Abundant safety research in the construction industry has been conducted in terms of safety performance improvement, such as the studies by Aksorn and Hadikusumo (2007), Chinda and Mohamed (2008), Choudhry (2012), Tam et al. (2004), and Teo and Ling

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(2006). However, previous safety researchers have focused on safety management systems without differentiating the safety intervention practices that may have different effects on worker safety behaviour performance. For this reason, the present study addresses the improvement of worker safety behaviour in the construction industry by integrating safety intervention practices. Identification of the relevant safety intervention components on which to concentrate is an important strategy to change unsafe worker behaviour. Meanwhile, the objective of the present study is to develop a model of integrated safety intervention practices to encourage positive worker safety behaviour. The most significant intervention and the related safety practices that should be focused on to improve safety worker behaviour have been identified by analysing the relationships.

## 2. Safety intervention

Research on construction companies considers that all the safety practices implemented are under one roof as a safety management system (Teo and Ling, 2006; Chan et al., 2004; Robson et al., 2007). Abundant safety practices implemented in construction companies are important to enforce to develop positive worker behaviour. Oyewole and Haight (2009) and Robson et al. (2001) define a safety intervention as a step to alter or implement methods to improve safety. For example, training programmes, engineering intervention, and administrative procedures are among the new safety practices, including programmes within the workplace or actions for purposely improving safety. In addition, Shakiyo and Haight (2010) state that the safety management in the organisation comprises two main intervention levels, as shown in Fig. 1. Thus, at the management level, safety intervention refers to the top management’s policies and safety administrative activities. At the technical level, safety intervention refers to any practices that ensure a safe working environment, including safety planning. At the human level, safety intervention refers to any practices to change human knowledge and cognition, considering safety practices that directly affect the worker.

Thus, the present study considers the integration of safety intervention, with the first level being management and the second level being human and technical. Fig. 2 illustrates the safety intervention that occurs at different levels; on the top is the management level, followed by the technical level and the human level. All three intervention components are considered to have a direct influence on workers’ safety behaviour. Human safety intervention is considered to influence the technical safety intervention. The present study classifies all of the important safety practices applied to the three intervention components, as identified by Robson et al. (2001) and Shakiyo and Haight (2010). This safety intervention levels perspective highlights the dynamic and integration of safety management influences for safety practices implementation at each different intervention level. The target for safety intervention is to change unsafe worker behaviour to safe worker behaviour, as Neal et al. (2000) consider workers’ safety behaviour to be one of the safety outcomes.

The different characteristics of this industry, such as a majority of the workers in the workplace being foreign, require the present

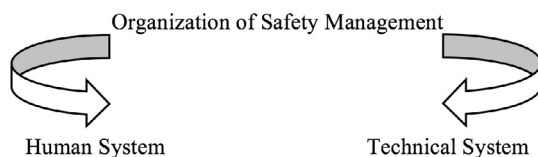


Fig. 1. Levels of safety intervention in the organisational structure (Shakiyo and Haight, 2010).

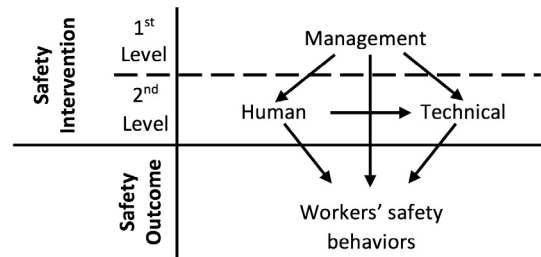


Fig. 2. Integrated management, human, and technical safety intervention practices.

study to determine the type of intervention that is appropriate to promote work safety behaviour. Ramli et al. (2014) conduct research on the industrial safety management of Malaysian multinational firms. According to them, based on the opinions of experts, several factors must be reviewed because every country has its own peculiarities and differences that may exist. They argue that different countries have different methods of establishing safety management that depend on the safety culture and the local culture. Due to the uniqueness of the Malaysian construction industry’s characteristics such as foreign workers from Indonesia, Bangladesh, and Nepal, this issue requires a wide range of research to understand how to implement safety management, as intervention works more effectively. Therefore, the present study is conducted to identify which safety intervention level group and safety practices are crucial to encourage safe behaviour among foreign construction workers.

Fundamental constructs (management safety intervention, technical safety intervention, human safety intervention, and workers’ safety behaviours), as developed in Fig. 3, and hypotheses associated with each path of the model are discussed below.

### 2.1. Management safety intervention

Many studies have found that management commitment and involvement are key elements in achieving success in safety performance in the workplace (Langford et al., 2000; Sawacha et al., 1999; Tam et al., 2004). It is difficult to perform safety practices and foster a culture of safety within an organisation without management support (Teo and Ling, 2006), which indicates that safety management is the backbone of intervention in the implementation of effective safety in the workplace. Robson et al. (2001) explain that the management of the organisation can influence the technical and human intervention levels.

Based on these previous studies, the following hypotheses have been formulated:

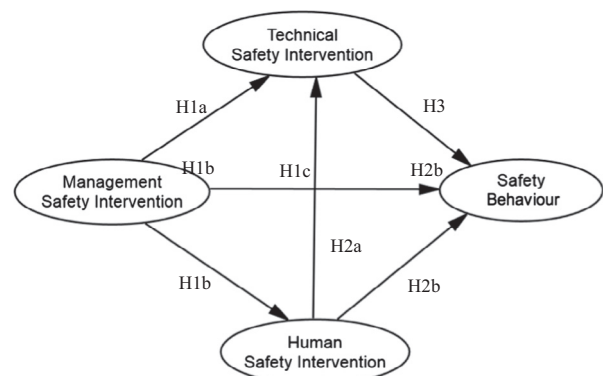


Fig. 3. Hypothesised integrated safety intervention structural equation model.

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