



Behavior-based safety on construction sites: A case study



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ABSTRACT

This work presents the results of a case study and describes an important area within the field of construction safety management, namely behavior-based safety (BBS). This paper adopts and develops a management approach for safety improvements in construction site environments. A rigorous behavioral safety system and its intervention program was implemented and deployed on target construction sites. After taking a few weeks of safety behavior measurements, the project management team implemented the designed intervention and measurements were taken. Goal-setting sessions were arranged on-site with workers' participation to set realistic and attainable targets of performance. Safety performance measurements continued and the levels of performance and the targets were presented on feedback charts. Supervisors were asked to give workers recognition and praise when they acted safely or improved critical behaviors. Observers were requested to have discussions with workers, visit the site, distribute training materials to workers, and provide feedback to crews and display charts. They were required to talk to operatives in the presence of line managers. It was necessary to develop awareness and understanding of what was being measured. In the process, operatives learned how to act safely when conducting site tasks using the designed checklists. Current weekly scores were discussed in the weekly safety meetings and other operational site meetings with emphasis on how to achieve set targets. The reliability of the safety performance measures taken by the company's observers was monitored. A clear increase in safety performance level was achieved across all categories: personal protective equipment; housekeeping; access to heights; plant and equipment, and scaffolding. The research reveals that scores of safety performance at one project improved from 86% (at the end of 3rd week) to 92.9% during the 9th week. The results of intervention demonstrated large decreases in unsafe behaviors and significant increases in safe behaviors. The results of this case study showed that an approach based on goal setting, feedback, and an effective measure of safety behavior if properly applied by committed management, can improve safety performance significantly in construction site environments. The results proved that the BBS management technique can be applied to any country's culture, showing that it would be a good approach for improving the safety of front-line workers and that it has industry wide application for ongoing construction projects.

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1. Introduction

What is behavior? Behavior is simply anything someone does or says. Psychologically, behaviors are actions or reactions of persons or things in response to external or internal stimuli. Over the past decade, much research has been conducted on [Ajzen and Fishbein's \(1980; Fishbein and Ajzen, 1975\)](#) theory of reasoned action. According to the theory, behavior is determined by

the behavioral intention to emit the behavior. The theory proposed that behavior is affected by behavioral intentions which, in turn, are affected by attitudes toward the act and by subjective norms ([Fishbein and Ajzen, 1975](#)). For this research, the behavior means the observable actions, because observable practices are what matters more for workers' safety on construction sites. Behavioral approach addresses how people behave on the job. One can know about someone's attitude by conducting observations of how they behave and what they convey on-site. According to [McSween \(2003\)](#), if we change safety habits of people, their attitudes about safety will follow, especially as their colleagues adopt better safety habits. When we have a group of people with similar habits and attitudes about safety, we begin to talk about people having a common safety culture; then we want to talk about changing the culture, we have to talk about changing people's behavior ([McSween, 2003](#)).

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This work presents a case study for using behavior-based safety (BBS) management in construction fields. BBS is the systematic application of psychological research on human behavior to the problems of safety (Cooper, 1994). Heinrich (1959) estimated that 85% of accidents can be attributed to unsafe acts. Blackmon and Gramopadhye (1995) stated that 98% of all accidents are caused by unsafe behavior. HSE (2002) revealed that 80–90% of all workplace accidents and incidents are attributed to unsafe behaviors. Nishigaki et al. (1994) found that most accidents occur because of human-ware failure. Reducing accidents and improving safety performance can only be achieved by systematically focusing upon those unsafe behaviors at construction sites (Choudhry and Fang, 2008; Choudhry, 2012). For example, not holding the handrail when ascending or descending stairs, not storing equipment after completing a task, etc., are all unsafe behaviors. The triggers for behaving unsafely include a wide range of management system faults that are associated with each incident. These triggers commonly include getting the job done, meeting excessive production targets, competing priorities, tight construction schedule, lack of training and lack of availability of equipment or materials. According to Behavioral Safety (2012), other triggers are often in the direct control of front line-management and or employees such as poor housekeeping and using personal protective equipment (PPE).

According to the accident pyramid, Heinrich (1959) proposed that for every 300 unsafe acts there are 29 minor injuries and 1 major injury. In other words, he suggested that the ratio between major injuries, minor injuries and no-injury accidents was 1:29:300. Widespread acceptance of Heinrich's theory of accident causation that unsafe acts lead to minor injuries and over time to a major injury sent safety managers and company presidents in pursuit of unsafe acts under the assumption that if they could control unsafe behavior then the major injury would not occur. With senior management commitment, a good safety program starts by conducting a thorough evaluation and step-by-step Job Safety Analysis (JSA) followed by the development of a written Safe Operating Procedure (SOP) for each construction activity (Hinze, 1997). If JSA and SOPs are poorly developed merely to satisfy administrative requirements of the safety management systems, damage to safety efforts is possible.

1.1. Objective

This work was carried out at a construction site of a construction firm (hereinafter called the company), that is considered a leader in the construction industry of Hong Kong. The company strives to focus on customers' needs and construct high quality buildings and infrastructure projects. The management of the company values its staff and always tries to ensure that their employees are working in a safe and healthy environment. Having achieved a good safety record over the past years, the company management considers that it is the right time to further improve site safety through a bottom up approach namely behavior-based safety (BBS) techniques. In addition, there is no alternate for the company's Health, Safety and Environment Management Systems (HSEMS) whether they are ISO 14001 or Occupational Health and Safety Assessment Series (OHSAS, 18001) standards (Choudhry et al., 2008). The Area Management System was working well for the company's construction projects. So, the company seems committed to continuously strengthening the implementation of its safety systems.

There were numerous subcontractors performing work on all the company's projects. All subcontractors were responsible to plan and conduct their own work. Nonetheless, when a safety lapse occurred resulting in an accident, the accident was charged to the prime contractor, the company. The writer was requested to help the company to devise ways for solving site safety problems. In the present scenario, the research team thought that BBS could

offer a better solution to this problem besides improving safety on the company's construction sites. Many manufacturing companies experienced a 40–75% reduction in their accidents rates within twelve months as a direct consequence of implementing the techniques associated with BBS (Behavioral Safety, 2012).

This work is an attempt to adopt and develop existing management techniques for safety improvement for the construction company and to evaluate their effectiveness in a BBS field study on a construction site in Hong Kong. Attempts to improve safety using safety poster campaigns have been attempted. Saarela et al. (1989) revealed that such campaigns did not make a lasting impact on accident and injury rates. Other methods such as incentive and reward systems (McAfee and Winn, 1989) were normally used to speed up the progress of work but usually did not reward safe working procedures. Incentives used to foster safe behavior could be expensive or applicable for the short term and might discourage operatives from reporting accidents and incidents. In this study, operatives mean the front-line workers (including both trades people and general operatives), supervisors, and drafts-people. The use of disciplinary action and punishment were likely not to be effective as those were infrequent, delayed, or of mild intensity. Additionally, construction supervisors were often reluctant to use them because of fear that resentment would lead to lowered morale, lack of cooperation and loss of productivity (Peter, 1991).

On the company's construction sites, serious accidents were relatively rare and non-serious accidents were under-reported, it then made sense to focus on behaviors that could improve construction site safety. McAfee and Winn (1989) demonstrated that safety behavior could be improved by systematically monitoring safety-related behaviors and providing feedback in conjunction with goal setting and training. Goal setting coupled with feedback were better than feedback alone; and participative goal setting was more effective than assigned goal-setting (Duff et al., 1994). Research in other countries was conducted on BBS including goal setting and feedback techniques (Komaki et al., 1978; Chhokar and Wallin, 1984; Duff et al., 1994; Sulzer-Azaroff and Austin, 2000; Geller, 2001, 2005; Svensson and Hyden, 2006). The results indicate that behavioral approaches could be one of the best techniques to improve site safety (Duff et al., 1994). BBS initiatives were useful toward improving safety performance (Al-Hemoud and Al-Asfoor, 2006; Choudhry, 2012). Nonetheless, no attempts have been made to apply BBS techniques for improving construction site safety within the company. Past studies (Duff et al., 1994; Geller, 2005) were done in western cultures and this study was carried out in the Chinese culture providing an insight into the generalizability of BBS concept beyond western cultures. The aim of this research is to find ways for further improving construction site safety at the company's construction projects. Specifically, the following main objectives are included for this research:

1. To develop, and introduce a suitable method of measuring safety performance to help the company to improve construction site safety;
2. To find ways for improving construction safety for the company's subcontractors conducting work on the firm's construction site; and
3. To use a method to assess safety management, based upon proven techniques for changing work behavior thus improving site safety by fostering safe behavior.

2. Background

Safety management by walking around (SMBWA), an intervention based on managers and employees participation was presented by Luria and Morag (2012) to demonstrate the ways in

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