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Investigating the effectiveness of fall prevention plan and success factors for program-based safety interventions

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ABSTRACT

Fall from height (FFH) is a perennial problem in the construction industry across many countries. In Singapore, construction worksites are required to develop and implement a fall prevention plan (FPP) to eliminate and mitigate the risk of fall hazards. The FPP is a document that records information such as fall prevention policy, roles and responsibilities, fall risk assessment, and emergency response. This study aims to evaluate the effectiveness of FPP in reducing the risk of FFH accidents and to identify the underlying factors influencing the success of a program-based safety intervention. A mixed method approach involving an exploratory site visit, 4 interviews, a questionnaire survey with 93 complete respondents, and content analysis of 17 FPP was conducted. In addition, an ordinal regression was conducted on the questionnaire survey data. The analyses indicate that FPP was perceived as an effective intervention because it requires clear allocation of responsibilities, increases the commitment to fall prevention and made competency requirements explicit. Nonetheless, the effectiveness of the FPP is limited by issues such as failure to implement the FPP, lack of contextualisation to site situations, lack of competency of frontline supervisors and workers, inadequate cooperation from sub-contractors and insufficient management commitment. The study provided empirical data to support insights on the underlying success factors for program-based safety interventions. The study raised concerns about the phenomenon of "paper exercise", where documents were created to satisfy safety requirements, but do not meet the intent of management or regulators. Further research on the phenomenon was recommended.

1. Introduction

Falls from height (FFH) not only result in severe injuries, they also impose significant cost and lost work time (Hinze et al., 2006; Lipscomb et al., 2004; Safe Work Australia, 2014). Chi et al. (2005) highlighted that FFH is the leading direct cause of fatalities in the Taiwanese construction industry. In the U.S., the Census of Fatal Occupation Injuries (CFOI) ranked FFH top three in fatality counts (United States Department of Labor, 2013). The Singapore Workplace Safety and Health Report 2014 (Workplace Safety and Health Institute, 2015) indicated that 45% of workplace fatalities came from the construction sector and 30% of the construction fatalities were due to FFH. These statistics clearly indicated the unacceptable risk posed by FFH.

To reduce the risk of FFH, the Manpower Ministry enacted the Singapore Workplace Safety and Health (Work at Heights) Regulations 2013 (WAH Regulation). The new regulation requires a fall prevention plan (FPP) for all construction worksites. In addition, according to the Code of Practice for Working Safely at Heights (Workplace Safety and Health Council, 2013), a FPP is "a documented site-specific plan prepared for the purpose of reducing or eliminating risk of falls". Each FPP should contain the following 10 components: (a) policy for fall prevention; (b) responsibilities; (c) risk management; (d) risk control measures; (e) safe work procedures; (f) use of personal protection equipment; (g) inspection and maintenance; (h) training; (i) incident investigations; and (j) emergency response.

Besides the FPP, construction companies also maintain a wide range of safety and health programs or systems, e.g. risk assessment, training management system and occupational health programs. All worksites are expected to have formal safety and health management systems (SHMS). Larger worksites will have to be audited and this usually requires extensive documentation.

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According to the systematic literature review by Robson et al. (2007), most research seem to indicate that SHMS are generally useful in improving safety and health, but the evidence is "inconclusive" on its effectiveness. Hale et al. (2010) highlighted the lack of study on effectiveness of "organizationally based intervention" and among the 17 projects that they evaluated, only 50% were assessed to be successful.

The components of the FPP replicate many of the SHMS elements and can be considered a program-based intervention. Therefore, its necessity and effectiveness need to be investigated. Furthermore, in view of the risk that FFH presents to the construction industry, it is important to study FPP and the factors influencing its success so as to assess if it is useful to promote its adoption internationally. Thus, this study aims to explore the effectiveness of FPP in reducing FFH accidents in the industry. More generally, the study provides insight into the factors influencing the effectiveness of program-based safety interventions. A mixed method research approach involving an exploratory site visit, face-to-face interviews, questionnaire survey and content analysis was adopted.

1.1. Fall prevention plan

Singapore is not the only country that promotes a program or system approach to fall prevention and protection. In fact, the Singapore FPP was probably modelled after the U.S. ANSI/ASSE Z359.2-2007 (American National Standards Institute, 2007). Z359.2 highlighted the following elements in a comprehensive fall protection program: policy statements, duties and responsibilities, training, fall hazard survey report, fall protection and emergency rescue procedures, fall hazards elimination or control, incident investigations, and evaluation and review of fall protection program. As can be observed, the elements are similar to the components of the Singapore FPP. However, Z359.2 does not apply to the construction industry, which is covered by ANSI/ASSE A10.32-2012 (American National Standards Institute, 2012). Even though A10.32 highlighted program elements like training, inspection, maintenance and rescue, it is not as detailed as Z359.2 in terms of guidance for program development. It is noted that A10.32 and Z359.2 appear to have strong emphasis on personal fall protection systems, i.e. use of anchors, lifelines, harnesses and other personal fall protection equipment.

In contrast, the UK does not have a similar requirement for FPP. Instead, according to the HSG150 (Health and Safety Executive, 2006), the Management of Health and Safety at Work Regulations 1999 (MHSWR) "require employers to plan, control, organise, monitor and review their work". The management system hinges on the risk assessment process. In addition, the UK enacted the Work at Height (WAH) Regulations in 2005. The UK WAH Regulations did not require a FPP, but it emphasised the importance of planning, supervision, competence, avoidance of WAH, inspection and duties of employer and persons at work.

Singapore had developed a hybrid approach, which integrated the FPP from the US and overarching workplace safety and health legislative framework similar to the UK system. As in the case of the UK, the Singapore Workplace Safety and Health Act 2009 is a "performance-based" legislation. This is in contrast to the more prescriptive US Occupational Safety and Health Administration (OSHA) legislations. In the performance-based approach, risk management and safety and health management systems are the cornerstones. Even though the Singapore WAH Regulations was enacted in 2013, the FPP was promoted in Singapore prior to the WAH Regulations. Thus, many construction contractors have developed their FPP before 2013.

2. Methods

As indicated earlier, the study included an exploratory site visit, 4 in-depth interviews, a questionnaire survey and content analysis of 17 FPPs. The mixed method approach was necessary to comprehensively assess the effectiveness of the FPP in reducing risk of FFH accidents. The sequence of the study is as follows:

1. The exploratory site visit was conducted to allow the researchers to gain practical and rich understanding of how FPP was developed and implemented on-site;
2. The 4 interviews were meant to facilitate the design of the questionnaire survey and, at the same time, provide background information on the topic;
3. The questionnaire survey was conducted to understand the perception of a wider group of practitioners and a logistic regression was conducted to identify critical factors influencing the perceived effectiveness of the FPP; and
4. The content analysis of FPPs allowed the researchers to assess the quality of FPPs based on the guidelines for FPP.

The comprehensive approach allows a systematic and triangulated approach for assessing the effectiveness of the FPP. The approach also facilitate the studying of underlying success factors for a program or system-based safety intervention. The data reported herein was collected between late 2013 and 2014, i.e. during the initial introduction of the WAH Regulations.

2.1. Exploratory site visit

An institution construction project (Project A) was selected for the site visit due to the amount of WAH activities and its accessibility to the researchers. Project A involves the building of a single block of 17 storeys with a basement. At the time of the visit, the site had a total of 450 workers working on-site. Of the 450 workers, about 200 of them were involved in work-at-height (WAH). Out of which 150 were involved in structural reinforced concrete work and the remaining 50 workers were involved in curtain wall installation and brick work. Site walk was conducted to understand the range of WAH activities and how the FPP was used in the project. Subsequently, an in-depth unstructured interview was conducted with the workplace safety and health officer (WSHO) of the project.

2.2. Interviews

After the site visit was conducted, the researchers reflected on the findings and two more unstructured interviews with workplace safety and health officers (WSHOs) were conducted. The site visit and two unstructured interviews provided the background for the four semi-structured interviews (Silverman, 2010). The four interviewees were three WSHOs working for main contractors and a project coordinator of a scaffold contractor. All four interviews were transcribed and the audio recordings ranged from 15 min to slightly more than 30 min. In addition to the semi-structured interviews, site walks (in addition to the initial exploratory site visit) were conducted at two of the sites to understand how the FPP was implemented. The interviews were guided by a list of questions, but the interviewer deviated from the questions in response to the information provided by the interviewees while keeping the purpose of the study in mind. The interview questions were closely linked to the design of the survey questions.