EVALUATING THE EFFECTIVENESS OF FALL PREVENTION PLAN: DO WE NEED ANOTHER SAFETY DOCUMENT?

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Fall from height (FFH) is a major problem in the construction industry in many countries including Australia, Singapore, Taiwan, and the U.S. In response to the perennial problem of FFH fatalities, the Singapore Manpower Ministry enacted the Work at Heights (WAH) Regulations in 2013. The WAH Regulations requires construction worksites to develop and implement a fall prevention plan (FPP) to eliminate and mitigate risk of fall hazards. Even though the FPP is meant to be site-specific, the FPP is essentially a document that may not have an impact on the risk of WAH. To evaluate the effectiveness of FPP in reducing the risk of FFH accidents, a mixed method study involving a case study, 6 interviews, questionnaire survey and content analysis of 17 existing FPP was conducted. A total of 93 complete questionnaire survey responses were gathered. The analyses suggest that FPP was perceived as an effective intervention in reducing FFH accidents because FPP requires clear allocation of responsibilities, increases the awareness of fall hazards and highlights important fall control measures to be implemented on-site. Nonetheless, the effectiveness of the FPP is limited by issues such as failure to implement the FPP, lack of contextualization to site situations, lack of competency of frontline supervisors and workers, inadequate cooperation from sub-contractors and insufficient management commitment. The study showed that the benefits of FPP are not due to the document per se and many of the FPP documentation are already required in risk management and safety and health management systems. Thus, it is recommended that the FPP documentation be reduced significantly, while retaining key components including site-specific responsibilities, detailed risk assessment and inspection and monitoring. The study provides useful insights on the underlying issues influencing safety and health interventions which are relevant to other countries.

Keywords: fall prevention plan, intervention, risk control, safety management.

INTRODUCTION

Falls from height (FFH) often result in severe injuries, significant cost and lost work time (Hinze *et al*. 2006; Lipscomb *et al*. 2004; Safe Work Australia 2014). The study by Chi *et al*. (2005) showed that FFH is the leading direct cause of fatalities in the Taiwanese construction industry. The 2012 U.S. Census of Fatal Occupation Injuries (CFOI) also ranked FFH top three in fatality numbers (United States Department of Labor 2013). Based on the Singapore Workplace Safety and Health Report 2014 (Workplace Safety and Health Institute 2015), 45% of workplace fatalities came from the construction sector and 30% of the construction fatalities were due to FFH.

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In response to the risk posed by FFH, the Singapore Workplace Safety and Health (Work at Heights) Regulations 2013 (WAH Regulation) was enacted in 2013. Under the WAH Regulations, a fall prevention plan (FPP) is required for all construction worksites. 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"*. A FPP includes 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.

Since compliance to documented safety rules and regulations is known to be problematic (Hale and Borys, 2013), the effectiveness of FPP in reducing FFH accidents is debatable. Besides the FPP, construction companies in many countries (e.g. Singapore and the U.K.) are also required to conduct and document risk assessment, maintain safety meeting records and training records. Larger sites are also expected to have formal safety and health management systems (SHMS), which usually requires extensive documentation for audit and record purposes. Moreover, the FPP seems to replicate many of the SHMS elements. Thus, this study aims to explore the perceived effectiveness of FPP in reducing FFH accidents. The study provides insight into the factors influencing the perceived effectiveness of a document-based intervention. A mixed method research approach involving case study, semi-structured interviews, questionnaire survey and content analysis was adopted. The data reported herein was collected between 2013 and 2014, i.e. during the initial introduction of the WAH Regulations.

CASE STUDY

An institution construction project (Project A) was selected for the case study, which was meant to give the authors a richer understanding of how FPP was developed and implemented on-site. The case study was kept unstructured to allow the researchers to explore the content of the FPP and site implementation issues. A site walk was conducted with the permission from the management and an interview was conducted with the Workplace Safety and Health Officer (WSHO) of the project. 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.

The contractor developed the FPP at two levels: corporate level and site level. The contractor had chosen this approach because the FPP was meant to be a site-specific document. Thus, the site level FPP had to account for the atypical nature of the projects and the different types of work conducted by the sub-contractors in different projects.

According to the contractor, they were able to use existing resources to develop the FPP. The contractor highlighted that the content in the Code of Practice for Working Safely at Heights (2013) was very useful for developing the FPP. In terms of implementation, the contractors opined that there was no specific improvement because they had been practising the content of the FPP prior to the enactment of the WAH Regulation. According to the contractor, the only difference that the FPP made was the legal obligation for the management to officially endorse the FPP.

SEMI-STRUCTURED INTERVIEWS

After the case study was conducted, the researchers reflected on the findings and planned for six semi-structured interviews. In addition to the semi-structured interviews, site walks were conducted at two of the sites. The interviewees included the workplace safety and health officers or project coordinators. As 2 of the interviewees did not agree to be audio recorded, four sets of interviews were transcribed. The interviews were guided by a list of questions, but the interviewer deviates from the questions in response to the information provided by the interviewees while keeping the purpose of the study in mind.

Based on the interviews, the development and implementation of site level FPP involved several parties such as the project manager, safety personnel, contractor engineers, the consultants and the sub-contractors. Prior to the development of the site level FPP, safety personnel discussed WAH issues with engineers, sub-contractors and site coordination meetings and site surveys were carried out. The discussions were focused on considerations such as identifying activities that require working at height, the work methods to be adopted, and the cost and time required for the WAH activity. After the details of the WAH activities were confirmed, the administrative part of the FPP had to be developed. Some of the key administrative details include records of workers who went through WAH training courses, the personal protective equipment received, and the permit-to-work application for WAH activities.

One of the key challenges was to train personnel for WAH activities because training courses were not easily available initially. Some companies conducted their in-house training to get their site personnel competent in WAH activities. Briefings were also conducted to familiarise workers with FFH hazards and the fall prevention measures stipulated in the FPP. In terms of provision of fall protection devices, much effort was spent on guardrails for open edges, proper access and egress, lifelines, anchorage points and personal protective equipment (PPE) to workers. The direct cost of compliance include the cost of training, purchase of fall protection equipment such as safety harnesses and appointment of WAH assessors to assess permit-to-work for WAH.

One of the key benefits of the FPP was that there were clear responsibilities assigned to management, competent persons and supervisors. The clear allocation of responsibilities increased safety awareness and promoted a sense of ownership (Hung *et al*. 2011). Even though one of the interviewees was positive about the effectiveness of the FPP, another interviewee commented that the effectiveness can only be observed over time. This was because many contractors were still getting their workers trained. On the other hand, it was highlighted that the FPP is only as good as the level of implementation. There were also concerns that the FPP can degenerate into a mere *"paper exercise"*. One of the key barriers to its successful implementation was the cooperation from sub-contractors who were usually the ones that carry out the WAH activities.

QUESTIONNAIRE SURVEY

The online questionnaire survey used in this study was disseminated through various organisations and informal groups, which included Singapore Contractors Association Limited (SCAL), Singapore Institute of Safety Officer (SISO), Facebook pages of workplace safety and health groups, and personal contacts of the researchers. The online survey was active for seven weeks.

Responses

At the end of response period, a total of 210 responses were received. Out of the 210 responses, 110 responses were incomplete and had to be discarded. However, there were responses by safety professionals from other industries such as petrochemicals, oil and gas, aviation and part-time workplace safety and health students who have no experience in the construction industry. Therefore, their responses were also discarded and 93 responses (44%) were used for the analysis.

Profile of Respondents

The age of the respondents ranged from 21 to more than 61 years old, with 42% of respondents in the range of 36-45 years old. 77.4% of respondents had more than 5 years of experience in the construction industry. Figure 1 shows that more than 80% of the respondents were workplace safety and health officers (WSHO), health, safety and environment (HSE) managers, or safety supervisor.

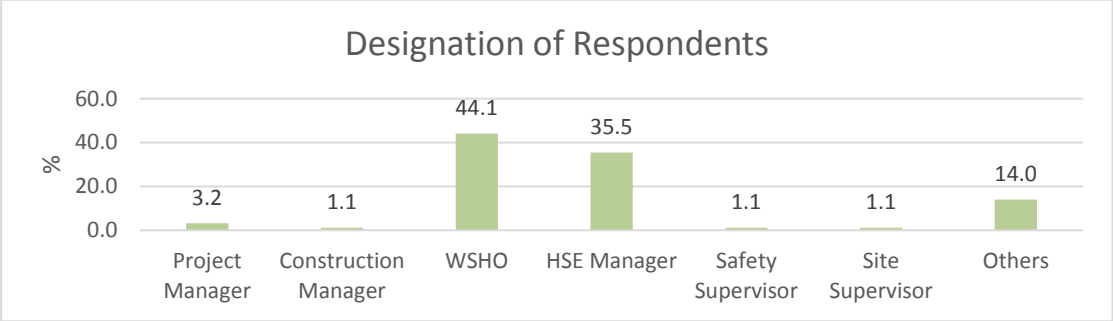

Figure 1: Designation of respondents

Results

With reference to Figure 2, majority of FPPs were developed as an extension of existing risk assessment (RA) and safety health management system (SHMS) (40.9%) or developed from scratch with reference to the CP for working safely at heights with (38.7%). Figure 3 indicates that the development of FPP involved a range of site-personnel.

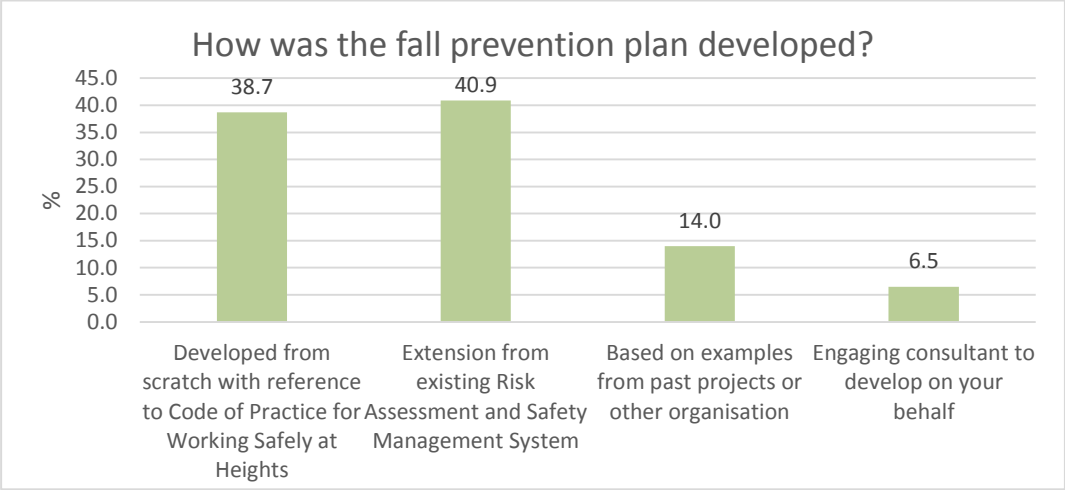

Figure 2: Development of the FPP

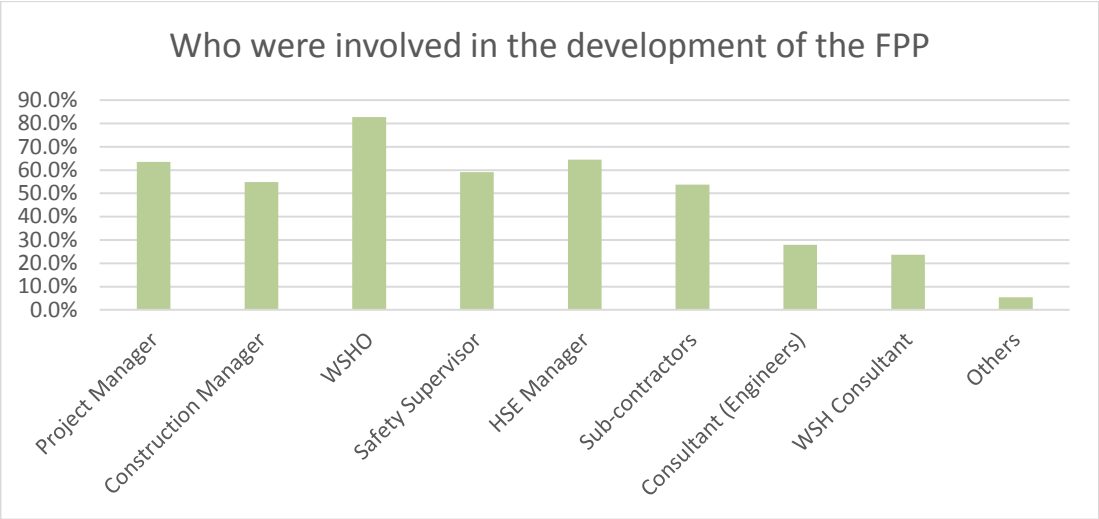

Figure 3: People involved in the development of the FPP

Figure 4 highlights the perceived challenges in implementing FPP. The key challenges include *"lack of commitment from sub-contractors"* (67.7%) and *"not enough competent staff"* (64.5%). 47.3% of respondents indicated a *"lack of commitment from management"* as one of the challenges they face when implementing FPP.

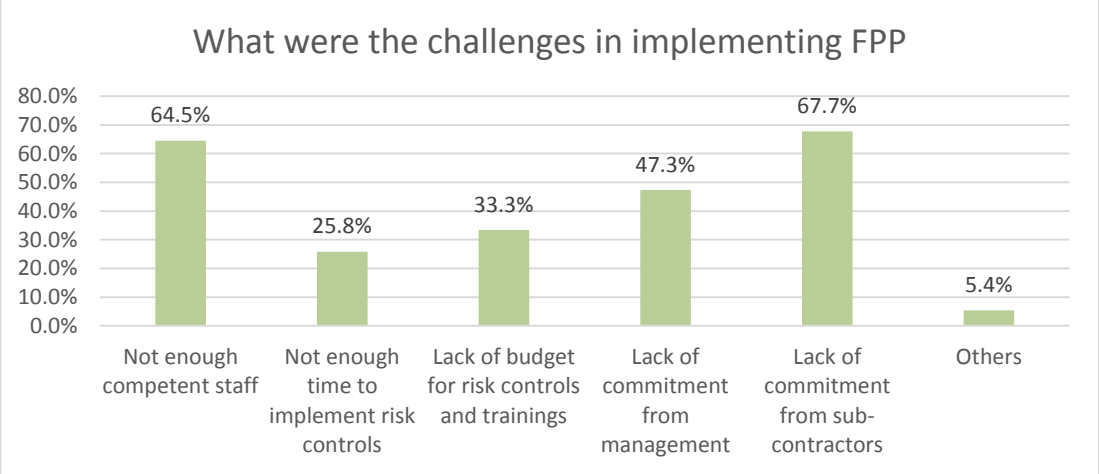

Figure 4: Challenges in implementing FPP

Figure 5 shows that for each of the FPP components at least 59% of the respondents indicated that the FPP component can be replicated from existing safety and health management system (SHMS) elements. It was noted that more than 70% of respondents indicated *"Risk management (Hazard identification and Risk Assessment)"*, *"Safe Work Procedures"*, and *"Roles and Responsibilities"* as components that can be replicated from the existing SHMS elements.

33.3% of respondents (Figure 6) indicated that there was no cost for developing the FPP. 28% indicated *"$2,001 – $3,000"* for developing the FPP. In Figure 7, 53.8% indicated that the cost of implementing FPP is at *"1% of contract sum"*.

Figure 8 shows that about 80% of respondents thinks that the FPP was effective in improving the safety of WAH.

When asked for the rationale for assigning *"effective"* or *"very effective, respondents provided reasons such as increased "provision for fall control measures"*, *"increased awareness"* and *"commitment towards FPP"*. On the other hand, the rationale for *"no*

effect", *"ineffective"* or *"very ineffective"* include *"paper exercise"*, *"lack of commitment from sub-contractors"*, *"additional documentation"* and *"unsupportive management"*. The respondents were also asked to provide recommendations to improve the effectiveness of FPP. Many of the recommendations were focused on actual implementation on-site, training, and management support.

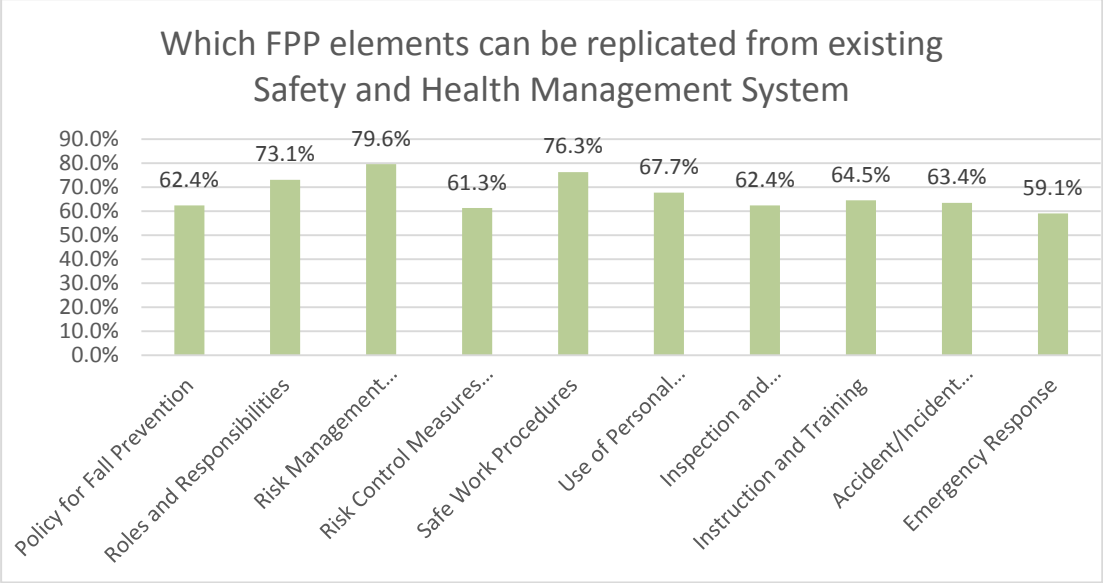

Figure 5: FPP elements that can be replicated from existing SHMS

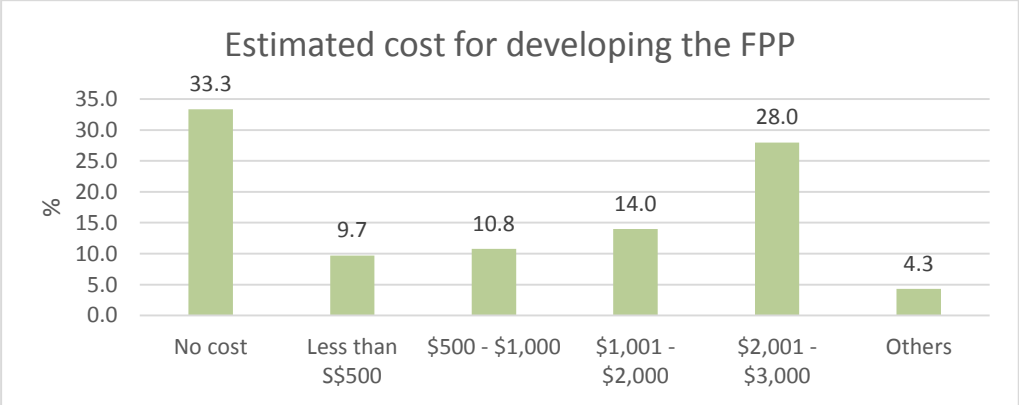

Figure 6: Estimated cost for developing the FPP

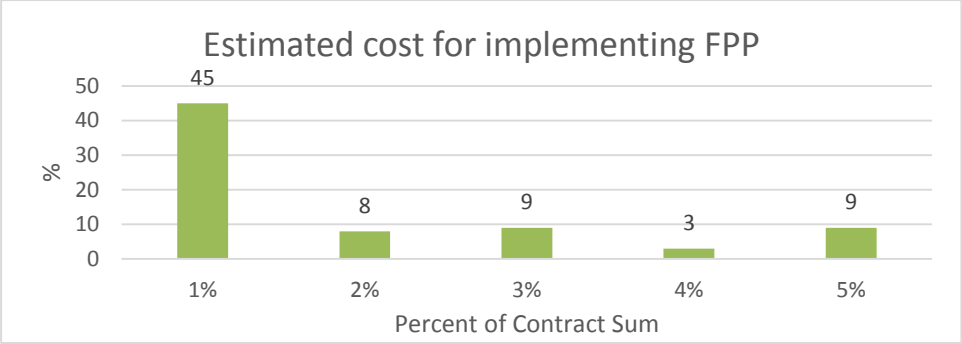

Figure 7: Estimated cost for implementing the FPP

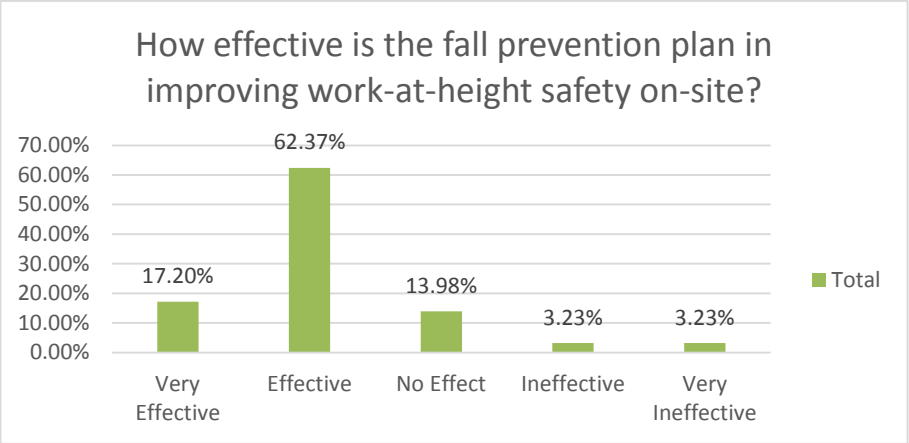

Figure 8: Perceived effectiveness of the FPP in improving WAH safety on-site

CONTENT ANALYSIS

Seventeen FPPs were obtained from the industry during the study. A 33 item checklist was developed based on the Code of Practice for Working Safely and Heights (Workplace Safety and Health Council 2013) and the authors' findings from the case study and interviews. The checklist was categorised into 10 sections. The first 9 sections were based on the 10 components of the FPP, but the components *"Risk Management"* and *"Risk control measures"* were combined due to their similarity. Section 10 was included to account for items not explicitly required in the first 9 components, but were deemed to be useful for a FPP. Some examples include reference to relevant regulations and list of sub-contractors' FPP. Each section had 2 to 8 items.

The authors then assessed the 17 FPPs and assigned a *"Yes"*, *"No"* or *"Unknown"* to each of the items. *"Unknown"* is assigned when relevant attachments or annexes were mentioned in the FPP, but were not provided. The percentage of *"Yes"* was then calculated for each FPP and for each item. Note that *"Unknown"* responses were removed from the calculation. For example, for a FPP with 3 *"Unknown"*, 20 *"Yes"* and 10 *"No"* will get 66.7% (20/30). In addition, an item with 2 FPP reported as *"Unknown"*, 5 *"Yes"* and *"10 "No"* will get 33.3% (5/15).

In terms of the score for the 17 FPPs, the average score was 32%, maximum was 71%, and the minimum was 0%. With reference to Table 1, it can be seen that the quality of the FPPs as perceived by the researchers were not high.

Table 1: Percentage of FPP with adequate content for each section

Section	**% of FPP with adequate content**
Responsibilities	58.8%
Training	54.0%
Policy for Fall Prevention	53.1%
Inspection and maintenance	40.0%
Others	36.0%
Safe Work Procedures	32.7%

Risk management and Risk Control	30.6%
Use of personal protection equipment	17.9%
Incident investigations	16.4%
Emergency response	12.7%
Average	35.2%

The evaluation showed that most of the FPPs were simply repeating the information found in the Code of Practice for Working Safely at Heights (Workplace Safety and Health Council 2013). There was a lack of contextualisation to the site conditions and activities. Many of the FPPs were focused on providing a generic framework and did not provide specific guidance on fall prevention measures.

KEY FINDINGS

Based on the results of the case study, interviews, questionnaire survey and content analysis, the key findings are summarised below.

1. The FPP was perceived to be effective in improving WAH safety because it increased awareness of FFH risk and provision for risk controls for WAH. This could be related to the clearer allocation of responsibilities for WAH safety and increased coordination and discussion on WAH issues. In addition, the additional requirement for WAH training increased the competency to manage FFH risk.

2. The FPP was not costly to develop and implement. This was probably because the FPP were developed based on the existing safety and health management system or the Code of Practice for Working Safely at Heights (WSHC 2013). However, this raises the question on the need for the FPP.

3. The evaluation of 17 existing FPP showed that current quality of the FPP (as perceived by the researchers) was very low. Many FPP were simply repeating the information in the Code of Practice for Working Safely at Heights (WSHC 2013) and did not provide adequate site-specific information on fall prevention.

4. The key barriers to an effective FPP were lack of commitment and lack of competency.

5. There were concerns that the FPP can become a *"paper exercise"* where the plan does not get implemented on site.

RECOMMENDATIONS

As the data was collected within a year of the enactment of the WAH Regulations, the impact of the FPP could not be fully assessed in this study. However, this study helps to assess the sentiments on the ground, provide suggestions for improvement and pre-empt possible problems. The study found that the FPP will not be able to reduce FFH accidents directly, but it did increase safety awareness among managers, and contractors. The industry was not adverse to the FPP because it was not costly to develop and implement. However, the level of quality of FPP appeared to be very low. The following two key recommendations are provided to improve the current situation:

1. Simplify FPP. Since all the components of the FPP can be replicated from the existing safety and health management systems (SHMS), the FPP need not be a standalone plan. However, to maintain the improved safety awareness, commitment, competency and communication, it is proposed that the FPP be scaled down significantly while maintaining the key requirements. This means that components such as policy for fall prevention, use of personal protective equipment, inspection and maintenance, training, incident investigation and emergency response should not be replicated from the SHMS. The requirements for training and responsibilities can be maintained without the need for a FPP. The FPP should focus on being a detailed and site-specific risk assessment document. This recommendation is logical because FFH is a high risk hazard, so construction companies are expected to conduct more thorough assessment of the hazard. Site personnel should be expected to study each WAH activity in detail and risk controls should be identified for specific tasks. The project manager, sub-contractors and relevant parties should participate in WAH risk assessment meetings to discuss the fall hazards and commit to the risk controls identified. The meeting notes should be recorded as part of the FPP, which should be a live document.

2. Monitor the implementation of the fall control measures. To prevent the FPP from becoming a *"paper exercise"*, the actions identified in the FPP must be tracked closely by the project manager and safety personnel. Inspections by competent personnel will have to be conducted frequently. In addition, there must be dedicated communication channels for workers and frontline staff to feedback on the effectiveness of the implemented measures.

LIMITATIONS

There were several limitations in the study. Firstly, the study was relying heavily on the perception of practitioners and their assessment on the impact of the FPP. This limitation was minimised with the different sources of data, particularly the evaluation of the actual FPPs obtained from the industry. Secondly, the interviewees and questionnaire respondents were predominantly safety personnel. More engineers, contractors and construction personnel should be surveyed. Thirdly, the content analysis was based on the evaluation of the research team, this can be improved if experienced practitioners were involved in the evaluation. Nevertheless, one of the researchers is a registered safety auditor and that helped to reduce the impact of this limitation. Lastly, the data collected were focused on the Singapore construction industry and the results may not be applicable to other countries. The study presents a case of how a document-based intervention was implemented in Singapore. The shortcomings and perceived benefits of the FPP were presented, but the impact of the local culture and structure on the findings could not be clearly established.

CONCLUSIONS

As the adoption of the FPP by the Singapore construction industry was still in the preliminary stage, the actual effectiveness of the FPP could not be clearly established. Based on this study, the FPP was deemed to be effective because it increased safety awareness, commitment, resources, communication and competency in preventing FFH accidents. The clear allocation of responsibilities and requirement for additional training brought more benefit than the FPP document itself. In addition, since it was generally felt that all the components of the FPP could be replicated from the safety and health management system, it appeared that the FPP document was redundant. To continue its benefits while preventing the FPP from becoming a *"paper exercise"*, it is

proposed that the FPP should be scaled down significantly and be positioned as a detailed risk assessment document. The document should be frequently discussed and actions closely tracked. Inspections must be planned to assure implementation and suitability of the risk control measures. Dedicated feedback and communication channels must be present to allow workers and frontline staff to feedback on FFH risks and controls.

The study provided insights on how a document-based intervention was being implemented and the underlying issues influencing the success of the intervention. The findings will be useful for organisations and countries trying to implement similar interventions. A follow-up study is being planned to provide a longitudinal evaluation of the effectiveness of FPP.

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