UTS ePRESS

Construction Economics and Building

Vol. 17, No. 4
December 2017

Citation: Durdyev, S., Mohamed, S., Lay, M.L., and Ismail, S. 2017. Key Factors Affecting Construction Safety Performance in Developing Countries: Evidence from Cambodia. *Construction Economics and Building*, 17:4, 48-65. http://dx.doi.org/10.5130/AJCEB.v17i4.5596

ISSN 2204-9029 | Published by UTS ePRESS | ajceb.epress.lib.uts.edu.au

RESEARCH ARTICLE

Key Factors Affecting Construction Safety Performance in Developing Countries: Evidence from Cambodia

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DOI: http://dx.doi.org/10.5130/AJCEB.v17i4.5596

Article History: Received 28/06/2017; Revised 01/09/2017 & 23/09/2017; Accepted 29/09/2017; Published 07/12/2017

Abstract

Although proper safety management in construction is of utmost importance; anecdotal evidence suggests that safety is not adequately considered in many developing countries. This paper considers the key variables affecting construction safety performance in Cambodia. Using an empirical questionnaire survey targeting local construction professionals, respondents were invited to rate the level of importance of 30 variables identified from the seminal literature. The data set was subjected to factor analysis. Correlations between the variables show that five key factors underlie the challenges facing the local industry; management and organisation, resources, site management, cosmetic and workforce. It is found that the forefront construction professionals (top management and government authorities) should take more responsibilities for further improvements in safety performance on project sites. Findings and recommendations of this study may be useful to construction professional who are seeking ways to improve safety records in developing countries.

DECLARATION OF CONFLICTING INTEREST The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article. **FUNDING** The author(s) received no financial support for the research, authorship, and/or publication of this article.

Keywords

Safety performance; OSH; construction site; Cambodia; construction safety.

INTRODUCTION

The construction industry is the second most dynamic driver of the Cambodian economy. According to the macroeconomic report by the Ministry of Economy and Finance (MEF, 2016), the construction industry contributes 9 to 10% annually to the country's gross domestic product. Moreover, it seems that investor appetite for construction projects is remaining strong, especially for residential and commercial buildings, as seen in the acceleration of construction project approval value to reach US$8.5 billion in 2016, compared with US$3.3 billion in 2015 (Hawkins and Sek, 2017). Paradoxically, notwithstanding its economic and employment contribution (Durdyev and Ismail, 2016), the sector is affected by issues such as the lack of a professionally qualified workforce, low construction productivity, and low health and safety standards. B2B Cambodia (2015) reported that Cambodia's construction labour standards and site conditions remain low, which is reflected in the country's poor construction safety performance (Jokkaw and Tongthong, 2016). For instance, according to Decent Work Country Programme Cambodia (2011–2015), in 2009, more than 1,500 labourers died because of occupational accidents on construction sites, as stated by the Ministry of Labour and Vocational Training (MLVT, 2011). However, because of inadequate reporting and non-disclosure of incidents, the number of reported accidents remains limited. With the largest proportion of capital investment in the construction sector going to development projects (Durdyev, Omarov and Ismail, 2017), improvement in the occupational safety and health (OSH) performance of the industry is essential to establish a more comprehensive knowledge base for preventative measures and a more conducive environment for enforcing OSH standards in the workplace.

Because construction is one of the most hazardous industries (Jannadi and Bu-Khamsin, 2002) and the labour-intensive nature of construction operations (Lessing, Thurnell and Durdyev, 2017) identifying and addressing OSH-limiting factors is a fundamental approach to enhancing the safety performance of the construction industry (Abdul-Rashid, Bassoni and Bawazeer, 2007). Construction safety research has received significant attention and several studies have investigated the factors affecting construction safety performance in other countries (Sawacha, Naoum and Fong, 1999; Tam, Zeng and Deng, 2004; Abdul-Rashid, 2007; Cheah 2007; Enshassi, Risqa and Arain, 2014). However, no notable research or industry initiatives had been undertaken in Cambodia until the commencement of this scoping study. Moreover, the industry operators and authorities responsible for safety have limited resources to address the myriad construction safety factors presented in the literature. Thus, of strategic importance is identifying the fewest number of factors that have the greatest influence on construction safety performance. This way, stakeholders can focus their efforts and available resources on addressing the most influential factors to ensure safe and efficient construction projects.

Most of construction safety-limiting factors are industry specific because of differences in the sociocultural, legislative and regulatory environments within which construction operations are undertaken. Thus, studies from other countries may not be entirely applicable in the Cambodian construction industry context. In the absence of empirical studies on construction safety-limiting factors in Cambodia, this study aims to contribute to filling an important

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knowledge gap by researching this subject, using the construction projects (residential and hospitality projects) as a starting point. To achieve this aim, this study was undertaken with the following objectives:

1. to identify the key factors limiting safety performance in the Cambodian construction industry
2. to establish the principal factors affecting construction safety performance from the identified sets of variables.

LITERATURE REVIEW

Because of its unique nature, construction is considered one of the most hazardous industries (Fang and Wu, 2013). It comprises a wide range of activities (both construction and repair) that rely intensively on labourers, heavy machinery and equipment. Construction workers engage in many activities that may expose them to serious hazards, such as falling from rooftops, encountering unguarded machinery, and being struck by heavy construction equipment (Popov, Lyon and Hollcroft, 2016). Therefore, safety procedures related to the construction industry or project sites have been established in different countries (Muiruri and Mulinge, 2014) to ensure that construction sites or the industry are not the cause of immediate danger to the public or workers at a project site. Construction safety regulations are also useful for ensuring that every finished product meets the required safety standards.

Various researchers have conducted studies regarding the safety of the construction industry, and identified factors causing poor performance on construction projects, as well as critical success factors influencing safe program implementation (Jazayeri and Dadi, 2017). For instance, Liu, Jazayeri and Dadi, (2017) introduced a weighted rating model to investigate the construction clients' (regardless the type of the construction project) influence on safety performance of any project site. The results show that the construction clients are not exempted from safety responsibility and their involvement obviously contributes to the overall construction safety performance.

From the contractors' perspectives, Jannadi and Bu-Khamsin (2002) researched the key elements of safety performance in Saudi Arabian construction projects. The most significant factors were management involvement, personal protective equipment, emergency/disaster planning and preparation, ionisation radiation, scaffolding and ladders, crane and lifting equipment, fire prevention, electrical equipment, excavation, trenching and shoring, and mechanical equipment. Further, Tam, Zeng and Deng (2004) investigated the factors affecting construction safety performance in China, and found that the priority issues were poor safety awareness among the firm's top leaders, lack of training, poor safety awareness among project managers, reluctance to input resources for safety, and reckless operations.

Ng, Cheng and Skitmore (2005) emphasised several predominant factors affecting construction safety performance at the organisational and project levels, of which 13 related to the organisational level, while 18 related to the project level. Based on mean scores and mean ratings, the study identified the following construction safety factors: implementation of a safety management system in accordance with legislation and compliance with OSH legislation, codes and standards at the organisation level, and provision of a safe working environment at the project level. Further, Abdul-Rashid, Bassoni and Bawazeer, (2007) identified the factors affecting construction safety performance of large contractors in Egypt, including safety awareness among the company's top management, safety awareness among project managers, and safety inspections by safety supervisors.

By adopting the analytical hierarchy process technique and Pareto principle, Al Haadir and Panuwatwanich (2011) indicated the critical success factors influencing safety program implementation in Saudi Arabia, including management support, clear and reasonable objectives, personal attitudes, teamwork, effective enforcement, safety training and suitable supervision. Moreover, Hinze, Hallowell and Baud (2013) analysed 22 safety practices implemented on construction sites for safety performance improvement. The results of an empirical data analysis revealed that the following safety activities differentiate safety performance: worker observation programs, worker safety perception surveys, tracking of first-aid injuries, supervisor involvement in policy making, active owner involvement in safety, site-specific safety training for managers, adequate safety staffing, and other practices. Further, Liu et al., (2015) developed a model for construction professionals by investigating the implications of the operational excellence concept through behavioural and cultural elements influencing the construction safety performance. From a more structured perspective, Gunduz, Birgonul and Ozdemir (2017) assessed the construction safety performance in Turkey by establishing a fuzzy structural equation model, and further classified the 30 most important observable variables under seven dimensions: demolition works, working at height and protection against falling, welding works, personal protective equipment, lighting and electricity, workers, and ladders and stairs. Based on the review of related literature, several studies from various perspectives have reported elements of a poor construction safety performance. However, the identification of the fewest number of elements causing poor construction safety performance is of strategic importance for the construction stakeholders in Cambodia.

The first objective of this study was to identify the factors influencing safety performance in construction projects in the Cambodian context. An in-depth review of the relevant literature was undertaken to identify the factors limiting construction project safety performance. Thirty-six factors were identified that provided the basis for designing a preliminary questionnaire. To refine the factors, pilot interviews were undertaken as described under the research method section. During the pilot interview phase of the study, 30 factors of the 36 sourced from the literature were identified as the most relevant to the Cambodian construction industry. The results of this exercise, produced a list of 30 project safety factors was included in the final version of the questionnaire as discussed in the research method section later. As depicted in Table 1, these project safety factors were identified in previous studies, which provided a basis for the efforts to identify the key factors constraining construction safety performance, with a robust literature backing.

Table 1 Factors affecting construction safety performance in Cambodia

No.	Factors affecting construction safety performance	Relevant literature
1	Lack of training	Ng, Cheng and Skitmore (2005)
2	Reckless operations	Kadiri et al. (2014)
3	Lack of skilled labour	Abdul-Rashid, Bassoni and Bawazeer (2007)

No.	Factors affecting construction safety performance	Relevant literature
4	Poor equipment	Sawacha, Naoum and Fong (1999)
5	Low educated workers	Enshassi, Risqa and Arain (2014)
6	Lack of personal protective equipment	Jannadi (1996)
7	Lack of technical guidance	Abdul-Rashid, Bassoni and Bawazeer (2007)
8	Lack of experienced project managers	Chinda and Mohamed (2008)
9	Excessive overtime work	Tam, Zeng and Deng (2004)
10	Insufficient promotion of safety awareness	Jokkaw and Tongthong (2016)
11	Ineffectiveness of current safety policies	Ng, Cheng and Skitmore (2005)
12	Tight schedule	Zhang et al. (2015)
13	Workers' physical fatigue	Hsu et al. (2008)
14	Financial pressure	Enshassi, Risqa and Arain (2014)
15	Lack of management commitment to safety programs	Shapira and Lyachin (2009)
16	Lack of inspection procedures onsite	Terwel and Vambersky (2013)
17	Lack of safe construction site environment	Sawacha, Naoum and Fong (1999)
18	Lack of safety supervisor onsite	Abdul-Rashid, Bassoni and Bawazeer (2007)
19	Lack of worker compensation insurance	Jokkaw and Tongthong (2016)
20	Poor safety awareness among top management	Tam, Zeng and Deng (2004)
21	Poor selection and control of subcontractors	Ng, Cheng and Skitmore (2005)
22	Poor legislation, codes and standards	Tam, Zeng and Deng (2004)
23	Lack of emergency plan and procedures	Abdul-Rashid, Bassoni and Bawazeer (2007)
24	Poor weather conditions	Shapira and Lyachin (2009)
25	Lack of monitoring the compliance of safety measures	Kadiri et al. (2014)
26	Insufficient safety budget	Chinda and Mohamed (2008)
27	Lack of protection in material transportation	Enshassi, Risqa and Arain (2014)
28	Reluctance to input resources for safety	Tam, Zeng and Deng (2004)
29	Poor accident record keeping and reporting system	Jannadi (1996), Ng, Cheng and Skitmore (2005)
30	Overlapping activities	Mitropoulos and Namboodiri (2011)

RESEARCH METHOD

This study adopted a questionnaire survey technique to investigate the key factors influencing construction safety performance in Cambodia, which has been encouraged and justified by various studies (Tam, Zeng and Deng, 2004; Abdul-Rashid, Bassoni and Bawazeer, 2007; Enshassi, Risqa and Arain, 2014) that aimed to gather responses from the appropriate respondents to achieve their objectives. Based on the findings of the review of relevant literature, the questionnaire has been designed by comprising the key construction safety factors, which are depicted in Table 1. The questions were outlined as simple as possible so that the respondents can understand the relationship of those factors with construction safety performance and easily rate their relative influence. A five-point Likert scale from '1 = very low' to '5 = very high' was adopted for guiding the respondents to seek for their feedback with different levels of impact. Prior to the second-stage quantitative data gathering, this study conducted semi-structured informal interviews (pilot survey) with five contractors and five safety engineers – with at least ten years of the industry experience – to test the feasibility and clarify the concept and design of the intended questionnaire. This helped improve the relevance and workability of the questions in the construction safety context of Cambodia (Tavakol and Dennick, 2011). The open-ended section of the questionnaire served to explore further factors that were not included in the subsets of variables for rating.

This study hand-distributed and collected the survey from the target respondents, as well as using an online survey method, as the appropriate methods of distributing the questionnaire survey forms. This method of questionnaire distribution enabled direct access to respondents to ensure that the questionnaire requirements were clear. In addition, it helped enhance the respondents' interest in answering the questionnaire in detail. The questionnaires were administered to the frontline stakeholders responsible for construction safety performance at various levels of construction firms that operated mainly in Phnom Penh city (home to most of the construction projects), as well as to authorities at the Ministry of Land Management, Urban Planning and Construction (MLMUPC), which is responsible for construction safety in Cambodia. To collect an adequate number of responses throughout Cambodia, additional approaches were taken to obtain the membership directories of the Cambodia Constructors Association (CCA) and Board of Engineers Cambodia (BEC).

DATA ANALYSIS

The research aim focused primarily on evaluating the measures of association between the underlying variables that were identified during the pilot interviews as having a potential influence on safety in construction projects. Ultimately, this study aimed to evaluate whether the set of variables were sufficiently inter-correlated and conceptually meaningful. If so, variables were grouped into a (relatively) small number of principal factors that could be useful to demonstrate the relationships among the set of correlative variables. Consequently, these principal factors were recommended as the focus for stakeholders' efforts and resources to enhance the safety performance of Cambodia's construction industry. Thus, factor analysis was adopted as an appropriate analytical method, which was consistent with the aim and empirical data for the study (Durdyev and Mbachu, 2017). Tests of reliability for this study comprised Cronbach's alpha test, Bartlett's test of sphericity and the Kaiser-Meyer-Olkin

(KMO) test, which were undertaken using the Statistical Package for the Social Sciences (SPSS) (Field, 2009).

RESEARCH FINDINGS AND DISCUSSION

SURVEY RESULTS

The questionnaires were administered to the frontline stakeholders responsible for construction safety performance at various levels in construction firms that operated mainly in Phnom Penh city, as well as authorities at the MLMUPC, which is responsible for construction safety in Cambodia. To collect an adequate number of responses throughout Cambodia, additional approaches were taken to obtain the membership directories of the CCA and BEC.

Invitations to participate in the survey were extended to the 114 key construction safety stakeholders that comprised the three sampling frames for the study—namely, eight authorities at the MLMUPC, 84 contractors (operating mainly in Phnom Penh city) registered with the CCA, and 22 construction safety engineers registered with the BEC. By the cut-off date for the survey, 92 usable responses were received. This represented an approximate 81% usable response rate, with most responses (67%) from contractors. Detailed analysis (refer to Table 2) of the demographic profiles of the respondents indicated that the clear majority (73%) occupied high-ranking positions in their organisations, with an average of nine years of work experience in the construction industry. The status and experience of many respondents added to the feedback quality and reliability of the study findings.

Table 2 Demographic profiles of the respondents

		Quantity	Percentage (%)
Questionnaire	Distributed	114	100
	Valid	92	81
Participants	Contractor	62	67
	MLMUPC member	8	9
	Construction safety engineer	22	24
Position in the organization	Director/Executive Director	23	25
	Manager/Associate Director	49	53
	Team Leader / supervisor	14	15
	General foreman/ sectional head	6	7

PRINCIPAL FACTORS AFFECTING CONSTRUCTION SAFETY PERFORMANCE IN CAMBODIA

The second objective of the study was to establish the principal factors from the identified factors that could significantly express the observed and correlated variables. SPSS was used to perform an exploratory factor analysis of the respondents' ratings of the 30 factors identified in the pilot interview stage of the study.

The SPSS-based results (scree plot and total variance explained output table) indicated five principal factors extracted from the 30 items. The first principal factor (with an initial eigenvalue of 14.22) explained 21.05% of the variance, while factors 2, 3, 4 and 5 (with initial eigenvalues of 12.25, 9.96, 7.62 and 4.14, respectively) explained 18.13%, 14.75%, 11.28% and 6.13%, respectively, of the variance. Thus, these five principal factors explained just over 71% of the variance in the 30 safety factors.

Table 3 presents several very significant results from the factor analysis, which are KMO, measures how suited the questionnaire survey data are for factor analysis and the Bartlett's sphericity test.

Table 3 KMO and Bartlett's test results

KMO measure of sampling adequacy	0.908	
Bartlett's test of sphericity	Approx. chi-square	2,395.244
	Sig.	0.000

KMO test results

The results of the KMO test showed a coefficient value of 0.908, which was greater than the threshold coefficient of 0.7 (Durdyev and Mbachu, 2017). Thus, this result indicated a strong measure of sampling adequacy and demonstrated that the partial correlations or multicollinearity structures between the variables were sufficient to justify aggregating the items into related sets for the purposes of extracting the principal factors.

Bartlett's test of sphericity

IBM (2015) recommended using Bartlett's test of sphericity to test the null hypothesis, which assumes that the extracted principal factors do not make unique contributions to the outcome being investigated or are significantly correlated with each other. In this study, the results of the Bartlett's test of sphericity were found to be significant (see Table 3). This led to the conclusion that the extracted principal factors contributed uniquely to the construction safety performance outcomes. The Bartlett's test results also indicated that varimax rotation was the most appropriate method for factor extraction (Bryman and Cramer, 2011). Thus, the results reinforced the reliability and validity of the five principal factors extracted from the 30 safety factors.

Factor loadings

Table 4 presents SPSS-based pattern matrix output. The table shows the five extracted principal factors and the variables that loaded on them. The results indicated that all item correlations were higher than 0.3, which indicated strong inter-item correlations within each principal factor. It also demonstrated a strong representation of the items by the extracted factors (Tabachnick and Fidell, 2007).

Table 3 indicates that most items loaded strongly and positively on factor 1. Based on the nature of the underlying constructs and a reasonable interpretation of what they were measuring (Bryman and Cramer, 2011), the principal factor was labelled 'management and organisation'. The second (labelled 'resources') and third (labelled 'site management') principal factors received seven and five of the 30 items, respectively. Four of the remaining items loaded on the fourth principal factor (labelled 'cosmetic'), while the fifth factor (labelled 'workforce') received the least of the total number of items.

Table 4 Pattern matrix output showing item loadings on the components

No	Eigenvalue	% of variance	Principal factor	Item	Factor loading
1	14.22	21.05	Management and organisation	Poor safety awareness of top management	0.838
				Insufficient promotion of safety awareness	0.788
				Lack of management commitment to safety programs	0.743
				Lack of training	0.696
				Lack of monitoring the compliance of safety measures	0.681
				Reluctance to input resources for safety	0.663
				Poor selection and control of subcontractors	0.650
				Lack of protection in material transportation	0.596
				Lack of emergency plan and procedures	0.593
				Tight schedule	0.502
				Overlapping activities	0.480
2	12.25	18.13	Resources	Lack of experienced project managers	0.831
				Lack of personal protective equipment	0.716
				Poor equipment	0.629
				Lack of skilled labour	0.606
				Low educated workers	0.582
				Insufficient safety budget	0.548
				Financial pressure	0.471

No	Eigenvalue	% of variance	Principal factor	Item	Factor loading
3	9.96	14.75	Site management	Lack of safe construction site environment	0.71
				Lack of technical guidance	0.678
				Lack of safety supervisor onsite	0.663
				Lack of inspection procedures onsite	0.572
				Poor accident record keeping and reporting system	0.569
4	7.62	11.28	Cosmetic	Ineffectiveness of current safety policies	0.807
				Poor legislation, codes and standards	0.652
				Poor weather conditions	0.574
				Lack of worker compensation insurance	0.433
5	4.14	6.13	Workforce	Reckless operations	0.820
				Excessive overtime work	0.636
				Workers' physical fatigue	0.589

Cronbach's alpha test

Once the principal factors were classified and titled, the Cronbach's alpha coefficient was further calculated (presented in Table 5) to verify the internal consistency of the items in each principal factor. The 'alpha if item removed' option helped check whether removal of any item improved the reliability of a specific principal factor that showed an unsatisfactory Cronbach's alpha value (Durdyev, Ismail and Kandymov, 2017). It was observed that removal of any item under the principal factor resulted in a lower Cronbach's alpha value, which indicated no reason to remove any item, as they all measured the same construct (Tabachnick and Fidell, 2007). At the broad category level, a Cronbach's alpha coefficient greater than 0.7 is considered high (Jang et al., 2011); hence, it was internally consistent.

Table 5 Results of Cronbach's alpha test

Principal factor	Cronbach's alpha	Result
Management and organisation	0.893	→ 0.7 (internally consistent)
Resources	0.815	
Site management	0.836	
Cosmetic	0.803	
Workforce	0.756	

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DISCUSSION

PRINCIPAL FACTOR #1: MANAGEMENT AND ORGANISATION

The results depicted in Table 4 show that issues pertinent to management and organisation explained most of the identified safety factors. This was also justified by this principal factor explaining 21.05% of the total variance among the 30 safety items. Thus, addressing the primary factors with accordance to their relative loading scores could result in construction safety performance enhancement for most residential projects and the overall construction industry in Cambodia. It is obvious that attitude (Teo, Ling and Chong, 2005) and support (Herrero et al. 2006) from the top management of an organisation play a significant role in cultivating a good safety culture, which will subsequently lead to efficient and effective construction safety performance. However, with cost, time and quality the main targets to achieve in construction projects, safety-related issues are not a priority of contractors. Therefore, construction safety stakeholders in Cambodia are recommended to commit to safety programs (Mohamed, 2002) and devote attention to ensure safety management provide regular training (Rowlinson, 2003), allocate sufficient resources (Rechenthin, 2004) and monitor (to improve) compliance with safety measures (Zohar, 2000). In addition, detailed pre-construction planning (Endroyo, Guraji and Besari, 2017) would play a significant role in avoiding a tight schedule and overlapping activities, which may cause safety-related problems. Some benefits of these implementations include increased labour productivity, lower construction site accidents, and ultimately improved industry reputation (Jaselskis, Anderson and Russell, 1996).

PRINCIPAL FACTOR #2: RESOURCES (MEN, MATERIALS, MACHINERY, MONEY AND METHOD)

Resources accounted for 18.13% of the total variance among the 30 safety items, and comprised approximately one-fourth of the items. In accordance with their item loadings, the factors influencing construction safety performance under this cluster perceived by the respondents were 'lack of experience project management', 'lack of personal protective equipment', 'poor equipment', 'lack of skilled labour', 'low educated labour', 'insufficient safety budget' and 'financial pressure'. These results are justified because any well-performed construction safety program cannot be achieved without adequate resources (Rechenthin, 2004; Aksorn and Hadikusumo, 2008). Therefore, top management commitment in construction projects in Cambodia will play a significant role in providing the required resources at an appropriate level, including an experienced and skilled workforce at various levels and sufficient financial support (money), facilities and machines (Rollenhagen and Kahlbom, 2001; Abudayyeh et al. 2006). Moreover, personal protective equipment must be available onsite, as the simple use of this equipment can protect labourers from the short- and long-term effects of construction worksite hazards.

PRINCIPAL FACTOR #3: SITE MANAGEMENT

As depicted in Table 4, safety items under the site management cluster comprised five of the 30 items, and explained about 15% of the total variance among the items. The effect of site management on safety performance was evident in Cooper (2010), who found that top management commitment affects the behaviours of middle managers, who affect the behaviours of construction site managers, who subsequently affect workforce behaviour regarding construction safety. In this principal factor, the most prominent construction safety item in Cambodia is lack of safe construction site environment. In 2008, Building and Woodworkers International conducted a survey, and over 70% of the workforce in Cambodia responded that their workplace lacked any safety committee (Sopheana, 2012). This result aligns with the findings of Abdelhamid and Everett (2000), who stated that one of the main causes of construction accidents is unsafe working conditions.

The second and third most influential construction safety items within the site management cluster were 'lack of technical guidance' and 'lack of safety supervisor onsite', respectively. The respondents' perceived that construction safety performance could be achieved through periodic training programs for workers to improve their safety skills on the job site, which was also supported by Fang, Chen and Wong (2006). However, the SPSS-based result indicated that appropriate supervision must be provided onsite by employing a relevant supervisor, who can act as a job site trainer by assigning tasks in line with labourers' ability. Moreover, onsite supervisors can set a good example by following the safety rules and correcting safety issues when required (Stranks, 2000).

PRINCIPAL FACTOR #4: COSMETIC

Being loaded by only four items, 'cosmetic'—the fourth principal factor—accounted for about 11% of the total variance among the 30 safety items. This principal factor was labelled 'cosmetic' because the relevant items are beyond the contractor's influence or control, including (according to their loadings): the ineffectiveness of current safety policies; poor legislation, codes and standards; poor weather conditions; and lack of worker compensation insurance. This result was justified because construction safety performance can only be achieved through effective guidance from safety policies. Therefore, as indicated by the survey results, government authorities have a central responsibility not only for improving current safety policies, but also for increasing their effectiveness (Thomas, 2012). In his study, Cheah (2007) recommended external pressure in the form of tighter and harsher legislation, which was also perceived to be the second prominent factor constraining construction safety performance in Cambodia. However, the major reasons for the inconsistent enforcement of safety policies and poor legislation are the lack of experienced staff, equipment and safety training (Sopheana, 2012).

The third safety item within the cosmetic cluster was 'poor weather conditions'. The most severe influence of this factor was felt when the project frontline stakeholders were found to be negligent for not taking all necessary measures. In their study, Kartam, Flood and Koushki (2000) concluded that, because of Cambodia's extreme weather conditions—including the heavy rainy season from June to November, and the extremely hot weather from March to May (felt temperature of about 40°C—labourers' state of mind and attention may be adversely affected. Because of the poor weather conditions between March and November, contractors plan their activities intensively (excessive overtime work) to be completed during the good weather season, which leads to 2.5 times more accidents on a project site (King and Hudson, 1985).

PRINCIPAL FACTOR #5: WORKFORCE

The principal factor related to workforce received the least factor loading, with three of the 30 safety items. This principal factor accounted for only 6% of the total variance among the 30 items. The most influential safety item within the workforce cluster was 'reckless operations', which had the second highest factor loading among the 30 items. The main causes of reckless operations on construction sites are economic conditions (low wages) (Pinto, Nunes and Ribeiro, 2011) low level of education and skills (Cooper and Cotton, 2000), pressure to work overtime (also the cause of workers' physical fatigue) (Caruso et al., 2004) and lack of safety training (Toole, 2002). In Cambodia, construction workers generally come from poor provinces, and are unskilled, uneducated and untrained. Therefore, it is evident that the main causes of poor construction safety performance mentioned above are applicable in the Cambodian construction industry context (Sopheana, 2012).

Considering the labour-intensive nature of construction projects (Durdyev and Mbachu, 2011), labourers perform a great diversity of construction project activities and are directly exposed to the associated risks of each activity (Pinto, Nunes and Ribeiro, 2011). Therefore, the safety of construction labourers is a significant issue during the project implementation process. It is recommended that construction safety authorities take effective action to enable further improvement in labour wages, education and skill levels. Perhaps workforce-related principal factors ranked lower than management-related factors because effective management (at various levels) avoids most labour-related safety issues on construction sites in Cambodia.

CONCLUSION

Numerous studies have been published on the various factors affecting the safety performance of the construction industry. However, in the absence of empirical studies on construction safety-limiting factors in Cambodia, this study has explored the principal factors influencing construction safety performance in residential building projects. A questionnaire survey was designed by including the factors affecting construction safety performance reported in the relevant literature. Only 92 usable responses (of 114 distributed) were received from the construction professionals (contractors, safety engineers and government authorities) responsible for the safety performance of the industry before the cut-off date. The collected data from respondents were rated using the terms 'least important', 'slightly important', 'of average importance', 'important' and 'most important' for the factors affecting construction safety performance, and were expressed in concrete numbers using a Likert scale. To determine the appropriate principal safety factors for residential building projects, exploratory factor analysis was performed.

Five principal construction safety factors of 30 variables were extracted from the SPSS-based analysis of the feedback from a survey of the industry's safety authorities. These principal factors were: (1) management and organisation, (2) resources, (3) site management, (4) cosmetic and (5) workforce. According to their influence, these principal factors explained approximately 21%, 18%, 15%, 11% and 6%, respectively, of the variance that described poor construction safety performance in the industry. The results of the KMO (measure of sampling adequacy), Bartlett's test (sphericity) and Cronbach's alpha (internal consistency) confirmed the reliability and validity of the design and findings.

In the management and organisation principal factor, the leading safety items were poor safety awareness among top management and insufficient promotion of safety awareness. In the resources factor, the most influential safety items were lack of experienced project managers and lack of personal protective equipment. In the site management factor, the most prominent safety items were provision of a safe site environment and lack of technical guidance. In the cosmetic factor, the leading safety item was ineffectiveness of current safety policies. In the workforce factor, the most influential safety item was reckless operations.

Based on the research outcomes, it can be inferred that the forefront construction professionals (top management and government authorities) are responsible for safety performance on project sites. Thus, the practical implication of these research outcomes is that top management's attitude towards the significance of construction safety must be strengthened, as it will influence the lower level workforce within the project team. Further, the construction management team is recommended to invest greater efforts into pre-construction planning by considering safety issues.

Despite the lack of professional 'certified' safety training and effective national safety standards, in collaboration with the Department of Occupational Health and Safety from the Ministry of Labour and Vocational Training, industry operators must invest more effort and resources to providing basic safety training for workers at various levels prior to starting construction projects. Further, provision of a safe site environment and personal protective equipment is essential, which will help stem avoidable work-related fatalities and injuries. In the booming Cambodian construction industry, while there is an urgent need for further improvements and increased (practical) effectiveness in current safety standards, industry operators must also comply with the country's current safety standards.

This study was limited to identifying the principal construction safety factors in residential building projects in Cambodia. Expansion of this scope in future research towards other types of construction projects (such as infrastructure projects) is recommended, as every construction project is unique because of its distinct organisational, operational and physical characteristics. Moreover, feedback from construction clients is recommended in future research, as these clients are key influencers of decisions and outcomes in the project delivery process.

In conclusion, to prevent Cambodian workers from continuing to risk their lives for lower than US$10/day, it is recommended that construction professionals (contractors and subcontractors) on the frontline of project activities, as well as government authorities, must input the available resources and invest their efforts into identified principal factors of this study, based on their levels of influence. By doing so, it is hoped that construction safety performance in Cambodia can be significantly improved to enable safe delivery of construction projects with fewer injuries and fatalities.

ACKNOWLEDGMENT

The support of the Department of Engineering and Architectural Studies, Ara Institute of Canterbury and the Research office of Zaman University are acknowledged. Appreciation is given to the construction professionals in Cambodia for providing their opinions, support and assistance.

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