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Occupational safety and health management in developing countries: a study of construction companies in Malawi

Wakisa Simukonda^a, Patrick Manu ^{b*}, Abdul-Majeed Mahamad^b and Krzysztof Dziekonski^b

^aFaculty of Built Environment, University of Malawi – The Polytechnic, Malawi; ^bDepartment of Architecture and the Built Environment, University of the West of England, UK

Purpose. Whilst occupational safety and health (OSH) management is recognized as an important mechanism for addressing poor OSH performance, limited empirical insight is available on OSH management by construction companies in sub-Saharan Africa. This study investigated OSH management by construction companies (i.e., contractors) in Malawi in order to unpick implementation issues that need attention. **Materials and methods.** 46 OSH management practices were probed through a survey of contractors. **Results.** Implementation of OSH practices amongst contractors is low, particularly for practices related to the policy, organizing, measuring and reviewing, and auditing elements of OSH management. Company size is associated with implementation of nearly half of the 46 OSH practices. Certification of the company to Standard No. OHSAS 1800:2007 is associated with the implementation of fewer practices. **Conclusions.** OSH management improvement efforts would need to focus on the elements with particularly low implementation of practices as well as include initiatives that focus on helping microenterprises to improve their OSH management. The association between business characteristics and OSH management may be more evident with certain elements, such as the organizing element. Furthermore, certification to Standard No. OHSAS 1800:2007 may not necessarily translate into greater implementation of OSH management practices, especially in developing countries.

Keywords: construction; developing countries; occupational safety and health management; sub-Saharan Africa; survey

1. Introduction

Construction workers' occupational safety and health (OSH) continues to be a problem in several countries as the industry is characterized by high numbers of work-related injuries and illnesses [1–4]. In the USA, the construction industry was responsible for 774 and 991 fatal injuries in 2010 and 2016, respectively [5,6]. In the UK, the Health and Safety Executive (HSE) [7] states that annually about 3% of workers suffer a work-related illness and about 3% of workers sustain a work-related injury.

Construction sites in developing countries are not in a state of utopia either. The fatal injury rate (i.e., the number of occupational fatal injuries per 100,000 workers) and the accident rate (i.e., the number of occupational accidents per 100,000 workers) for sub-Saharan African countries are estimated to be 21 per 100,000 workers and 16,012 per 100,000 workers, respectively [8]. The construction industry is ranked second in Tanzania [9] and third in South Africa [8] as the largest contributor to occupational accidents. Whilst it is responsible for 9.6% of fatal injuries in Tanzania [10], the industry accounted for 376 fatal injuries in South Africa for the period 2004–2008 [8]. Statistics for construction safety and health accidents in Malawi are not available because data are non-existent [11,12]. However,

the International Labour Organization (ILO) [13] OSH estimates for Malawi in all occupations indicate that the number of accidents causing more than 3 days of absence from work was almost 1 million for the period 2004–2009, an average of 200,000 accidents per year. Inferring from the construction OSH situation in Tanzania and South Africa, which share similar characteristics with Malawi, the construction OSH situation in Malawi can also be said to be poor.

The economic impacts of occupational injuries and illnesses on enterprise performance are unprecedented. Among others, occupational injuries and illnesses disrupt the production process, deteriorate human capital and damage the corporate image [2,14,15]. In the UK, occupational injuries and illnesses in construction were associated with an estimated loss of 1.7 million working days and GBP 0.9 billion for the period 2014–2015 and 2013–2014, respectively [7]. Overall, occupational injuries and illnesses account for a loss of about 1–6% of a nation's gross domestic product [16] and about 4% of the global gross domestic product [12].

However, occupational safety and health management systems (OSH MSs) have been recognized as an important means for improving OSH performance. OSH MSs are

*Corresponding author. Email: patrick.manu@uwe.ac.uk

reported to promote the safety climate and corporate image, increase production and prevent the loss of human capital and associated costs [14,17–19]. Realizing the importance of OSH management, the Malawi government launched a 5-year national OSH programme to improve safety and health in workplaces in line with the Malawi decent work agenda for the period 2011–2016 [12]. Its overarching goal was to achieve a continual reduction of at least 5% annually in occupational fatal injuries through systematic management of OSH [12]. The specific objectives of the programme endeavoured to improve OSH management systems and infrastructure, enhance information management and dissemination, increase awareness of occupational tuberculosis and other diseases, and strengthen the legal OSH framework [12]. These objectives were designed to be realized through the formulation of a coherent national OSH policy, harmonization of OSH legislation, increasing OSH awareness and improving the accidents data recording system, among others [12].

While an evaluation of the impact of the programme is yet to be released, a textual analysis of the programme reveals some potential inadequacies. For instance, the OSH programme lacks initiatives targeting micro, small and medium-sized firms (SMEs) which, according to previous studies (e.g., [20,21]), struggle with OSH management. Furthermore, the programme neither explicitly mentions OSH MSs nor provides direction as to which elements and practices of OSH management need attention so that improvement efforts can be targeted at those elements and practices. OSH management still depends on compliance with minimum regulations, presumably unknown by consumers and sluggishly enforced by authorities [13]. Additionally, studies have highlighted the dearth of literature on OSH management in construction within the sub-Saharan African region [22,23]. In Malawi, the only published study on OSH in the construction industry assessed the knowledge of legislation relative to OSH and safety culture among construction industry professionals [11]. Thus, an in-depth analysis of OSH management practices of construction firms in Malawi is non-existent, creating a knowledge gap which needs to be addressed. Hence, the focus of this study is an investigation of OSH management practices implemented by construction firms in Malawi in order to unpick implementation issues that need attention.

2. OSH MSs

The concept of OSH MSs as a key prevention strategy for occupational accidents emerged in the 1990s. Major industrial accidents (i.e., the 1974 Flixborough explosion in the UK, the 1984 Bhopal chemicals leak in India and the 1986 Chernobyl disaster in Ukraine) had formative influences on the concept [24–27]. The earliest solutions for improving OSH focused on procedures for the safe physical

environment [28]. However, it was acknowledged that the industries' nature of operations which were becoming more dynamic and complex necessitated the application of new approaches to maintain OSH [26,27]. Workplace organizational factors such as OSH management activities which ensure swift response to imponderables and random changes in businesses through continuous improvement of performance were identified as possible solutions [26,27]. Meanwhile, the British Standards Institution (BSI) defines OSH MSs as 'part of an organisations management system used to develop and implement its OSH policy and manage its OSH risks' [29,p.3]. Anchoring their foundation in the management system, Ghallagher et al. [30] suggest that OSH MSs should comprise defined objectives, inter-related elements, links with other organizations' systems and requirements for system maintenance. As the fundamental property of the system is the interdependence of its variables, the authors argue that the linking of these components to achieve OSH objectives is what underlines OSH MSs. Recently, many authors have advocated for the amalgamation of multiple systems into a single integrated management system (IMS). Jørgensen et al. [31] state that operating separate management systems is wasteful as it entails significant financial commitments on the part of the organization. As a result, some organizations have amalgamated at least two parts of quality, environmental and OSH management systems in order to optimize resource utilization [1,31,32]. Despite the appetite for IMS, separate management systems remain in use, e.g., Standard No. OHSAS 18001:2007 [29] for OSH management.

2.1. Systematic OSH MSs

Various OSH management models have been developed by public and private institutions as well as individuals. Most of these models are based on the HSE model [33] and a few have been further improved. Therefore, only a handful of models are relevant and these are discussed in chronological order.

2.1.1. Successful OSH management (HSG 65)

Officially known by its series number HSG 65, the model was first published in 1991 and revised in 1997 by the HSE [33]. It is a universal non-mandatory blueprint, conceived as the OSH standard for all sectors of occupations [34]. Its objective is to minimize occupational accidents through an effective and proactive management structure [33,34]. HSG 65 embraces OSH as an integral part of the management function [34]. The model has six elements designated as policy, organizing, planning, measuring, auditing and reviewing (POP MAR) that are linearly sequenced except for auditing, which represents a supra-system element [33–35]. Based on the HSE [33], the elements are defined as follows:

- Policy: the overall OSH philosophy and fundamental principles crafted in line with the organization's core activities and current legislation.
- Organizing: designing an effective management structure and allocating resources for delivery of OSH policy.
- Planning and implementation: sequencing action steps to guide implementation of OSH policy through a systematic OSH management structure and the actual operation.
- Measuring performance: actual measurement of performance against the set standards to determine areas which need improvement through active and reactive monitoring.
- Auditing: conducting an independent audit of the performance of the overall OSH MSs to ensure perfect functioning for the continuous improvement of the OSH MS.
- Reviewing performance: the systematic review of the effectiveness of OSH MSs based on feedback from measuring and auditing and applying lessons learnt to improve system performance.

Whilst the model is easier to comprehend, it has been criticized for lack of clarity and specification of its inputs and outputs, lack of empirical evidence to support its practicality and redundancy of auditing and measuring performance [35,36]. Nevertheless, the model is the basis of succeeding OSH management models.

2.1.2. Standard No. OHSAS 18001:2007

In the late 1990s, OSH MS certification was becoming a long-range strategy for an organization's business competition and conformance in a number of areas [32,36]. As a result, organizations started demanding OSH MSs against which their OSH MSs could be evaluated and certified [29,37]. The main objective of the standard is to create and maintain a safe working environment [37] and promote good health of workers [18,38] through systematic OSH management [37,39]. Its main elements include OSH policy, planning, implementation and operation, checking and corrective action, and management review [29]. The standard is based on Deming's philosophy of the plan–do–check–act (PDCA) process which promotes principles of continuous improvement and internalization of OSH into core business management [17,35,37]. Other international standards relating to quality management and environmental management adopt the same approach and therefore are compatible with Standard No. OHSAS 18001:2007 [40]. Despite being criticized for lack of cogent direction and clarification on the purpose of non-financial audit [35], Standard No. OHSAS 18001:2007 is a compellable international OSH MS of choice [29].

2.1.3. McDonald et al.'s safety management model

McDonald et al.'s model [41] coalesces salient components of the HSE model [33]. It is a self-regulatory feedback model with seven elements divided into two levels of safety management functions, namely, operational performance and system auditing [35]. Operational performance comprises policy, standards, planning and organizing, and normal operational practice, and the whole system is subject to audit and review [41]. Overall, the model is comprehensible and its linear-structured elements are easy to follow. Nevertheless, the model lacks clear interrelated relationships among its elements and supplementary pragmatic evidence [35] to corroborate its effectiveness in addressing safety issues in its niche.

2.1.4. Perezgonzalez's safety management model

Perezgonzalez's [35] model presents an enhanced hypothetical safety management model by exploiting gaps in the HSE [33] and McDonald et al. [41] models. Its main elements include policy, planning and organization, operational practice and monitoring [35]. It also has pre-adjustment and change and post-adjustment and change stages which inform operational practice and organizational OSH goals at the higher level in order to influence desired outcomes [35].

2.1.5. ILO-OSH 2001

The ILO-OSH 2001 [27] model reflects the universal principles enshrined in ILO's OSH model, particularly the OSH convention of 1981 (i.e., No. 155) [26]. It is intended to be used at both the organizational and the national levels, non-mandatorily [26,27]. At the organizational level, the guidance promotes incorporation of OSH MS components into the organizational overall policy and management arrangements, while at the national level it encourages the establishment of a national framework for OSH MSs supported by national laws and regulations [27]. The model has five elements including OSH policy, planning, implementation, measuring and evaluation, and management review [26,27].

2.1.6. HSE managing for OSH

The HSE [42] OSH management model abandons the POPMAR structure and adopts a PDCA approach. Like previous versions, the model seeks to help organizations develop and implement OSH management arrangements while abiding by the law [42]. The elements of this model include plan (i.e., policy and planning), do (i.e., risk profiling, organizing and implementing the plan), check (i.e., measuring performance and investigating incidents) and act (i.e., learning lessons and reviewing performance) [33].

Overall, the majority of the models are based on the original model of the HSE [33] in terms of their elements

and corresponding OSH practices. As such, the models inherit the weaknesses of the HSE [33] model, particularly by presenting a management process rather than a management system for addressing the OSH incidences. Table 1 summarizes the key elements of the models discussed.

2.2. Effectiveness of OSH MSs: the research evidence

Robson et al. [17] state that the current strand of literature does not unequivocally demonstrate the practical effectiveness of OSH MSs in addressing OSH challenges. Nevertheless, there are arguments in favour of the value of OSH MSs in addressing OSH challenges in all sectors, including the construction industry. Robson et al. [17] conducted a systematic literature review of 13 articles on the effectiveness of OSH MSs in addressing occupational accidents. The findings revealed that accidents frequency decreased by 24–34 and 18% for voluntary and mandatory OSH MSs, respectively. In addition, a 13–52% decrease in workers' compensation was recorded over 3 years [17]. Yoon et al. [19] conducted a study on the effect of OSH MSs on work-related accident rates in the South Korean construction industry. They found annual average accident rates of 0.18 and 0.30 victims/100 employees for OSH MS-certified and non-certified construction companies, respectively. Furthermore, the fatal accident rates for OSH MS-certified companies plummeted by 10.3% when compared to non-certified companies [19]. On the other hand, Abad et al. [2] studied the impact of Standard No. OHSAS 18001:2007 on safety performance and labour productivity in 149 Spanish companies between 2006 and 2009. The study revealed a 1.43% decrease in the rate of accidents, a 4.21% increase in labour productivity and a deeper embedded safety culture as a result of an extra year of safety experience, yielding a further 0.80% reduction in accident rates [2]. These studies and others demonstrate the effectiveness of OSH MSs in addressing OSH management performance challenges.

3. Research design

The overarching aim of the study was to investigate the OSH management practices implemented by construction companies in Malawi in order to identify the OSH management elements and practices which need improvement. In order to achieve the aim, a quantitative research design, in particular a survey, was adopted. The quantitative survey was used due to its suitability for obtaining a generalized view of a phenomenon [43], which in the case of this study is the OSH management practices of construction companies in Malawi. The survey strategy has also been used by previous studies that examined OSH management practices by construction companies in other developing countries [20,21]. This study targeted senior company management personnel such as directors, OSH managers and engineers as they are more likely to have

good knowledge of their companies' OSH management practices [21].

3.1. Survey design

A questionnaire instrument was designed for the survey. The questionnaire comprised multiple questions with fixed response categories, i.e., dichotomous yes or no and multiple choices, as well as open-ended questions. The questionnaire comprised three sections as follows: (a) introduction (i.e., a prefatory section containing general instructions for filling the questionnaire); (b) respondents' and company profile (i.e., sought information related to professional roles, experience, company size and age), which was used for establishing the relationship between business characteristics and implementation of OSH management practices; (c) business safety and health management practices. Drawing from practices within OSH management elements (i.e., summarized in Table 1), the last section elicited responses on the OSH management practices implemented by construction companies in Malawi. A total of 46 OSH management practices were probed.

Prospective respondents were drawn from a list of construction firms compiled by Malawi's National Construction Industry Council (NCIC) and registered for the 2016/17 financial year. The list comprised 1527 construction firms registered in building, civil and electrical engineering categories. Simple random sampling (SRS) aided by Microsoft Excel version 2016 was employed to draw a list of 320 firms from the population. Using researchers' contacts in Malawi, the email addresses of the sampled contractors were obtained for administration of the questionnaire. Where this was unsuccessful, the selected contractors were randomly replaced to maintain the sample size. A softcopy of the questionnaire together with a link to an online version hosted by Bristol online survey (BOS) was emailed to the selected contractors. Accompanying the questionnaire was a request for company personnel in a management role to complete the questionnaire.

3.2. Data analysis

The data were screened and coded in order to obtain numerical values for analysis. Subsequently, the data were exported to SPSS version 23.0. The level of implementation of OSH management practices by the construction companies was assessed based on Manu et al.'s [21] categorization of the implementation levels, i.e., low implementation (i.e., where 0–49% of companies implement a practice), moderate implementation (i.e., where 50–59% of companies implement a practice) and high implementation (i.e., where over 70% of companies implement a practice). The procedure adopted for establishing the associations between business characteristics and the implementation of OSH management

Table 1. Summary of key elements of occupational safety and health management systems (OSH MSs).

OSH management element	Description of element and example of practice	OSH MS					
		HSE [33]	McDonald et al. [41]	ILO-OSH 2001 [27]	Perezgonzalez et al. [35]	Standard No. OHSAS 18001:2007 [29]	HSE [42]
Plan							
Policy	Overall organization OSH guiding philosophy, e.g., OSH policy document	✓	✓	✓	✓	✓	✓
Planning	Establishment of implementation procedures, e.g., OSH objectives and project OSH plans	✓	✓	✓	✓	✓	✓
Do							
Risk assessment	Identification of potential risks and management measures, e.g., preparing risk assessment for work package				✓	✓	✓
Organizing	Organization of activities to deliver OSH plans, e.g., providing financial and human resources	✓	✓	✓	✓	✓	✓
Implementation	Operationalization of OSH programme, e.g., providing OSH inductions and training	✓	✓	✓	✓	✓	✓
Check							
Measuring performance	Assessing whether goals are being achieved, e.g., incident investigation	✓	✓	✓	✓	✓	✓
Act							
Auditing and lessons learnt	Assessing the effectiveness of OSH MS for continuous improvement, e.g., internal or external audits	✓			✓	✓	✓

Note: HSE = Health and Safety Executive; ILO-OSH = International Labour Organization – Occupational Safety and Health.

practices involved using Pearson's χ^2 test as employed by Kheni et al. [20] and Manu et al. [21]. The dependent variables (i.e., implementation of OSH management practices) were dichotomous yes or no and were defined as yes (i.e., implementation of OSH management practice) and no (i.e., non-implementation of OSH management practice). Three hypotheses were formulated and tested:

- H_1 : certification to Standard No. OHSAS 18001:2007 [29] will be significantly associated with implementation of OSH management practice.
- H_2 : company age (i.e., the number of years the company has been in operation) will be significantly associated with implementation of OSH management practice [20].

- H_3 : company size will be significantly associated with implementation of OSH management practice [20].

4. Results

The results of the study are presented under three sections: respondents' and company profile; OSH management practices; relationship between the business characteristics and implementation of OSH management practices.

4.1. Respondents' and company profile

The response rate and professional roles of the respondents are presented in Tables 2 and 3, respectively. The response rate is regarded as good considering that the normal response rate in construction ranges from 20 to 30%

[44]. The mean working experience of the respondents is 7.0 years and a banded distribution of their experience is shown in Figure 1. Taken together, the responses provided by the respondents can thus be considered to be an accurate depiction of their companies' OSH management practices.

Table 4 summarizes the companies' profile. Over 70% of the companies are micro and small companies. This is in consonance with the demographic profile of companies in the construction industry of other countries [20,21,45], where the sector is largely dominated by micro and small enterprises. Just like in other countries [21], the category of a firm's registration in Malawi is not mutually exclusive as

Table 2. Response rate.

Survey characteristic	Number	%
Distributed questionnaires	320	100 of sample size
Returns	75	23.4 of distributed questionnaires
Used for analysis	75	100 of returns

Table 3. Respondents' professional roles.

Professional role	Frequency	%
Company director/manager	32	42.7
Site manager	2	2.7
Occupational safety and health manager/supervisor	3	4.0
Site agent	3	4.0
Project manager	5	6.7
Site engineer	5	6.7
Procurement and administrative officer	1	1.3
Cost estimator/quantity surveyor	24	32.0

companies sometimes undertake multiple work categories such as building works and civil engineering works, as evidenced by the results presented in Table 4. Figure 2 shows that fewer than 20% of the companies are certified to Standard No. OHSAS 18001:2007.

4.2. OSH management practices

Table 5 presents results for statistical analysis of OSH management practices. As mentioned previously, the practices were dichotomous yes or no and were defined as follows: 1 = *yes* (i.e., implementation of OSH management practice) and 0 = *no* (i.e., non-implementation of OSH management practice). In order to show the OSH management practices implemented across the sample of construction firms, attention is drawn to the percentage of companies that implement a practice. As highlighted earlier, the levels of implementation are categorized into low implementation (i.e., 0–49%), moderate implementation (i.e., 50–69%) and high implementation (i.e., over 70%) [21]. The findings are presented in the following under the key elements of OSH management:

- **Policy:** this element assessed two OSH management practices. The findings indicate low implementation for Pol1 and Pol2 (i.e., 44.0 and 41.3%, respectively).
- **Organizing:** 14 practices were assessed within this element. Org3 recorded high implementation (i.e., 70.7%) while Org1 and Org9 showed moderate implementation (i.e., 52.0 and 56.0%, respectively). Low implementation was registered for the remaining 11 practices.
- **Risk assessment:** this element assessed five practices. Risk5 recorded high implementation with 80.0% while Risk1 and Risk2 showed moderate

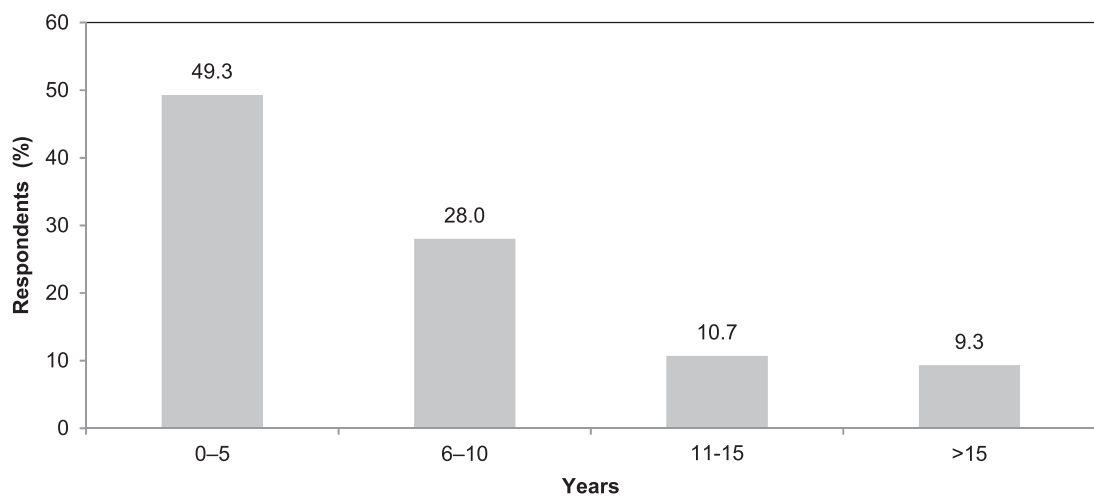


Figure 1. Respondents' working experience.

Note: Sum of % is <100% due to non-response by some participants.

Table 4. Profile of the companies.

Respondents' company profile	Frequency ^a	% ^b
Size of company		
Micro firm: ≤10 employees	38	50.7
Small firm: 11–50 employees	16	21.3
Medium firm: 51–150 employees	14	18.7
Large firm: >150 employees	5	6.7
Age of company (years)		
≤10	34	45.3
11–15	19	25.3
>15	21	28.0
Sectors of work undertaken by company		
Public-sector works	35	46.7
Private-sector works	31	41.3
Works undertaken by company		
Building	50	66.7
Civil engineering	46	61.3
Electrical and mechanical	9	12.0
Business class of registration (MWK^c)		
2.5–30 million	9	12
50–75 million	7	9.3
100–200 million	21	28.0
500 million to >1 billion	36	48.0
2015/16 annual turnover (MWK)		
0–10 million	10	13.3
11–75 million	14	18.7
76–200 million	12	16.0
>201 million	36	48.0

^aSum of frequency could be <75 due non-responses by some participants. Sum of contractors in the category of registration is greater than 75 as some contractors are registered in both building and civil engineering categories.

^bSum of % could be <100% due to non-response by some participants.

^cMWK = Malawi Kwacha, EUR 100 = MWK 84,916.4; USD 100 = MWK 71,892.1, the exchange rate used is the average August 2017 interbank exchange rate obtained from <https://www.oanda.com/currency/average>.

implementation. Low implementation was recorded on Risk3 and Risk4.

- **Planning:** five practices were assessed within this element. High implementation was seen for Pln2 (i.e., 74.7%). Pln1 and Pln3 registered moderate implementation while Pln4 and Pln5 recorded low implementation.
- **Implementing:** this element assessed 12 practices. Practices Impl7, Impl8 and Impl9 recorded high implementation, i.e., 80.0, 92.0 and 89.3%, respectively. The other practices registered either moderate or low implementation.
- **Measuring and reviewing performance:** five practices were examined under this element. High implementation was observed on Meas&rev3 (i.e.,

70.7%), while Meas&rev4 recorded moderate implementation (i.e., 61.3%). The other three practices registered low implementation.

- **Auditing:** all three practices under this element, i.e., Aud1, Aud2 and Aud3, recorded low implementation with 33.3, 12.0 and 44.0%, respectively.

Overall, the observed level of implementation is summarized as follows: low = 29 practices, moderate = 10 practices and high = 7 practices.

4.3. Associations between company characteristics and OSH management practices

The findings of the Pearson's χ^2 test determining significant statistical associations between business characteristics and implementation of OSH management practices are presented in Tables 6–8. The conventional statistical significance level of $p = 0.050$ was adopted [46]. H_0 (i.e., no association between variables) was rejected if the significance level was small (i.e., $p < 0.050$). For the sake of brevity, the tables present only OSH management practices which are significantly associated with business characteristics.

4.3.1. Association between certification to Standard No. OHSAS 18001:2007 and implementation of OSH management practices

The results of the association between certification to Standard No. OHSAS 18001:2007 and implementation of OSH practices are presented in Table 6. The observed results revealed significant association between certification to Standard No. OHSAS 18001:2007 and implementation of nine OSH management practices (i.e., Pol1, Org1, Org2, Org4, Org6, Org11, Pln1, Pln4 and Impl11). Therefore, the first hypothesis (i.e., certification to Standard No. OHSAS 18001:2007 will be significantly associated with the implementation of OSH management practice) was accepted for these practices. The superscript letters (i.e., c and d) for the counts presented in Table 6 show the results of a z -test that compares column proportions (i.e., comparison between the '% within practice' for implementation of a practice and '% within practice' for non-implementation of that practice) [46]. These superscripts enable interpretation of the nature of the association. Different superscript letters indicate that the proportion within practice for implementation and the proportion within practice for non-implementation are significantly different [46]. For example, for Pol1, the different superscript letters for 36 and 21 mean that 90.0% is significantly different from 67.7%. Similarly, 10.0 and 32.3% are significantly different. Thus the proportion of companies not certified to Standard No. OHSAS 18001:2007 that do not implement Pol1 (i.e., 90.0%) is significantly greater than the proportion of non-certified companies that implement Pol1

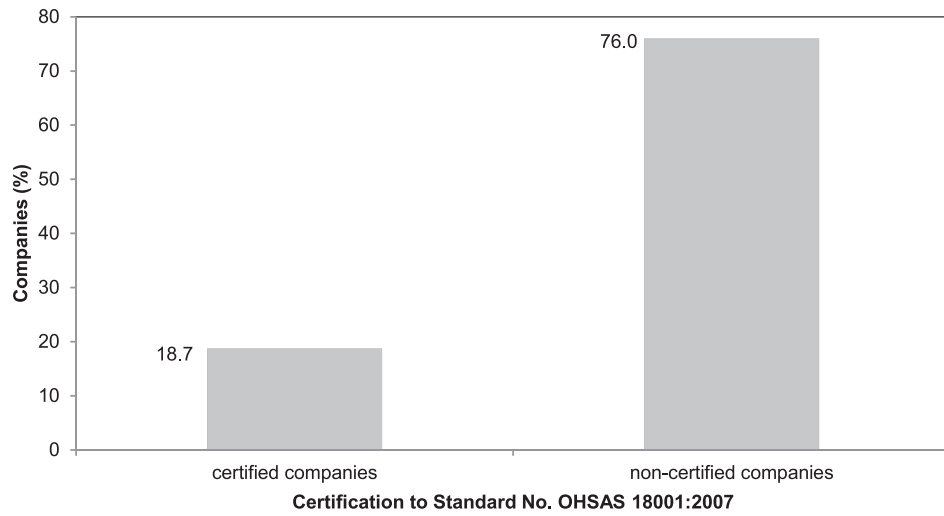


Figure 2. Certification to Standard No. OHSAS 18001: 2007 [29] by construction companies.
Note: Sum of % is <100% due to non-response by some participants.

Table 5. Extent of implementation of occupational safety and health (OSH) management practices.

OSH management element	OSH management practice			Frequency ^b	% ^c	Extent of implementation
	Practice code ^a	Description of practice				
Policy	Pol1	A formal company OSH policy statement		33	44.0	Low
	Pol2	A company director with overall responsibility for OSH		31	41.3	Low
Planning	Pln1	Preparing OSH plans for every construction project		45	60.0	Moderate
	Pln2	Provision of OSH insurance cover for sites		56	74.7	High
	Pln3	Pricing to cover OSH requirements for projects		46	61.3	Moderate
	Pln4	Preparing method statements		32	42.7	Low
	Pln5	Setting OSH performance targets		2	28.0	Low
Organizing	Org1	Providing OSH supervisors on sites		39	52.0	Moderate
	Org2	Communicating OSH information to workers through newsletters, leaflets, posters, etc.		24	32.0	Low
	Org3	Engaging with workers on OSH issues, e.g., OSH meetings and suggestion schemes		53	70.7	High
	Org4	Networking with other companies' / institutions' (insurance companies, government offices) about OSH issues		19	25.3	Low
	Org5	Propagating OSH practices to external stakeholders, e.g., clients		14	18.7	Low
	Org6	A designated OSH department		12	16.0	Low
	Org7	Assessing the competence of workers and subcontractors		19	25.3	Low
	Org8	A company designated OSH budget		26	34.7	Low
	Org9	Display of regulatory OSH posters on construction sites		42	56.0	Moderate
	Org10	Display of company OSH policy on construction sites, company website, and head/branch offices		17	22.7	Low
	Org11	Provision of OSH annual reports		11	14.7	Low
	Org12	A designated OSH manager		21	29.0	Low
	Org13	Providing OSH training for site safety supervisors and site managers		33	44.0	Low
	Org14	Providing training programmes for safety manager(s)		18	24.0	Low
Risk assessment	Risk1	Undertaking overall project risk assessments before projects start		44	58.7	Moderate
	Risk2	Designing site rules and measures to mitigate assessed risks		42	56.0	Moderate
	Risk3	Undertaking risk assessments for work packages/operations before they start		25	33.3	Low

(Continued).

Table 5. Continued.

OSH management element	OSH management practice				Extent of implementation	
	Practice code ^a	Description of practice	Frequency ^b	% ^c		
Implementing	Risk4	Reviewing and updating risk assessments during construction	31	41.3	Low	
	Risk5	Informing employees about hazards on sites before work starts	60	80.0	High	
	Impl1	Implementing site OSH rules and measures	48	64.0	Moderate	
	Impl2	Amending and correcting OSH plans during construction	27	36.0	Low	
	Impl3	Rewarding workers for safe work behaviour	13	17.3	Low	
	Impl4	Site inductions for workers	31	41.3	Low	
	Impl5	Training programmes for site workers	44	58.7	Moderate	
	Impl6	Carrying out site OSH inspections regularly	44	58.7	Moderate	
	Impl7	Provision of sanitation and welfare facilities on sites (e.g., toilets, canteens, drinking water)	60	80.0	High	
	Impl8	Provision of personal protective equipment	69	92.0	High	
	Impl9	Provision of first-aid equipment on sites	67	89.3	High	
	Impl10	Disciplining workers for unsafe work behaviour	33	44.0	Low	
	Impl11	Assigning OSH supervisor(s) on site	33	44.0	Low	
	Impl12	Conducting regular health checks for employees	28	37.3	Low	
	Measuring and reviewing performance	Meas&rev1	Measuring OSH performance against set targets	24	32.0	Low
		Meas&rev2	Reviewing and updating OSH plans after projects completion	25	33.3	Low
		Meas&rev3	Keeping incident records on every project	53	70.7	High
Meas&rev4		Investigating the causes of incidents, accidents and near-misses	46	61.3	Moderate	
Meas&rev5		Publishing or sharing lessons learnt from incident investigations across the company or on projects	20	26.7	Low	
Auditing	Aud1	Undertaking periodic safety management auditing	25	33.3	Low	
	Aud2	Use of external consultant for undertaking safety management auditing	9	12.0	Low	
	Aud3	Use of in-house personnel for undertaking safety management auditing	33	44.0	Low	

^aAud1–Aud3, Impl1–Impl12, Org1–Org14, Meas&Rev1–Meas&Rev5, Pln1–Pln5, Pol1–Pol2 and Risk1–Risk5 are codes representing their corresponding OSH management practices.

^bSum of frequency could be <75 due non-responses by some participants.

^cSum of % could be <100% due to non-response by some participants.

(i.e., 67.7%). Conversely, the proportion of companies certified to Standard No. OHSAS 18001:2007 that do not implement Pol1 (i.e., 10.0%) is significantly less than the proportion that implement Pol1 (i.e., 32.3%). The pattern of association thus suggests that companies that are certified to Standard No. OHSAS 18001:2007 are more likely to implement Pol1. This pattern of association applies to the other practices in Table 6 as shown by the different superscript letters for the counts of those practices.

4.3.2. Association between company age and the implementation of OSH management practices

The cross-tabulation (see Table 7) presents findings for the association between company age and the implementation of OSH management practices. The findings reveal that

company age is significantly associated with 10 OSH practices, namely, Pol2, Org1, Org3, Org7, Org8, Org13, Risk2, Pln1, Impl11 and Aud1. As such, the second hypothesis (i.e., company age will be significantly associated with the implementation of OSH management) is accepted for these practices. An examination of the superscript letters for the counts presented in Table 7 reveals an overall pattern such that, as companies get older (i.e., company age increases), the more likely they are to implement these practices. For instance, for Pol2, a significantly greater proportion of the companies aged up to 10 years do not implement Pol2. Amongst companies aged between 11 and 50 years there is no significant difference between the proportion that implement and the proportion that do not implement Pol2. However, for companies aged over 50 years, a significantly greater proportion implement Pol2.

Table 6. Association between certification to Standard No. OHSAS 18001: 2007 and implementation of occupational safety and health (OSH) practices.

OSH management practice ^a	Implementation of practice ^b	Standard No. OHSAS 18001: 2007 [29] non-certified			Standard No. OHSAS 18001: 2007 [29] certified			Pearson's χ^2			Cramer's ϕ_c	
		Count	Expected count	% within practice	Count	Expected count	% within practice	Value	df	p (two-sided)	Value	p
Pol1	0	36 ^c	32.1	90.0	4 ^c	7.9	10.0	5.466	1	0.033	0.277	0.033
	1	21 ^d	24.9	67.7	10 ^d	6.1	32.3					
Org1	0	31 ^c	26.5	93.9	2 ^c	6.5	6.1	7.265	1	0.008	0.320	0.008
	1	26 ^d	30.5	68.4	12 ^d	7.5	31.6					
Org2	0	43 ^c	39.3	87.8	6 ^c	9.7	12.2	5.224 ^e	1	0.050	0.280	0.026
	1	14 ^d	17.7	63.6	8 ^d	4.3	36.4					
Org4	0	45 ^c	41.6	86.5	7 ^c	10.4	13.5	4.912 ^e	1	0.037	0.278	0.037
	1	11 ^d	14.4	61.1	7 ^d	3.6	38.9					
Org6	0	52 ^c	47.4	88.1	7 ^c	11.6	11.9	11.221 ^e	1	0.001	0.438	0.001
	1	5 ^d	9.6	41.7	7 ^d	2.4	58.3					
Org11	0	53 ^c	49.0	86.9	8 ^c	12.0	13.1	9.634 ^e	1	0.003	0.410	0.003
	1	4 ^d	8.0	40.0	6 ^d	2.0	60.0					
Pln1	0	27 ^c	23.3	93.1	2 ^c	5.7	6.9	5.091	1	0.033	0.268	0.033
	1	30 ^d	33.7	71.4	12 ^d	8.3	28.6					
Pln4	0	37 ^c	32.9	90.2	4 ^c	8.1	9.8	6.083	1	0.018	0.293	0.018
	1	20 ^d	24.1	66.7	10 ^d	5.9	33.3					
Imp11	0	36 ^c	31.3	92.3	3 ^c	7.7	7.7	7.905	1	0.007	0.334	0.007
	1	21 ^d	25.7	65.6	11 ^d	6.3	34.4					

^aImpl11, Org1, Org2, Org4, Org6, Org11, Pln1, Plan4 and Pol1 represent OSH management practices as indicated in Table 5.

^b0 = non-implementation of practice; 1 = implementation of practice.

^{c,d}Each superscript letter denotes a subset of OSH management practice categories whose column proportions do not differ significantly from each other at the 0.05 level.

^eSome expected frequencies are <5, hence the likelihood ratio has been used in place of Pearson's χ^2 .

Table 7. Association between company age and implementation of occupational safety and health (OSH) practices.

OSH management practice ^a	Implementation of practice ^b	≤10 years			11–50 years			>50 years			Pearson's χ^2			Cramer's ϕ_c																																																																																																																																																																																																																																					
		Count	Expected count	% within practice	Count	Expected count	% within practice	Count	Expected count	% within practice	Value	df	p (two-sided)	Value	p																																																																																																																																																																																																																																				
Pol2	0	25 ^c	19.8	58.1	10 ^c	11.0	23.3	8 ^c	12.2	18.6	7.011	2	0.034	0.308	0.034																																																																																																																																																																																																																																				
	1	9 ^d	14.2	29.0	9 ^c	8.0	29.0	13 ^d	8.8	41.9						Org1	0	22 ^c	16.1	62.9	9 ^c	9.0	25.7	4 ^c	9.9	11.4	10.857	2	0.004	0.383	0.004	1	12 ^d	17.9	30.8	10 ^c	10.0	25.6	17 ^d	11.1	43.6	Org3	0	16 ^c	10.1	72.7	5 ^c	5.6	22.7	1 ^c	6.2	4.5	11.260	2	0.003	0.390	0.003	1	18 ^d	23.9	34.6	14 ^c	13.4	26.9	20 ^d	14.8	38.5	Org7	0	28 ^c	25.3	50.9	16 ^c	14.1	29.1	11 ^c	15.6	20.0	7.420	2	0.025	0.317	0.025	1	6 ^c	8.7	31.6	3 ^c	4.9	15.8	10 ^d	5.4	52.6	Org8	0	26 ^c	22.1	54.2	15 ^c	12.3	31.3	7 ^c	13.6	14.6	12.824	2	0.001	0.416	0.001	1	8 ^c	11.9	30.8	4 ^c	6.7	15.4	14 ^d	7.4	53.8	Org13	0	21 ^c	19.3	50.0	14 ^c	10.8	33.3	7 ^c	11.9	16.7	7.260	2	0.028	0.313	0.028	1	13 ^c	14.7	40.6	5 ^c	8.2	15.6	14 ^d	9.1	43.8	Risk2	0	17 ^c	15.2	51.5	12 ^c	8.5	36.4	4 ^c	9.4	12.1	8.599	2	0.015	0.341	0.015	1	17 ^c	18.8	41.5	7 ^c	10.5	17.1	17 ^d	11.6	41.5	Pln1	0	15 ^c	13.8	50.0	11 ^c	7.7	36.7	4 ^c	8.5	13.3	6.579	2	0.037	0.298	0.037	1	19 ^c	20.2	43.2	8 ^c	11.3	18.2	17 ^d	12.5	38.6	Impl11	0	24 ^c	18.4	60.0	11 ^c	10.3	27.5	5 ^c	11.4	12.5	11.988	2	0.003	0.396	0.003	1	10 ^d	15.6	29.4	8 ^c	8.7	23.5	16 ^d	9.6	47.1	Aud1	0	27 ^c	22.5	55.1	13 ^c	12.6	26.5	9 ^c	13.9	18.4	7.810	2	0.018	0.325	0.018	1	7 ^d	11.5	28.0
Org1	0	22 ^c	16.1	62.9	9 ^c	9.0	25.7	4 ^c	9.9	11.4	10.857	2	0.004	0.383	0.004																																																																																																																																																																																																																																				
	1	12 ^d	17.9	30.8	10 ^c	10.0	25.6	17 ^d	11.1	43.6						Org3	0	16 ^c	10.1	72.7	5 ^c	5.6	22.7	1 ^c	6.2	4.5	11.260	2	0.003	0.390	0.003	1	18 ^d	23.9	34.6	14 ^c	13.4	26.9	20 ^d	14.8	38.5	Org7	0	28 ^c	25.3	50.9	16 ^c	14.1	29.1	11 ^c	15.6	20.0	7.420	2	0.025	0.317	0.025	1	6 ^c	8.7	31.6	3 ^c	4.9	15.8	10 ^d	5.4	52.6	Org8	0	26 ^c	22.1	54.2	15 ^c	12.3	31.3	7 ^c	13.6	14.6	12.824	2	0.001	0.416	0.001	1	8 ^c	11.9	30.8	4 ^c	6.7	15.4	14 ^d	7.4	53.8	Org13	0	21 ^c	19.3	50.0	14 ^c	10.8	33.3	7 ^c	11.9	16.7	7.260	2	0.028	0.313	0.028	1	13 ^c	14.7	40.6	5 ^c	8.2	15.6	14 ^d	9.1	43.8	Risk2	0	17 ^c	15.2	51.5	12 ^c	8.5	36.4	4 ^c	9.4	12.1	8.599	2	0.015	0.341	0.015	1	17 ^c	18.8	41.5	7 ^c	10.5	17.1	17 ^d	11.6	41.5	Pln1	0	15 ^c	13.8	50.0	11 ^c	7.7	36.7	4 ^c	8.5	13.3	6.579	2	0.037	0.298	0.037	1	19 ^c	20.2	43.2	8 ^c	11.3	18.2	17 ^d	12.5	38.6	Impl11	0	24 ^c	18.4	60.0	11 ^c	10.3	27.5	5 ^c	11.4	12.5	11.988	2	0.003	0.396	0.003	1	10 ^d	15.6	29.4	8 ^c	8.7	23.5	16 ^d	9.6	47.1	Aud1	0	27 ^c	22.5	55.1	13 ^c	12.6	26.5	9 ^c	13.9	18.4	7.810	2	0.018	0.325	0.018	1	7 ^d	11.5	28.0	6 ^c	6.4	24.0	12 ^d	7.1	48.0																				
Org3	0	16 ^c	10.1	72.7	5 ^c	5.6	22.7	1 ^c	6.2	4.5	11.260	2	0.003	0.390	0.003																																																																																																																																																																																																																																				
	1	18 ^d	23.9	34.6	14 ^c	13.4	26.9	20 ^d	14.8	38.5						Org7	0	28 ^c	25.3	50.9	16 ^c	14.1	29.1	11 ^c	15.6	20.0	7.420	2	0.025	0.317	0.025	1	6 ^c	8.7	31.6	3 ^c	4.9	15.8	10 ^d	5.4	52.6	Org8	0	26 ^c	22.1	54.2	15 ^c	12.3	31.3	7 ^c	13.6	14.6	12.824	2	0.001	0.416	0.001	1	8 ^c	11.9	30.8	4 ^c	6.7	15.4	14 ^d	7.4	53.8	Org13	0	21 ^c	19.3	50.0	14 ^c	10.8	33.3	7 ^c	11.9	16.7	7.260	2	0.028	0.313	0.028	1	13 ^c	14.7	40.6	5 ^c	8.2	15.6	14 ^d	9.1	43.8	Risk2	0	17 ^c	15.2	51.5	12 ^c	8.5	36.4	4 ^c	9.4	12.1	8.599	2	0.015	0.341	0.015	1	17 ^c	18.8	41.5	7 ^c	10.5	17.1	17 ^d	11.6	41.5	Pln1	0	15 ^c	13.8	50.0	11 ^c	7.7	36.7	4 ^c	8.5	13.3	6.579	2	0.037	0.298	0.037	1	19 ^c	20.2	43.2	8 ^c	11.3	18.2	17 ^d	12.5	38.6	Impl11	0	24 ^c	18.4	60.0	11 ^c	10.3	27.5	5 ^c	11.4	12.5	11.988	2	0.003	0.396	0.003	1	10 ^d	15.6	29.4	8 ^c	8.7	23.5	16 ^d	9.6	47.1	Aud1	0	27 ^c	22.5	55.1	13 ^c	12.6	26.5	9 ^c	13.9	18.4	7.810	2	0.018	0.325	0.018	1	7 ^d	11.5	28.0	6 ^c	6.4	24.0	12 ^d	7.1	48.0																																														
Org7	0	28 ^c	25.3	50.9	16 ^c	14.1	29.1	11 ^c	15.6	20.0	7.420	2	0.025	0.317	0.025																																																																																																																																																																																																																																				
	1	6 ^c	8.7	31.6	3 ^c	4.9	15.8	10 ^d	5.4	52.6						Org8	0	26 ^c	22.1	54.2	15 ^c	12.3	31.3	7 ^c	13.6	14.6	12.824	2	0.001	0.416	0.001	1	8 ^c	11.9	30.8	4 ^c	6.7	15.4	14 ^d	7.4	53.8	Org13	0	21 ^c	19.3	50.0	14 ^c	10.8	33.3	7 ^c	11.9	16.7	7.260	2	0.028	0.313	0.028	1	13 ^c	14.7	40.6	5 ^c	8.2	15.6	14 ^d	9.1	43.8	Risk2	0	17 ^c	15.2	51.5	12 ^c	8.5	36.4	4 ^c	9.4	12.1	8.599	2	0.015	0.341	0.015	1	17 ^c	18.8	41.5	7 ^c	10.5	17.1	17 ^d	11.6	41.5	Pln1	0	15 ^c	13.8	50.0	11 ^c	7.7	36.7	4 ^c	8.5	13.3	6.579	2	0.037	0.298	0.037	1	19 ^c	20.2	43.2	8 ^c	11.3	18.2	17 ^d	12.5	38.6	Impl11	0	24 ^c	18.4	60.0	11 ^c	10.3	27.5	5 ^c	11.4	12.5	11.988	2	0.003	0.396	0.003	1	10 ^d	15.6	29.4	8 ^c	8.7	23.5	16 ^d	9.6	47.1	Aud1	0	27 ^c	22.5	55.1	13 ^c	12.6	26.5	9 ^c	13.9	18.4	7.810	2	0.018	0.325	0.018	1	7 ^d	11.5	28.0	6 ^c	6.4	24.0	12 ^d	7.1	48.0																																																																								
Org8	0	26 ^c	22.1	54.2	15 ^c	12.3	31.3	7 ^c	13.6	14.6	12.824	2	0.001	0.416	0.001																																																																																																																																																																																																																																				
	1	8 ^c	11.9	30.8	4 ^c	6.7	15.4	14 ^d	7.4	53.8						Org13	0	21 ^c	19.3	50.0	14 ^c	10.8	33.3	7 ^c	11.9	16.7	7.260	2	0.028	0.313	0.028	1	13 ^c	14.7	40.6	5 ^c	8.2	15.6	14 ^d	9.1	43.8	Risk2	0	17 ^c	15.2	51.5	12 ^c	8.5	36.4	4 ^c	9.4	12.1	8.599	2	0.015	0.341	0.015	1	17 ^c	18.8	41.5	7 ^c	10.5	17.1	17 ^d	11.6	41.5	Pln1	0	15 ^c	13.8	50.0	11 ^c	7.7	36.7	4 ^c	8.5	13.3	6.579	2	0.037	0.298	0.037	1	19 ^c	20.2	43.2	8 ^c	11.3	18.2	17 ^d	12.5	38.6	Impl11	0	24 ^c	18.4	60.0	11 ^c	10.3	27.5	5 ^c	11.4	12.5	11.988	2	0.003	0.396	0.003	1	10 ^d	15.6	29.4	8 ^c	8.7	23.5	16 ^d	9.6	47.1	Aud1	0	27 ^c	22.5	55.1	13 ^c	12.6	26.5	9 ^c	13.9	18.4	7.810	2	0.018	0.325	0.018	1	7 ^d	11.5	28.0	6 ^c	6.4	24.0	12 ^d	7.1	48.0																																																																																																		
Org13	0	21 ^c	19.3	50.0	14 ^c	10.8	33.3	7 ^c	11.9	16.7	7.260	2	0.028	0.313	0.028																																																																																																																																																																																																																																				
	1	13 ^c	14.7	40.6	5 ^c	8.2	15.6	14 ^d	9.1	43.8						Risk2	0	17 ^c	15.2	51.5	12 ^c	8.5	36.4	4 ^c	9.4	12.1	8.599	2	0.015	0.341	0.015	1	17 ^c	18.8	41.5	7 ^c	10.5	17.1	17 ^d	11.6	41.5	Pln1	0	15 ^c	13.8	50.0	11 ^c	7.7	36.7	4 ^c	8.5	13.3	6.579	2	0.037	0.298	0.037	1	19 ^c	20.2	43.2	8 ^c	11.3	18.2	17 ^d	12.5	38.6	Impl11	0	24 ^c	18.4	60.0	11 ^c	10.3	27.5	5 ^c	11.4	12.5	11.988	2	0.003	0.396	0.003	1	10 ^d	15.6	29.4	8 ^c	8.7	23.5	16 ^d	9.6	47.1	Aud1	0	27 ^c	22.5	55.1	13 ^c	12.6	26.5	9 ^c	13.9	18.4	7.810	2	0.018	0.325	0.018	1	7 ^d	11.5	28.0	6 ^c	6.4	24.0	12 ^d	7.1	48.0																																																																																																																												
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	1	17 ^c	18.8	41.5	7 ^c	10.5	17.1	17 ^d	11.6	41.5						Pln1	0	15 ^c	13.8	50.0	11 ^c	7.7	36.7	4 ^c	8.5	13.3	6.579	2	0.037	0.298	0.037	1	19 ^c	20.2	43.2	8 ^c	11.3	18.2	17 ^d	12.5	38.6	Impl11	0	24 ^c	18.4	60.0	11 ^c	10.3	27.5	5 ^c	11.4	12.5	11.988	2	0.003	0.396	0.003	1	10 ^d	15.6	29.4	8 ^c	8.7	23.5	16 ^d	9.6	47.1	Aud1	0	27 ^c	22.5	55.1	13 ^c	12.6	26.5	9 ^c	13.9	18.4	7.810	2	0.018	0.325	0.018	1	7 ^d	11.5	28.0	6 ^c	6.4	24.0	12 ^d	7.1	48.0																																																																																																																																																						
Pln1	0	15 ^c	13.8	50.0	11 ^c	7.7	36.7	4 ^c	8.5	13.3	6.579	2	0.037	0.298	0.037																																																																																																																																																																																																																																				
	1	19 ^c	20.2	43.2	8 ^c	11.3	18.2	17 ^d	12.5	38.6						Impl11	0	24 ^c	18.4	60.0	11 ^c	10.3	27.5	5 ^c	11.4	12.5	11.988	2	0.003	0.396	0.003	1	10 ^d	15.6	29.4	8 ^c	8.7	23.5	16 ^d	9.6	47.1	Aud1	0	27 ^c	22.5	55.1	13 ^c	12.6	26.5	9 ^c	13.9	18.4	7.810	2	0.018	0.325	0.018	1	7 ^d	11.5	28.0	6 ^c	6.4	24.0	12 ^d	7.1	48.0																																																																																																																																																																																
Impl11	0	24 ^c	18.4	60.0	11 ^c	10.3	27.5	5 ^c	11.4	12.5	11.988	2	0.003	0.396	0.003																																																																																																																																																																																																																																				
	1	10 ^d	15.6	29.4	8 ^c	8.7	23.5	16 ^d	9.6	47.1						Aud1	0	27 ^c	22.5	55.1	13 ^c	12.6	26.5	9 ^c	13.9	18.4	7.810	2	0.018	0.325	0.018	1	7 ^d	11.5	28.0	6 ^c	6.4	24.0	12 ^d	7.1	48.0																																																																																																																																																																																																										
Aud1	0	27 ^c	22.5	55.1	13 ^c	12.6	26.5	9 ^c	13.9	18.4	7.810	2	0.018	0.325	0.018																																																																																																																																																																																																																																				
	1	7 ^d	11.5	28.0	6 ^c	6.4	24.0	12 ^d	7.1	48.0																																																																																																																																																																																																																																									

^aAud1, Org1, Org3, Org7, Org8, Org13, Pln1, Pol2, Impl11 and Risk2 represent OSH management practices as indicated in Table 5.

^b0 = non-implementation of practice; 1 = implementation of practice.

^{c,d}Each superscript letter denotes a subset of OSH management practice categories whose column proportions do not differ significantly from each other at the 0.05 level.

4.3.3. Association between business size and implementation of OSH management practices

Table 8 presents findings for the association between company size and implementation of OSH management practices. The likelihood ratio was used to interpret the results because more than 20% of the expected counts were <5 [46]. The findings reveal significant associations between company size and 20 OSH management practices. Therefore, the third hypothesis (i.e., company size will be significantly associated with the implementation of OSH management practice) is accepted for these practices. An examination of the superscript letters for the counts presented in Table 8 reveals a general pattern of association such that as company size moves from micro to medium, a company is more likely to implement those practices. For example, for Pol1, Pol2, Org1, Org2, Org3, Org4 and others, a significantly greater proportion of micro companies do not implement these practices. However, a significantly greater proportion of medium-sized companies implement those practices.

5. Discussion

As already highlighted, the findings can be considered to give a credible reflection of the firms' OSH management practices in view of the profile of the respondents, i.e., almost all of the respondents are in construction management-related roles and they also have reasonable working experience in their roles. Similar respondents' profiles were observed by Kheni et al. [20] and Manu et al. [21] in their studies on OSH management practices of construction businesses in Ghana, Malaysia, Thailand and Cambodia. Micro-sized firms and SMEs constituted over 90% of the companies, which is again in consonance with previous studies [21,22]. Many of these companies were registered as over MWK 1 billion on the NCIC scale of classification of contractors. Companies in this class are considered capable of executing large projects either independently or in partnerships.

The study has revealed that the implementation of OSH management practices by construction firms in Malawi is

generally poor. The general low implementation of OSH management practices observed in this study is in accord with the study by Takala et al. [47] which indicated an inverse relationship between national competitiveness (i.e., as measured by the World Economic Forum [48] Global Competitiveness Index) and rate of occupational fatal accidents. National competitiveness is defined as 'the set of institutions, policies and factors that determine the level of productivity' [48,p.ix]. This inverse relationship suggests that countries like Malawi, which have a low competitiveness index [48], would have higher rates of occupational fatal accidents and by inference also have weaker systems for managing OSH.

As summarized in Table 9, policy and auditing elements of OSH management are the least considered, with all practices within these elements registering low implementation. Other elements with unsatisfactory implementation levels of the OSH practices are organizing (i.e., 78.6%), measuring and reviewing performance (i.e., 60%) and implementing (i.e., 50%). The low level of implementation of OSH practices within these elements is not surprising considering that the majority of firms are micro and SMEs. The implementation of OSH practices within these elements requires a commitment of resources. However, previous studies have noted that SMEs usually lack resources to enable them to invest in OSH management and other areas [22,49]. The observed association between the size of business and implementation of OSH management practices is thus in line with the extant literature. Kheni et al. [20] and Manu et al. [21] similarly reported associations between company size and implementation of OSH management practices.

In addition, the results of the Pearson's χ^2 test revealed that company age and firms' certification to Standard No. OHSAS 18001:2007 are significantly associated with the implementation of some OSH practices, particularly the practices within the organizing element. Thus, younger firms and companies without certification to Standard No. OHSAS 18001:2007 are less likely to implement those OSH management practices. The association between certification to Standard No. OHSAS 18001:2007 and

Table 9. Summary of the implementation level of occupational safety and health (OSH) management practices.

OSH management element	Extent of implementation of OSH management practices				
	Low	Moderate	High	Total	Low implementation (%)
Policy	2	0	0	2	100
Organizing	11	2	1	14	78.6
Risk assessment	2	2	1	5	40.0
Planning	2	2	1	5	40.0
Implementation	6	3	3	12	50.0
Measurement and reviewing	3	1	1	5	60.0
Auditing	3	0	0	3	100
Total	29	10	7	46	63.0

implementation of OSH management practices is indirectly supported by the work of Yoon et al. [19] and Abad et al. [2] in which OSH management certification was associated with better OSH performance, and by inference better implementation of OSH management. However, it is interesting to note that certification to Standard No. OHSAS 18001:2007 is associated with the implementation of less than a quarter of the 46 practices (i.e., nine practices). Whilst this suggests that certification to Standard No. OHSAS 18001:2007 may be of low added value to OSH management by construction companies in Malawi, a plausible explanation for the observed limited association could be the cost involved in sustaining the requirements/expectations of the certification. This view is supported by studies which have reported that the cost of implementation is a major barrier to the implementation of international management systems (e.g., environmental management systems) in developing countries [50,51].

The association between certification to Standard No. OHSAS 18001:2007 and the limited number of practices also raises concern about: (a) the quality of the OSH management audits undertaken by the certifying organizations; (b) the quality of routine monitoring undertaken by the certifying organizations to check that the requirements of the certification are being upheld. The auditing and routine monitoring are lax as shown by Table 5 (i.e., all of the practices within the auditing element registered low implementation). Furthermore, there was no association between certification to Standard No. OHSAS 18001:2007 and the implementation of practices within the auditing element (see Table 6). Thus, regarding (internal or external) OSH management auditing, there is no significant difference between certified and non-certified companies. This further confirms a laxity in the auditing and routine monitoring undertaken by certifying organizations.

The literature shows that a national OSH programme can be instrumental as part of efforts to improve OSH performance [52,53]. For instance, an evaluation by the HSE Construction Division [53], in respect of the UK nationwide safety and health initiative, namely, Revitalising Health and Safety (RHS), showed that injury rates in construction persistently met the national RHS targets. Furthermore, an evaluation of the Vietnamese national OSH programme for the period 2006–2010 highlighted several impacts of the programme, including: (a) a reduction in the rate of fatal injuries; (b) a decrease in the number of new cases of occupational diseases; (c) increased attention amongst businesses to the development of OSH MSs; (e) increased awareness amongst enterprises about the importance of OSH to production and productivity [52]. A subsequent iteration of the Vietnamese programme for the period 2011–2015 included specific objectives which focused on SMEs (e.g., a target to attain an annual average increase of 2000 SMEs which effectively apply OSH MSs) [52]. Such recognition of the need to pay attention to OSH management by SMEs could be useful, given the tendency

for SMEs to lag in OSH management implementation as shown by this study and others [20,21]. However, referring to the Malawi national OSH programme, the programme seems to parade a one-size-fits-all approach as it does not discriminate businesses based on characteristics such as size, as recommended by Kheni et al. [20]. This approach can be ineffective in the construction sector due to the varied nature of construction activities/works and businesses undertaking those activities/works [54]. As a result, it would be helpful for the Malawi national OSH programme to incorporate initiatives that seek to strengthen the capacity of micro companies in OSH management.

6. Conclusion

Against the backdrop of the poor status of OSH in construction, particularly in developing countries, and coupled with the significance of OSH management by companies to OSH performance, this study inquired into the implementation of OSH management practices by contractors in Malawi. Overall, a low level of implementation of OSH management practices was observed. The least implemented OSH management practices were also observed to be related to the policy, organizing, measuring and reviewing, and auditing elements of OSH management. Additionally, business characteristics, namely, company size, age and certification to Standard No. OHSAS 18001:2007, were associated with the implementation of some OSH practices, especially practices related to the organizing element of OSH management. However, the association between company size and the implementation of OSH practices is more prominent. It would therefore be helpful if efforts aimed at improving OSH management within the construction sector of Malawi focus on the OSH management elements with particularly low implementation of practices. Additionally, such efforts would need to include initiatives that focus on helping microenterprises to improve their OSH management. Aligned to this, subsequent iterations of the Malawi national OSH programme could incorporate interventions targeted at these OSH management elements as well as microbusinesses.

The findings also contribute to the wider discourse on OSH management by suggesting that the association between business characteristics and OSH management may be more evident with certain elements such as the organizing element. Furthermore, within the context of developing countries (where cost is a major barrier to implementation of international management systems), certification to Standard No. OHSAS 1800:2007 may not necessarily translate into greater implementation of OSH management practices. Organizations that offer certification services would therefore need to tighten the quality of their OSH management audits and routine monitoring.

Disclosure statement

No potential conflict of interest was reported by the authors.

ORCID

Patrick Manu  <http://orcid.org/0000-0001-7766-8824>

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