TECHNICAL PAPER

JOURNAL OF THE SOUTH AFRICAN INSTITUTION OF CIVIL ENGINEERING
ISSN 1021-2019
Vol 60 No 3, September 2018, Pages 61–72, Paper 1193

The influence of health and safety practices on health and safety performance outcomes in small and medium enterprise projects in the South African construction industry

J N Agumba, T C Haupt

Health and safety (H&S) management is imperative for construction projects owing to the high level of fatalities and accident rates experienced. However, very few studies have used mixed-method research to examine H&S practices that are tailored towards small and medium construction enterprises (SMEs) to establish whether they influenced overall H&S performance. A Delphi study involving 16 H&S experts produced a refined H&S conceptual model comprising five H&S practices and one H&S performance outcome which were tested on 216 construction SMEs. Exploratory factor analysis and confirmatory factor analysis confirmed that the H&S practices and performance were valid, reliable and acceptable variables. Structural equation modelling (SEM) produced a good-fit model. Upper management commitment and involvement in H&S influenced overall H&S performance indirectly through the mediating variables of project supervision and H&S resources and training. These three H&S practices are essential in influencing H&S performance at project level of construction SMEs, and are viewed as catalysts for H&S culture. However, to ensure that H&S performance by construction SMEs is improved, upper management personnel should be committed and involved in H&S at project level.

INTRODUCTION

The H&S of workers is part and parcel of human security (International Labour Organization (ILO 2003)). The South African Occupational Health and Safety Act 181 of 1993 of states that every worker has a right to a healthy and safe working environment.

Federated Employer Mutual Assurance (2017) reported that by June 2017, 24 fatal accidents had occurred in the South African construction industry, including construction SMEs. Although the average fatality rate had decreased in the UK, the Health and Safety Executive (HSE 2016) reported that in 2015 there were 43 fatalities in construction. In Hong Kong, construction recorded the highest number of work-related fatalities and accident rates (Labour Department 2016). In the US, 904 incidents were recorded in construction, which included construction transportation; fires and explosion; falls, trips and slips; workers exposed to harmful substances or environment and workers coming into contact with objects and equipment (Bureau of Labour Statistics (BLS 2016)). The construction industry is still plagued by poor H&S performance. However, these work-related fatalities, injuries and incidents are preventable.

These statistics suggest that the construction industry is dangerous and hazardous, and this damages its reputation. These fatality, injury and incident rates have a negative cost effect on the economy as employees could be forced to take early retirement due to permanent disability, which makes them an economic burden due to their unemployability and pension payments. Furthermore, medical expenses incurred is likely to put a strain on the economy.

The poor H&S performance in the construction industry in South Africa is exacerbated by limited commitment of

DR JUSTUS N AGUMBA (Pr CM, MCIOB) is a registered professional construction manager and chartered member of the Institute of Building. He holds a PhD in Engineering Management, a Master's degree in Construction Management and a Bachelor's degree in quantity surveying. He has worked as a site agent, an estimator, a draughtsman and a lecturer in both Kenya and South Africa. He is currently senior lecturer and researcher at the Durban University of Technology. He has published articles in peer-reviewed academic journals and presented papers at local and international conferences where he received Best Paper awards.

Contact details:
Department of Construction Management and Quantity Surveying
Durban University of Technology
Cnr Steve Biko and Botanic Rds
Berea
Durban
4001
South Africa
+27 31 373 2466
justusa@dut.ac.za

PROF THEO C HAUPT (Pr CM, ACHASM) is the current holder of the SARCHI Chair: Sustainable Work, Environment, Education and Transformation, the eThekwini Chair: Sustainable Built Environment and a Newton Advanced Fellowship. He is an NRF-rated Research Professor: Engineering at Mangosuthu University of Technology. His PhD thesis dealt with alternative approaches to the management of occupational health and safety on construction sites. His recent focus has been on the cost implications of the present OH&S legislative and regulatory framework in South Africa and he has served on the Advisory Council for Occupational Health and Safety of the Minister of Labour. His other research interests include the areas of construction industry development and education.

Contact details:
Faculty of Engineering
Mangosuthu University of Technology
Umlazi
Durban
4066
South Africa
+27 82 686 3457
theo.haupt@mut.ac.za

Keywords: construction industry, health and safety practices, health and safety outcomes, small and medium enterprise projects

SMEs to comply with basic construction requirements and their casual attitude towards H&S. SMEs do not properly maintain their tools and equipment, their personnel do not use their personal protective equipment, and they view H&S interventions as a luxury (cidb 2004). This is not unique to South Africa. Unnikrishnan *et al* (2014) found that in India safety management practices are inadequately implemented in the work environment of SMEs. According to the cidb (2009), SMEs lack formal occupational health and safety management systems (OHSMSs). According to Benjaoran and Bhokha (2010), most construction projects do not establish such a system on site. SMEs lack H&S training and competence (cidb 2009), and these shortcomings could jeopardise the improvement of H&S at the project level of construction SMEs.

The poor H&S performance of the construction industry in South Africa provided the impetus for promulgating the Construction Regulations of 2003 (Smallwood & Haupt 2005) which were revised in 2014. For compliance with the regulations, Azimah *et al* (2009) argue that H&S management should be addressed. Unnikrishnan *et al* (2014) emphasise that H&S management practices should be improved to comply with H&S standards, which will result in better productivity.

The underperformance by construction SMEs is caused by their financial constraints and their lack of managerial and technical skills (Department of Public Works (DPW), 1999; Agumba *et al* 2005; Martin 2010). This hinders the implementation of H&S practices, leading to poor H&S culture. It is imperative to identify H&S practices that are suitable, viable and manageable for construction SMEs.

H&S performance measures are classified as lagging and leading indicators (Toellner 2001). Leading indicators can either be subjective or objective (Grabowski *et al* 2007). On the other hand, lagging indicators are measured by the number of accidents and workers' compensation statistics (Mohamed 2002). However, they can still be measured subjectively (Chinda & Mohamed 2008). The use of leading indicators instead of lagging indicators is increasingly advocated (Hinze 2005) to measure H&S performance. Flin *et al* (2000) state that H&S climate measurement is a leading indicator which measures the H&S culture of an organisation. However, for an optimum H&S culture to manifest, H&S practices should be implemented and practised effectively.

Previous studies have not reached consensus regarding the H&S practices that could improve the H&S performance of construction SMEs and also evaluate their H&S culture (Mearns *et al* 2003; Teo & Ling 2006; Fernández-Muñiz *et al* 2007; Chinda & Mohamed 2008; Molenaar *et al* 2009; Cheng *et al* 2012). According to Grabowski *et al* (2010) and Hinze *et al* (2013), this is a leading H&S indicator.

The present study conceptualised a model linking H&S practices and overall H&S performance. The theoretical model was used to determine the relationship between H&S practices and H&S performance. Two specific research questions were addressed:

- Which H&S practices are valid and reliable for managing H&S in construction SMEs?
- What is the influence of the H&S practices on the H&S performance on construction SME projects?

MODEL CONSTRUCTS AND HYPOTHESES

The conceptual model shown in Figure 1 suggests that H&S performance is directly determined by one independent factor, namely upper management commitment and involvement in H&S. This factor indirectly determines H&S performance via the intermediary factors of employee involvement and empowerment in H&S and an occupational health and safety management system (OHSMS) defined by eight practices.

Upper management commitment and involvement in H&S

The importance of management commitment and involvement in H&S is fundamental to an organisation's H&S culture (O'Toole 2002; Arboleda *et al* 2003; Choudhry *et al* 2008; Khdair *et al* 2012). Several studies on H&S performance improvement (Mohammed 2002; Abudayyeh *et al* 2006; Fernández-Muñiz *et al* 2007; Aksorn & Hadisukumo 2008; Teo *et al* 2008; Azimah *et al* 2009) established that management commitment and involvement in H&S was critical in terms of H&S management systems. It influences H&S performance by reducing accidents, disease, worker absenteeism and injuries. Fernández-Muñiz *et al* (2007) established that management commitment positively influences employee involvement in H&S. Langford *et al* (2000) found that when management practices H&S, employees are willing to participate in H&S. The hypotheses proposed were:

H1. Upper management commitment and involvement in H&S positively influence employee involvement and empowerment in H&S

H2. Upper management commitment and involvement in H&S positively influence H&S outcomes

Fernández-Muñiz *et al* (2007) established that management commitment positively influences the safety management system, which comprises policy, incentives, preventive and emergency planning, control, training and communication. Surienty *et al* (2010) established that management commitment in H&S is positively associated with occupational H&S management implementation. Chinda and Mohamed (2008) found that leadership influenced H&S culture. When upper management is committed and involved in the organisation's H&S, OHSMS implementation will be successful. The hypotheses proposed were:

H3a Upper management commitment and involvement in H&S positively influence appointment of H&S staff

H3b Upper management commitment and involvement in H&S positively influence effective formal and informal written communication

H3c Upper management commitment and involvement in H&S positively influence effective formal and informal verbal communication

H3d Upper management commitment and involvement in H&S positively influence effective H&S resources

H3e Upper management commitment and involvement in H&S positively influence effective project planning of H&S

H3f Upper management commitment and involvement in H&S positively influence effective project supervision

H3g Upper management commitment and involvement in H&S positively influence effective H&S training

H3h Upper management commitment and involvement in H&S influence effective H&S policy

Occupational health and safety management system

The potential impact of H&S practices such as management commitment and involvement and workforce involvement and empowerment in H&S are fundamental

drivers of H&S performance improvement. The involvement of management and the workforce needs to be supported by a comprehensive OHSMS to bring about the improvement of H&S performance. The literature review identified the following essential H&S practices defining OHSMS:

Appointing or hiring of H&S staff

According to Vredenburgh (2002), the promotion of H&S culture can be influenced when workers are predisposed to display H&S-conscious attitudes in their work. Grabowski *et al* (2010), Hinze (2005) and Sawacha *et al* (1999) indicate that hiring H&S staff will improve H&S performance. The Construction Regulations 2014 advocate that H&S personnel be hired. Grabowski *et al* (2010) state that hiring quality personnel in H&S positions influences H&S performance. The hypotheses proposed were:

H4a Appointment of H&S staff positively influences employee involvement and empowerment in H&S

H5a Appointment of H&S staff positively influences H&S performance outcome.

Formal and informal written communication

Cooper (1998) indicates the importance of communication in influencing H&S performance in the form of formal and informal verbal and written communication, which is the transfer of information to employees about possible risks in the workplace and the correct way to combat them. The Health and Safety Executive (HSE 2008) highlights the need for written information regarding H&S procedures and the correct way to perform tasks, which would reinforce what has been verbally communicated. Azimah *et al* (2009) indicate that consistent communication of H&S legislation and regulations is vital to achieve good H&S performance. Dingsdag *et al* (2008b) argue that workers' perceptions of H&S culture are reinforced by good H&S communication. Fernández-Muñiz *et al* (2007) found that communication as part of the OHSMS influences H&S performance and employee involvement in H&S. Grabowski *et al* (2010) also established that communication influences H&S performance. The hypotheses proposed were:

H4b Formal and informal written communication positively influences employee involvement and empowerment

H5b Formal and informal written communication positively influences H&S performance outcome

Formal and informal verbal communication

The Health and Safety Executive (2008) highlights the need for H&S information to be verbally communicated to workers before changes are made to the way their work activities are executed. Furthermore, Fernández-Muñiz *et al* (2007) and Kheni *et al* (2006) established the importance of verbal communication in improving H&S performance. Fernández-Muñiz *et al* (2007) found that communication as part of the OHSMS influences H&S performance and employee involvement in H&S. The hypotheses proposed were:

H4c Effective formal and informal verbal communication positively influences employee involvement and empowerment in H&S

H5c Effective formal and informal verbal communication positively influences H&S performance outcome

Health and safety resources

Health and safety resources enable H&S performance of the project to be achieved (Abudayyeh *et al* 2006; Rajendran & Gambatese 2009). Choudhry *et al* (2007) established that the availability of resources was a good predictor of H&S performance. Fernández-Muñiz *et al* (2007) indicated that H&S resources influence employee involvement and H&S performance. Rajendran and Gambatese (2009) showed that the availability of H&S resources influences the reduction of injuries of workers in construction projects. Two hypotheses were proposed:

H4d H&S resources positively influence employee involvement and empowerment in H&S

H5d H&S resources positively influence H&S performance outcomes

Project planning of H&S

Project planning of H&S involves evaluating risks and establishing necessary H&S measures to avoid accidents, which include planning for emergencies (Fernández-Muñiz *et al* 2007). Arocena and Nuñez (2010) indicate that H&S planning is an element of OHSMS for SMEs and, when implemented, reduces accidents. Fernández-Muñiz *et al* (2007) found that planning influences employee involvement and H&S performance. The hypotheses proposed were:

H4e Effective project planning of H&S positively influences employee involvement and empowerment in H&S

H5e Effective project planning of H&S positively influences H&S performance outcomes

Project supervision

Project supervision verifies the extent to which goals have been met, as well as compliance with internal norms or work procedures (Fernández-Muñiz *et al* 2007). Teo *et al* (2008) and Fang *et al* (2004) indicate that supervision influences H&S performance. Fernández-Muñiz *et al* (2007) found that control influences employee involvement and H&S performance. The hypotheses proposed were:

H4f Effective project supervision positively influences employee involvement and empowerment in H&S

H5f Effective project supervision positively influences H&S performance outcomes

Training in health and safety

Langford *et al* (2002) found that training of operatives and H&S supervisors ensures H&S awareness and improved performance. Zeng *et al* (2008) point out that some accidents such as falling from a height and being hit by falling materials on construction sites can easily be prevented by implementing training programmes for employees. The influence of H&S training to improve H&S performance has been addressed by many researchers (Sawacha *et al* 1999; Tam *et al* 2004; Kheni *et al* 2006; Choudhry *et al* 2007; Fernández-Muñiz *et al* 2007; Aksorn & Hadisukumo 2008; Dingsdag *et al* 2008b). Fernández-Muñiz *et al* (2007) also established that training in H&S influences employee involvement. The hypotheses proposed were:

H4g Effective training in H&S positively influences employee involvement and empowerment in H&S

H5g Effective training in H&S positively influences H&S performance outcomes

Health and safety policy

Health and safety policy are the rules and procedures that employees' and management should adhere to in the workplace and are the bedrock of the OHSMS. According to Cox and Cheyne (2000), the major factor that influences H&S is the extent to which workers perceive the H&S rules and procedures as being implemented and promoted in the organisation. Ng *et al* (2005) and Fernández-Muñiz *et al* (2007) established the importance of H&S policy for improving

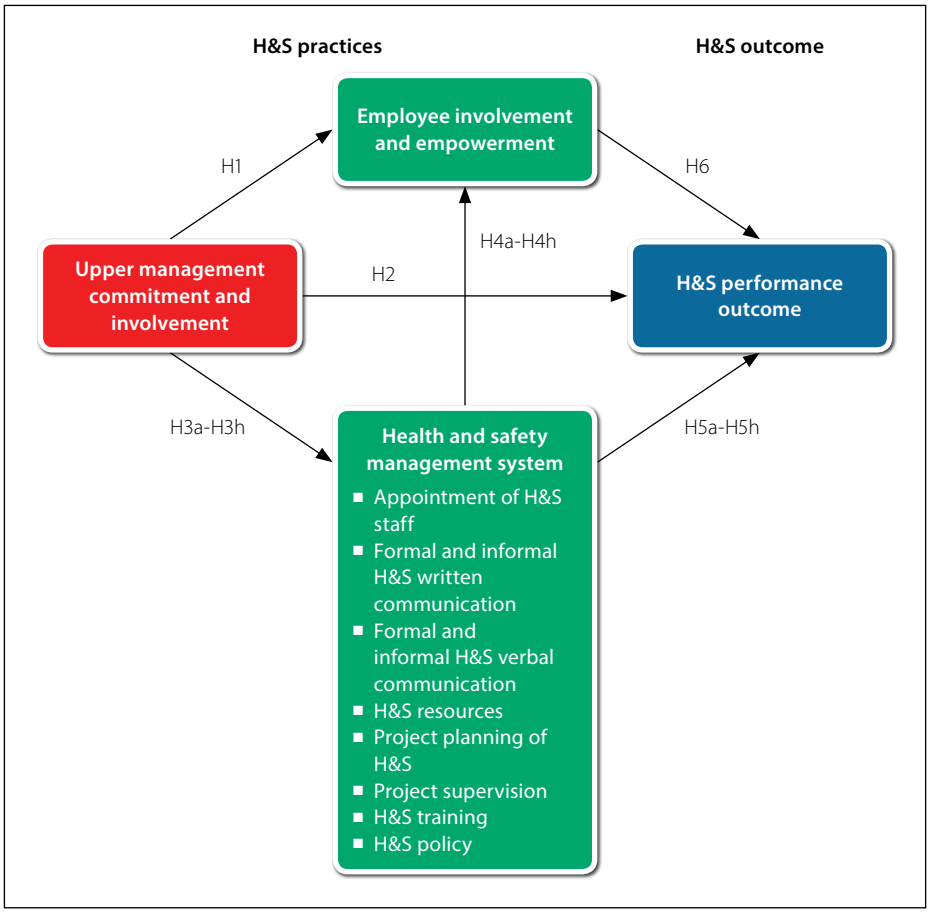

Figure 1 Health and safety conceptual model

H&S performance. Reece (2009) and Davies and Tomasin (1996) indicate that policy statements should indicate how upper management delegates H&S responsibilities. The H&S policy should state the commitment of management to providing H&S information, training and advice to employees. Fernández-Muñiz *et al* (2007) found that H&S policy positively influences employee involvement and H&S performance. The hypotheses proposed were:

H4h H&S policy is positively associated with employee involvement and empowerment in H&S

H5h H&S policy is positively associated with H&S performance outcomes

Employee involvement and empowerment in H&S

Employee involvement (or worker participation) and empowerment are important in improving H&S performance (Fernández-Muñiz, *et al* 2007; Arocena *et al* 2008; Aksorn & Hadisukumo 2008; Azimah *et al* 2009; Reece 2009). Empowered employees should be given authority and responsibility, and held accountable for making the required decisions in the organisation (Arocena *et al* 2008). The empowerment of workers is a necessary requirement building trust and cooperation, and it is essential for developing a vibrant H&S culture (Dingsdag *et al* 2008b). According to Reece (2009), employee involvement could prevent both personal and material damage.

Fernández-Muñiz *et al* (2007) found that employee involvement in H&S reduces the number of personnel injuries, material damage, absenteeism and time lost, and improves employees' motivation. Azimah *et al* (2009), Arocena *et al* (2008) and Aksorn and Hadisukumo (2008) further established that the involvement of employees in H&S positively influences H&S performance by reducing accidents. The hypothesis proposed was:

H6 Employees' involvement and empowerment are positively associated with health and safety performance outcomes

Health and safety performance

Health and safety performance defines the dependent variable which is influenced by the independent and intermediate variables. Fernández-Muñiz *et al* (2007) noted that subjective measures will overcome the limitations of objective responses, which are defined by the occurrence of accidents and near misses. The current study used subjective measures. The rating scale is a modified version of the earlier studies of Lu and Shang (2005), Fernández-Muñiz *et al* (2007) and Chinda and Mohamed (2008), who used subjective measures.

RESEARCH METHODOLOGY

A mixed-method research paradigm was adopted for this study, which entailed an exploratory design. The Delphi method was used to attain consensus on H&S measures that are ideal for improving H&S performance in construction SME projects. This method enabled the development of a refined questionnaire survey which was distributed to SMEs. The mixed method ensured rigour of the methodology.

The Delphi questionnaire consisted of 64 H&S measures, categorised in ten H&S practices. Four rounds of Delphi survey were used to reach consensus on the H&S practices proposed for H&S performance improvement. Twenty H&S experts were purposively sampled, of whom 16 were involved in all the Delphi iterations. The experts rated the H&S measures according to their importance and effect on improving H&S performance at the project level of SMEs. The retained H&S measures had to attain a median value of between 9.00 and 10.00 for importance. Their impact value had to be between 90% and 100%. The two scales were used to ensure stringency in retaining a measure and to avoid bias by using only one measure to determine consensus. Thirty-one H&S measures were retained which were considered to improve H&S at the project level of SMEs. The retained H&S measures comprised the final questionnaire presented to construction SMEs in South Africa. The 31 H&S measures defined five H&S practices. H&S performance was defined by nine H&S measures. The SME respondents were required to indicate their level of agreement with the use of the H&S measures in their projects, rated on a five-point Likert scale, where 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.

Other parts of the questionnaire were designed to profile the participants in terms of their position in the organisation, gender, race, experience in the construction industry and qualifications. The questionnaire also profiled the organisation according to the type of business and geographic location. The questionnaire was piloted with eight personnel members from eight construction SMEs who were

knowledgeable about H&S measures practised at the project level. The final version of the questionnaire was presented to 1 450 conveniently sampled SMEs. The data was collected using e-mail, and a drop-and-collect method was adopted, which resulted in 228 questionnaires being returned. This represented a 15.7% response rate, which concurs with the findings of Kongtip *et al* (2008). Only 216 questionnaires were deemed valid for analysis. According to Kline (2005), over 200 usable questionnaires for statistical analysis using structural equation modelling are sufficient. Similarly, Pallant (2013) indicates that over 200 usable questionnaires are adequate to undertake robust statistical analysis. The software used was the Statistical Package for Social Science (SPSS) version 20 for the descriptive statistical analysis of the data. The frequencies, mean scores and standard deviation, and the factor analysability of the H&S practices and performance were computed. Similarly, exploratory factor analysis (EFA) was used to determine the unidimensionality and reliability of the H&S practices and performance. Reliability was tested using Cronbach's alpha with a cut-off value of 0.70 as recommended by Hair *et al* (2006). Maximum Likelihood with Promax Rotation was selected as the extraction and rotation methods in the EFA. Confirmatory factor analysis (CFA) was used to determine the acceptability of the H&S practices and performance. The Tucker Lewis Index (TLI), which should be greater than 0.90; the root mean square error of approximation (RMSEA) and standardised root mean squared residuals (SRMR) less than 0.08; *p*-value less than 0.05; and normed chi-squared (x^2/df) less than 5 were applied. The structural equation model (SEM) using *M*plus version 6.1 was used to test the influence of the H&S practices on H&S performance. The data of the model was found to be acceptable after the fit indices of the model had been checked.

RESULTS AND DISCUSSION

Demographic descriptive statistics

The results indicated that 29.0% of the respondents were business owners, 67.0% had titles such as H&S representatives and site agents, and 86.0% were male. Africans comprised 61.0% of the respondents, 30.0% were white and 6.0% were Asian/Indian and coloureds. The majority of the

Table 1 Result of Delphi round 4

H&S practices and measures	Importance median	Median impact (%)
Appointment of H&S staff		
Employing at least one qualified manager with H&S training to oversee H&S on multiple projects	8.00	75.00
At least one staff member with H&S training is employed on each project	8.00	80.00
Employing at least one H&S representative on each project	7.50	70.00
Formal and informal written communication		
Provision of written information about H&S procedures	8.50	85.00
Provision of written information about the correct way to perform tasks	8.00	80.00
Written circular/brochure that informs workers about the risks associated with their work	7.00	80.00
Written circular/brochure that informs workers about preventive measures to reduce risk	7.00	80.00
Formal and informal verbal communication		
Provide clear verbal instructions to both literate and non-literate employees about H&S	9.50	80.00
H&S information verbally communicated to workers before changes are made to the way their work activities are executed	9.00	80.00
Organise regular meetings to verbally inform workers about the risks associated with their work	9.00	85.00
Organise regular meetings to verbally inform workers about preventive H&S measures of risky work	9.00	90.00
H&S resources		
Provision of personal protective equipment (PPE)	9.00	80.00
Training in H&S by attending seminars/workshops	8.50	80.00
Material safety data sheets provided for all hazardous materials on site	9.00	80.00
Employing technically skilled employees with H&S training	9.00	80.00
Adequate information brochures on H&S	8.00	80.00
Provision of a budget for H&S	10.00	90.00
Provision of correct tools, equipment and plant to execute construction	9.50	90.00
Provision of good welfare facilities such as showers, canteens, toilets	10.00	85.00
Project planning of H&S		
Ergonomics are considered when deciding the method of construction	9.00	80.00
Re-engineering is considered to reduce hazards	9.00	85.00
When head office decides on the method of construction H&S is included in the decision-making process	9.00	85.00
Each project has a site-specific H&S plan	9.00	85.00
Layout of the site considers H&S aspects	9.00	90.00
Use of hazard-identification procedures	9.00	90.00
Use of risk-assessment procedures	9.00	85.00
Constructability of project is reviewed	9.00	80.00
Scheduling for H&S	9.00	90.00
Project supervision		
Proper supervision by staff trained in H&S	9.00	90.00
Identification of hazards by at least one staff member trained in H&S	9.00	90.00
Results of inspection discussed at H&S meeting	9.00	85.00
H&S inspections done at least daily	9.00	90.00
Local authorities and H&S enforcement agencies visit sites for inspection	9.00	90.00
Ad hoc informal H&S inspections of work place	9.00	90.00
Regular H&S audits of projects	9.00	90.00

Legend: Measures in black reached consensus and were retained, whereas the red measures did not reach consensus and were not retained.

Continued on page 66

Table 1 *continued … Results of Delphi round 4*

H&S practices and measures	Importance median	Median impact (%)
Training in H&S		
Workers undergo induction on H&S before commencing work on a particular site	9.50	90.00
Workers trained in proper care of PPEs	9.00	90.00
Workers trained in proper use of PPEs		
Workers are regularly trained in H&S	9.00	90.00
Instruction manuals or safe work procedures are used to aid in preventive action	9.00	80.00
Employer helps employees to train in-house (study leave, grants)		
Workers are given time off for training	8.00	80.00
Upper management commitment and involvement in H&S		
Managers encourage and support worker participation, commitment and involvement in H&S activities	10.00	90.00
Managers encourage and support training of employees in H&S	9.50	90.00
Managers communicate regularly with workers about H&S	10.00	90.00
Managers actively monitor the H&S performance of their projects and workers	10.00	90.00
Managers take responsibility for H&S	10.00	90.00
Managers actively and visibly lead in H&S matters	10.00	90.00
Managers regularly visit workplaces to check work conditions or communicate with workers about H&S	10.00	90.00
Managers encourage and arrange meetings with employees and other managers to discuss H&S matters	10.00	90.00
Managers conduct toolbox talks themselves	9.00	90.00
Managers ensure that the H&S budget is adequate	9.50	90.00
Managers recognise and reward outstanding H&S performance of workers	9.00	90.00
H&S policy		
Proper implementation of safety management system	9.00	85.00
Company has H&S policy	8.00	80.00
Written in-house H&S rules and regulations for all workers reflecting management concern for safety, principles of action and objectives of achievement	8.00	80.00
The firm coordinates its H&S policies with other human resource policies to ensure the wellbeing of workers	8.50	90.00
Worker/employee involvement and empowerment in H&S		
Workers are involved in production of H&S policy	9.00	90.00
Workers provide written suggestions on H&S	8.50	85.00
Workers are kept informed of provisions of H&S plan	9.00	85.00
Workers are involved in H&S inspections	9.00	90.00
Workers are consulted when H&S plan is compiled	9.00	90.00
Workers are involved in development of H&S rules and safe work procedures	9.00	90.00
Workers have the explicit right to refuse to work in potentially unsafe unhealthy conditions	9.50	90.00

Legend: Measures in black reached consensus and were retained, whereas the red measures did not reach consensus and were not retained

respondents, 80.0%, indicated that they had over six years of experience in the construction industry. 28.2% of the respondents had a matric qualification, 12.0% had basic schooling with some having no qualifications, and the remaining 58.3% had post-secondary school qualifications.

37% of the SMEs were operating as subcontractors, 35.6% as general contractors, and 4.2% were civil contractors, suggesting that SMEs are involved in various kinds of construction activities. The majority (90.7%) of the respondents' conducted business in Gauteng Province.

Delphi results and discussion

Table 1 indicates that 31 H&S measures were retained from the 64 H&S measures identified in the literature. The H&S measures that were not retained did not attain the recommended median value of 9.00, which was considered to be very important, and a 90% cut-off value was considered to have a major impact. These 31 H&S measures were then categorised into five H&S practices. These practices represented the refined conceptual H&S model after Round 4 of the Delphi survey. This is illustrated in Figure 2.

Three of the original H&S practices conceptualised in Figure 1 were retained with the measures hypothesised to define them, namely upper management commitment and involvement in H&S with 11 measures, worker/employee involvement, and empowerment in H&S with five measures, and project supervision with six measures. However, two H&S practices were renamed. The first one was project H&S planning and communication with four measures. This combination concurred with the National Examination Board in Occupational Safety and Health (NEBOSH). The combination of these H&S measures to re-name the H&S practices was aimed at achieving the recommended number of measures, namely three, per construct. This was to enable robust statistical analysis to be done using SPSS (Pallant 2013) and SEM (Kline 2005).

The second adopted name was H&S resource and training with five measures. This combined practice is in line with the findings of Choudhry *et al* (2007). The combination was acceptable because two measures were retained in the H&S resource practice, and three were retained in the H&S training practice. The refined H&S conceptual model was then tested statistically.

Exploratory factor analysis

Prior to the assessment of the structural model, exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were carried out. The EFA determined the validity and reliability of the five H&S practices and the H&S performance outcome. Two measurement properties were used, namely convergent validity and internal reliability. The results are tabulated in Table 2.

The five independent variables of upper management commitment and involvement in H&S, employee involvement and empowerment in H&S, project H&S

planning and communication, project supervision, and H&S resources and training were reliable. Their individual Cronbach's alpha coefficients were > 0.70, indicating acceptable internal reliability as recommended by Hair *et al* (2006). The Kaiser-Meyer-Olkin (KMO) of each variable was greater than the recommended value of 0.60 and the Bartlett's Test of Sphericity was $p < 0.000$. The results are in line with the suggested cut-off values according to Pallant (2013), which suggest that factor analysis could be conducted with the data.

Factor analysis revealed that the measures of upper management commitment and involvement in H&S, employee involvement and empowerment in H&S, project H&S planning and communication, project supervision, and H&S resources and training loaded together on the respective variables. The factor loadings for all the measures were greater than the recommended value of 0.40 as suggested by Field (2005) and Hair *et al* (2006), therefore achieving convergent validity. The eigenvalue for each of the constructs suggested that they were unidimensional. It can be stated that sufficient evidence of validity and reliability was provided for these H&S practices which enabled CFA to be undertaken. The results are supported by the findings from previous studies by Findley *et al* (2004), Fernández-Muñiz *et al* (2007), Choudhry *et al* (2007) and Agumba and Haupt (2008).

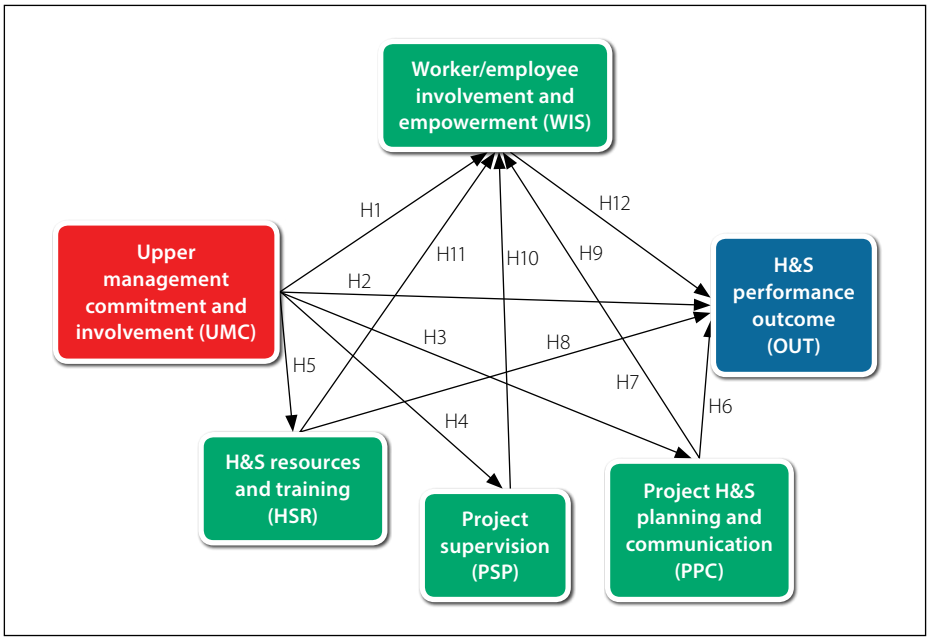

Figure 2 Refined conceptual model for H&S performance improvement for SMEs

The dependent variable of H&S performance was reliable. The Cronbach's alpha was greater than 0.70 at 0.907, indicating acceptable internal reliability as suggested by Hair *et al* (2006). A KMO of 0.905 with Bartlett's Test of Sphericity of $p < 0.000$ was obtained. These were in line with the recommendation of Pallant (2013). These results suggested that factor analysis could be conducted with the data. All nine measures of H&S performance outcome converged together on this factor. The factor loadings were greater than 0.668 as shown in Table 2, which were greater than the recommended value of 0.40 as suggested by Field (2005) and Hair *et al* (2006). The eigenvalue of 5.267 explained 58.521% of the variance in the data. Therefore sufficient evidence of validity was achieved. The results indicate that the factor was unidimensional.

Table 2 H&S practices and H&S performance outcome

Upper management commitment and involvement in H&S	Eigenvalue 5.107 % of variance 46.427		
H&S measures	**Cronbach level after deletion**	**Factor loading**	**Rank**
I/we communicate regularly with workers about H&S	0.847	0.786	1
I/we actively monitor the H&S performance of the projects and workers	0.844	0.778	2
I/we encourage discussions on H&S with employees	0.849	0.728	3
I/we regularly visit workplaces to check work conditions or communicate with workers about H&S	0.850	0.717	4
I/We actively and visibly lead in H&S matters by e.g. walk-through of the site	0.855	0.672	5
I/we take responsibility for H&S, e.g. stopping dangerous work on site, etc	0.854	0.667	6
I/we ensure that the H&S equipment is bought, e.g. hardhats, overalls, etc	0.857	0.618	7
I/we regularly conduct toolbox talks with the workers	0.857	0.604	8
I/we provide workers with H&S training when there is less work in the project	0.865	0.491	9
I/we reward workers who make an extra effort to do work in a safe manner	0.873	0.465	10
I/we encourage and support worker participation, commitment and involvement in H&S activities	0.867	0.452	11
Employee involvement and empowerment in H&S	**Eigenvalue 3.079 % of variance 61.577**		
H&S measures	**Cronbach level after deletion**	**Factor loading**	**Rank**
Our workers are involved in the production of H&S policy	0.778	0.863	1
Our workers help in developing H&S rules and safe work procedures	0.776	0.839	2
Our workers are consulted when the H&S plan is compiled	0.791	0.814	3
Our workers are involved in H&S inspections	0.832	0.598	4
Our workers can refuse to work in potentially unsafe unhealthy conditions	0.857	0.458	5

Continued on page 66

Table 2 *continued ... H&S practices and H&S performance outcome*

Project H&S planning and communication	Eigenvalue 2.786 % of variance 69.644		
H&S measures	**Cronbach level after deletion**	**Factor loading**	**Rank**
Our firm uses procedures to identify possible H&S hazards on site	0.788	0.833	1
I/we include H&S in our projects programme	0.784	0.822	2
I/we consider H&S when layout of site is done	0.823	0.769	3
I/we organise regular meetings to verbally inform workers about the risks of their work and preventive measures	0.850	0.665	4
Project supervision	**Eigenvalue 3.640 % of variance 60.662**		
H&S measures	**Cronbach level after deletion**	**Factor loading**	**Rank**
I/we allow supervision of work by staff trained in H&S	0.837	0.786	1
I/we undertake informal H&S inspection of the workplace daily	0.837	0.781	2
One of our employees trained in H&S identifies hazardous activities	0.848	0.718	3
I/we undertake formal H&S inspection of the workplace daily	0.850	0.714	4
I/we allow local authorities and H&S enforcement agencies to visit sites for inspection	0.850	0.693	5
I/we regularly undertake H&S audits of projects	0.854	0.666	6
H&S resources and training	**Eigen value 3.281 % of variance 65.628**		
H&S measures	**Cronbach level after deletion**	**Factor loading**	**Rank**
I/we provide the correct tools and equipment to execute construction work	0.832	0.782	1
I/we ensure that workers are trained to do the work safely	0.830	0.771	2
I/we ensure our workers are properly trained to take care of and use personal protective equipment	0.834	0.763	3
I/we conduct induction of all workers on H&S before commencing work on a particular site	0.835	0.751	4
I/we buy hardhats, gloves, overalls, etc for workers	0.847	0.708	5
H&S performance outcome	**Eigen value 5.267 % of variance 58.521**		
H&S measures	**Cronbach level after deletion**	**Factor loading**	**Rank**
The way we currently manage H&S in our projects promotes awareness of H&S among our employees	0.893	0.803	1
The way we currently manage H&S in our projects leads to reduction in the total cost related to accidents and injuries	0.891	0.795	2
The way we currently manage H&S in our projects promotes safe work behaviour	0.897	0.754	3
The way we currently manage H&S in our projects has reduced the number of workers affected by work-related illnesses and diseases	0.895	0.732	4
The way we currently manage H&S in our projects helps us to achieve our clients' expectations	0.897	0.729	5
The way we currently manage H&S in our projects has reduced the number of damaged materials on site	0.897	0.717	6
The way we currently manage H&S in our projects has helped us to reduce worker absenteeism in our projects	0.899	0.697	7
The way we currently manage H&S in our projects has helped us to reduce the number of personnel accidents and injuries	0.902	0.672	8
The way we currently manage H&S in our projects has had a positive influence on workers' morale	0.901	0.668	9

Assessment of the measurement model

The EFA statistics were valid and reliable, which enabled the measurement model to be analysed using CFA. The results in Table 3 indicate that four of the five H&S practices tested did not fit in some of the statistical indices proposed, which led to re-specification. The re-specified H&S practices were management commitment and involvement, project supervision, project H&S planning and communication, and H&S resources and training. Four of the H&S practices' *p*-values were not acceptable. This was due to the large amount of data analysed which tends to produce significant results. Pallant (2013) argues that the *p*-value cannot be used as a solitary measure to determine the acceptable fit of a construct. The *p*-values of H&S performance and employee involvement and empowerment were acceptable.

The fit indices for management commitment and involvement, employee involvement and empowerment, project supervision, project planning and communication fitted after re-specification, apart from the *p*-values. The *p*-values were significant. However, the other indices fitted, indicating that the H&S practices had a good fit. To support this finding the normed chi-square was less than the recommend value of 5. The CFI and TLI were greater than the recommended value of 0.90. The RMSEA and SRMR were less than the recommended value of 0.088. This result is in agreement with the findings of Fernández-Muñiz *et al* (2007).

The fit indices for H&S resources and training fitted after the re-specification of the practice, apart from the TLI. The

Table 3 Confirmatory factor analysis

H&S practices	No of metrics	x^2	*Df*	x^2/df	*p-value*	RMSEA	CFI	TLI	SRMR
Management commitment & involvement	11	58.980	43	1.37	0.053	0.041	0.965	0.956	0.043
Employee involvement & empowerment	5	9.00	5	1.80	0.1091	0.061	0.982	0.964	0.033
Project supervision	4	12.506	8	1.563	0.1300	0.051	0.982	0.966	0.033
Project H&S planning & communication	6	2.227	1	2.227	0.1356	0.075	0.993	0.961	0.011
H&S resources & training	5	10.699	4	2.68	0.0302	0.088	0.941	0.853	0.040
H&S lagging indicator/outcome	9	55.379	25	2.22	0.0004	0.075	0.938	0.910	0.049

p-value indicated a non-significant result of less than 0.05. The normed chi-square was less than 5, indicating good fitting practice. The CFI was greater than 0.90, whereas the TLI was less than 0.088, indicating weak fit practice. The RMSEA indicated a close fit with a value of 0.088, and the SRMR indicated a good fit with a value of less than 0.08.

The fit indices for H&S performance outcome fitted after the re-specification of the practice. The *p*-value indicated a non-significant result of less than 0.05. The normed chi-square was less than 5, indicating good fitting practice. The CFI and TLI were greater than 0.90, and the TLI indicated good fitting practice. The RMSEA and SRMR indicated a good fit with a value of less than 0.08. The results of the measurement models suggest that the refined conceptual model of H&S can be used to determine a perfect fit model of H&S for construction SMEs.

Assessment of the structural model

Before the hypotheses were tested, the goodness-of-fit indices were examined to establish whether the data fitted the hypothesised model perfectly. The results in Table 4 indicate the goodness-of-fit indices for the structural model in Figure 3. The chi-square was significant with a *p*-value of less than 0.05, indicating that the null hypothesis of the model not fitting could be rejected. The normed chi-square ratio x^2/df was 1.77, which was below the recommended value of 3.00. The RMSEA was 0.06, which was below 0.08, and the SRMR was 0.074, which was less than the recommended value of 0.08. The CFI was 0.849 and the TLI was 0.837. These values were less than the acceptable cut-off value of 0.90. Although the data did not fit the model perfectly, it could be described as having achieved a close fit. This enabled the results of the relationships of the constructs to be interpreted.

Figure 3 shows that six relationships could not be rejected and six were rejected. The finding indicates that upper management commitment and involvement in H&S influenced project H&S planning and communication, project supervision, and H&S resources and training. A notable finding was that upper management commitment and involvement in H&S did not directly influence employee involvement and empowerment and H&S performance as per the hypothesised model. This was contrary to the findings of Fernández-Muñiz *et al* (2007) and Azimah *et al* (2009) respectively. However, it can be argued that upper management commitment and involvement in H&S influenced employee involvement and empowerment indirectly through the mediating variable of project supervision. However, employee involvement and empowerment in H&S did not influence H&S performance as hypothesised.

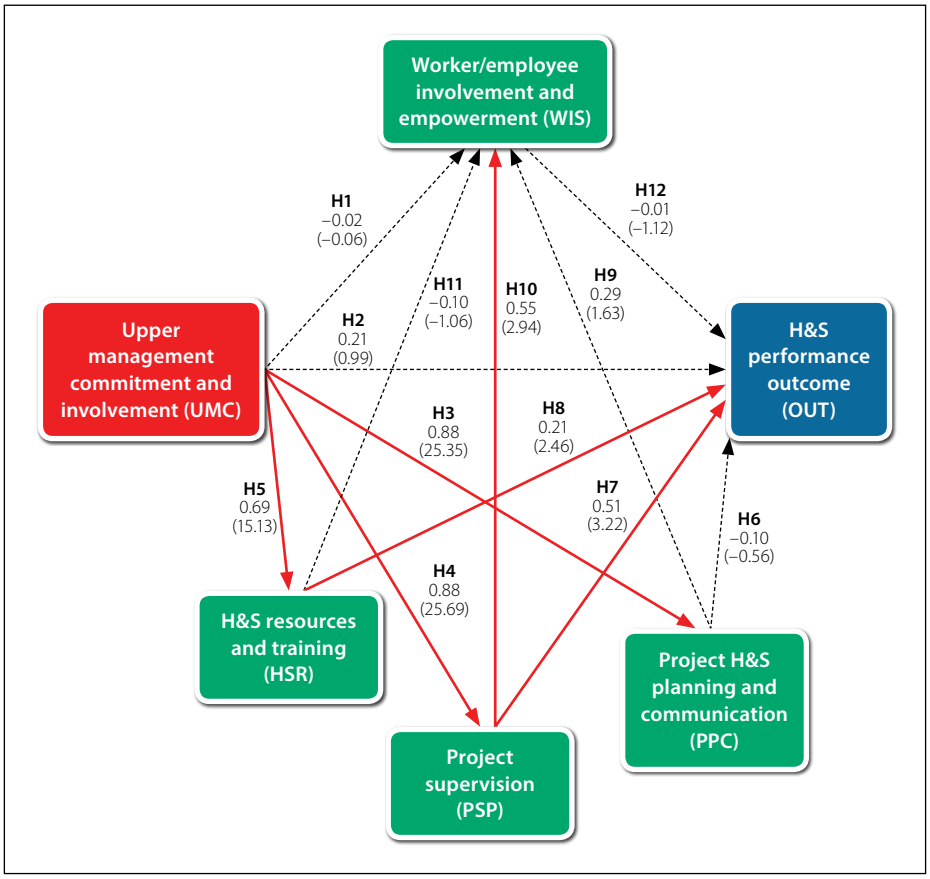

Figure 3 Tested conceptual H&S performance improvement model

Table 4 Goodness-of-fit values for the structural model

Model	x^2	*Df*	x^2/df	*p*-value	RMSEA	CFI	TLI	SRMR
Hypothesised model	1 276.46	722	1.77	0.0000	0.060	0.849	0.837	0.074

Upper management commitment and involvement in H&S influenced H&S performance indirectly through the mediating variables of project supervision and H&S training and resources. Arguably, if upper management personnel are committed and involved in H&S, H&S performance will improve. This finding suggests that upper management involvement and commitment are critical for H&S performance success. The findings further established that employee involvement and empowerment in H&S were only influenced by project supervision. However, it was not influenced by upper management commitment and involvement in H&S, project H&S planning and communication, and H&S resources and training as originally hypothesised.

Furthermore, project H&S planning and communication did not influence H&S performance as hypothesised. These results are contrary to the findings of Fernández-Muñiz *et al* (2007). However, it can be argued that Fernández-Muñiz *et al* (2007) tested the H&S practices as part of the OHSMS. They suggest that the OHSMS is influenced by management commitment, which in turn influences employee involvement and H&S performance outcomes. However, testing the hypothesised H&S practices in the OHSMS individually in this study gave a better thrust to the H&S practices that are directly influenced by upper management involvement and commitment in H&S and eventually impact H&S performance.

CONCLUSION

The present study elicited information from H&S stakeholders in the construction industry regarding current H&S practices in SMEs and contributed to the existing literature by providing empirical evidence addressing the research questions. Results from the exploratory factor analysis indicated that the five H&S practices, namely upper management commitment and involvement in H&S, employee involvement and empowerment in H&S, project supervision, project H&S planning, communication in H&S and H&S resources and training, and the H&S performance outcomes were valid and reliable measures of H&S in SMEs. Attaining the desired levels of validity and reliability enabled the confirmatory factor analysis to be undertaken. The results indicated that the five H&S practices and H&S performance achieved an acceptable fit model to enable the structural model to be analysed. The results of the structural equation modelling indicated that upper management commitment and involvement in H&S influenced H&S performance indirectly through the mediating variables of project supervision and H&S training and resources. Each relationship was positive and significant.

The findings inform SME contractors involved in building and civil engineering that upper management personnel should be committed and involved in H&S as they are the catalyst to ensure improvement in H&S performance. They will ensure that project supervision is undertaken to eliminate any hazards involved in the project. Furthermore, they will ensure that H&S resources and training are provided to their employees. In addition, the significant relationships in the tested model which influenced the H&S performance outcome can be deemed to be the minimum H&S practices that construction SMEs in civil and building projects should adopt. This will ensure that they have a small set of H&S practices to implement to improve their H&S performance outcomes, thereby ensuring that H&S culture is improved.

This finding is important, especially in a country where H&S is not given the necessary attention. It is therefore suggested that upper management commitment and involvement in H&S, project supervision and H&S resources and training should constitute the construction H&S performance improvement model (CHSPIM). Finally, the findings of this study have contributed to the H&S body of knowledge in the South African construction industry.

RECOMMENDATIONS TO THE INDUSTRY

The managerial and practical implications of this study that should assist civil and building contractor SMEs to improve their H&S performance are three non-negotiable H&S practices. These H&S practices are upper management commitment and involvement in H&S, project supervision, and H&S resources and training. In addition, the proposed H&S model will enable H&S culture to be developed at project level for construction SMEs.

Furthermore, it can be argued that South African construction SMEs require only a few manageable H&S practices that would assist them in managing their H&S activities effectively. This is because construction SMEs do not have the resources that large construction firms have to enable them to implement a large number of H&S practices. Furthermore, these H&S practices would act as early warning signs that an accident will occur if they are not implemented at all or not implemented properly.

In addition, construction SMEs may find the developed questionnaire useful for auditing their H&S performance and benchmarking their H&S practices against those of their competitors. The practices can eventually be used to identify H&S areas that are problematic in the workplace and that require special and immediate attention.

Finally, the H&S practices can be used to improve the minimal compliance with the requirements of the 2014 Construction Regulations so as to reduce site closures by the Department of Labour in South Africa due to non-compliance.

LIMITATIONS OF THE STUDY

Despite the findings of this study and the recommendations for future research, several limitations were identified, namely:

- The majority of the respondents conducted their business in Gauteng Province, which prevents the findings from being generalised to all the provinces of South Africa.
- The use of the self-reporting in the questionnaire for the independent, intervening and dependent variable is vulnerable to bias reporting, which is acknowledged in this study.

FURTHER STUDY

It is recommended that further research be done. An employee survey is advocated, as the current study focused on upper management personnel and those knowledgeable about the current H&S practices in their organisation. It is proposed that these practices be validated using structural equation modelling to determine their relationship to and influence on H&S performance, i.e. reduction in accidents, injuries and damage to property, and to improve the motivation of the work force. Finally, the use of field observations is also recommended for future study to overcome the bias that a self-reporting questionnaire is perceived to have.

ACKNOWLEDGEMENT

The research funding support of the National Research Foundation (NRF) is

gratefully acknowledged, without which this project would not have been possible.

REFERENCES

Abudayyeh, O, Fredericks K T, Butt, E S, & Shaar, A 2006. An investigation of management's commitment to construction safety. *International Journal of Project Management*, 24: 167–174.

Agumba, J N & Haupt, T 2008. Perceptions of construction health and safety performance improvement enablers. *Proceedings, Association of Schools of Construction of Southern Africa (ASOCSA) 3rd Built Environment Conference*, 6–8 July, Westin Grand, Cape Town, 184–200.

Agumba, J N, Adegoke, I O & Otieno, F A O 2005. Evaluating project management techniques in small and medium enterprises delivering infrastructure in South Africa construction industry. *Proceedings,* 3rd cidb Postgraduate Conference 2005, 9–11 October, Eskom Convention Centre, Midrand, 52–65.

Aksorn, T & Hadisukumo, B H W 2008. Critical success factors influencing safety performance program in Thai construction projects. *Safety Science*, 46: 707–727.

Arboleda, A, Morrow, P C, Crum, M R & Shelley, M 2003. Management practices as antecedents of safety culture within trucking industry: Similarities and differences by hierarchical level. *Journal of Research*, 34: 189–197.

Arocena, P & Nunez, I 2010. An empirical analysis of the effectiveness of occupational health and safety management systems in SMEs. *International Small Business Journal*, 28: 398–419.

Arocena, P, Nunez, I & Villanueva, M 2008. The impact of prevention measures and organizational factors on occupational injuries. *Safety Science*, 46: 1369–1384.

Azimah, N, Abdullah C, Spickett T J, Rumchev, B K & Dhaliwal S S 2009. Assessing employees' perception on health and safety management in public hospitals. *International Review of Research Papers*, 5: 54–72.

Benjaoran, V & Bhokha S 2010. An integrated safety management with construction management using 4D CAD model, *Safety Science,* 48: 395–403.

Bureau of Labour Statistics 2016. *Injuries, illnesses, and fatalities. Census of Fatal Occupational Injuries (CFOI) – Current and Revised Data*. Available at: **https://stats.bls.gov/iif/oshcfoi1.htm#2015** (accessed on 15 June 2017).

Cheng, W L E, Ryan, N & Kelly, S 2012. Exploring the perceived influence of safety management practices on project performance in the construction industry. *Safety Science*, 50: 363–369.

Chinda, T & Mohamed, S 2008. Structural equation model of construction safety culture. *Engineering, Construction and Architectural Management*, 15: 114–131.

Choudhry, M R, Fang, D, Lew, J J & Jenkins, L J 2007. Assessing safety climate in construction. A case study in Hong Kong. *Proceedings,* Associated Schools of Construction (ASC), 43rd Annual Conference, 11–14 April, Northern Arizona University, Flagstaff, AZ.

Choudhry, R M, Fang, D & Ahmed, S 2008. Safety management in construction: Best practices in Hong Kong. *Journal of Professional Issues in Engineering Education and Practice*, 134: 20–32.

cidb (Construction Industry Development Board) 2004. *SA construction industry status report*. Pretoria: cidb.

cidb (Construction Industry Development Board) 2009. *Construction health and safety in South Africa. Status and recommendations*. Pretoria: cidb.

Cooper, D 1998. *Improving Safety Culture: A Practical Guide.* Chichester, UK: Wiley.

Cox, S J & Cheyne, A J T 2000. Assessing safety culture in offshore environments. *Safety Science*, 34: 111–129.

Davies, V & Tomasin, K 1996. *Construction Safety Handbook*, 2nd ed. New York: Thomas Telford.

Department of Public Works (South Africa) 1999. *White paper on Creating an Enabling Environment for Reconstruction Growth and Development in the Construction Industry.* Available at: **http://www.info.gov.za/whitepaper/1999/environment.htm** (accessed on 1 July 2017).

Dingsdag, D, Biggs, H & Cipolla, D 2008a. Safety Effectiveness Indicators (SEIs): Measuring construction industry safety performance. In Thomas, J & Piekkala-Fletcher, A (Eds). *Proceedings, 3rd Conference of the Cooperative Research Centre (CRC) for Construction Innovation – Clients Driving Innovation: Benefiting from Innovation,* 12–14 March, Gold Coast, Australia.

Dingsdag, P D, Biggs, C H & Sheahan, L V 2008b. Understanding and defining OH&S competency for construction site positions: Worker perceptions. *Safety Science*, 46: 619–633.

Fang, D P, Xie, F, Huang, X Y & Li, H 2004. Factor analysis based studies on construction workplace safety in China. *International Journal of Project Management*, 22: 43–49.

Federated Employer Mutual Assurance 2017. *FEM's accident stats as at June 2017.* Available at: **http://www.fem.co.za/Layer_SL/FEM_Home/FEM_Accident_Stats/FEM_Accident_Stats.htm** (accessed on 9 August 2017).

Fernandez-Muniz, B, Montes-Peon M J & Vazquez-Ordas, J C 2007. Safety culture: Analysis of the causal relationships between its key dimensions. *Journal of Safety Research*, 38: 627–641.

Field, A 2005. *Discovering Statistics Using SPSS (and Sex, Drugs and Rock 'N 'Roll)*, 2nd ed. London: SAGE.

Findley, M, Smith, S, Tyler K, Petty G & Enoch, K 2004. Injury and cost control safety program elements in construction. Which ones best prevent injuries and control-related workers' compensation costs? *Professional Safety,* 49: 14–21.

Flin, R, Mearns, K, O'Connor, P & Bryden, R 2000. Measuring health and safety climate: Identifying the common features. *Safety Science*, 34: 177–192.

Grabowski, M, Ayyalasomayajula, P, Merrick, J, Harrald, R J & Roberts, K 2007. Leading indicators of safety in virtual organizations. *Safety Science,* 45: 1013–1043.

Grabowski, M, You, Z, Song, H, Wang, H & Merrick, R W J 2010. Sailing on Friday: Developing the link between safety culture and performance in safety critical systems. *IEEE Transactions on Systems Management and Cybernetics. Part A: Systems and Humans*, 40: 263–284.

Hair, J F, Black, W C, Babin, J B, Anderson, R E & Tatham, R L 2006. *Multivariate data analysis*, 6th ed. Upper Saddle River, NJ: Pearson/Prentice Hall.

HSE (Health and Safety Executive) 2008. *Successful health and safety*. Richmond, UK: HSE.

HSE (Health Safety Executive) 2016. *Statistics on fatal injuries in the workplace in Great Britain 2016.* Available at: **http://www.hse.gov.uk/statistics/pdf/fatalinjuries.pdf** (accessed on 5 May 2017).

Hinze, J 2005. A paradigm shift: Leading to safety. *Proceedings, 4th Triennial International Conference on Rethinking and Revitalizing Construction Safety, Health, Environment and Quality*, 17–20 May, Port Elizabeth, 1–11.

Hinze, J Thurman S & Wehle A 2013. Leading indicators of construction safety performance. *Safety Science*, 51: 23–28.

ILO (International Labour Organization) 2003. *Safety in numbers. Pointers for global safety culture at work*. Geneva: ILO.

Khdair, A W, Shamsudin, M F & Subramaniam, C 2012. Conscientiousness, management practices and safety performance: A proposed relationship in the oil and gas industry in Iraq. *International Journal on Social Science Economics and Art*, 2: 20–25.

Kheni, A N, Gibb, G A & Dainty, A 2006. Health and safety management practices of small and medium sized construction business. *Proceedings, CIB W99 International Conference on Global Unity for Safety and Health in Construction*, 27–30 June, Beijing, China, 91–101.

Kline, R 2005. *Principles and Practices of Structural Equation Modelling,* 2nd ed. New York: The Guilford Press.

Kongtip, P, Yoosook, P & Chantanakul, S 2008. Occupational health and safety management in small and medium-sized enterprises: An overview of the situation in Thailand. *Safety Science*, 46: 1356–1368.

Labour Department (Occupational Safety and Health Branch) 2016. *Occupational Safety and Health Statistics Bulletin (Hong Kong)*, 16: 1–8.

Langford, D, Rowlinson, S & Sawacha, E 2002. Safety behavior and safety management: Its influence on the attitudes of workers in the UK construction

industry. *Engineering Construction, Architecture and Management*, 7(2): 133–140.

Lu, C & Shang, K 2005. An empirical investigation of safety climate in container terminal operators. *Journal of Safety Research*, 36(3): 297–308.

Maloney, F W, Cameron, I & Hare, B 2007. Tradesmen involvement in health and safety. *Journal of Construction Engineering and Management*, 133: 297–305.

Martin, l 2010. Challenges faced by South African emerging contractors. Review and update, *Proceedings*, Construction, Building and Real Estate Research Conference of the Royal Institute of Chartered Surveyors, 2–3 September, Université Paris-Dauphine.

Mearns, K, Whitaker, M S & Flin, R 2003. Safety climate, safety management practice and safety performance in offshore environments. *Safety Science*, 41: 641–680.

Mohamed, S 2002. Safety climate in construction site environments. *Journal of Construction Engineering and Management*, 128: 375–384.

Molenaar, R K, Park J-I & Washington, S 2009. Framework for measuring corporate safety culture and its impact on construction safety performance. *Journal of Construction Engineering and Management*, 135: 488–496.

Ng, T S, Cheng, P K & Skitmore, R M 2005. A framework for evaluating the safety performance of construction contractors. *Building and Environment*, 40: 1347–1355.

O'Toole, M 2002. The relationship between employees' perceptions of safety and organizational culture. *Journal of Safety Research*, 33: 231–243.

Pallant, J 2013. *SPSS Survival Manual: A Step-by-Step Guide to Data Analysis Using IBM SPSS*, 5th ed. London: Allen and Unwin.

Rajendran, S & Gambatese, A J 2009. Development and initial validation of sustainable construction safety and health rating system. *Journal of Construction Engineering and Management*, 135: 1067–1075.

Reese, D C 2009. *Occupational Health and Safety Management: A Practical Approach*, 2nd ed. New York: Taylor and Francis.

Republic of South Africa 1993. *Occupational Health and Safety Act, No 181 of 1993*. Government Gazette 337, Cape Town.

Sawacha, E, Naoum, S & Fong, D 1999. Factors affecting safety performance on construction sites. *International Journal of Project Management*, 17: 309–315.

Smallwood, J & Haupt, T 2005. The need for construction health and safety (H&S) and the construction regulations: Engineers' perceptions. *Journal of the South African Institution of Civil Engineering*, 47: 2–8.

Surienty, L, Hong, T K & Hung, K D 2010. *Occupational safety and health (OSH) in SMEs in Malaysia: A preliminary investigation.* Paper presented at the International Conference for Business and Economics Research (ICBER), Kuching, Sarawak.

Tam, C M, Zeng, S X & Deng, Z M 2004. Identifying elements of poor construction safety management in China. *Safety Science*, 42: 569–586.

Teo, A L E & Ling Y Y F 2006. Developing a model to measure the effectiveness of safety management systems of construction sites. *Building and Environment*, 41: 1584–1592.

Teo, A L E, Theo, H & Feng, Y 2008. Construction health and safety performance in developing and developed countries: A parallel study in South Africa and Singapore. In: Hinze, J, Bohmer, S & Lew, J (Eds). *Proceedings*, CIB W99 14th International Conference on Evolution of and Directions in Construction Health and Safety, 9–11 March, Gainesville, FL, USA, 485–499.

Toellner, J 2001. Improving safety and health performance: Identifying and measuring leading indicators. *Professional Safety*, 46: 42–47.

Unnikrishnan, S, Iqbal, R, Singh, A & Nimkar, M I 2014. Safety management practices in small and medium enterprises in India. *Safety and Health at Work*, 6: 46–55.

Vredenburgh, G H 2002. Organizational safety: Which management practices are most effective in reducing employee injury rates? *Journal of Safety Research*, 33: 259–276.

Zeng, S X, Tam, V W Y & Tam, C M 2008. Towards occupational health and safety systems in the construction industry of China. *Safety Science*, 46: 1155–1168.