ASOCSA2011-44

Critical indicators for measuring health and safety performance improvement in Small and Medium construction Enterprise projects

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ABSTRACT

Purpose
The common measures of measuring health and safety (H&S) performance have, been down stream indicators. Such measures alone are regarded as inadequate in providing meaningful information to help reduce the cause of workplace injury or illness. Researchers have indicated that there is no consensus on what constitutes appropriate H&S performance indicators. This study sought to validate the identified set of leading indicators to enable personnel of small and medium construction enterprises (SME) monitor and improve H&S performance on their projects.

Methodology
The Delphi approach was used where the views of H&S experts were canvassed on 64 potential indicators, categorized into 10 core elements. Consensus was achieved after three successive rounds. The expert's scored each indicator on a 10-point Likert scale of importance where 1=not at all important and 10= very important. They had opportunity to consider their scores informed by the group median score. The scales adapted for consensus were: ***strong consensus***, median 9-10, mean 8-10, inter quartile range (IQR) ≤1 and ≥80%(8-10); ***good consensus***, median 7-8.99, mean 6-7.99, IQR≥1.1≤2 and ≥60%≤79%(8-10); ***weak consensus***, median ≤ 6.99, mean ≤5.99 and IQR≥2.1≤3 and ≤ 59%(8-10).

Findings
The key findings indicate that there was a good to strong consensus of 53 indicators. Nine of the indicators had weak consensus. The indicators with weak consensus were from the core elements of appointment of H&S staff one measuring indicators, formal and informal written communication, four

indicators, H&S policy, three indicators and training in H&S, one measuring indicator.

Research limitations
The limitations were, reliance of a structured questionnaire survey in the three successive rounds of Delphi method to reach consensus and experts were not allowed to add any more indicators.

Practical implications
The indicators identified through literature review and validated using Delphi method will enhance H&S performance improvement in SMEs projects.

Originality/value
This study makes contribution to the body of knowledge on the subject where no consensus has been reached pertaining to critical indicators for measuring H&S performance in SMEs project in South Africa. The elements and indicators can further be developed into a structured H&S performance improvement model/framework for SMEs.

Keywords
Critical indicators; health and safety; measuring; performance improvement

1.1 INTRODUCTION

The construction industry is unique as construction activities are performed at outdoor under conditions not conducive for health and safety (H&S). Workers at the construction sites have to face constant changes in the nature of work i.e. the location of work and work with new workers. Most people tend to relate construction industry to a high risk working environment when compared to the other industries (Root, 2005). Further Root, (2005) opines that the reputation of the construction industry relies on the expertise of implementation and managing safety, while meeting the consumer's requirements.

Traditionally, senior managers of most organizations frown upon the management of a workplace where high injury rates are reported. This pre-occupation with outcome performance measures fuels the culture of underreporting of accidents and incidents. Arguably therefore the use of traditional outcome safety measures as a stand alone assessment of workplace safety or as a measure of performance amongst different organizations in the same industry is inherently flawed (Trethewy, 2003). Trethewy (2003) further indicates that the absence of low probability incident does not necessarily mean that core risks are effectively managed but merely that such an incident has just not happened yet.

The above sentiments, advocates shifting from the traditional ways of measuring H&S performance i.e. lagging indicators to leading or positive performance indicators. Therefore the overarching research question is; what are the leading indicators that will influence H&S performance improvement at project level of SMEs?

1.2 Health and safety in South Africa construction industry

The construction 'blitzes' undertaken by the Department of Labour (DoL) determined major non-compliance to H&S legislation, this level of non-compliance as well as the number of fatalities resulted in a scathing attack on the construction industry by Minister Mdladlana, the Minister of Labour (DoL, 2004). Despite isolated reports of improvement, there is very limited commitment to comply with basic requirements, let alone promote a culture of health and safety. Employers view H&S as a cost in the system. It also indicates that small contractors can barely maintain tools and regard safety equipment as luxury items. Even where protective clothing and equipment are provided, workers often avoid their use, including the use of safety goggles and masks when working with grinders and asbestos (Construction Industry Development Board- CIDB, 2004).

The continuing poor H&S performance of the construction industry in the form of fatalities, injuries, and disease, the number of large-scale construction accidents, and the general non-participation by key project stakeholders such as clients and designers, provided the catalyst for promulgation of consolidated construction H&S legislation in the form of the Construction Regulations (Smallwood and Haupt, 2005). Compliance with the Construction Regulations (2003) in South Africa, present significant challenges involving cost, compliance, design and implementation capacity, clients such as the Department of Public Works (DPW) and consultants agree that implementation would require raised understanding on the implications and importance of H&S in the construction industry (CIDB, 2004).

Occupational accidents and diseases impose an enormous cost on South Africa. The DoL, (2007) indicated that construction accidents account for 4% of the global gross domestic product (GDP). Occupational accidents and diseases in South Africa account for approximately 3.5% of its GDP, which, translates to about R30 billion (about US$4.2 billion). There are other aspects apart from the financial and economic impacts which cannot be measured in any accurate and tangible terms, namely the strain of the loss of a family member, particularly if the worker was the only family bread winner. The most complete accident figures are compiled by the Compensation Commissioner. Construction H&S statistics provided by the DoL covering the period 2004/05 to 2007/08 show a sharp rise in accidents from, 54 fatalities and 159 non-fatal accidents (i.e. temporary or permanent disablement) to around 160 fatalities and around 400 non-fatal accidents respectively (DoL, 2008 cited in CIDB, 2008).

Aside from the direct compensation and medical costs associated with accidents the costs to the economy are immense and include rework, lost time, damage to plant and equipment, disruption, productivity loss and loss of skills to the economy (CIDB, 2004).

These views highlight the importance of identifying and validating H&S leading indicators to be used by SMEs in the South African construction industry at project level to improve H&S performance.

1.3 ELEMENTS FOR H&S PERFORMANCE IMPROVEMENT

According to Fernandez Muniz *et al.* (2007), gaps still remain in the literature, where researchers have conceded rather less importance to measuring the situational characteristics of safety management system (SMS), which Mearns *et al.* (2003) consider to be an integral part of organization's safety culture. Fernandez-Muniz *et al.* (2007) further indicates that there is no consensus of what constitutes the SMS i.e. what the organisation does in H&S management. Mohamed and Chinda (2005) further indicate that their is need to investigate the casual relationship between goal of overall H&S performance improvement and what construction firms actually do on H&S management. This relationship provides an indication of the potential for H&S performance improvement. Ng *et al.* (2003) developed a framework for evaluating the safety performance of contractors in Hong Kong at both the organization level and project level. The factors identified by the researchers for project level were: project management commitment, hazard management, information, training, and promotions, but to name a few. The factors for organization level were administrative and management commitment, H&S training, selection and control subcontractors, safety review; accident record and legislation, codes and standards.

Critical elements influencing H&S performance, that have been replicated in most literature are management commitment and employee involvement and they appear to be easily demonstrated and promoted through risk assessments, inspections, audits, training, hazard reporting and completing corrective actions (Fernandez Muniz *et al.* 2007). Few studies have focused on H&S elements tailored towards SMEs which makes this study important. Based on the above discussions this research identified 64 potential indicators and categorized them into ten core elements viz.; appointment of H&S staff, formal and informal written communication, formal and informal verbal communication, H&S resources, project planning of H&S, project supervision, training in H&S, upper management commitment to H&S, policy on H&S and worker's/employee involvement. The identification of these elements and indicators is beyond the scope of this research work due to the number of pages required. A full complimentary paper can be obtained from the authors, which will be presented in the West African Built Environment Researcher conference in Ghana 2011.

1.4 PROBLEM STATEMENT

The problems and challenges faced in South Africa construction industry on H&S by SMEs needs to be addressed. So far there has been little research on leading indicators that can be more closely tied to the H&S culture or H&S management of SMEs at project level in South Africa. In order to get a better understanding, there is a need to identify important positive performance indicators (PPI) that will improve H&S performance of SMEs at project level, hence reducing accidents, injuries, fatalities and illnesses in their projects. In order to answer the overarching research question stated above, this paper delves into the following specific objectives;

- To assess the characteristics of the experts; and

- To determine the important positive performance indicators to be used for measuring health and safety performance improvement at project level of SMEs.

1.5 METHODOLOGY

An extensive systematic literature review was conducted in journal articles, conference proceedings and relevant H&S books from 1976 - 2010. A list of 64 leading indicators, were then identified. The leading indicators were categorized into ten core elements. The elements and indicators were used to develop a Delphi questionnaire. A panel of experts were selected and took part in a three round of Delphi process. The experts rated the indicators on a 10 point Likert scale of importance, the importance scale, where *1&2 = unimportant, 3&4 = slightly important, 5&6 = neutral, 7&8 = important, 9&10 =very important.*
In order to qualify as an expert the following had to be fulfilled, each individual was required to meet at least three of the following minimum requirements: 1) minimum five years of work experience in either academia or industry; 2) at least one professional qualification: 3) an editor, book, or book chapter authorship, 4) minimum qualification for industry practitioners diploma and academics bachelor degree: 5) five or more publications in conferences and journals, 6) member or committee chair of faculty, 7) safety association member and 8) offers workshop or training in H&S. This is more stringent criteria than the recommended number of at least two by (Rodgers and Lopez, 2002). 20 experts both academics and industry practitioners of H&S agreed to participate; they were selected globally and consented to the introductory questionnaire survey via e-mail, sixteen experts finished all the three rounds. Optimal sample size in research with the Delphi technique has not been established but research has been published based on samples that vary from 10 and 50 to much larger numbers as indicated by (Campbell and Cantril, 2001).

In the first round the experts were asked to rate the importance and the impact of the indicators to the improvement of H&S at project level of SMEs projects. The second and third round of the Delphi questionnaire included a qualitative component that offered experts the opportunity to provide additional feedback in the form of written comments. After round 2 and round 3, the degree of consensus achieved in the Delphi process was assessed by calculating the group median, mean, percentage of respondents rating of between 8 to 10 on importance and inter-quartile range. The group median was used as a feedback to the experts in the successive rounds.

Each round built on responses to the former round. Experts were provided with a summary of the series of rounds. This summary included the feedback to each expert: his or her own score on each item, the group median ratings, and a synopsis of written comments. The experts were then asked to reflect on the feedback and re-rate each indicator/action in light of the new information. The scales of consensus adapted for this research were: ***strong consensus***, median 9-10, mean 8-10, inter quartile range (IQR) ≤1 and ≥80%(8-10); ***good consensus***, median 7-8.99, mean 6-7.99, IQR≥1.1≤2 and ≥60%≤79%(8-10); ***weak consensus***, median ≤ 6.99, mean ≤5.99 and IQR≥2.1≤3 and ≤ 59%(8-10).

The Delphi technique has four important features. First it is characterized by its anonymity, thus encouraging honest opinion free from group pressure (Jones and Hunter, 1995). Second iteration allows experts to change their opinions in subsequent rounds. Thirdly, controlled feedback illustrates the distribution of the group's response, in addition to individual's previous response. Finally the Delphi technique can be used to engage participants who are separated by large distances because it can be distributed by mail or online (Hasson *et al.,* 2000). This method was therefore appropriate in validating the leading indicators identified. The limitation to this modified Delphi method is that experts were not allowed to add any core elements or indicators.

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1.6 RESULTS

1.6.1 Characteristics of the expert's panel

20 potential experts fulfilled the proposed criteria, but sixteen experts finished all the three rounds of the Delphi study. The experts were internationally recruited and voluntarily accepted to participate in this onerous task. The array number of experts is from Australia (6), America (1), South Africa (7), Italy (1), Portugal (2), Ireland (1), Scotland (1), and Pakistan (1). 95% of experts were male, the female experts who were invited to participate declined the invitation hence the result indicates that construction industry is still male dominated. The sixteen experts who completed the three rounds of Delphi, eight had PhDs, five with master's degree, one with bachelor degree and two with diploma. The accumulated industrial experience of the experts is 118 years at an average of 7.38 years and academic experience of 95 years at an average of 5.94 years. The experts especially the academics have extensively contributed to the body of knowledge on H&S with vast publications in peer reviewed conferences and journals. The experts are professionally registered in their countries.

1.6.2 The important leading/positive performance indicators

Table 1.1 Important indicators to measure H&S performance improvement

Health and safety core elements and indicators	IQR	%(8-10)	Mean	Median
Appointment of H&S staff				
Employing at least one qualified manager with H&S training to oversee H&S on multiple projects	2.00	69	7.75	8.00
At least one staff member with H&S training is employed on each project	2.00	63	7.75	8.00
Employing at least one H&S representative on each project	3.00	44	7.06	7.00
Formal and informal written Communication				
Provision of written information about H&S procedures	3.00	63	8.19	8.50
Provision of written information about the	2.50	56	7.63	8.00

Proceedings 6th Built Environment Conference
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31 July -2 August 2011
JHB, South Africa
ISBN:978-0-86970-713-5

Health and safety core elements and indicators	IQR	%(8-10)	Mean	Median
correct way to perform tasks				
Written circular/brochure that informs workers about the risks associated with their work	2.25	50	7.56	7.50
Written circular/brochure that inform workers about the preventive measures to reduce risk	2.25	50	7.50	7.50
Formal and informal verbal communication				
Provide clear verbal instructions to both literate and illiterate employees about H&S	1.00	100	9.44	9.50
H&S information verbally communicated to workers before changes are made to the way their work activities are executed	2.00	100	9.06	9.00
Organize regular meetings to verbally inform workers about the risks associated with their work	2.00	94	8.63	9.00
Organize regular meetings to verbally inform workers about the preventive H&S measures of risky work	2.00	94	8.69	9.00

Scales adapted: ***strong consensus***, median 9-10, mean 8-10, inter quartile range (IQR) ≤1 and ≥80%(8-10); ***good consensus***, median 7-8.99, mean 6-7.99, IQR≥1.1≤2 and ≥60%≤79%(8-10); ***weak consensus***, median ≤ 6.99, mean ≤5.99 and IQR≥2.1≤3 and ≤ 59%(8-10).

Continued Table 1.1 Important indicators to measure H&S performance improvement

Health and safety core elements and indicators	IQR	%(8-10)	Mean	Median
H&S resources				
Provision of personal protective equipment (PPE)	1.00	100	9.31	9.50
Training in H&S through attending seminars/workshops	1.25	88	8.50	8.50
Material schedule data sheets provided for all hazardous materials on site	1.75	75	8.06	9.00
Employing technically skilled employees with H&S training	1.00	94	9.13	9.00
Adequate information brochures given on H&S	1.50	69	7.60	8.00
Provision of a budget for H&S	1.00	100	9.50	10.00
Provision of correct tools, equipment and plant to execute construction	2.00	100	9.19	9.50
Provision of good welfare facilities such as showers, canteens, toilets	2.00	94	9.06	9.00
Project planning of H&S				
Ergonomics is considered when deciding the method of construction	2.00	100	9.06	9.00
Reengineering is considered to reduce hazards	2.00	94	9.00	9.00
When head office decides on the method of construction H&S is included in decision making process	1.00	94	9.13	9.00
Each project has a site-specific H&S plan	1.00	94	9.19	9.00
Layout of the site considers H&S aspects	1.00	100	9.38	9.00
Use hazard identification procedures	1.00	100	9.13	9.00
Use of risk assessment procedures	2.00	94	8.69	9.00
Constructability of project is reviewed	1.25	88	8.69	9.00
Scheduling for H&S	1.25	94	9.06	9.00
Project supervision				
Proper supervision by staff trained in H&S	2.00	81	8.44	9.00

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	IQR	%(8-10)	Mean	Median
Identification of hazards by at least one staff member trained in H&S	1.25	88	8.63	9.00
Results of inspections discussed at H&S meetings	2.00	94	9.00	9.00
H&S inspections done at least daily	1.50	75	8.44	9.00
Local authorities and H&S enforcement agencies visit sites for inspection	2.00	81	8.63	9.00
Ad hoc informal H&S inspections of work place	1.25	81	8.56	9.00
Regular H&S audits of projects	1.25	88	9.00	9.00

The data is based on a ten-point Likert scale of importance, where *1&2 = unimportant, 3&4 = slightly important, 5&6 = neutral, 7&8 = important, 9&10 =very important*

Continued Table 1.1 Important indicators to measure H&S performance improvement

Health and safety core elements and indicators	IQR	%(8-10)	Mean	Median
Training in H&S				
Workers undergo induction on H&S before commencing work on a particular site	1.00	94	9.31	9.50
Workers trained in proper care and use of personal protective equipment	1.25	88	8.94	9.00
Workers are regularly trained in H&S	1.00	88	8.94	9.00
Instruction manuals or safe work procedures are used to aid in preventive action	2.25	75	8.25	9.00
Workers are given time off for training	1.50	75	8.06	8.00
Upper management commitment in H&S				
Managers encourage and support worker participation, commitment and involvement in H&S activities	1.00	94	9.31	9.50
Managers encourage and support training of employees in H&S	1.00	94	9.19	9.00
Managers communicate regularly with workers about H&S	1.00	94	9.44	10.00
Managers actively monitor the H&S performance of their projects and workers	1.00	94	9.38	10.00
Managers take responsibility for H&S	0.25	94	9.63	10.00
Managers actively and visibly lead in H&S matters	1.00	94	9.50	10.00
Managers regularly visit workplaces to check work conditions or communicate with workers about H&S	1.00	94	9.38	10.00
Managers encourage and arrange meetings with employees & other managers to discuss H&S matters	1.00	94	9.31	9.50
Managers conduct toolbox talks themselves	1.25	88	8.63	9.00
Managers ensure that the H&S budget is adequate	1.00	94	9.31	9.50
Managers recognize and reward outstanding H&S performance of workers	1.25	88	8.75	9.00
H&S policy				
Proper implementation of safety management system	2.25	75	8.31	9.00
Company has H&S policy	2.25	75	8.25	8.50
Written in-house H&S rules and regulations for all workers reflecting management concern for	2.25	63	7.75	8.00

safety, principles of action and objectives of achievement				
The firm coordinates its H&S policies with other human resource policies to ensure the well-being of workers	1.50	75	8.25	8.50

Continued Table 1.1 Important indicators to measure H&S performance improvement

Health and safety core elements and indicators	IQR	%(8-10)	Mean	Median
Worker/employee involvement in H&S				
Workers are involved in production of H&S policy	2.00	100	9.06	9.00
Workers provide written suggestions on H&S	1.25	81	8.56	8.50
Workers kept informed of provisions of H&S plan	1.25	94	8.81	9.00
Workers are involved in H&S inspections	1.25	100	8.94	9.00
Workers are consulted when the H&S plan is compiled	2.00	88	8.81	9.00
Workers are involved in development of H&S rules and safe work procedures	2.00	94	8.88	9.00
Workers have the explicit right to refuse to work in potentially unsafe, unhealthy conditions	1.00	100	9.38	9.50

The scales adapted: strong consensus, median 9-10, mean 8-10, inter quartile range (IQR) ≤1 and ≥80%(8-10); **good consensus,** median 7-8.99, mean 6-7.99, IQR≥1.1<2 and ≥60%≤79%(8-10**); weak consensus**, median ≤ 6.99, mean ≤5.99 and IQR≥2.1≤3 and ≤ 59%(8-10).

Table 1.1 indicates the results for round 3 of Delphi survey. A total of 62 indicators were rated, two were discarded after round 2 because of ambiguity and were merged. Fifty three indicators had a good to strong consensus whereas nine indicators had weak consensus. Indicators with weak consensus had IQR≥2.1≤3 or percentage rating of between, 8 to10 for importance was less than 59%.

The indicators with weak consensus or central tendency were; the employment of at least one H&S representative on each project these was categorised under appointment of H&S staff element. The other element that had indicators with weak consensus was formal and informal written communication. These indicators were; provision of written information about H&S procedures, provision of written information about the correct way to perform tasks and written circular/brochure that inform workers about the preventive measures to reduce risk as indicated in Table 1 these indicators fulfilled the consensus for importance based on their mean and median.

H&S training element had one indicator with weak consensus i.e. instruction manuals or safe work procedures are used to aid in preventive action. Lastly H&S policy had three indicators with weak consensus they were; proper implementation of safety management system, company has H&S policy and written in-house H&S rules and regulations for all workers reflecting management concern for safety, principles of action and objectives of achievement, there IQR were ≥2.1≤3. The result in Table 1.1

further indicates that there was good to strong consensus of 53 indicators. All eleven upper management commitment indictors attained strong consensus based on their mean, median, inter quartile range and percentage of respondents who rated the indicator, between 8 to 10 importance ratings. This was followed by employee involvement indicators the seven indicators attained good consensus to strong consensus hence the experts agreed that these indicators will improve health and safety performance. 20 indicators attained strong consensus with managers taking responsibility of H&S highly rated to improve H&S performance, its IQR was 0.25.

1.7 DISCUSSIONS

This is the first reported study to develop a set of positive performance indicators specifically designed to evaluate early warnings in H&S performance within SMEs to improve their H&S performance at project level in South Africa. These measures are relevant for all SMEs in the construction industry to assist them in improving there H&S performance. It is interesting to note that between formal & informal written communication and formal and informal verbal communication experts have indicated a good to strong consensus for verbal communication than written communication. SMEs managers need to conduct more tool box talks to ensure the information is communicated appropriately, especially providing clear verbal instructions to both literate and illiterate employees on H&S.

Its' quite evident from the results that upper management indicators are considered important this result correlates with the study of (Fernandez-Muniz et al., 2007). It is also interesting to note that material schedule data sheet (MSDS) is indicated as important and achieved a good consensus from the experts. This is a step in the right direction because of the different types of materials that contain hazardous chemicals, it vital for the parties using these materials to know their effect in their health, as some of them have long term effect on employees' health.

1.8 CONCLUSIONS

Majority i.e. fifty three (53) leading indicators attained a good to strong consensus while nine indicators had weak consensus. The limitations of the study were the reliance of a structured questionnaire survey in the three successive rounds of Delphi method to reach consensus and experts were not allowed to add any more indicators. The elements and indicators can further be developed into a structured H&S performance improvement model for SMEs.

The researchers are advocating for a fourth round of Delphi to ensure a thorough consensus of the leading indicators that had weak consensus based on their IQR in order to eliminate the varied dispersion of respondents.

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