

Indicators for Measuring Health and Safety Performance Improvement of Small and Medium Construction Enterprises in South Africa

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Abstract

This study identified and validated leading indicators for health and safety (H&S) performance improvement measurement in the construction industry in South Africa. The requirements of the study were that the process used to identify the elements and indicators should be comprehensive, be reproducible, and reflect the perspective of stakeholders. A three round of consensus-building process i.e. Delphi technique was used to validate the indicators. The experts rated the indicators on a 10 point Likert scale of importance and impact, the importance scale 1=unimportant and 10=very important, and impact scale 1=no impact and 10= major impact. The data was analyzed to determine the importance and the impact of the indicators in improving H&S performance at project level of SMEs. The experts reached consensus on 62 indicators based on the median, mean and inter-quartile range for each indicator. The indicators were categorised into ten core elements which were identified from literature review. This approach proved to be feasible and cost effective. Despite the diversity in the background of the experts, the Delphi technique was effective in achieving consensus through successive rounds of participation. The resulting indicators reflected the views of all the experts.

Keywords

Construction Industry, Delphi Technique, Health and Safety, Performance Measures Indicators, Small and Medium

1. Introduction

Improvement to small and medium construction enterprises (SMEs) safety standards could inevitably be helped by continuous monitoring and review of their H&S performance. According to Azimah *et al.*, (2009) they indicated that legislation is inadequate to address those problems in managing H&S in the workplace. This is due to the “people” element having a tendency in engaging in unsafe or safe behavior according to their interpretation and the unsafe behavior that can lead to accidents. Mitchison and Papadakis (1999) demonstrated that effective safety management improves level of safety in an organization and thus can be seen to decrease damages and harm from incidents (cited from Bottani *et al.*, 2009). Mearns *et al.*, (2003), indicated that safety management refers to the tangible practices, responsibility and performance related to safety. They further indicated the association between safety management, safety climate and safety culture. They noted that safety climate is perceived as the precise indicator of overall safety culture while safety management practices display the safety culture of top management and as a result, good safety management practices are reflected in enhanced safety climate of all employees. For these reasons Azimah *et al.*, (2009), states that the implementation of effective occupational health and safety (OHS) management

in organizations will assist to resolve OHS problems successfully and is also a means to legal compliance.

Fernandez-Muniaz *et al.*, (2007) indicated there is no consensus of what measures constitutes the health and safety management system. Trethewy, (2003) further insists that most OHS management systems have been preoccupied with the outcome of work place accidents and illnesses, which is inherently flawed. They further stated the absence of a low probability incident does not necessarily mean that core risks are effectively managed but merely that such an incident has just not happened yet. "What gets measured usually gets done" is a reminder of the importance of measuring positive performance if useful H&S objectives are to be achieved (Glendon *et al.*, 1995). At an operational level lost time injury frequency rates (LTIFRs) have traditionally been used as a performance indicator of H&S outcomes however the use of process (what gets done) indicators is currently recommended (Hopkins, 1994). Organisations therefore need to develop a range of process performance measures that are relevant to their requirements, what works for one industry may not for another. In other words features of upstream OHS culture and management system that have the greatest downstream consequences must be identified and indicators developed to show these are operating (Blewett *et al.*, 1997).

2. Health and safety performance in South Africa

Occupational accidents and disease impose an enormous cost on South Africa. The Department of Labour, (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 \$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 Department of Labour (DoL) covering the period 2004/2005 to 2007/08 show a sharp rise in accidents up to 2007/08; to around 160 fatalities and around 400 non-fatal accidents (i.e. temporary or permanent disablement) (Construction Industry Development Board (CIDB, 2008).

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 health and safety as a cost in the system. 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. 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).

Walker (cited in HSE, 2007) indicated that SMEs have shown to experience proportionately more accidents than large enterprise. It has also been indicated in various research projects that models for measuring H&S performance for large contractors will not be applicable to SMEs; this is a challenge as this is what is currently taking place. This can be reflected in a study conducted by Lin *et al.*, (2001) in Australia. The authors concluded there is need to improve OHS performance within small enterprises. Based on the aforementioned problems and challenges this study poses this overarching research question, what are the main H&S elements and leading indicators that will improve H&S performance in construction SMEs projects?

3. Problem Statement

Based on the above overarching research question, so far there has been little research of 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 construction industry, in order to get a better understanding of their performance. There is need to identify and validate appropriate positive performance indicators that will improve H&S culture and H&S management performance of SMEs, in order to reduce injuries, illness and fatalities in projects undertaken by them.

To answer the above main research question the following specific research objectives were set;

- To determine the characteristics of the experts;
- To determine the important leading performance indicators to improve health and safety performance; and
- To determine the impact of the leading performance indicators to improve health and safety performance.

4. Research Methodology

A list of 64 leading indicators were identified through thorough systematic literature review in journal articles, conference proceedings and relevant H&S books from 1976- 2010. The leading indicators were categorized into ten core elements. The experts rated the indicators on a 10 point Likert scale of importance and impact, the importance scale 1=unimportant and 10=very important, and impact scale 1=no impact and 10= major impact. The rating of the indicators was achieved using a panel of experts in three round of Delphi questionnaire survey.

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, 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 *et al.*, 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 *et al.*, (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 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 the feedback and rerate 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 and interquartile range (IQR) ≤ 1 ; good consensus, median 7-8.99, mean 6-7.99, $IQR \geq 1.1 < 2$; weak consensus, median ≤ 6.99 , mean ≤ 5.99 and $IQR \geq 2.1 \leq 3$.

5. Results

5.1 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 per expert and academic experience of 95 years at an average of 5.94 years per expert. 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.

5.2 The important leading indicators

Table 1: Important leading indicators to improve H&S performance

Health and safety (H&S) core elements and indicators	IQR	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	7.75	8
At least one staff member with H&S training is employed on each project	2	7.75	8
Employing at least one H&S representative on each project	3	7.06	7
Formal and informal written Communication			
Provision of written information about H&S procedures	3	8.19	8.5
Provision of written information about the correct way to perform tasks	2.5	7.63	8
Written circular/brochure that informs workers about the risks associated with their work	2.26	7.56	7.5
Written circular/brochure that inform workers about the preventive measures to reduce risk	2.26	7.50	7.5
Formal and informal verbal communication			
Provide clear verbal instructions to both literate and illiterate employees about H&S	1	9.44	9.5
H&S information verbally communicated to workers before changes are made to the way their work activities are executed	2	9.06	9
Organize regular meetings to verbally inform workers about the risks associated with their work	2	8.63	9
Organize regular meetings to verbally inform workers about the preventive H&S measures of risky work	2	8.69	9

The scales of consensus adapted for this research were: **strong consensus**, median 9-10, mean 8-10 and interquartile range (IQR) ≤ 1 ; **good consensus**, median 7-8.99, mean 6-7.99, IQR $\geq 1.1 < 2$; **weak consensus**, median ≤ 6.99 , mean ≤ 5.99 and IQR $\geq 2.1 \leq 3$.

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: Important leading indicators to improve H&S performance

Health and safety (H&S) core elements and indicators	IQR	mean	Median
H&S resources			
Provision of personal protective equipment (PPE)	1	9.31	9.5
Training in H&S through attending seminars/workshops	1.25	8.5	8.5
Material schedule data sheets provided for all hazardous materials on site	1.75	8.06	9
Employing technically skilled employees with H&S training	1	9.13	9
Adequate information brochures given on H&S	1.5	7.6	8
Provision of a budget for H&S	1	9.5	10
Provision of correct tools, equipment and plant to execute construction	2	9.19	9.5
Provision of good welfare facilities such as showers, canteens, toilets	2	9.06	9
Upper management commitment in H&S			
Managers encourage and support worker participation, commitment and involvement in H&S activities	1	9.31	9.5
Managers encourage and support training of employees in H&S	1	9.19	9
Managers communicate regularly with workers about H&S	1	9.44	10
Managers actively monitor the H&S performance of their projects and workers	1	9.38	10
Managers take responsibility for H&S	0.25	9.63	10
Managers actively and visibly lead in H&S matters	1	9.5	10
Managers regularly visit workplaces to check work conditions or communicate with workers about H&S	1	9.38	10
Managers encourage and arrange meetings with employees & other managers to discuss H&S matters	1	9.31	9.5
Managers conduct toolbox talks themselves	1.25	8.63	9
Managers ensure that the H&S budget is adequate	1	9.31	9.5
Managers recognize and reward outstanding H&S performance of workers	1.25	8.75	9
H&S policy			
Proper implementation of safety management system	2.25	8.31	9
Company has H&S policy	2.25	8.25	8.5
Written in-house H&S rules and regulations for all workers reflecting management concern for safety, principles of action and objectives of achievement	2.25	7.75	8
The firm coordinates its H&S policies with other human resource policies to ensure the well-being of workers	1.5	8.25	8.5
Worker/employee involvement in H&S			
Workers are involved in production of H&S policy	2	9.06	9
Workers provide written suggestions on H&S	1.25	8.56	8.5
Workers kept informed of provisions of H&S plan	1.25	8.81	9
Workers are involved in H&S inspections	1.25	8.94	9
Workers are consulted when the H&S plan is compiled	2	8.81	9
Workers are involved in development of H&S rules and safe work procedures	2	8.88	9
Workers have the explicit right to refuse to work in potentially unsafe, unhealthy conditions	1	9.38	9.5

The literature review to identify the core elements and the indicators are beyond the scope of this paper. The results in Table 1 indicate that there was good consensus to very strong consensus of the majority of the indicators identified in the literature and validated by the panel of experts. The results are of round 3 of Delphi survey. The consensus of importance was arrived at when the indicators fulfilled at least two criteria of the three advocated for i.e.; median, mean and IQR. All the upper management commitment measuring indicators were considered to be very important as they attained strong consensus on the mean, median and inter quartile range. 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 H&S performance. Appointing of H&S staff had three indicators. Employing of at least one H&S representative on each project had weak consensus the IQR was 3, but the mean and median reflected good consensus. The other core element that had indicators with weak consensus of the IQR was formal and informal written communication. These indicators were; the 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 there $IQR \geq 2.1 \leq 3$. Their means and medians achieved good consensus. The indicators were still considered to have achieved good consensus and were retained. H&S policy indicators had weak consensus on their IQR which were analysed to be between, $IQR \geq 2.1 \leq 3$. Their mean and median attained good to strong consensus and hence have been retained as important indicators to improve H&S performance.

5.3 The impact of the leading indicators

Table 2: Impact of leading indicators to improve H&S performance

Health and safety (H&S) core elements and indicators	IQR	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	7.75	7.5
At least one staff member with H&S training is employed on each project	2	7.75	8
Employing at least one H&S representative on each project	2	7	7
Formal and informal written Communication			
Provision of written information about H&S procedures	2.25	7.63	8.5
Provision of written information about the correct way to perform tasks	2.25	7.44	8
Written circular/brochure that informs workers about the risks associated with their work	1.5	7.44	8
Written circular/brochure that inform workers about the preventive measures to reduce risk	2.25	7.44	8
Formal and informal verbal communication			
Provide clear verbal instructions to both literate and illiterate employees about H&S	1	8.38	8
H&S information verbally communicated to workers before changes are made to the way their work activities are executed	1	8.31	8
Organize regular meetings to verbally inform workers about the risks associated with their work	1.25	8.69	8.5
Organize regular meetings to verbally inform workers about the preventive H&S measures of risky work	1	8.81	9
H&S resources			
Provision of personal protective equipment (PPE)	1.25	8	8
Training in H&S through attending seminars/workshops	2	7.81	8
Material schedule data sheets provided for all hazardous materials on site	2	7.33	8
Employing technically skilled employees with H&S training	1.25	8.38	8
Adequate information brochures given on H&S	2	7.13	8
Provision of a budget for H&S	2	8.88	9
Provision of correct tools, equipment and plant to execute construction	1	8.63	9
Provision of good welfare facilities such as showers, canteens, toilets	1.25	8.25	8.5

Continued Table 2: Impact of leading indicators to improve H&S performance

Health and safety (H&S) core elements and indicators	IQR	Mean	Median
Project planning of H&S			
Ergonomics is considered when deciding the method of construction	1	8.25	8
Reengineering is considered to reduce hazards	1	8.5	8.5
When head office decides on the method of construction H&S is included in decision making process	1	8.56	8.5
Each project has a site-specific H&S plan	1	8.38	8.5
Layout of the site considers H&S aspects	1	8.56	9
Use of hazard identification procedures	1.5	8.8	9
Use of risk assessment procedures	1.25	8.19	8.5
Constructability of project is reviewed	1.25	8.25	8
Scheduling for H&S	1.25	8.81	9
Project supervision			
Proper supervision by staff trained in H&S	1.25	8.56	9
Identification of hazards by at least one staff member trained in H&S	1.25	8.31	9
Results of inspections discussed at H&S meetings	1.25	8.25	8.5
H&S inspections done at least daily	1	8.5	9
Local authorities and H&S enforcement agencies visit sites for inspection	1	8.31	9
Ad hoc informal H&S inspections of work place	1	8.5	9
Regular H&S audits of projects	1.25	8.56	9
Training in H&S			
Workers undergo induction on H&S before commencing work on a particular site	1.25	8.44	9
Workers trained in proper care and use of personal protective equipment	1	8.31	9
Workers are regularly trained in H&S	1.25	9	9
Instruction manuals or safe work procedures are used to aid in preventive action	1.25	8	8
Workers are given time off for training	1	8.21	8
Upper management commitment in H&S			
Managers encourage and support worker participation, commitment and involvement in H&S activities	1.25	9	9
Managers encourage and support training of employees in H&S	0.5	8.94	9
Managers communicate regularly with workers about H&S	0.25	9	9
Managers actively monitor the H&S performance of their projects and workers	0.5	8.94	9
Managers take responsibility for H&S	1.25	9	9
Managers actively and visibly lead in H&S matters	0.5	9	9
Managers regularly visit workplaces to check work conditions or communicate with workers about H&S	0.5	8.88	9
Managers encourage and arrange meetings with employees & other managers to discuss H&S matters	1.25	8.88	9
Managers conduct toolbox talks themselves	1.25	8.38	9
Managers ensure that the H&S budget is adequate	1.25	9	9
Managers recognize and reward outstanding H&S performance of workers	1.25	8.56	9
H&S policy			
Proper implementation of safety management system	1	8.19	8
Company has H&S policy	2.25	7.56	8
Written in-house H&S rules and regulations for all workers reflecting management concern for safety, principles of action and objectives of achievement	3	7.38	8
The firm coordinates its H&S policies with other human resource policies to ensure the well-being of workers	2	8	9

Continued Table 2: Impact of leading indicators to improve H&S performance

Health and safety (H&S) core elements and indicators	IQR	Mean	Median
Worker/employee involvement in H&S			
Workers are involved in production of H&S policy	1.25	8.38	9
Workers provide written suggestions on H&S	1.25	7.94	8.5
Workers kept informed of provisions of H&S plan	2	8.06	8.5
Workers are involved in H&S inspections	0.25	8.88	9
Workers are consulted when the H&S plan is compiled	1.25	8.31	9
Workers are involved in development of H&S rules and safe work procedures	1.25	8.5	9
Workers have the explicit right to refuse to work in potentially unsafe, unhealthy conditions	1.25	8.94	9

The scales of consensus adapted for this research were: strong consensus, median 9-10, mean 8-10 and interquartile range (IQR) ≤ 1 ; good consensus, median 7-8.99, mean 6-7.99, $IQR \geq 1.1 < 2$; weak consensus, median ≤ 6.99 , mean ≤ 5.99 and $IQR \geq 2.1 \leq 3$.

All data is based on a ten-point Likert scale of impact with indicators, where 1&2 = no impact, 3&4 = low impact, 5&6 = moderate impact, 7&8 = high impact, 9&10 = major impact

Table 2 indicate the result of the impact of the indicators. The result indicate that appointment of health and safety (H&S) staff indicators had good consensus as they had $IQR \leq 2$ and their median and mean were in the bracket of good consensus, formal and informal written communication element had four indicators to measure it only one indicator had a good consensus on the IQR, the other three had weak consensus in the IQR analysis, their mean and median attained good consensus, formal and informal verbal communication element was measured using four indicators, three of the indicators had strong consensus based on their impact when implemented. H&S resources elements had eight indicators, the result indicate a good to strong consensus when implemented. Provision of correct tools, equipment and plant to execute construction had an $IQR \leq 1$, which indicates a strong consensus. Project planning of H&S had a scale of nine indicators they all had good consensus and high to major impact to improve H&S performance as their median and mean indicates. The indicators that indicated strong consensus as per the experts rating were; ergonomics is considered when deciding the method of construction, reengineering is considered to reduce hazards, when head office decides on the method of construction H&S is included in decision making process, each project has a site-specific H&S plan and layout of the site considers H&S aspects. These indicators had an $IQR \leq 1$.

Project supervision had a scale of eight indicators the IQR, median and mean indicates a good to strong consensus, the impact of using this indicators has a high to major impact as indicated by the median. Training in H&S had five indicators all the indicators had a good to strong consensus and the impact is high to major when used to manage H&S. Upper management commitment to H&S had eleven indicators to measure this element. All the indicators had a good to strong consensus. They will also have a major to high impact in improving H&S performance as indicated as indicated by t by the median and mean. Policy on H&S element had four indicators to measure, one indicator had strong consensus this was proper implementation of safety management system two other indicators had weak consensus based on their IQR, but their median indicates high impact when used. Worker's/employee involvement had seven indicators all had a good to strong consensus rating. Experts have indicated that if employees will be involved in H&S inspections their will be a high to major impact in H&S improvement.

6. Discussions

The results indicate that upper management commitment, employee involvement, H&S resources, H&S planning, supervision H&S, training in H&S and formal and informal verbal

communication indicators are viewed as important and have high to major impacts in improving H&S performance of SMEs. The indicators attained a good to strong consensus in improving H&S performance. Some of the indicators for H&S policy, formal and informal written communication and appointment of H&S staff had weak consensus based on their IQR i.e. the dispersion of the respondents was varied. This result also indicates that written communication may not be that helpful for SMEs to improve their H&S performance. According to one of the experts' comment "people do not read what they are given".

This is the first reported study to develop a set of leading indicators specifically designed to evaluate early warnings indicators in H&S within SMEs to improve their H&S performance at project level in South Africa using Delphi method. 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.

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