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Perceptions of Construction Health and Safety Performance Improvement Enablers

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ABSTRACT

Purpose of this paper
The performance of the construction sector relative to occupational health and safety is persistently problematic. It is well-known that measuring health and safety (H&S) performance helps to ensure that construction organizations are achieving their H&S policy objectives and targets. As such performance measurement constitutes a communication vehicle. Consequently, it plays a key role in research related to development of key performance indicators in the construction industry. However, the challenge is to determine what needs to be measured. This paper discusses the development of a performance improvement model based on several enablers.

Methodology
A descriptive survey was used to conduct this research using a structured questionnaire. The gathered data were analyzed using Statistical Package for the Social Sciences (SPSS) and data reduction using factor analysis suggested the key elements of the improvement model. The reliability for internal consistency of the H&S enablers were determined using Cronbach's alpha test.

Findings
The study identified important enablers that need to be included in an improvement model. Further, the priority of these differed between top management, site management and general workers.

Research limitation and implication
Given that the sample was drawn from participants at H&S training workshops suggests that it is possible that there could be a sample selection bias in the findings. It is possible that as a consequence a number of key enablers that were identified in the literature did not emerge during data reduction process.

Value
The findings of this research project provide the basis for the further development of a H&S performance improvement model.

Keywords: health and safety; performance measurement; performance improvement

1. INTRODUCTION

Construction health and safety has for many years been a major problem and concern (Teo, Ling and Ong, 2005). The industry has typically been described as being one with either no or, at best, a poor health and safety culture (Blockley, 2005). In fact, construction workers are two to three times more likely to die on the job than workers in other industries while the risk of serious injury is almost three times higher (Haupt, 2001). In order to effect H&S performance improvement the H&S culture of construction organizations needs to be improved (Haupt and Smallwood, 2007).

The measurement of performance is a critical component of any health and safety (H&S) management system (Mitchell, 2000). It has been established that measuring H&S performance helps to ensure that organizations achieve their H&S policy objectives and targets. As such it provides information about how organizations are performing relative to H&S allowing them to identify problem areas in which improvements can be made. Performance measurement provides the basis for reviews of H&S practices and organizational processes. These reviews can be used for comparative analysis and/or benchmarking.

Academics, construction industry researchers and stakeholders have long recognized the importance of the construction industry and have endeavoured to find ways of assessing and improving its performance (Willis and Rankin, 2007). Experience on construction sites reveals that while there is an increased focus on health, safety and quality issues, H&S hazards and quality errors are often repeated week after week. Managers find further improvement of construction processes difficult (Marosszeky, 2005). Globally, the fatality incident rate in the construction industry is higher than in most of other industries (Duff, 1998). The rate of serious injury in Australia is 50% higher than the all industry average (Cole, 2003). In the United Kingdom, for example, on average five construction workers are killed every two weeks and one member of public is killed every month

by construction activities (Snashall, 1990). In order to bring about sustained improvements in H&S performance in the construction sector, rigorous, reliable and valid measurement of H&S performance is required.

2. CONSTRUCTION H&S IN SOUTH AFRICA

Traditionally, cost, quality and time have constituted the parameters within which projects have been managed. However, increasing awareness relative to the role of health and safety (H&S) in overall project performance has engendered a focus on H&S by a range of stakeholders. The number of large-scale construction accidents in South Africa in recent years and consequent media coverage has further raised the level of awareness (Department of Labour, 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 in H&S by key project stakeholders such as clients and designers, provided the catalyst for a new approach to construction H&S in South Africa. The Construction Regulations promulgated in 2003 under the OH&S Act of 1993 require a range of new multi-stakeholder interventions such as, for example, that designers substitute hazardous materials, amend designs that necessitate the use of hazardous processes, and consider ergonomics during commissioning and other phases of projects (Smallwood and Haupt, 2005).

Occupational accidents and disease in construction impose an enormous cost on South Africans. Costs to employers include property damage, lost production time, lost skills as well as the cost of engaging and retraining replacements (The National Occupational Health and Safety Policy, 2003). While construction accidents account for 4% of the global gross domestic product (GDP), in South Africa they account for approximately 3.5% of its GDP, which, translates to about R30 billion (about $4.2 billion) (The Department of Labour, 2007). 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. Due to the industry's nature of mobility and immigrants, construction is the third hardest hit by HIV and AIDS (Construction Industry Development Board (CIDB, 2004). These views highlight the importance of a model to measure performance improvement of H&S in the construction industry.

3. ENABLERS FOR H&S PERFORMANCE IMPROVEMENT

According to Mohamed and Chinda (2005) the causal relationship between the goal of overall H&S performance improvement and what construction firms actually do has not been fully investigated. This relationship provides an indication of the potential for performance improvement. Teo, Ling and Chua (2004) developed a model to evaluate the perceptions of various stakeholder of construction H&S (Figure 1.1) on the basis of three levels. Level 1 sets out the goal of the evaluation, level 2 the factors that impact H&S and level 3 the sub-factors which would impact H&S on projects.

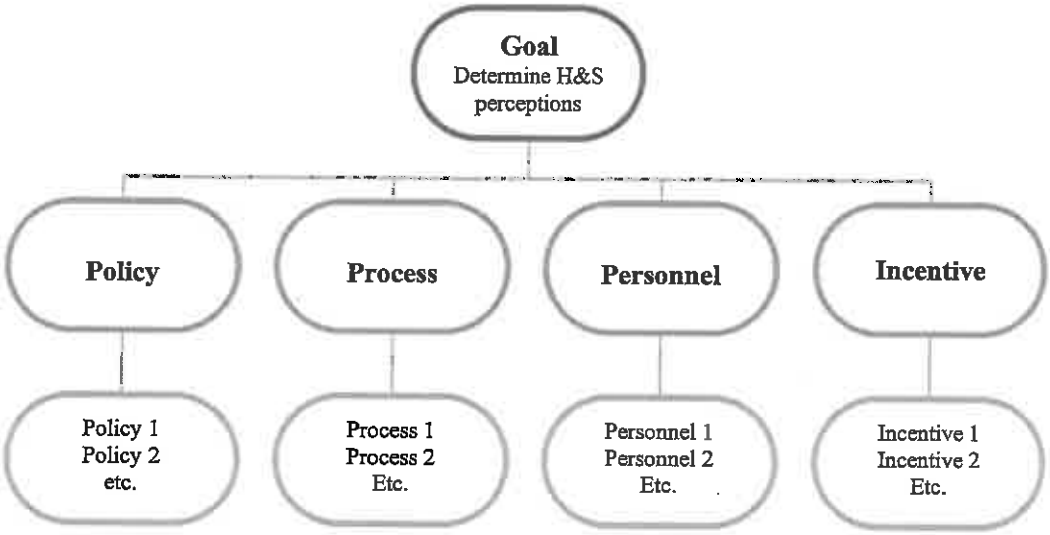

Figure 1.1 3P+I model adapted from Teo and Ong (2005)

Teo and Ling (2006) further developed this model and they argued that the relationship was critical between four main components of such management systems, namely Policy, Process, Personnel and Incentive (3P+I) to achieve high levels of construction H&S.

Similarly, this paper, based on a current doctoral study to develop an improvement model for the SME sector, examines the views of a sample of industry participants on various enablers of construction H&S performance using a conceptual model. It is hypothesized that these enablers would represent components of a model to improve the H&S performance and culture of construction organizations (refer to Figure 1.2). The components are, namely,

- Management commitment and involvement;
    - The importance given to construction H&S by management where H&S is an organizational value and not just a priority;

- Worker empowerment;
  - The engagement and/or involvement of workers in key aspects of H&S such as the development of H&S policy, H&S plans, risk assessments, H&S inspections and audits, H&S feedback forums, Safe Work Procedures (SWPs) and contractor selection;
- Training and resources;
  - Training of workers in SWPs as part of construction activities and, for example, the proper use of PPE and provision of appropriate PPE, orientation and induction; materials, tools and equipment; and welfare facilities
- Project planning and supervision;
  - Involves consideration of H&S when choosing construction methods, materials, and supervision;
- Vision and policy;
  - Involves the importance within the organization of H&S and the setting of strategic H&S goals such as elimination of hazards at source; zero tolerance of poor H&S;
- Appointments;
  - The employment of staff and workers trained in construction H&S.

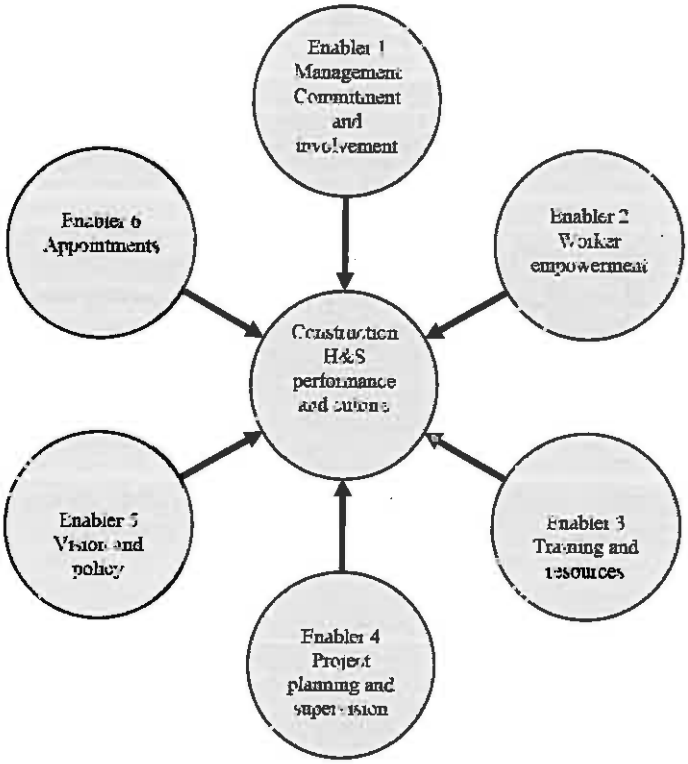

Figure 1.2 Enablers of construction H&S (Haupt and Smallwood, 2007)

However, it is recognized that leadership strongly influences all of these enablers as evidenced in Figure 1.3. The pivotal role of management in construction health and safety (H&S) performance improvement is well documented. Several studies have determined a positive correlation between management commitment and direct involvement or participation in construction H&S initiatives and H&S management and overall performance (Fred, Arn and Gatlin-Watts, 1999; Lingard and Rowlinson, 2005; Hinze, 1997; Levitt and Samelson, 1993; Statzer, 1999; Teo and Ling, 2006). The importance of top management commitment and the issues of institutional culture cannot be underestimated (Teo and Ling, 2006). Improved H&S performance within an organization has to be a strategic choice. The extent to which top management choose to themselves demonstrate healthy and safe work practices and make decisions will determine the success of H&S initiatives. It makes good business sense for those charged with managing construction firms and

projects to focus as much on H&S as they do on other competitive priorities. Arguably, an injury-free environment creates positive worker attitudes, commitment and sense of awareness and responsibility. This environment results in higher quality and lower total production costs due to reduced rework and scrap, lost time, workers' compensation and lost workdays (Ansari and Modaress, 1997).

4. RESEARCH METHODOLOGY

A questionnaire survey instrument was developed from relevant literature to establish the perceptions of various construction industry stakeholders of site health and safety. Inter alia, participants in the survey were presented with 65 statements (i.e. items) addressing the enablers shown in Figure 1.2 and on a five-point Likert scale[1] asked to indicate their level of agreement with each statement. Various constructs were operationalized through several items which were evaluated on the basis of the Likert scale. In this way, the evaluation of the perception of participants of the constructs was carried out. Other parts of the questionnaire were designed to profile the participants in terms of their level of involvement in construction, gender, stakeholder status, level of education, construction-related qualifications and experience, exposure to injury and illness, exposure to construction H&S training and information, and views on causes of accidents. The sample was drawn from participants attending a national series of H&S workshops over a two-year period subsequent to the promulgation of the Construction Regulations in 2003. Following questionnaire pre-testing, the final version of the questionnaire was presented to workshop participants to complete. The Statistical Package for Social Sciences (SPSS) was used to conduct descriptive statistical analysis of the data to compute mean scores, standard deviation, skewness and kurtosis. The results showed neither outlying nor severely skewed cases. SPSS was also used for an exploratory factor analysis (EFA). Only findings relative to top management perceptions are presented.

[1] A five-point Likert scale of agreement was used where 1= strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; and 5 = strongly agree.

Figure 1.3 Leadership as driver of enablers of construction H&S improvement (Haupt and Smallwood, 2007)

5. RESEARCH FINDINGS

5.1 Sample profile

The type of organization that participants were involved in is shown in Table 1.

Table 1 Type of organization

Organization type	%
Local authority	3.1
Developer	4.9
Architectural practice	0.9
Engineering practice	24.8
Contractor	31.9
Sub-contractor	8.0
H&S practitioner	8.4
Public sector client	11.5
Private sector client	6.6

Most participants were involved in contractor organizations (31,9%) and engineering practices (24,8%).

Table 2 Profile of sample

Gender				
	Sample %	Top management %	Site management %	Other workers %
Males	74.9	66.1	84.9	70.5
Experience				
	Number of years	Number of years	Number of years	Number of years
Construction	8.36	10.02	10.91	2.87
Current site/project	5.73	6.53	6.45	1.25
Health and safety training				
	Sample %	Top management %	Site management %	Other workers %
	75	66	82	67
Education level				
	Sample %	Top management %	Site management %	Other workers %
None	1.2	0.0	0.8	4.8
<Grade 5	0.6	0.0	0.8	1.6
Grade 5-8	5.6	0.0	0.8	17.5
Grade 9-12	10.9	15.7	21.8	28.6
>Grade 12	72.7	84.3	75.9	47.6
Construction qualification				
	Sample %	Top management %	Site management %	Other workers %
None	45.4	40.0	32.8	60.7
Learnership	5.2	0.0	6.4	9.8
Trade	17.6	14.3	25.6	8.2
Diploma	22.2	24.3	26.4	18.0
Other	9.5	21.4	8.8	3.3

As evidenced from Table 2, of the 325 participants, 26,4% were involved in construction at top management level, 49,8% at site supervisor level and the remaining 23,8% at general worker level. Males made up 74.9% of the sample. Top and site management had median years of experience in

construction of 10,02 and 10,91 years respectively and had been with their current employers for median 6,53 and 6,45 years respectively. Other workers had a median 2,87 years of experience in construction and had been with their current employers for a median 1,25 years. This finding confirms the itinerant nature of construction employment in the lower categories of employment. About three-quarters of all participants had received some form of H&S training. However, site managers had received more H&S training than both top management and other workers. These groups are the ones that should have received more if not the same level of training given their influence on construction H&S performance. Most participants (72.9%) had education levels above Grade 12. It is also evident that all top management participants had education levels above Grade 9. With respect to construction qualifications, most of the respondents (45.4%) had no construction qualifications. The "other" category comprised mostly a range of degrees in built environment disciplines. However, of concern is the high numbers of top and site managers without construction qualifications, namely 40% and 32,8% respectively.

From Table 3 it is evident that several of the respondents had both been injured and contracted illnesses while involved in construction.

Table 3 Frequency of injuries and sickness/illness

Injuries				
	Sample %	Top management %	Site management %	Other workers %
Construction	13.2	12.1	13.4	16.9
Current site/project	6.7	4.2	6.8	8.5
Sickness/Illness				
Construction	27.3	25.4	31.3	26.4
Current site/project	30.9	30.4	33.8	23.7

5.2 Exploratory factor analysis (EFA)

EFA was conducted to identify the structure among the questionnaire items, and also for data reduction where appropriate. Principle axis factoring with the varimax rotation method was used to examine the dimensionality of the various enabling constructs and for better interpretability of factor loadings. A cut-off factor loading of 0,45 was used to screen out items that were weak indicators of the constructs. The correlation matrix indicated a large number of correlations exceeded 0,45 and were therefore suitable for factoring.

Table 4 Total variance explained

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.410	24.127	24.127	8.978	23.020	23.020	5.067	12.992	12.992
2	3.124	8.010	32.137	2.690	6.898	29.918	2.362	6.057	19.050
3	2.701	6.925	39.062	2.231	5.721	35.639	2.201	5.643	24.693
4	2.107	5.404	44.465	1.660	4.256	39.895	2.117	5.428	30.121
5	1.845	4.730	49.195	1.489	3.818	43.712	1.713	4.393	34.514
6	1.562	4.005	53.201	1.106	2.836	46.549	1.671	4.284	38.798
7	1.340	3.436	56.637	.900	2.307	48.856	1.656	4.245	43.043
8	1.266	3.246	59.882	.819	2.101	50.956	1.509	3.870	46.914
9	1.143	2.931	62.814	.709	1.819	52.776	1.506	3.862	50.776
10	1.062	2.724	65.538	.648	1.661	54.437	1.428	3.661	54.437

Extraction Method: Principal Axis Factoring.

The Bartlett test of sphericity was significant and the Kaiser-Meyer-Olkin measure of sampling adequacy exceeded 0.6. Inspection of the anti-image correlation matrix revealed that all sampling measures were well above the acceptable level of 0.5 – in most cases between 0.8 and 0.9. Based on Eigenvalues > 1, the EFA of the remaining 39 items extracted ten factors accounting for 54,44% of the total variance. Factor 1 was predominantly accounted for by 11 items (12.99% of the initial total variance) (Refer Table 4).

After closer examination of the identified factors, further analysis was done. The remaining 32 items extracted seven factors that accounted for 51,28% of the total variance (Refer Table 5).

Table 5 Total variance explained (7 factors)

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.830	27.595	27.595	8.369	26.153	26.153	4.809	15.027	15.027
2	2.758	8.619	36.214	2.312	7.225	33.378	2.382	7.443	22.471
3	2.269	7.089	43.303	1.749	5.466	38.844	2.172	6.787	29.257
4	1.848	5.775	49.079	1.370	4.282	43.126	2.132	6.662	35.919
5	1.552	4.850	53.928	1.151	3.598	46.724	1.722	5.382	41.301
6	1.278	3.995	57.923	.799	2.498	49.222	1.658	5.180	46.481
7	1.074	3.358	61.281	.660	2.061	51.283	1.537	4.802	51.283

Table 6 shows the factors and factor loadings extracted from EFA after eliminating a further factor which did not fit the model being developed. The factors were the enablers hypothesized to improve the H&S performance and culture of construction organizations.

Table 6 Factors and factor loadings extracted from EFA

Item	Worker empowerment	Training and resources	Project planning and supervision	Policy and vision	Management commitment & involvement	Appointments
WORKER INVOLVEMENT IN PRODUCTION OF H&S POLICY	.713					
H&S INSPECTIONS USED AS TRAINING TOOL	.694					
WORKERS KEPT INFORMED OF PROVISIONS OF H&S PLAN	.669					
WORKERS INVOLVED WITH H&S INSPECTIONS	.639					
WORKERS CONSULTED WHEN H&S PLAN COMPILED	.631					
PROJECTS HAVE PROJECT SPECIFIC H&S PLANS	.628					
RESULTS OF INSPECTIONS DISCUSSED AT H&S MEETINGS	.587					
H&S INSPECTIONS DONE REGULARLY & AT LEAST DAILY	.581					
LOCAL AUTHORITIES AND H&S ENFORCEMENT AGENCIES VIST SITES	.508					
REGULAR H&S AUDITS ARE DONE ON PROJECTS	.508					
CONTRACTORS SELECTED ON BASIS OF H&S PERFORMANCE RECORD	.471					
WORKERS PROVIDED WITH PPE		.764				
WORKERS TRAINED IN PROPER CARE & USE OF PPE		.694				

Table 6 Continued

Item	Worker empowerment	Training and resources	Project planning and supervision	Policy and vision	Management commitment & involvement	Appointments
REGULAR H&S MEETINGS		.563				
WORKERS UNDERGO INDUCTION BEFORE WORK		.500				
ERGONOMICS NOT CONSIDERED WHEN DECIDING METHOD			.697			
REENGINEERING NOT CONSIDERED TO REDUCE EXPOSURE			.634			
H&S NOT CONSIDERED WHEN CHOOSING CONSTRUCTION METHOD			.587			
HEAD OFFICE NEVER CONSIDER H&S WHEN DECIDING METHOD			.471			
GENERAL LACK OF PROPER SUPERVISION			.459			
H&S IS PROJECT/SITE MANMNT PRIORITY				.851		
H&S IS PROJECT/SITE MANMNT VALUE				.768		
PROJECT/SITE MANMNT INSIST ON HAZARD ELIMINATION				.537		
HEAD OFFICE ALWAYS ADDRESS H&S ISSUES					.791	
H&S OF WORKERS IMPORTANT TO HEAD OFFICE					.596	
HEAD OFFICE INTOLERANT OF POOR H&S					.558	
EMPLOYS H&S STAFF ON PROJECTS						.603
TRAINED H&S REPS ON SITE						.579
WORKERS REGULARLY TRAINED IN H&S						.488

Extraction Method: Principal Axis Factoring.
Rotation Method: Varimax with Kaiser Normalization.
A Rotation converged in 7 iterations.

The Cronbach's alpha (α) reliability test was applied to ensure the appropriateness of groupings of the six factors extracted. Given that the value of 0,70 is generally accepted as the minimum desired value of the α

coefficient. As evident in Table 7, the reliability coefficients range from 0.72 to 0.88, all of which are acceptable.

Table 7 Internal consistency of the extracted factors

Latent factor	Cronbach's alpha (α)
Worker empowerment (11 items)	0.88
Training and resources (4 items)	0.79
Project planning and supervision (5 items)	0.72
Vision and policy (3 items)	0.81
Management commitment and involvement (3 items)	0.76
Appointments (3 items)	0.72

From Table 8 it is evident that worker empowerment, training and resources, project planning and supervision, vision and policy, management and commitment and appointments were identified as key enablers of H&S performance and culture improvement. However, by ranking the enablers according to their composite means, it is apparent that levels of importance of the enablers differed between the sample groups. For example, worker empowerment and training and resources were more important to top and site management than to other workers. Further, to other workers worker empowerment and management commitment and involvement were more important than to top and site management. A deeper investigation of the rankings suggest a close alignment of enabler importance between site management and other workers hinting at a disconnect between top management and what actually happens on construction sites.

Table 8 Ranking of composite means

Enabler/element	Sample Mean	Rank	Top management Mean	Rank	Site management Mean	Rank	Other workers Mean	Rank
Worker empowerment	3.88	1	3.98	1	3.39	5	3.31	5
Training and resources	3.81	2	3.95	2	3.98	1	3.65	1
Project planning and supervision	1.34	3	1.21	6	2.50	6	3.19	6
Vision and policy	3.48	4	3.47	3	3.71	3	3.51	3
Management commitment and involvement	3.32	5	3.32	4	3.86	2	3.63	2
Appointments	2.62	6	2.51	5	3.58	4	3.33	4

6. CONCLUSIONS

The study confirmed from data collected via a questionnaire survey management commitment and involvement, training and resources, vision and policy, worker empowerment, project planning and supervision, and appointments as key enablers of a H&S performance and culture improvement model. However, the role of leadership in influencing the effectiveness of each of the enablers cannot be overlooked. Leaders should be role models in promoting safe work behavior, ensure that workers accept their H&S responsibilities, and set realistic and achievable H&S policy and goals which are communicated throughout the organization. Leadership is therefore the primary driver to effective H&S performance culture improvement.

The study is limited in that it relied heavily on a self-reported method of data collection with the consequent possibility of bias in the final outcome of the study. Further, there are a number of other key enablers identified in the literature that did not emerge during the EFA.

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