THE INFLUENCE OF PROJECT MANAGERS ON CONSTRUCTION HEALTH AND SAFETY IN SOUTH AFRICA

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INTRODUCTION

Construction occupational fatalities, injuries and disease result in considerable human suffering and affect, not only the workers directly involved, but also their families and communities and contribute to the national cost of medical care, and rehabilitation (Smallwood, 1996).

However, occupational fatalities, injuries and disease also contribute to variability of resource, which increases project risk. Such risk can manifest itself in damage to the environment, reduced productivity, non-conformance to quality standards and time overruns, and ultimately in an increase in the cost of construction. Other possible manifestations include damage to client property and, or impaired production processes, and a poor client and contractor image as a result of accidents (Smallwood, 1996).

Literature review

Given that all project stakeholders — clients, designers, project managers (PMs) and contractors — influence and contribute to construction health and safety (H&S), PMs, in their capacity as project leaders and co-ordinators, are uniquely positioned to integrate H&S into all aspects of the design and construction processes (Smallwood, 1996; Hinze, 1997). However, only one of the nine project management knowledge areas in the Project Management Body of Knowledge (PMBOK) makes any reference to H&S (and that is perfunctory), namely project human resource management (Project Management Institute, 1996). Given that occupational fatalities, injuries, disease, and accidents in general increase project risk, it is significant that a further knowledge area, namely project risk management does not make reference to H&S.

Traditionally PMs have focused on cost, quality and time. However, this traditional approach has not been successful, with the greater percentage of projects not being completed within budget, or to quality and time requirements (Allen, 1999). The need for a paradigm shift and focus on H&S is amplified by the complementary role of H&S in overall project performance cited by various authors — H&S enhances productivity, quality, time and ultimately, cost (Hinze, 1997; Levitt and Samelson, 1993).

Given the documented impact of accidents, the influence of H&S on other project parameters, the need for a multi-stakeholder approach to H&S, the minimal status afforded to H&S by the Project Management Body of Knowledge and the unique position and role of PMs in projects, the objectives of this study are to determine:

- PM perceptions relative to the importance of H&S and other project parameters
- the frequency at which PMs consider and refer to H&S during the design and development, and implementation or construction phases
- the frequency at which PMs consider and refer to H&S relative to various design and related activities
- the frequency at which various procurement related situations and interventions, which affect H&S, are encountered and taken by PMs respectively
- the aspects or actions which PMs perceive can improve or contribute to an improvement in H&S performance
- the perceived impact of inadequate or the lack of H&S on other project parameters and project risk.

Project life-cycle

Given that projects are unique and involve a certain degree of risk the PMBOK recommends that projects be subdivided into several phases to provide for better management control. These phases, which are collectively referred to as the project life cycle (Project Management Institute, 1996), are:

- concept and initiation
- design and development

- implementation or construction
- commissioning and handover.

This paper addresses only the second and third phases, namely design and development, and implementation or construction, hereafter referred to as design and construction for reasons of brevity.

Holistic client satisfaction

Research conducted in the USA among a range of electrical contractor clients developed a client satisfaction model. The model consists of five satisfaction quality dimensions: safety, project management, contractor/customer relationship, cost and prepared/skilled workforce (Cook, Andersen and Andersen, 2000). A national survey conducted during the research indicated safety to be the most important quality dimension, followed by project management and contractor/customer relationship. Prepared/skilled workforce and cost dimensions were jointly ranked lowest in importance.

Research conducted in the UK among consultants (Kometa, Olomolaiye and Harris, 1996) investigated the fundamental needs of clients. The computation of a relative importance index enabled the needs to be ranked in terms of importance. Quality, time and cost were ranked third, fourth and fifth after the first ranked 'functionality of a building' and the second 'safety', both during construction and throughout the life of a building.

Research conducted in South Africa investigated the degree of importance of eleven project parameters according to architects (Smallwood, 2000a). Based upon an importance index, client satisfaction was ranked first, followed by project quality, project cost and project time — H&S was ranked eleventh.

The influence of design

According to Jeffrey and Douglas (1994) it has to be accepted that in terms of causation there is a link between design decisions and safe construction. This is based on research carried out by the European Foundation for the Improvement of Living and Working conditions, which concluded, that of site fatalities, 35% were caused by falls, which could have been reduced through design decisions. Schneider and Susi (1994) in turn say that constructing a new building is, by its very nature, a problem in ergonomics, as construction requires work at floor and ceiling level, resulting in, *inter alia*, kneeling, bending, reaching out, twisting and in general, the adoption of uncomfortable work postures.

Designers influence H&S directly through design specific, supervisory and administrative interventions. Design specific interventions include:

- concept design
- general design
- selection of type of structural frame
- site location
- site coverage
- details
- method of fixing
- specification of materials and finishes.

Supervisory and administrative interventions include:

- reference to H&S upon site handover, and during site visits and inspections
- inclusion of H&S as an agenda item during site meetings
- requiring of H&S reporting by contractors.

Designers also influence H&S indirectly through type of procurement system used, prequalification, project time, partnering and the facilitating of pre-planning (Smallwood, 2000b).

A further role identified for designers is that of optimal interaction with clients, particularly at the design brief stage. This is the most crucial phase for the successful, and healthy and safe completion of any project. Deviations from it at a later stage resulting in variation orders (VOs) can be the catalyst that triggers a series of events from designer through to workers that culminates in an accident on site. Consequently, clients must know exactly what they require and develop a comprehensive brief for the design team (Jeffrey and Douglas, 1994).

Designers, and consequently PMs, also influence the pre-planning of H&S. Pre-planning H&S realises a structured approach to H&S related issues by both designers and contractors. Liska (1994) maintains there are two parts to pre-planning: pre-project and pre-task, and that pre-planning provides the foundation for project H&S programmes. Pre-planning identifies all the ingredients of and resources

required for the H&S programme to be effective and efficient. However, the design of a project is a great influence on determining the method of construction and the requisite H&S interventions. Consequently, designers need to make sufficient design related information available at pre-project stage to facilitate budgeting for adequate resources. This is reinforced by Oluwoye and MacLennan (1994) who found that among PMs and site managers of multi-storey projects in Sydney, Australia, drawings, legislation and site inspections are the sources of information most frequently consulted for H&S planning.

Constructability is a further design related issue; 'design for safe construction' is one of 16 constructability design principles listed by Adams and Ferguson (McGeorge and Palmer, 1997). However, most of the other 15 principles are indirectly related to, and consequently do influence H&S. Method of fixing, size, mass and area of materials, position of components, *inter alia*, amplify the relevance of constructability to H&S. Consequently PMs and designers should assess constructability throughout the design stage of a project. It is notable that prior research conducted in South Africa to determine the role of PMs in H&S, indicates that 'evaluating constructability' is the occasion throughout all project stages when PMs deliberate H&S most frequently (Smallwood, 1996).

Procurement related issues

Procurement systems and related issues are important as they affect, among other things, contractual relationships, the development of mutual goals and the allocation of risk, and ultimately provide the framework within which projects are executed (Dreger, 1996). Research indicates that procurement systems influence H&S. Evidence gathered suggests incorrect choice and use of procurement systems has contributed to neglect of H&S by project stakeholders (Rwelamila and Smallwood, 1999). Design-build complements H&S as a result of the integration of the design and construction processes (Meere, 1990). However, the traditional construction procurement system (TCPS) which entails, *inter alia*, the evolution of a design by designers, the preparation of bills of quantities and related documentation by quantity surveyors, the engagement of a contractor through competitive bidding, invariably on the basis of price, does not complement H&S. This may be due to the separation of the design and construction processes, the incompleteness of design upon both preparation of documentation and the commencement of construction, and the engagement of contractors on the basis of price (Rwelamila and Smallwood, 1999).

Competitive tendering marginalises H&S. Market conditions in South Africa are such that contractors frequently find themselves in the iniquitous position that should they make the requisite allowances for H&S, they run the risk of losing a tender or negotiations to a less committed competitor (Smallwood, 1996). Fryer (1997) says that clients may have to accept that there is an 'H&S premium' to pay in the cost of construction. During research conducted in South Africa approximately 50% of PMs advocated the inclusion of a provisional sum for H&S (Smallwood, 1996). This would ensure that all tenderers allocate an equitable amount of resources to H&S.

South African contract documentation does not engender H&S. Although references are made to H&S in standard contract documentation, they are generally indirect, hardly coercive, and depending upon the level of commitment, contractors continue to address H&S to varying degrees (Smallwood and Rwelamila, 1996).

Project duration also impacts on H&S. A shortened contract period may result in a project duration that is incompatible with the nature and scope of the work to be executed (Hinze, 1997). A shortened contract period invariably results in a relative increase in the number of workers and/or the number of hours worked per worker, amount of plant and equipment introduced and used in the workplace, and the simultaneous contributions of an increased number of subcontractors (SCs). Research conducted in South Africa determined project schedule to be the primary cause of stress among construction management and workers, and overtime was ranked 13 out of a total of 27 causes of stress (Smallwood and Ehrlich, 1999). Hinze (1997) cites pressure to meet unrealistic deadlines as a common source of mental diversion, which diversion increases the susceptibility of injury.

Various authors, for example, Levitt and Samelson (1993), advocate prequalification

of general contractors (GCs) and SCs on H&S by clients and GCs respectively. The purpose of pre-qualification in the H&S sense is to provide a standardised method for the selection of contractors on the basis of demonstrated safe work records, H&S commitment and knowledge, and the ability to work in a healthy and safe manner. This will ensure that only H&S conscious contractors are selected.

Construction phase

PMs can implement processes, strategies and undertake various interventions that can complement H&S, during the construction phase.

Partnering is a process that brings the various stakeholders involved in a project together, i.e. client, designers, general contractor, subcontractors and suppliers. The process includes the developing of mutual goals and mechanisms for solving problems. There are two reasons for expecting partnering to reduce accidents: first, the improvement in all-round relations on the project, which in turn, according to research, results in reduced accidents; second, the performance objectives, which form part of the partnering charter, usually include a specific mention of H&S (Levitt and Samelson, 1993).

The prior research conducted in South Africa included a structured interview (Smallwood, 1996). Haddon, a PM, says: “PMs should not turn a blind eye, and if necessary issue site instructions, as H&S is an integral part of working on site.” He recommends that PMs refer to H&S during initial site inspections and site handovers (due to the effects of the project on the immediate environment), at site meetings (if the GC or SCs are not addressing it), and during site inspections and discussions (as “H&S is the most important aspect on site.”)

Other research findings are that the majority of PMs always or often made reference to H&S during site handovers, site meetings, site inspections and site discussions.

Oosthuizen (1994) maintains PMs will be successful in their endeavours if they adopt a holistic approach as H&S, productivity and quality are inextricably intertwined. Ideally, PMs should make frequent reference to H&S on all occasions during the construction phase, namely site handovers, meetings, inspections and discussions, to ensure that the project environment is conducive to and complementary to the synergy between H&S, productivity, quality and time (Smallwood, 1996).

Risk

During the prior research conducted in South Africa, 95.8% of PMs maintained that inadequate H&S, or the lack of it, increased project risk (Smallwood, 1996). Although inadequate, or non-existent H&S results in variability of resource output, and consequently an increase in risk, it also results in the probability of an accident. Given that, firstly, risk is a function of probability and impact, and secondly, that the outcome of accidents is largely fortuitous, the potential risks that are a result of inadequate or non-existent H&S are substantial.

Generic tools and techniques to engender H&S

According to Kerzner (1992), oral communication, which is preferred by most people in the construction industry is a major source of communication breakdown. However, Oosthuizen (1994) maintains this problem can be circumvented by formalizing the process of communication and recommends the use of checklists and the implementation of a documented quality management system (QMS).

Hood (1994) concurs, and says problems related to H&S, productivity and quality can frequently be traced to substandard, inconsistently applied or non-existent operating procedures and practices. Standard operating practices and procedures, and safe work procedures (SWPs), are the core component of both QMSs and H&S management systems as they guarantee uniformity of operation throughout an organisation. They effectively ensure that each time a task is performed, it is done consistently, correctly and in a healthy and safe manner.

The need for QMSs is not constrained to construction — according to Cornick (1991) there are a number of incentives for design practices to implement QMSs in their practices, e.g. reduced liability risk because of a reduction in professional indemnity insurance premiums. This occurs as a result of the systematic discipline demanded of any process by the application of a QMS — client requirements are clearly defined and agreement thereof is recorded, sources of information pertaining to any design decision

are clearly defined and documented, responsibilities for project quality are clearly defined and documented, and there is reduced supervisory responsibility relative to the construction process.

Consequently PMs should endeavour to procure the services of designers and contractors that have documented QMSs, and, in the case of contractors, documented H&S management systems that include SWPs. Prequalification of designers and contractors on the basis of documented QMSs, and contractors on the basis of documented H&S management systems including SWPs, will engender the implementation of such systems and procedures.

RESEARCH

Sample frame

The sample frame was intended to consist of 'construction' PMs, who were members of the Project Management Institute of South Africa (PMISA). However, the PMISA would not provide the researchers with a membership directory, as they were concerned about the confidentiality of their membership. Provision of the directory would have enabled the identification and sole inclusion of the construction PMs in the survey. Consequently 489 questionnaires were mailed by the PMISA on behalf of the researchers to a sample frame, which supposedly consisted of construction PMs. However, a response was received from both an information technology (IT) PM, and a general contractor PM member. Further, it is significant to note that the total membership of the more recently established Association of Construction Project Managers (ACPM), established by the construction PMs that seceded from the PMISA, is 95. Therefore, although the 30 responses received constitutes a response rate of 6.2% (30/487), the 'theoretical' response rate is in the order of 31.6% (30/95). However, the former level of response reflects the general level of response to national construction related surveys conducted among various sample frames in South Africa. Further, it should be noted that the possibility exists that the respondents might constitute the more committed PMs in general, and particularly with respect to H&S, and consequently a degree of bias exists — the perceived bias may overstate the importance of parameters, the frequency of consideration or reference to H&S on various occasions and relative to various design related aspects, the potential contribution to improvement in H&S by various aspects and actions, and the impact of inadequate H&S on various project parameters, and the level of risk.

Importance index (II)

Given that respondents were required to respond in terms of frequency and importance, it was necessary to compute an importance index (II) with a minimum value of 0, and a maximum value of 3 or 4, to enable a comparison of, and to rank various aspects/actions, parameters, occasions, and situations/interventions. The II is calculated using the formulae:

$$\frac{4n_1 + 3n_2 + 2n_3 + 1n_4 + 0n_5}{n_1 + n_2 + n_3 + n_4 + n_5}$$

where n_1 = Very important/always
n_2 = Important/often
n_3 = Neutral/sometimes
n_4 = Not really important/rarely
n_5 = Not important/never and don't know

or

$$\frac{3n_1 + 2n_2 + 1n_3 + 0n_4}{n_1 + n_2 + n_3 + n_4}$$

where n_1 = Very important/often
n_2 = Important/sometimes
n_3 = Fairly important/rarely
n_4 = Not important and unsure/never and don't know

It should be noted that 'don't know' responses have been consolidated with 'not important' and 'never' responses on the basis that not knowing the degree of importance of a parameter, or whether H&S is addressed on various occasions or relative to various aspects, is tantamount to H&S not being important or never addressed, i.e. if H&S was important, or if it was addressed, then respondents would know.

FINDINGS

The responding PMs worked for practices, which employed an average of 5.7 PMs.

The greater percentage of practices, represented by PMs, managed projects as follows:

- A$ 16.7m per annum (36.7%),
- A$ 8.3m $\leq$ A$ 16.7m' (16.7%),

- A$ 4.2m ≤ A$ 8.3m' (16.7%),
- A$ 0.17m ≤ A$ 0.83m (16.7%)

i.e. approximately one-third of practices were large in South African terms.

The practices represented by PMs were, on average, principal agent for 77.7% of projects for which they provided project management services. Infrastructure (39%) and industrial (30%) predominated among the types of construction undertaken by the practices, followed by commercial (19.7%).

No particular level predominated among the level of structures/construction:

- ground (23.3%)
- 0–10 floors (16.7%)
- single storey (13.3%),
- double storey (13.3%).

Respondents were asked to rate the three key total quality management (TQM) parameters of contractor H&S, labour productivity and quality on a scale of 'very important' to 'not important'. Table 1 indicates the resultant rankings based on an II with a maximum value of 3.0 and a minimum value of 0.0. It is significant that the values of all the IIs are above the midpoint value of 1.5, which indicates that all three parameters can be deemed to be perceived as important by PMs.

Table 1: Importance of contractor H&S, labour productivity and quality to PMs

Parameter	Degree of importance (%)				II	Rank
	Very	Important	Fairly	Not		
Quality	76.7	20.0	3.3	0.0	2.73	1
H&S	60.0	26.7	13.3	0.0	2.45	2
Labour productivity	53.3	36.7	10.0	0.0	2.43	3

Table 2: Importance of various project parameters to PMs

Parameter	Degree of importance (%)					II	Rank
	Very ..... Not						
	1	2	3	4	5		
Client satisfaction	76.7	23.3	0.0	0.0	0.0	3.77	1
Project quality	73.3	23.3	3.3	0.0	0.0	3.70	2
Project cost	70.0	23.3	6.7	0.0	0.0	3.63	3
Project time	60.0	33.3	6.7	0.0	0.0	3.53	4
Project health and safety	60.0	20.0	16.7	3.3	0.0	3.37	5
Public health and safety	56.7	6.7	30.0	6.7	0.0	3.13	6
Labour productivity	36.7	40.0	13.3	10.0	0.0	3.03	7
Environment (natural)	40.0	23.3	23.3	10.0	0.0	2.97	8
Worker satisfaction	20.0	43.3	23.3	13.3	0.0	2.70	9
Designer satisfaction	20.0	40.0	26.7	13.3	0.0	2.67	10
Contractor satisfaction	16.7	36.7	33.3	13.3	0.0	2.56	11

Respondents were also asked to rate eleven project parameters on a scale of 1 (very important) to 5 (not important). Table 2 indicates the resultant rankings based on an II with a maximum value of 4.0 and a minimum value of 0.0. It is significant that the values of all the IIs are above the midpoint value of 2.0, which indicates that all the project parameters can be deemed to be perceived as important by PMs. It is also significant that the II values of the top seven ranked project parameters are above 3.0, which indicates that these project parameters can be deemed to be perceived as very important, or close thereto. Client satisfaction achieved a ranking of first, followed by the traditional project parameters of quality, cost and time. It is notable that project H&S and public H&S achieved rankings of fifth and sixth respectively.

Table 3 presents the frequencies at which PMs consider or refer to construction H&S on various occasions in terms of the frequency range: always, often, sometimes, rarely, never and don't know. The fourteen occasions are ranked based upon an II with a maximum value of 3.0 and a minimum value of 0.0. It is significant that the values of all the IIs are above the midpoint value of 2.0, which indicates that the consideration of or reference to H&S on various occasions can be deemed to be prevalent. It is also significant that the II values of the top six ranked occasions are equal to or higher than 3.0, which indicates that H&S is 'always'/'often' considered or referred to on these occasions. Site meetings achieved a ranking of first; followed by site handover, site inspections/discussions, constructability reviews, pre-tender meeting, and prequalifying contractors. It is notable that the highest ranked 'upstream' occasion, constructability reviews, achieved a ranking of fourth, followed by prequalifying contractors, sixth. However, preparing project documentation and detailed design, which achieved rankings of seventh and eighth, followed closely.

Table 3: Frequency at which PMs consider, or refer to construction H&S on various occasions

Occasion	Frequency (%)						II	Rank
	Always	Often	Sometimes	Rarely	Never	Don't know		
Site meetings	56.7	26.7	13.3	3.3	0.0	0.0	3.37	1
Site handover	63.3	13.3	16.7	6.7	0.0	0.0	3.33	2
Site inspections/discussions	53.3	26.7	16.7	3.3	0.0	0.0	3.30	3
Constructability reviews	46.7	23.3	26.7	3.3	0.0	0.0	3.13	4
Pre-tender meeting	43.3	26.7	23.3	6.7	0.0	0.0	3.07	5
Prequalifying contractors	40.0	36.7	6.7	16.7	0.0	0.0	3.00	6
Preparing project documentation	43.3	20.0	20.0	13.3	0.0	0.0	2.97	7
Detailed design	26.7	36.7	30.0	6.7	0.0	0.0	2.83	8
Client meetings	26.7	33.3	30.0	10.0	0.0	0.0	2.77	9
Evaluating tenders	33.3	30.0	20.0	10.0	6.7	0.0	2.73	10
Concept (design)	23.3	36.7	26.7	13.3	0.0	0.0	2.70	11
Design coordination meetings	23.3	33.3	30.0	13.3	0.0	0.0	2.67	12
Working drawings	23.3	30.0	10.0	26.7	6.7	0.0	2.38	13
Deliberating project duration	16.7	20.0	33.3	20.0	10.0	0.0	2.13	14

Table 4 presents the frequencies at which PMs consider/refer to construction H&S relative to various design related aspect in terms of the frequency range: always, often, sometimes, rarely, never and don't know. The sixteen aspects are ranked based upon an II with a maximum value of 4.0 and a minimum value of 0.0. It is significant that the values of all the IIs are above the mid-point value of 2.0, which indicates that the consideration of or reference to H&S relative to various design related aspects can be deemed to be prevalent. It is significant that only specification achieved an II value equal to or higher than 3.0, which indicates that H&S is 'always'/'often' referred to relative thereto. Type of structural frame and method of fixing achieved rankings of second and third respectively, followed closely by position of components and design (general). Given that certain materials contain hazardous chemical substances it is notable that content of material achieved a ranking of sixth. Given that materials handling, and more specifically the mass of materials, contributes to manual materials handling, it is also notable that mass, edge, texture and surface area of materials achieved rankings from thirteenth to sixteenth respectively. However, finishes and schedule, which encapsulate materials and processes, achieved rankings of eleventh and twelfth respectively. Plan layout, site location, elevations and details achieved II values of 2.62 and higher.

Table 4: Frequency at which PMs consider / refer to construction H&S relative to various design related aspects

Aspect	Frequency (%)						II	Rank
	Always	Often	Sometimes	Rarely	Never	Don't know		
Specification	33.3	43.3	10.0	6.7	3.3	0.0	3.00	1
Type of structural frame	43.3	23.3	16.7	6.7	6.7	0.0	2.93	2
Method of fixing	26.7	46.7	16.7	10.0	0.0	0.0	2.90	3
Position of components	30.0	33.3	20.0	10.0	0.0	0.0	2.89	4
Design (general)	33.3	30.0	26.7	3.3	6.7	0.0	2.80	5
Content of material	33.3	23.3	26.7	10.0	6.7	0.0	2.67	6
Plan layout	23.3	33.3	26.7	10.0	3.3	0.0	2.66	7
Site location	33.3	26.7	20.0	10.0	10.0	0.0	2.63	8
Elevations	23.3	33.3	23.3	13.3	3.3	0.0	2.62	9=
Details	20.0	36.7	26.7	10.0	3.3	0.0	2.62	9=
Finishes	30.0	30.0	6.7	23.3	6.7	0.0	2.55	11
Schedule	23.3	30.0	20.0	20.0	3.3	0.0	2.52	12
Mass of materials	30.0	16.7	23.3	20.0	6.7	0.0	2.45	13
Edge of materials	16.7	20.0	43.3	6.7	6.7	3.3	2.28	14
Texture of materials	20.0	26.7	13.3	20.0	10.0	3.3	2.21	15
Surface area of materials	13.3	23.3	33.3	26.7	3.3	0.0	2.17	16

Table 5 presents the frequencies at which PMs achieve/encounter/use various procurement related situations/interventions in terms of the frequency range: often, sometimes, rarely, never and don't know. The eight aspects are ranked based upon an II with a maximum value of 3.0 and a minimum value of 0.0. It is significant that the values of all the IIs are above the midpoint value of 1.5, which indicates that the achieving/encountering/use of the situations/ interventions can be deemed to be prevalent. It is also significant that the top four ranked situations/interventions are cited by literature as having a negative influence on H&S are clients revise their requirements, competitive tendering, drawings are revised, and variation orders. Similarly, with respect to the sixth ranked situation, design is separated from construction. Although the situations/interventions which complement H&S achieved rankings of fifth, seventh and eighth (i.e. optimum project period, prequalification of contractors, and design is complete when construction commences) their II values are all above the midpoint value of 1.50.

Table 6 indicates the extent to which PMs perceive various aspects/actions can contribute to an improvement in H&S performance. Respondents could respond relative to 'yes', 'no' and 'unsure', as opposed to scaled responses. With the exception of choice of procurement system, prequalification of contractors on quality, partnering, optimum project programme, the majority of PMs responded in the affirmative to the various aspects/actions. It should be noted that the level of affirmative support relative to the aforementioned is in conflict with the literature (Dreger, 1996; Oosthuizen, 1994; Levitt and Samelson, 1993; Hinze, 1997). The level of 'unsure' responses relative to choice of procurement system, partnering, optimum project programme and project specific plan for quality is possibly attributable to a lack of knowledge and/or familiarity therewith. The level of affirmative response relative to the top three ranked aspects/actions is significant. It is also significant that two of the top three are solely design related, and that the third aspect/action, project specific plan for H&S and quality requires both designer and contractor input. Various authors ratify the perceived potential contribution by clients and contractor programming, including, Hinze (1997) and Levitt and Samelson (1993). The fifth to seventh rankings achieved by QMS, prequalification of contractors on H&S, and contract documentation, reflect the potential contribution expressed in the literature (Hood, 1994; Levitt and Samelson, 1993; Smallwood and Rwelamila, 1996).

Table 5: Frequency at which PMs achieve/encounter / use various procurement related situations/interventions

Situation/intervention	Frequency (%)					II	Rank
	Often	Sometimes	Rarely	Never	Don't know		
Clients revise their requirements	83.3	16.7	0.0	0.0	0.0	2.83	1=
Competitive tendering	83.3	16.7	0.0	0.0	0.0	2.83	1=
Drawings are revised	73.3	23.3	3.3	0.0	0.0	2.70	3
Variation orders	70.0	20.0	10.0	0.0	0.0	2.60	4
Optimum project period	60.0	23.3	16.7	0.0	0.0	2.43	5
Design is separated form construction	46.7	33.3	13.3	6.7	0.0	2.20	6
Prequalification of contractors	33.3	46.7	16.7	3.3	0.0	2.10	7
Design is complete when construction commences	36.7	23.3	30.0	10.0	0.0	1.87	8

Labour productivity, cost of construction and project programme predominated in terms of the extent to which project parameters are perceived to be negatively affected by inadequate or non-existent H&S (Table 7). Less than half of the PMs identified quality, environment, client satisfaction and designer satisfaction.

Possible responses to the question: "Does inadequate H&S increase overall project risk?" included 'yes', 'no' and 'don't know. 93.3% of PMs responded in the affirmative. During the prior research conducted in South Africa, 95.8% of PMs responded in the affirmative (Smallwood, 1996).

63.3% of PMs responded that H&S should be afforded status equal to that of the traditional project parameters of cost, quality and schedule. Those respondents who responded in the negative were requested to qualify their response. Nine of the ten responses were different, ranging from "Should always have higher status" to "H&S goes hand in hand with quality" and "H&S can be delegated to contractors under PM's supervision."

Table 6: Extent to which various aspects/actions can contribute to an improvement in H&S performance according to PMs

Aspect/action	Response (%)			Rank
	Yes	No	Unsure	
Project specific plan for H&S, and quality	96.7	3.3	0.0	1
Designer prioritization / consideration	86.7	0.0	10.0	2=
Constructability reviews by designers	86.7	6.7	3.3	2=
Client actions	73.3	13.3	10.0	4
Quality management system	70.0	13.3	10.0	5=
Prequalification of contractors on H&S	70.0	16.7	10.0	5=
Contract documentation	66.7	26.7	3.3	7=
Contractor programming	66.7	23.3	10.0	7=
Project specific plan for quality	63.3	13.3	23.3	9
Optimum project programme	46.7	26.7	23.3	10
Prequalification of contractors on quality	40.0	43.3	10.0	11
Partnering	36.7	33.3	26.7	12
Choice of procurement system	33.3	36.7	26.7	13

Table 7: Extent to which inadequate or the lack of health and safety negatively affects other project parameters

Parameter	Response (%)	Rank
Labour productivity	83.3	1
Cost of construction	73.3	2
Project programme	66.7	3
Quality	43.3	4
Client satisfaction	40.0	5=
Environment	40.0	5=
Designer satisfaction	23.3	7

CONCLUSION

The conclusions, based upon the literature and descriptive surveys, have been presented relative to the objectives of the study.

The importance of H&S and other project parameters to PMs

The descriptive survey reflects the findings of literature, namely that quality, cost and time are the 'most important' parameters. Although these parameters achieved rankings of second, third and fourth, the first ranked, client satisfaction, is a function of satisfactory performance relative to quality, cost and time. Project H&S, which is the subject of this paper, and a directly related parameter, public H&S, achieved rankings of fifth and sixth respectively. Labour productivity which impacts substantially on cost and time, and which is influenced by H&S and quality, only achieved a ranking of seventh. A similar analogy applies to worker satisfaction, which achieved a ranking of ninth. However, the values of all the IIs for the parameters are above the midpoint value of 2.0, which indicates that they can be deemed to be important to PMs.

Relative to this objective it can be concluded that PMs prioritise the traditional project parameters of cost, quality and time. However, almost the majority of PMs recognise the need for H&S to be afforded status equal to that afforded to cost, quality and time.

The frequency at which PMs consider and, or refer to H&S during the design and construction phases

Given that the values of the IIs for all the occasions were above the midpoint value of 2.0, it can be concluded that H&S can be deemed to be considered and/or referred to by PMs on all occasions. However, the top three ranked occasions are all construction related, i.e. site meetings, site handover, and site inspections/discussions, which indicates a preference by PMs to address H&S during construction. The top ranked design occasion, constructability reviews, which achieved a ranking of fourth, indicates a preference by PMs to 'filter', rather than influence the design of designers. Ultimately, however, this occasion represents the optimum occasion for PMs, as opposed to detailed design, which achieved a ranking of eighth. The subsequent rankings of pre-tender meeting, prequalifying contractors and preparing project documentation indicate an appreciation for and the use of procurement related occasions to engender H&S.

Relative to this objective it can generally be concluded that PMs consider and refer to construction H&S more frequently during construction, than during procurement and design.

The frequency at which PMs consider and, or refer to H&S relative to various design related activities

Given that the values of the IIs for all the various design related activities were above the midpoint value of 2.0, it can be concluded that H&S can be deemed to be considered and, or referred to by PMs during all the design related activities. Although no particular category of design related activities predominate, assembly (including type of structural frame, method of fixing and position of components) achieved substantially higher rankings than materials related aspects such as mass, edge, texture and surface area.

The frequency at which various procurement related situations or interventions, which affect H&S, are encountered or taken by PMs respectively

Given that the II values for all the various procurement related situations and interventions are above the midpoint value of 1.5, it can be concluded that the situations or interventions are encountered or taken by PMs.

Relative to this objective it can be generally concluded that situations or interventions that negatively affect H&S, are encountered or taken more frequently than those that positively affect H&S. The former being clients revise their requirements, competitive tendering, drawings are revised, and variation orders and the latter being optimum project period, prequalification of contractors, and design is complete when construction commences.

The aspects or actions, which PMs perceive can improve or contribute to an improvement in H&S performance

The majority of PMs identified nine out of thirteen aspects/actions identified in the literature as having the potential to improve or contribute to an improvement in H&S performance.

The top four ranked aspects or actions clearly indicate the necessity for a multi-stakeholder approach to H&S, i.e. project specific plan for quality, designer prioritisation/consideration, constructability reviews by designers, and client actions.

The level of negative, and particularly unsure responses relative to certain aspects or actions indicates that PMs may not be familiar with, or do not appreciate the potential influence of the following aspects or actions: choice of procurement system, partnering, optimum project programme, project specific plan for quality, and pre-qualification of contractors on quality.

Relative to this objective it can generally be concluded that various design, procurement and construction related aspects and actions have the potential to improve or contribute to an improvement in H&S.

The perceived impact of inadequate or non-existent H&S on other project parameters and project risk

Although PMs appreciate the extent to which inadequate or non-existent H&S negatively affects labour productivity, cost of construction and project programme, they do not do so relative to the other project parameters. Despite the latter status quo, PMs do appreciate that inadequate H&S increases overall project risk.

RECOMMENDATIONS

The following recommendations are suggested based on the findings of the study:

- Health and safety should be afforded status equal to that afforded the traditional project parameters/performance measures of cost, quality and time by clients, designers, PMs and contractors.

- The PMBOK should be amended so that it presents H&S as an individual knowledge area, and so that H&S is included in the knowledge area of project risk management. Consequently project management programmes should include H&S education.

- PMs should consider or refer to H&S more frequently during the upstream phases of design, namely concept design, preparation of working drawings and design coordination meetings. A similar recommendation applies relative to evaluating tenders and deliberating project duration.

- Relative to design related aspects, PMs should consider or refer to H&S more frequently in relation to elevations, details, finishes and schedules, and various characteristics of materials.

- PMs should endeavour to integrate design and construction, realise an optimum client brief, finalise design before construction commences, discourage client changes, pre-qualify contractors on H&S and quality, include a specific mention of, and a financial allowance for, H&S in contract documentation, avoid competitive tendering, and realise the implementation of QMSs in design and construction.

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