THE ROLE OF HEALTH AND SAFETY (H&S) IN PROJECT MANAGEMENT

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Traditionally, cost, quality and time have constituted the parameters within which projects have been managed. This practice is a result of traditional theory and practice, which has been perpetuated by the project management body of knowledge (PMBOK) and project management texts.

Two of the nine project management knowledge areas are directly linked to health and safety (H&S), namely human resource management and risk management, by virtue of the fact that H&S is a ‘life and death’ issue. H&S is also directly related to another knowledge area, namely quality management.

The outcome of accidents is largely fortuitous; damage and loss could be minor, major, or even catastrophic. In practical terms accidents could result in first aid treatment, or a permanent disabling injury (loss of a forearm), or multiple fatalities, and / or the loss of a plant.

H&S is the catalyst for the synergy between H&S and the traditional and non-traditional project parameters of cost, the environment, productivity, quality, time, and client and worker satisfaction. Conversely, inadequate or the lack of H&S, and / or accidents, marginalize performance relative to the other project parameters.

The paper reports on a literature and descriptive survey, and presents empirical findings from a study conducted among construction project managers (PMs), inter alia: PM prioritise the traditional project parameters of cost, quality and time; PMs consider and refer to H&S more frequently during construction, than procurement and design related occasions; PMs generally consider and refer to H&S relative to various design related activities; PMs encounter design and procurement related situations which negatively impact H&S, more frequently than situations which complement H&S; the potential exists for various design, procurement and related aspects and actions to contribute to an improvement in H&S performance, and inadequate H&S negatively impacts on other project parameters and increases project risk.

The paper concludes that H&S: is the catalyst for performance relative to the other project parameters; is not afforded the status deserving of its role, and is essential for the achievement of ‘best practice’. The paper also recommends that the PMBOK be amended to afford H&S the status it deserves.

Keywords: construction, health and safety, project management, client satisfaction

1. 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 [1].
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 [1].

Given that all project stakeholders—clients, designers, PMs and contractors influence and contribute to construction H&S, PMs, in their capacity as project leaders and coordinators, are uniquely positioned to integrate H&S into all aspects of the design and construction processes [1; 2].

The PMBOK defines project management as the application of knowledge, skills, tools and techniques to project activities to meet or exceed stakeholder needs and expectations. To achieve this requires balancing competing demands among: scope, time, cost and quality; stakeholders with differing needs and expectations, and needs and expectations [3]. Walker [4] in turn, defines construction project management as: “the planning, control and coordination of a project from conception to completion on behalf of a client requiring the identification of the client’s objectives in terms of utility, function, quality, time and cost.” It is notable that both definitions place emphasis on cost, quality and time. Further, only one of the nine project management knowledge areas make perfunctory reference to H&S, namely project human resource management [3]. 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.

The focus on cost, quality and time by project management is probably attributable to client measurement of project performance on the basis of cost, quality, time, and utility – utility includes constructability [5]. A further aspect is that traditionally, cost, quality and time have constituted the parameters within which projects have been procured and managed [6]. Although this traditional approach has been perpetuated by tertiary construction education, clients, designers, project leaders and the construction industry, it has not been successful, with the greater percentage of projects not being completed within budget, and to quality and time requirements [7].

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 [2; 8]. Conversely, research conducted in South Africa investigated, inter alia, the extent to which inadequate H&S negatively affects other project parameters. The majority of PMs responded in the affirmative to cost, environment, productivity, quality and client perceptions, and slightly less to time. Hinze [2] simply contends that no project can be considered a success if a worker has been killed or permanently disabled.

Due to projects being unique and involving a certain degree of risk, the PMBOK recommends that they be subdivided into several phases to provide for better management control. These phases which are collectively referred to as the project life - cycle are: concept and initiation; design and development; implementation or construction, and commissioning and handover [3]. The paper only addresses the second and third phases, namely design and development, and implementation or construction, hereafter referred to as design, and construction, for reasons of brevity.

Given the level of accidents, 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 PMBOK, and the unique position and role of PMs in construction projects, a study consisting of phases in terms of intervals, was initiated in 1995. Objectives of the study are to determine:
PM perceptions relative to the importance of H&S and other project parameters;
the perceived impact of inadequate or the lack of H&S on other project parameters and
project risk;
the perceived impact of optimum H&S on performance relative to 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, and
the aspects or actions which PMs perceive can improve or contribute to an improvement in
H&S performance.

2. LITERATURE SURVEY

2.1 Statistics
During 1997, the latest year for which occupational injury statistics are available, a total of 17 932
medical aid cases, 7 714 temporary total disabilities, 686 permanent disabilities, and 141
fatalities were reported to the Compensation Commissioner in South Africa [9]. Based upon
approximately 230 working - days per year, this is the equivalent of 77.97, 33.54, 2.98, and 0.61
respectively, per working day. The disabling injury incidence rate (DIIR) 1.31 means that 1.31
workers per 100 incurred disabling injuries. This is the fifth highest DIIR out of a total of twenty
five industries, after fishing, mining, transport, and wood, and is approximately 30% higher than the
‘All industries’ DIIR 1.09. However, the 107 fatalities among the 341 825 workers insured by the
Accident Fund (AF) is the equivalent of a fatality rate of 31.3 fatalities per 100 000 full-time
equivalent construction workers, which does not compare favourably with international rates.

The severity rate (SR) indicates the number of days lost due to accidents for every 1 000 hours
worked. The construction industry SR 1.37 is the fourth highest, after fishing, mining, and transport.
Given that the average worker works 2 000 hours per year, if the SR is multiplied by 2, the average
number of days lost per worker per year can be computed – the construction industry lost 2.74
working days per worker during 1997. This is equivalent to 1.2% of working time.

2.2 Cost of accidents
The cost of accidents can be categorised as being either direct or indirect. Direct costs tend to be
those associated with the treatment of the injury and any unique compensation offered to workers as
a consequence of being injured and are covered by workmen’s compensation insurance premiums.
Indirect costs which are borne by contractors include: reduced productivity for both the returned
worker(s) and the crew or workforce; clean-up costs; replacement costs; stand-by costs; cost of
overtime; administrative costs; replacement worker orientation; costs resulting from delays;
supervision costs; costs related to rescheduling; transportation, and wages paid while the injured is
idle [2]. Various studies have realised differing ratios between the indirect and direct costs: 1.67
times for non-minor injuries and more than 5 times for minor injuries with direct costs less than
US$50 [2], and 20 times [10]. Research indicates the total cost of accidents to constitute, inter alia,
6.5% of the value of completed construction [11] and approximately 8.5% of tender price [12].

2.3 Cost of health and safety
According to The Business Roundtable [11] data collected from a significant sample of contractors
working at various construction sites in the United States of America in 1980 indicated that the cost
of administering a construction H&S programme usually amounts to about 2.5% of direct labour
costs. These costs include: H&S programme; salaries for H&S and certain administrative personnel;
H&S meetings; inspection of tools, plant and equipment; site inspections; personal protective
equipment (PPE), and miscellaneous supplies and equipment. Based on two South African construction projects direct labour costs constitute 10.64% of project value in which case the cost of administering a H&S programme of 2.5% of direct labour cost is equivalent to 0.266% (0.025 x 10.64%) of project value - R2 660 per R1m.

More extensive research conducted in a regional entity of a large national South African general contractor (GC) determined the actual mean cost of H&S on 16 projects, which would have either qualified for, or had a BIFSA H&S Star Grading status of between 3 and 5 stars, to be 0.22% of project value - R2 200 per R1m [13].

2.4 Impact of inadequate H&S
Research conducted among PMs in South Africa investigated the impact of inadequate H&S on various project parameters. Productivity (87.2%) and quality (80.8%) predominated, followed by cost (72.3%), client perception (68.1%), environment (66%), and schedule (57.4%) [1]. H&S is a prerequisite for productivity and quality as, housekeeping, inter alia, complements access and ergonomics. Accidents result in increased cost, damage to the environment and can substantially retard project progress as a result of either, decreased productivity, or a cessation of the works. Client perception may be adversely affected by accidents, as accidents are not project requirements, and / or clients may schedule specific H&S related contractual requirements, particularly in the case of projects in or adjacent to an existing facility.

2.5 Relationship between H&S and quality
Quality, which means conformance to requirements, amplifies the need for H&S, as conformance to requirements entails inter alia, conformance to SABS and other contractual requirements, legislation, and if applicable, ISO environmental, H&S, and quality management systems. Consequently, an activity or project cannot be said to be successful, if disabling injuries or fatalities have been incurred during the process [2]. A further aspect is that injuries and fatalities are not project requirements, and consequently, constitute defects.

2.6 Synergy
The Associated General Contractors of America (AGC) [14] defines synergism as “the interaction of different entities so that the combined effect is greater than the sum of individual efforts.” International literature unequivocally indicates that H&S engenders optimum cost, sustainability of the environment, productivity, quality, time performance, and client and worker satisfaction [15].

2.7 Holistic client satisfaction
Shenhar, Levy & Dvir [16] maintain the meeting of budget, schedule and technical goals are important in the early stages of a project. However, the criteria to determine the success of a project include: technical performance; efficiency of execution; managerial and organisational implications; personal growth, and manufacturability and business performance. They also maintain that customer satisfaction should be reviewed relative to four stakeholders: client; developer; project team, and end user.

Research conducted in the UK among consultants investigated the fundamental needs of clients. Based upon a relative importance index, functionality of a building was ranked first, followed by safety, both during construction and throughout the life of a building, quality, time, and cost [17].

2.8 The influence of design
According to Jeffrey and Douglas [18] 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.
Designers influence H&S, directly and indirectly. Directly, as a result of: design; supervisory, and administrative interventions. Design interventions include: concept design; general design; selection of type of structural frame; site location; site coverage; details; method of fixing, and 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, and the requiring of H&S reporting by contractors. Indirectly, as a result of: type of procurement system used; pre-qualification; project time; partnering, and the facilitating of pre-planning [19].

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 culminate in an accident on site. Consequently, clients must know exactly what they require and develop a comprehensive brief for the design team [18].

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 maintains that there are two parts to pre-planning: pre-project and pre-task, and that pre-planning provides the foundation for project H&S programmes [20]. 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, sufficient design related information, needs to be available at pre-project stage to facilitate budgeting for adequate resources. According to a study conducted by Oluwoye and MacLennan among PMs and site managers of multi-storey projects in Sydney, drawings, legislation and site inspections are the sources of information most frequently consulted for H&S planning [21].

Constructability is a further design related issue. ‘Design for safe construction’ is one of sixteen constructability design principles listed by Adams and Ferguson [22]. However, most of the other fifteen principles are indirectly related to, and consequently 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. Research conducted in South Africa determined identified ‘evaluating constructability’ as the occasion throughout all project stages when PMs deliberated H&S most frequently [1].

2.9 Procurement related issues
Procurement systems and related issues are important as they affect, among other, contractual relationships, the development of mutual goals, the allocation of risk, and ultimately, provide the framework within which projects are executed [23]. Evidence gathered suggests incorrect choice and use of procurement systems has contributed to neglecting of H&S by project stakeholders [24]. The traditional construction procurements 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. Primarily 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 [24]. However, Design-Build complements H&S as a result of the integration of the design and construction processes [24].
Competitive tendering marginalizes 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. During research conducted in South Africa, approximately 50% of PMs advocated the inclusion of a provisional sum for H&S, which would ensure that all tenderers allocate an equitable amount of resources to H&S [1].

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 [1].

Project duration also impacts on H&S, as a shortened duration may be incompatible with the nature and scope of the work to be executed [2]. Hinze [2] cites pressure to meet unrealistic deadlines as a common source of mental diversion, which diversion increases the susceptibility of injury.

Various authors advocate the pre-qualification of 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 standardized 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 [2; 8].

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

Partnering, a process which brings the various stakeholders involved in a project together: client; designers; general contractor; subcontractors, and suppliers, entails, inter alia, 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 [8].

Research conducted in South Africa determined that the majority of PMs always, or often, made reference to H&S during site handovers, site meetings, site inspections and site discussions [1]. Smallwood maintains that PMs should make frequent reference to H&S on all occasions during the construction phase, to ensure that the project environment is conducive to and complementary to the synergy between H&S, productivity, quality and time [1].

2.11 Risk
Although the PMBOK [3] knowledge area, project risk management, does not make reference to H&S, the potential outcome of inadequate or the lack of H&S and the contribution thereof to project risk amplifies the need for focus on H&S by PMs. During research conducted in South Africa, 95.8% of PMs maintained that inadequate, or the lack of H&S increased project risk [1]. Inadequate, or the lack of H&S result in both, variability of resource output, and consequently an increase in risk, and also in the probability of an accident. Given that, risk is a function of probability and impact, and that the outcome of accidents is largely fortuitous, the potential risks as a result of inadequate, or the lack of H&S, are substantial.
3. RESEARCH

3.1 Sample frame
The sample frame consisted of construction PMs, which were members of the Project Management Institute of South Africa (PMISA). 489 questionnaires were mailed by the PMISA on behalf of the researcher to assure confidentiality of PMISA’s membership directory. It is significant to note that the total membership of the more recently established Association of Construction Project Managers (ACPM) is approximately 100. 30 responses were included in the analysis of the data, which constitutes a response rate of 6.2% (30 / 487) – two responses did not satisfy the criteria for inclusion. This level of response reflects the general level of response to national construction related surveys conducted among various sample frames in South Africa. It should be noted that the possibility exists that the respondents might constitute the more committed construction PMs in general, 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 or the lack of H&S on various project parameters and the level of risk.

3.2 Analysis
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:

\[ \frac{4n_1 + 3n_2 + 2n_3 + n_4 + 0n_5}{n_1 + n_2 + n_3 + n_4 + n_5} \]  or  \[ \frac{3n_1 + 2n_2 + n_3 + 0n_4}{n_1 + n_2 + n_3 + n_4} \]

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

3.3 Findings
The PMs worked for practices:
- which on average employed 5.7 persons;
- the greater percentage (36.7%) of which project managed projects with a total value of more than R 100m per annum;
- which on average were principal agent on 77.7% of projects they provided project management services for;
- which were predominantly involved with infrastructure (39%) and industrial (30%) type projects, and
- which were exposed to all 'height level' categories.

Respondents were asked to rate the importance of construction H&S, labour productivity, and quality on a scale of ‘very important to not important’, to enable the computation of an II with a minimum value of 0.0, and a maximum value of 3.0. Quality (2.73) achieved a ranking of 1st, followed by H&S (2.45) and labour productivity (2.43), which indicates that they can all be deemed as perceived to be important.
Respondents were also asked to rate eleven project parameters on a scale of 1 (very important) to 5 (not important), to enable the computation of an II with a minimum value of 0.0, and a maximum value of 4.0 (Table 1). 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 as perceived to be important to PMs. It is also significant that the II values of the top five ranked project parameters are above 3.2, which indicates that these project parameters can be deemed to be perceived as important to very important (Table1). 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 achieved a ranking of fifth. The top five were followed by public H&S, labour productivity, environment (natural), worker satisfaction, designer satisfaction, and contractor satisfaction.

Table 1. The five most important project parameters according to PMs.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Degree of importance (%)</th>
<th>II Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Client satisfaction</td>
<td>76.7 23.3 0.0 0.0 0.0</td>
<td>3.77</td>
</tr>
<tr>
<td>Project quality</td>
<td>73.3 23.3 3.3 0.0 0.0</td>
<td>3.70</td>
</tr>
<tr>
<td>Project cost</td>
<td>70.0 23.3 6.7 0.0 0.0</td>
<td>3.63</td>
</tr>
<tr>
<td>Project time</td>
<td>60.0 33.3 6.7 0.0 0.0</td>
<td>3.53</td>
</tr>
<tr>
<td>Project health and safety</td>
<td>60.0 20.0 16.7 3.3 0.0</td>
<td>3.37</td>
</tr>
</tbody>
</table>

Table 2 presents the frequencies at which PMs consider or refer to construction H&S on seven of fourteen occasions in terms of the frequency range, always to never. The seven occasions are ranked based upon an II with a minimum value of 0.0, and a maximum value of 3.0. It is significant that the values of all fourteen 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. Site meetings, site handover, and site inspections/discussions predominated. It is notable that the highest ranked ‘upstream’ occasion, constructability reviews, achieved a ranking of fourth, followed by pre-qualifying contractors, sixth.

Table 2. Top seven occasions in terms of the frequency at which PMs consider / refer to H&S.

<table>
<thead>
<tr>
<th>Occasion</th>
<th>Frequency (%)</th>
<th>II Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site meetings</td>
<td>56.7 26.7 13.3 3.3 0.0 0.0 0.0</td>
<td>3.37</td>
</tr>
<tr>
<td>Site handover</td>
<td>63.3 13.3 16.7 6.7 0.0 0.0 0.0</td>
<td>3.33</td>
</tr>
<tr>
<td>Site inspections / discussions</td>
<td>53.3 26.7 16.7 3.3 0.0 0.0 0.0</td>
<td>3.30</td>
</tr>
<tr>
<td>Constructability reviews</td>
<td>46.7 23.3 26.7 3.3 0.0 0.0 0.0</td>
<td>3.13</td>
</tr>
<tr>
<td>Pre-tender meeting</td>
<td>43.3 26.7 23.3 6.7 0.0 0.0 0.0</td>
<td>3.07</td>
</tr>
<tr>
<td>Pre-qualifying contractors</td>
<td>40.0 36.7 6.7 16.7 0.0 0.0 0.0</td>
<td>3.00</td>
</tr>
<tr>
<td>Preparing project documentation</td>
<td>43.3 20.0 20.0 13.3 0.0 0.0 0.0</td>
<td>2.97</td>
</tr>
</tbody>
</table>

Table 3 presents the frequencies at which PMs consider / refer to construction H&S relative to eight of sixteen design related aspects, in terms of the frequency range, always to never. The eight aspects are ranked based upon an II with a minimum value of 0.0 and a maximum value of 4.0. It is significant that the values of all sixteen IIs are above the midpoint value of 2.0, which indicates that the consideration of / reference to H&S relative to various design related aspects can be deemed to be prevalent. Specification, type of structural frame, method of fixing, position of components, and
design (general) predominated. Given that certain materials contain hazardous chemical substances (HCSs) it is notable that content of material achieved a ranking of sixth. Given that materials handling, and more specifically the mass of materials contribute 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 encapsulates 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 3. Top eight design related aspects in terms of the frequency at which PMs consider / refer to H&S.

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Frequency (%)</th>
<th>II</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specification</td>
<td>33.3</td>
<td>3.00</td>
<td>1</td>
</tr>
<tr>
<td>Type of structural frame</td>
<td>43.3</td>
<td>2.93</td>
<td>2</td>
</tr>
<tr>
<td>Method of fixing</td>
<td>26.7</td>
<td>2.90</td>
<td>3</td>
</tr>
<tr>
<td>Position of components</td>
<td>30.0</td>
<td>2.89</td>
<td>4</td>
</tr>
<tr>
<td>Design (general)</td>
<td>33.3</td>
<td>2.80</td>
<td>5</td>
</tr>
<tr>
<td>Content of material</td>
<td>33.3</td>
<td>2.67</td>
<td>6</td>
</tr>
<tr>
<td>Plan layout</td>
<td>23.3</td>
<td>2.66</td>
<td>7</td>
</tr>
<tr>
<td>Site location</td>
<td>33.3</td>
<td>2.63</td>
<td>8</td>
</tr>
</tbody>
</table>

Respondents were asked to respond in terms of the frequency at which they achieve / encounter / use various procurement related situations / interventions in terms of the frequency range: often; sometimes; rarely, and never, to enable the computation of an II with a minimum value of 0.0, and a maximum value of 3.0. 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: 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, namely, optimum project period, pre-qualification of contractors, and design is complete when construction commences, their II values are all above the midpoint value of 1.50.

Table 4 indicates the extent to which PMs perceive various aspects / actions can contribute to an improvement in H&S performance. With the exception of choice of procurement system, pre-qualification of contractors on quality, partnering, and 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 literature [2; 8; 23]. The level of ‘unsure’ response 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 designer and contractor input. Various authors support the perceived potential contribution by clients and contractor programming [2; 8]. The fifth to seventh rankings achieved by QMS, pre-qualification of contractors on H&S, and contract documentation, reflects the potential contribution expressed in literature [8].
Table 4. Extent to which various aspects / actions can contribute to an improvement in H&S performance according to PMs.

<table>
<thead>
<tr>
<th>Aspect/Action</th>
<th>Response (%)</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Project specific plan for H&amp;S, and quality</td>
<td>96.7</td>
<td>3.3</td>
</tr>
<tr>
<td>Designer prioritization/consideration</td>
<td>86.7</td>
<td>0.0</td>
</tr>
<tr>
<td>Constructability reviews by designers</td>
<td>86.7</td>
<td>6.7</td>
</tr>
<tr>
<td>Client actions</td>
<td>73.3</td>
<td>13.3</td>
</tr>
<tr>
<td>Quality Management System</td>
<td>70.0</td>
<td>13.3</td>
</tr>
<tr>
<td>Pre-qualification of contractors on H&amp;S</td>
<td>70.0</td>
<td>16.7</td>
</tr>
<tr>
<td>Contract documentation</td>
<td>66.7</td>
<td>26.7</td>
</tr>
<tr>
<td>Contractor programming</td>
<td>66.7</td>
<td>23.3</td>
</tr>
<tr>
<td>Project specific plan for quality</td>
<td>63.3</td>
<td>13.3</td>
</tr>
<tr>
<td>Optimum project programme</td>
<td>46.7</td>
<td>26.7</td>
</tr>
<tr>
<td>Pre-qualification of contractors on quality</td>
<td>40.0</td>
<td>43.3</td>
</tr>
<tr>
<td>Partnering</td>
<td>36.7</td>
<td>33.3</td>
</tr>
<tr>
<td>Choice of procurement system</td>
<td>33.3</td>
<td>36.7</td>
</tr>
</tbody>
</table>

Labour productivity (83.3%) and cost of construction (73.3%) predominated among project parameters negatively affected by H&S, followed by project programme (66.7%), quality (43.3%), client satisfaction (40%), environment (40%), and designer satisfaction (23.3%).

93.3% of PMs responded that inadequate H&S increased overall project risk. During previous research conducted in South Africa, 95.8% of PMs responded in the affirmative [1].

63.3% of PMs responded that H&S should be afforded status equal to that of the traditional project parameters of cost, quality and time.

4. CONCLUSIONS

4.1 The importance of H&S and other project parameters to PMs
The descriptive survey reflects the findings of literature, namely that, cost, quality and time are the ‘most important’ parameters. Although client satisfaction achieved a ranking of first, it is essentially a function of satisfactory performance relative to cost, quality and time, and other parameters, H&S included. Given that project H&S achieved a ranking of fifth, and the extent of identification therewith, it can be concluded that H&S is perceived to be important to very important. The degree of importance attached to H&S, the impact of inadequate or the lack of H&S on other project parameters, and the recommended level of response relative to enhanced project status for H&S, indicate a need to afford H&S status equal to that afforded to cost, quality and time.
4.2 The impact of inadequate or the lack of H&S on other project parameters and risk
The descriptive survey findings generally reinforce the findings of literature, namely that productivity, cost, quality, time, environment, and client satisfaction, are negatively affected by inadequate or the lack of H&S. However, the findings of both the literature and descriptive surveys unequivocally indicate that project risk is increased as a result of inadequate or the lack of H&S.

4.3 The synergistic effect of optimum H&S on performance relative to other project parameters
The findings of literature indicate that H&S is the catalyst for the synergy between itself and other project parameters.

4.4 The frequency at which PMs consider and, or refer to H&S during the design and construction phases
The findings of literature indicate that PMs should consider H&S during the design and construction phases of projects. Based upon the descriptive survey findings it can be concluded that H&S can be deemed to be considered and, or referred to by PMs on all occasions. However, the findings indicate a preference by PMs to consider / refer to H&S during construction, rather than on procurement and design related occasions, and a preference by PMs to ‘filter’, rather than influence the design of designers. Although procurement related occasions achieved lower rankings, PMs do appreciate the ‘H&S’ potential of, and use such opportunities to engender H&S.

4.5 The frequency at which PMs consider and, or refer to H&S relative to various design related activities
The findings of literature indicate that design influences H&S in a number of ways. Based upon the descriptive survey findings it can be concluded that H&S can be deemed to be considered / referred to by PMs during all the design related activities. Although no particular category of design related activities predominate, assembly, in the form of, 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.

4.6 The frequency at which various procurement related situations or interventions, which affect H&S, are encountered or taken by PMs respectively
The findings of literature indicate that a range of procurement related situations or interventions affect H&S. Based upon the descriptive survey findings it can generally be concluded that situations or interventions, which negatively affect H&S, are encountered or taken more frequently than those, which positively affect H&S. The former being: clients revise their requirements; competitive tendering; drawings are revised, and variation orders. The latter being: optimum project period; pre-qualification of contractors, and design is complete when construction commences.

4.7 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 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, and more specifically, the potential and need for PMs to contribute, namely: project specific plan for quality; designer prioritization / consideration; constructability reviews by designers, and client actions.

The level of negative, and particularly, unsure response relative to certain aspects or actions indicates that PMs may not be familiar with, or not appreciate the potential influence of choice of procurement system, partnering, optimum project programme, and project specific plan for quality.
5. RECOMMENDATIONS

H&S should be afforded status equal to that afforded to cost, quality and time, and the PMBOK should be amended to reflect H&S as an individual knowledge area, and to include H&S in the knowledge area, project risk management.

PMs should consider / refer to H&S more frequently during the upstream phases of design, and relative to all aspects of design. 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 realize the implementation of QMSs in design and construction.

REFERENCES


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John obtained a BSc (Building Management) from the University of Port Elizabeth in 1984. As a bursary holder he worked for Murray and Roberts (EP) (Pty) Ltd during his fourth and fifth years of study, and continued to do so till he left their employ in 1990.

Thereafter he joined the Department of Construction Management at the University of Port Elizabeth, where he is currently the Head of Department, and an Associate Professor in Construction Management and Materials and Methods. John is also the Programme Director for the MSc (Built Environment) programme.

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He is a Past President of the South African Institute of Building (SAIB), and also a member of the Institute of Safety Management (IoSM), and the Ergonomics Society of South Africa (ESSA).