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The need for construction health and safety (H&S) and the Construction Regulations: engineers' perceptions

John Smallwood and Theo Haupt

International research indicates that clients, designers, project managers, and quantity surveyors influence and can contribute to H&S.

The promulgation of the South African Construction Regulations in July 2003 has realised client, designer, and quantity surveyor responsibility for H&S. Clients are required to – inter alia – provide the principal contractor (PC) with an H&S specification and ensure that PCs have made adequate allowance for H&S. Designers are required to – inter alia – provide the client with all relevant information about the design, which will affect the pricing of the works, inform the contractor of any known or anticipated dangers or hazards, provide the contractor with a geo-science technical report, and the methods and sequence of construction, and modify the design where dangerous procedures would be necessary, or substitute hazardous materials.

Given the implications of the Construction Regulations, and the opportunity presented by the presentation of a national series of Construction Regulations seminars, a survey was conducted to determine the perceptions of primarily engineering delegates.

Findings include that: contractors predominate in terms of the perceived extent to which stakeholders can contribute to H&S; the implementation of quality management systems (QMSs) would complement construction H&S; client satisfaction predominates in terms of the importance of various project parameters, followed by quality, cost, and time; productivity and time predominate among parameters negatively affected by inadequate H&S; approximately 61 % of respondents stated that the Construction Regulations would result in between an improvement to major improvement / major improvement in H&S.

INTRODUCTION

Traditionally, cost, quality and time have constituted the parameters within which projects have been managed. However, increasing awareness relative to the role of H&S in overall project performance and the inclusion of H&S as a project performance measure by, inter alia, petro-chemical organisations, has engendered focus on H&S by a range of stakeholders.

The number of large-scale construction accidents in South Africa in recent years and the consequential media coverage have further raised the level of awareness. Recent construction 'blitzes' undertaken by the Occupational Health and Safety Inspectorate, Department of Labour, determined a large amount of non-compliance to H&S legislation by the construction industry. This non-compliance coupled with a recent three-fatality accident, resulted in a scathing attack on the construction industry by Minister Mdladlana, the Minister of Labour (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' by key project stakeholders such as clients and designers, provided the catalyst for a new approach to construction H&S. This new approach culminated in the promulgation of 'consolidated' construction H&S legislation in the form of the Construction Regulations on the 18 July 2003.

The Construction Regulations require a range of 'new' multi-stakeholder interventions, inter alia, that designers substitute hazardous materials, amend designs that necessitate the use of hazardous processes, and consider ergonomics during the commissioning and other phases of projects. Furthermore, the Construction Regulations require a range of procurement related interventions relative to H&S.

Given the abovementioned and the opportunity presented by a national series of Construction Regulations seminars, a survey was conducted to determine the perceptions of primarily engineering delegates regarding

- the extent to which various project stakeholders can contribute to construction H&S
- the importance of various project parameters
- the extent to which inadequate H&S negatively affects the various project parameters
- the extent to which the Construction Regulations will contribute to an improvement in H&S, and
- H&S culture and practices complementary to, or which marginalise H&S

LITERATURE SURVEY

Statistics

During 1999, the latest year for which comprehensive occupational injury statistics are available, a total of 14 418 medical aid cases,

Keywords: Health and safety, multi-stakeholder, Construction Regulations

Table 1 Degree of importance of various parameters to respondents' organisations (Smallwood 2004b)

Parameter	Response (%)					II	Rank	
	Unsure	Not important			Very important			
		1	2	3				4
Project quality	0,0	1,0	0,0	3,1	26,8	69,1	3,63	1
Public health and safety	0,0	2,1	3,2	12,8	21,3	60,6	3,35	2
Schedule (time)	0,0	1,0	0,0	15,5	38,1	45,4	3,27	3=
Cost	0,0	2,1	3,1	10,3	35,1	49,5	3,27	3=
Project health and safety	3,1	3,1	5,2	13,4	36,1	39,2	2,97	5

4 587 temporary total disablements, 315 permanent disablements, and 137 fatalities were reported to the Compensation Commissioner in South Africa (2005). These equate to 1 temporary disablement for every 102 workers, 1 permanent disablement for every 1 041, and 1 fatality for every 3 925. The disabling injury incidence rate (DIIR) 0,98 means that 0,98 workers per 100 incurred disabling injuries, the all industry average being 0,78. The number of fatalities among the workers insured by the Accident Fund (AF) is the equivalent of a fatality rate of 25,5 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 1,14 is the fourth highest, after fishing, mining, and transport, the all industry average being 0,59. 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 2,28 working days per worker during 1999. This is equivalent to 1,0 % of working time.

The holistic issue relative to statistics is that the outcome of accidents is largely fortuitous; it can be minor, moderate, major, or even catastrophic. An accident could result in a project coming to a standstill, hence the relevance to designers, particularly when a designer is the principal agent. Furthermore, H&S is not just a contractor issue as given that design practices are employers they are required to address the H&S of their employers, in both the office environment, and on projects.

Cost of accidents (COA)

The COA 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; costs resulting from delays; supervision costs; costs related to rescheduling; transportation, and wages paid while the injured is idle (Hinze 1994). Recent research conducted in the United Kingdom (UK) determined indirect costs to be 11 times the direct costs – 11:1 (Movement for Innovation 2003). Research conducted in South Africa determined the indirect costs to be 14,2 times the direct costs (Smallwood 2000a).

Research conducted in the United States of America indicates the total cost of acci-

dents to constitute, inter alia, 6,5 % of the value of completed construction (The Business Roundtable 1995) and in the UK approximately 8,5 % of tender price (Anderson 1997). Based upon the respective indirect cost multipliers determined in the UK and South Africa, namely 11 and 14,2, and the estimated compensation insurance for 2002, the total cost of accidents could have been between:

■ $R200,1 \text{ m} + (R200,1 \text{ m} \times 11) = R2 \text{ 401,2 m}$ and

■ $R200,1 \text{ m} + (R \text{ 200,1 m} \times 14,2) = R3 \text{ 041,5 m}$ Further, based upon the value of construction work completed in the year 2002, namely R56 343 million (South African Reserve Bank 2003) the total COA could have been between 4,3 % ($R2 \text{ 401,2 m} / R56 \text{ 343 m}$) and 5,4 % ($R3 \text{ 041,5 m} / R56 \text{ 343 m}$) (Smallwood 2004a).

However, the issue relative to the CoA is that ultimately clients incur the cost thereof. Given that designers are concerned with the optimisation of value they should endeavour to contribute to efforts to mitigate accidents.

Status of health and safety

Table 1 indicates that in terms of an importance index (II) ranging between 0,0 to 4,0, with a minimum value of 0,0, a midpoint value of 2,0, and a maximum value of 4,0, that project H&S is the least important among five project parameters (Smallwood 2004b). Although H&S culture is addressed in another subsection, it should be noted that the perceived importance of H&S is likely to influence the adopting of H&S as a value, as opposed to a priority. The adopting of H&S as a value is important as priorities change, and hence the importance of the status of H&S. However, the adopting of H&S as a value is a prerequisite for addressing and optimising the other constituents of H&S culture.

Synergy

The Associated General Contractors of America (AGC) (1992) defines synergism as 'the interaction of different entities so that their combined effect is greater than the sum of individual efforts'. To facilitate TQM and to enable it to proliferate in the organisation requires that quality efforts be linked to, among others, H&S and productivity.

Research conducted among project managers (PMs) in South Africa (Smallwood 1996) determined, inter alia, that productivity (87,2 %) and quality (80,8 %) predominated in terms of aspects negatively affected by inadequate H&S, followed by cost (72,3 %), client perception (68,1 %), environment (66 %), and schedule (57,4 %). A total of 95,8 % of PMs also stated that inadequate or the lack of H&S increases overall project risk – risk increases as a result of increased variability of resources.

The synergy between H&S and the other project parameters is of relevance to designers, particularly where they are the principal agent, due to the following. Productivity impacts on schedule, and quality is directly related to the functional area of designers. The need for designers to contribute to the optimisation of value amplifies the relevance of H&S as a result of the indirect effect of H&S on value as a result of the positive impact of optimum H&S on cost. Therefore, given the synergy between H&S and the other project parameters, the requirements of the Construction Regulations essentially contribute to the creation of an enabling environment.

Cost of prevention (COP)

Rowlinson (1997) maintains H&S performance cannot be measured in economic terms, but only in social terms. Consequently, the appropriate level of expenditure on H&S should be based upon economic, political and social considerations.

However, various authors quantify the cost of prevention. The Business Roundtable (1995) cites research conducted in the USA, which determined that the cost of administering an H&S programme usually amounts to 2,5 % of direct labour costs. Based upon two projects undertaken by a South African general contractor and given that direct labour costs typically constitute 25 % of the total project, the cost of administering an H&S programme was estimated to amount to 0,65 % (25 % x 2,5 %) of the total project cost (Smallwood 2000a).

Research conducted by Lai (Tang, Lee & Wong 1997) in Hong Kong revealed that most contractors set aside an amount of less than 0,5 % and some even less than 0,25 % of the contract sum for investing in H&S on their contracts.

During recent research conducted among a group of 'best practice H&S' general contractors (GCs) the question: 'On average, approximately what percentage does the cost of H&S constitute of total project cost?' was asked. Eight GCs responded. Two GCs (25 %) recorded percentages, namely 3 % and 0,5 %, and six (75 %) identified ranges: three (37,5 %) '0 ≤ 1 %' and three (37,5 %) '> 1 ≤ 2 %' (Smallwood 2004).

The COP is of relevance to designers, particularly where they are the principal agent, because of the following.

First, in terms of the Construction Regulations, clients may appoint designers or other consultants as their agents to fulfil their responsibilities. Given that clients are required to ensure that principal contractors have made adequate allowance for H&S, the COP is important. A further issue is that should the allowance for H&S be inadequate, based upon the negative effect of inadequate or the lack of H&S on the other performance parameters, overall project performance could be impaired.

Qualitative and quantitative benefits of investing in H&S

Numerous authors advocate investing in H&S because of the diverse range of benefits that accrue. The Bureau of Labour Statistics (BLS) (Concrete Construction 1991) contends that H&S training not only ensures compliance, but that it can

■ reduce absenteeism

Culture	Management system	Exposure	End point
Values	Education/training	Behaviour	Incidents
Vision	Practices	Conditions	
Goals	Programme	Plant and equipment	
Mission	Site layout	Facilities	
Assumptions	Behavioural consequences		
Purpose	Priorities		
	Attitude		
	Measurement system		
	Improvement model		
	Resources		

Figure 1 Incidents are downstream (adapted from Krause 1993)

Figure 1 indicates that H&S culture occurs upstream of and influences management system, which in turn occurs upstream of and influences exposure, which precedes all incidents (Krause 1993)

- lower compensation costs, and
- increase efficiency

However, some authors are more specific and cite percentage increases and decreases, inter alia Bentil (1992), who cites findings by Du Pont Safety Services which indicate that construction firms that make H&S a priority can reduce lost workday accidents by an average of 37 % in the first year and between 10 % and 20 % in each subsequent year.

According to Korman (Bentil 1992) a panel erector who developed a formal H&S programme was able to reduce its workers' compensation claims from US\$800 000 a year to US\$56 000 in 1989. Another contractor who had no formal H&S programme in 1986 paid workers' compensation claims in excess of US\$500 000 after working nearly 600 000 person hours. In 1987, after hiring a full-time H&S director and implementing a formal H&S programme, their claims were reduced to US\$300 000 after working nearly 700 000 worker hours. By 1988 the amount of claims had been reduced to less than US\$115 000 after working nearly 600 000 worker hours and by mid-1989 claim amounts had been reduced to less than US\$50 000 after working over 600 000 worker hours. That is, over a period of 3½ years they reduced their claims by 90 %.

The relevance of the qualitative benefits of H&S to designers is the positive indirect impact thereof on overall project performance. Reduced absenteeism and increased efficiency positively impact on project time. Lower compensation insurance costs reduce the labour 'overhead'.

H&S culture

Culture is collectively made up of values, vision, goals, mission, assumptions, and purpose (Smallwood 2002a). Top H&S performance must be accepted as an achievable goal to realise an optimum H&S culture. Goals must be set at a high level. If an organisation sets goals at a low level they will probably attain such goals. Achieving the industry norm or marginally better is also unlikely to be of much comfort. 'Zero accidents' is a goal worth pursuing. Such a goal requires belief in the achievement thereof, and the US Construction Industry Institute maintains that adopting such a goal constitutes a 'significant H&S paradigm

shift', when accompanied by top-down commitment (Hinze 1997).

However, awareness is a prerequisite for the development of an optimum H&S culture, and H&S education and training in turn, are a prerequisite for an appropriate level of awareness relative to H&S. Given the extent to which construction H&S is addressed in civil engineering programmes, as cited in the section 'Status of tertiary built environment H&S education' below, then the level of H&S awareness is unlikely to be optimum and so, too, the H&S culture. Furthermore, H&S education and training influence perceptions relative to, inter alia, the importance of H&S, and therefore the constituents of H&S culture – the view of H&S as a value, the vision of a fatality, injury, and disease free workplace, the goal of zero incidents, the mission to continually improve H&S, the assumption that dedicating resources to H&S will result in benefits, and the higher-level purpose of H&S being the sustainability of the organisation vis-à-vis the prevention of fatalities, injuries and disease.

Multi-stakeholder contributions

Clients, project managers (PMs) and designers influence H&S and quality directly and indirectly (Smallwood 2000b).

General design, type of structural frame, plan configuration, details, specification of materials, method of fixing, and constructability in general, directly influence H&S and quality, to varying degrees. Site coverage, project duration, type of procurement system, contract documentation, pre-qualification of contractors, and reference to H&S during site handover, meetings, inspections and discussions, indirectly influence H&S and quality, to varying degrees.

Given that designers influence H&S directly and indirectly, they need to be aware of such influence and to be able to contribute. However, a prerequisite for such awareness and contributions is appropriate tertiary built environment education, which should include construction H&S.

Client and designer responsibilities in terms of the Construction Regulations

Clients are required to (Republic of South Africa 2003):

- prepare and provide the principal contractor (PC) with an H&S specification
- provide the PC with any information that may affect H&S
- appoint each PC in writing
- ensure that the PC implements and maintains an H&S plan (conduct audits at least monthly)
- stop work not in accordance with the H&S plan
- provide sufficient H&S information when changes are made to design and construction
- ensure that every PC has workers' compensation insurance cover
- ensure that PCs have made provision for the cost of H&S in their tenders
- discuss the contents and approve the H&S plan
- ensure that a copy of the H&S plan is available, and
- appoint a PC that is competent and has the resources

However, clients may appoint an agent in terms of the responsibilities, but the agent must be competent and have the resources.

Relative to structures, designers are required to (Republic of South Africa 2003):

- provide clients with all relevant information that may affect the pricing of the work
- inform PCs of any dangers or hazards and provide information for the safe construction of the design
- include a geo-science technical report, the design loading of the structure, and the methods and sequence of construction in a report made available to the PC
- modify the design or make use of substitute materials where the design necessitates the use of dangerous structural or other procedures, or materials hazardous to H&S
- consider H&S during maintenance subsequent to the completion of the project
- conduct inspections to ensure conformance of construction to design
- stop construction work not in accordance with design
- conduct a final inspection and issue a completion certificate, and
- minimise ergonomic hazards during commissioning and other phases

Many of the client responsibilities, such as the preparation and provision of an H&S specification and the provision of information that may affect H&S, require designer input. Therefore, the client and designer responsibilities require designers to possess certain surface competencies in the form of knowledge and skills, a prerequisite for which is H&S education and training.

Status of tertiary built environment H&S education

Research undertaken to investigate the extent to which construction H&S is addressed in tertiary built environment programmes in South Africa determined that construction management programmes placed the most emphasis on construction H&S, followed by quantity surveying. Approximately half of civil engineering programmes included construction H&S, and the minority of architectural programmes did (Smallwood 2002b; Smallwood 2002c; Smallwood 2002d).

The issue is that H&S education and training is a prerequisite for an appropriate level of awareness relative to H&S, which in turn

Table 2 Respondents' stakeholder group

Stakeholder	(%)
Architect	1,3
Contractor	1,3
Engineer	89,0
Insurer	0,0
Project manager	1,3
Private sector client	0,0
Public sector client	4,5
Quantity surveyor	0,6
Other	0,6

Table 3 Source of awareness of Construction Regulations

Source	(%)
Industry magazines	17,6
Newspaper(s)	5,9
Notification by association	47,1
Practice note(s)	15,0
Seminar notification	12,4
Upon promulgation	8,5
Other	11,8

Table 4 Extent to which stakeholders can contribute to H&S, according to respondents

Stakeholders	Response (%)							Mean score	Rank	
	Unsure	Nil	Minor							Major
			1	2	3	4	5			
Contractors	0,7	0,0	0,7	0,0	4,7	13,3	80,7	4,74	1	
Project managers	0,0	0,0	2,6	4,0	20,5	27,8	45,0	4,09	2	
Engineers	0,7	0,0	1,3	3,3	22,9	33,3	38,6	4,05	3	
Clients	0,7	0,7	3,3	8,0	19,3	23,3	44,7	3,99	4	
Architects	5,4	0,7	4,7	10,1	22,1	30,9	26,2	3,68	5	
Quantity surveyors	2,7	4,0	17,3	22,7	28,7	14,0	10,7	2,76	6	

is a prerequisite for the development of an optimum H&S culture.

Quality assurance and management

Assurance does not mean guarantee, but rather that clients, customers, and suppliers can be confident that quality will be realised. Confidence in turn results from consistency. Given that people are not similar in terms of personality traits, personal goals, philosophy and culture, they require systems to enable them to be consistent and achieve standards first time every time. Consistency can only result from a documented quality management system (QMS), which effectively integrates quality assurance (QA), quality control (QC) and quality improvement (QI) (Smallwood 2000a).

Krause (1993) argues that quality and H&S are 'two sides of the same coin'. Crosby (1987) defines quality as 'conformance to requirements'. Project requirements are generic and include H&S - the Construction Regulations have scheduled a range of specific H&S requirements relative to both clients and designers. Consequently, within the context of H&S, designers are required to contribute either as designers per se, or as client-appointed H&S agents. The four absolutes of quality according to Crosby (1987) provide further insight to the relevance of quality to H&S. The relevance of the definition of 'conformance to requirements' to H&S is obvious, as H&S legislation, standards, and organisation policy and rules, constitute requirements. The system of prevention relative to quality is logical in that the traditional system of appraisal invariably results in rework. Within the context of H&S, 'prevention' is logical in that a fatality or permanent disablement cannot be reversed. The quality performance standard of 'zero defects' is relevant as the appropriate H&S performance standard of 'zero incidents' is logical, in that the outcome of incidents is largely fortuitous - they could be minor, moderate, major, or catastrophic. Crosby advocates

a measurement system in the form of the cost of non-conformance (CONC), as the CONC represents a financial measure and can be related to monthly and annual business volume and profitability. Similarly, the COA can be related to monthly and annual business volume and profitability.

RESEARCH

Sample stratum and response

The sample stratum consisted of 252 delegates attending four seminars presented by the authors in association with the South African Association of Consulting Engineers (SAACE). A survey questionnaire was circulated at the inception of each of the one-day seminars to avoid any possible influence of the respondents' responses as a result of the seminar contents. Two hundred and one questionnaires were included in the analysis of the data, which equates to a response rate of 79,8 %.

Analysis

The analysis of the data consisted of the calculation of descriptive statistics to depict the frequency distribution and central tendency of responses to fixed response questions to determine the degree of concurrence relative to a range of statements.

Findings

Table 2 indicates the stakeholder constituency of the respondents. Given that the seminars were undertaken in association with SAACE, the prevalence of engineers among the delegates is to be expected.

Table 3 indicates the respondents' source of awareness of the Construction Regulations. Given that the Construction Regulations were promulgated on the 18 July 2003 and the first seminar was presented on 9 February, the findings are significant - only 8,5 % of respondents became aware of the Construction Regulations upon promulgation, which reflects on the effectiveness of the *Government Gazette*

as a medium for announcing new or amended legislation. It is notable that 12,4 % became aware upon notification of the seminar, 47,1 % upon notification by association, and 15 % by practice notes. The percentage responses relative to the latter two sources amplify the role of SAACE and similar associations.

Table 4 indicates the extent to which various stakeholders can contribute to H&S according to respondents in terms of percentage responses to a range of 1 (minor) to 5 (major), and in terms of a mean score ranging between 1 and 5. With the exception of quantity surveyors (2,76), the mean scores are all above the midpoint score of 3,00, which indicates that all stakeholders are perceived to be able to contribute to H&S. It is notable that the mean score for contractors falls within the upper category of $> 4,20 \leq 5,00$, which indicates that they are deemed to be able to make between a near major to major contribution / major contribution. Given that the mean scores for project managers, engineers, clients and architects are $> 3,40 \leq 4,20$, they can be deemed to be able to make between a contribution to near major contribution / near major contribution.

Given that engineers and architects are both designers, it is notable that the respondents perceive engineers as being able to contribute more than architects.

Table 5 indicates the extent to which various stakeholders concur with various statements in terms of percentage responses to a range 'strongly disagree' to 'strongly agree', and in terms of a mean score ranging between 1 and 5. It is notable that the mean scores are all above the midpoint score of 3,00, which indicates that in general the stakeholders can be deemed to concur with the various statements. Given that the mean scores for the first three statements are $> 4,20 \leq 5,00$, concurrence can be deemed to be between agree to strongly agree / strongly agree. The highest level of concurrence is relative to 'Accidents contribute to the cost of construction'. This is notable, as enlightened built environment practitioners often use the contribution of accidents to the cost of construction as a motivation for H&S. It is also notable that 'The implementation of QMSs would complement / improve construction H&S' ranked second, is ranked above 'The implementation of QMSs would complement / improve construction'.

Given that the mean scores for the statements ranked third to seventh fall within the category $> 3,40 \leq 4,20$, concurrence can be deemed to be between neutral to agree / agree - the eighth ranked 'All accidents can be prevented' fell marginally outside this range. Further, given that the mean scores for the statements ranked seventh to tenth fall within the category $> 2,60 \leq 3,40$, discordance can be deemed to be between disagree to neutral/neutral. Although the mean score for all accidents can be prevented is above the midpoint score of 3,0, it is notable that 4,5 % of respondents strongly disagree, 31,2 % disagree and 9,1 % are neutral - notable in that this response indicates acceptance that 'accidents are part of the construction process'.

Table 6 indicates the importance of seven parameters in terms of percentage responses to a range of 1 (not important) to 5 (very important), and in terms of a mean score

Table 5 Degree of concurrence with various statements

Statement	Response (%)					Mean score	Rank
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree		
Accidents contribute to the cost of construction	0,0	0,7	2,0	51,0	46,3	4,43	1
The implementation of quality management systems (QMSs) would complement/improve construction H&S	0,0	0,7	2,0	63,2	34,2	4,31	2
The implementation of quality management systems (QMSs) would complement/improve construction	0,0	1,3	2,0	63,8	32,9	4,28	3
The implementation of quality management systems (QMSs) would complement/improve design	0,0	3,9	11,1	59,5	25,5	4,07	4=
Designer tertiary education does not adequately address construction H&S	0,0	0,0	16,1	60,4	23,5	4,07	4=
The construction industry has a poor H&S culture	0,0	9,6	16,4	52,7	21,2	3,86	6
There has been an increase in the number of major accidents over the last ten years relative to prior years	2,0	10,5	28,3	47,4	11,8	3,57	7
The separation of the design and construction processes marginalises construction H&S	3,4	18,1	27,5	40,9	10,1	3,36	8
The separation of the design and construction processes marginalises overall project performance	4,0	20,1	24,8	45,0	6,0	3,29	9
All accidents can be prevented	4,5	31,2	9,1	43,5	11,7	3,27	10

Table 6 Degree of importance of various parameters to respondents' organisations

Parameter	Response (%)					Mean score	Rank	
	Unsure	Not important			Very important			
		1	2	3				4
Client satisfaction	0,7	0,0	0,0	0,7	16,0	82,7	4,83	1
Quality	0,0	0,0	0,0	2,6	19,7	77,6	4,75	2
Cost	0,0	0,0	0,0	9,2	49,3	41,4	4,32	3
Time	0,7	0,0	0,7	11,9	43,0	43,7	4,31	4
Productivity	0,7	0,0	0,0	11,3	47,0	41,1	4,30	5
Environment	0,0	0,0	3,3	28,9	39,5	28,3	3,93	6
H&S	0,0	1,0	5,1	30,3	39,4	24,2	3,81	7

Table 7 Extent to which inadequate H&S negatively affects project parameters

Parameter	Response (%)						Mean score	Rank	
	Unsure	Nil	Minor			Major			
			1	2	3				4
Productivity	4,0	0,0	0,7	6,0	24,2	40,9	24,2	3,85	1
Time	2,0	0,7	2,0	4,6	25,8	40,4	24,5	3,83	2
Client satisfaction	4,6	0,7	2,0	11,3	21,9	32,5	27,2	3,76	3
Cost	2,6	0,0	3,3	6,6	27,2	36,4	23,8	3,73	4
Quality	2,0	0,7	3,3	11,3	26,7	36,0	20,0	3,60	5
Environment	4,0	0,7	2,7	11,3	41,3	28,0	12,0	3,37	6

ranging between 1 and 5. It is notable that the mean scores are all above the midpoint score of 3,00, which indicates that in general the respondents can be deemed to perceive the parameters as important. However, given that the mean scores for the top five parameters are > 4,20 ≤ 5,00, the respondents can be deemed to perceive them to be between

more than important to very important / very important. Given that the mean scores for the environment and H&S are > 3,40 ≤ 4,20, the respondents can be deemed to perceive them to be between important to more than important / more than important. Furthermore, it is significant that the subject of the study, H&S, is ranked last, with a mean score 1,02

Table 8 Perceived extent to which the Construction Regulations will contribute to an improvement in H&S

Improvement	(%)
Unsure	19,3
Nil	0,0
Minor	1,3
Near minor	3,3
Improvement	14,7
Near major	34,0
Major	27,3
Mean score	4,02

below the first ranked client satisfaction mean score 4,83. These findings correlate with those emanating from a study conducted among member practices of SAACE – project H&S was ranked fifth in terms of the importance of five project parameters (Smallwood 2004b). The importance of H&S in that study was presented in the form of an importance index (II) range with a minimum value of 0,0 and a maximum value of 4,0. The II value for H&S of 2,97 equates to 74,3 % of maximum importance, and the mean score for H&S of 3,81 presented in table 6 equates to 70,3 %.

Table 7 indicates the extent to which inadequate H&S negatively affects project parameters in terms of percentage responses to 'Nil' and a range of 1 (minor extent) to 5 (major extent), and in terms of a mean score ranging between 1 and 5. It is notable that the mean scores are all above the midpoint score of 3,00, which indicates that in general the respondents deem inadequate H&S to negatively affect the various parameters, which correlates with the findings of numerous international studies. However, given that the mean scores for the top five parameters are > 3,40 ≤ 4,20, the respondents can be deemed to perceive the effect to be between some extent to near major / near major extent – the environment falls just outside this category.

Table 8 indicates the perceived extent to which the Construction Regulations will contribute to an improvement in H&S. Given that the mean score is above the midpoint score of 3,0, the Construction Regulations are perceived as being able to contribute to an improvement. The actual score of 4,02 indicates that the perceived extent is between a contribution to near major contribution / near major contribution. This finding indicates that the respondents appreciate the intended enabling role of the Construction Regulations.

SUMMARY AND CONCLUSIONS

Introduction

Given that the findings arose from voluntary seminars attended by predominantly engineers, the sample stratum is best described as a convenience sample. Furthermore, it should be stated that the findings could be deemed to be biased as the seminar delegates are likely to constitute the more committed. However, given this qualification it is also argued that in general relative to the stated responses, the actual situation may be less healthy: the various stakeholders may be perceived as being likely to make a lesser contribution to H&S; H&S may be less important; inadequate H&S may be perceived to have a lesser negative

effect on other project parameters, and the Construction Regulations are perceived as being likely to make a lesser contribution to an improvement in H&S.

General

The sources contributing to the awareness of the Construction Regulations indicate that all stakeholders contribute to the informing of industry stakeholders regarding new legislation. However, the government medium of the *Government Gazette* can be concluded to be ineffective. Furthermore, given the percentage responses relative to 'notification by association', SAACE can be concluded to contribute substantially to such informing.

The recognition that all stakeholders can contribute to H&S, the degree of concurrence relative to a range of statements, the perceived importance of H&S (least) relative to the traditional project parameters of cost, quality and time, and the perceived extent to which the Construction Regulations will contribute to an improvement in Construction Regulations, underscore the need for the promulgation of the Construction Regulations.

The extent to which various project stakeholders can contribute to construction H&S

The perception that all stakeholders can contribute to construction H&S indicates that the respondents understand and appreciate the multi-stakeholder nature of H&S. Furthermore, such a perception is important as people act or do not act, based upon perceptions.

The importance of various project parameters

With the exception of client satisfaction, the descriptive survey reflects the findings of literature, namely that quality, cost and time are the 'most important' parameters. Although H&S is perceived to be between more than important to very important / very important, it is concluded that the traditional project parameters (cost, quality and time) are more important than H&S.

The extent to which inadequate H&S negatively affects the various project parameters

The mean scores relative to the various project parameters indicate that respondents understand and appreciate the impact of inadequate H&S.

The extent to which the Construction Regulations will contribute to an improvement in H&S

The perceived contribution by the Construction Regulations to an improvement in H&S indicates that there was and is a need to improve H&S, and also for the Regulations.

H&S culture, and practices complementary to, or which marginalise H&S

The level of concurrence relative to various statements confirms the findings of the literature survey. Therefore it can be concluded that accidents marginalise overall project performance; there is a need to improve design, construction and H&S; QMSs have a role to

play relative to the improvement of design, construction and H&S; designer tertiary education is inadequate; the separation of design and construction marginalises H&S and overall project performance, and the industry has a poor H&S culture.

RECOMMENDATIONS

Although it is accepted practice that practitioners must ensure that they acquaint themselves with new legislation, the finding that only 8,5 % of respondents became aware of the Construction Regulations upon promulgation indicates that the government needs to review the media used to inform stakeholders regarding new legislation, that is, the publication of such legislation in *Government Gazettes*.

The extent to which various project stakeholders can contribute to construction H&S

The perceived potential contribution by engineers to construction H&S needs to be capitalised upon by industry stakeholders. SAACE and SAICE have a major potential facilitating role to play in providing CPD, and along with the Engineering Council of South Africa (ECSA), engendering the appropriate level of attention to construction H&S in tertiary education.

The importance of various project parameters

Engineers need to elevate the status of construction H&S to equal, or exceed that afforded to the traditional project parameters of cost, quality and time. However, a prerequisite for such elevation is awareness or enhanced awareness of the importance of and role of construction H&S in terms of the synergy between H&S and the other project parameters. Awareness or enhanced awareness in turn will require interventions such as optimum tertiary education and CPD in terms of construction H&S.

The extent to which inadequate H&S negatively affects the various project parameters

Engineers need to endeavour to quantify the synergistic role of construction H&S. This is important as they invariably make a major contribution to projects and / or often fulfil the function of principal agent, and consequently can communicate the synergistic role of H&S. This recommendation further reinforces the need for optimum tertiary education and CPD in terms of construction H&S.

The extent to which the Construction Regulations will contribute to an improvement in H&S

Given the perceived contribution by the Construction Regulations to an improvement in H&S, it is imperative that construction H&S, and more specifically the Construction Regulations, are included in tertiary education and CPD.

H&S culture, and practices complementary to, or which marginalise H&S

The degree of concurrence relative to various statements amplifies the need for the

following: endeavours to enhance the H&S culture of the industry such as those directed towards engendering the realisation that all accidents can be prevented; the motivation for H&S based upon inter alia, the cost of construction; the implementation of QMSs during design and construction; the inclusion of construction H&S in designer tertiary education, and the integration of design and construction through procurement systems such as design-build.

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