THE INFLUENCE OF CLIENTS ON CONTRACTOR HEALTH AND SAFETY (H&S)

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Clients influence contractor H&S directly and indirectly. Choice of structural frame and selection of materials, and provision of finance and incentives, constitute direct means of influence. Appointment of designers, decision regarding contract duration, pre-qualification of contractors, contract documentation, and contractor required reporting on H&S, constitute indirect means of influence. However, the degree to which clients influence contractor H&S depends upon the status of H&S in their organisations. Inadequate H&S negatively affects cost, productivity, quality, schedule, environment and client satisfaction. Conversely, benefits of client consideration for and involvement in contractor H&S resulting in enhanced H&S accrue to both clients and contractors. Traditionally, world wide, petro-chemical organisations have maintained rigorous contractor H&S management programmes. Given this, a study was initiated to investigate the influence of a Shell's H&S requirements on contractors' H&S performance while undertaking the construction of service stations. Selected findings emanating from a survey of contractors include: H&S is perceived to be more important to Shell than other project parameters; the positive impact of Shell's project H&S requirements manifests itself in a number of ways; and a range of procurement, design and construction related interventions can contribute to an improvement in construction H&S.

Keywords: client influence, petro-chemical, contractor health and safety, benefits

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. Furthermore, the Construction Regulations promulgated on the 18 July 2003 in South Africa has effectively resulted in client responsibility for construction H&S.

Given the completion of a previous client influence on contractor H&S study in South Africa in 1998 and the involvement of the author in Shell Construction and Project's H&S related endeavours a study was conducted among inter alia, Shell's contractors to determine the:

- perceived importance of various project parameters to Shell and themselves;
- influence of Shell on their H&S performance, if any, and if so, the benefits thereof;
- extent to which inadequate or the lack of H&S negatively affects the various project parameters;

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- perceived status and source of their H&S knowledge, and needs relative thereto;
- potential contribution by various stakeholders to an improvement in construction H&S on Shell projects, and
- potential contribution by various aspects / actions to an improvement in construction H&S on Shell projects.

LITERATURE SURVEY

Statistics

During 1998, the latest year for which occupational injury statistics are available, a total of 15 795 medical aid cases, 6 901 temporary total disablements, 535 permanent disablements, and 143 fatalities were reported to the Compensation Commissioner in South Africa (2003). Based upon approximately 230 working - days per year, this is the equivalent of 68.67, 30.00, 2.33, and 0.62 respectively, per working day. The disabling injury incidence rate (DIIR) 1.31 means that 1.31 workers per 100 incurred disabling injuries. The number of fatalities among the workers insured by the Accident Fund (AF) is the equivalent of a fatality rate of 37.2 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 1.6 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 3.2 working days per worker during 1998. This is equivalent to 1.4% of working time.

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, 2000).

Research conducted in the United States of America indicates the total cost of accidents to constitute, inter alia, 6.5% of the value of completed construction (The Business Roundtable, 1995) and in the United Kingdom 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:

- R 200.1m + (R 200.1m x 11) = R 2 401.2m, and
- R 200.1m + (R 200.1m x 14.2) = R 3 041.5m

Further, based upon the value of construction work completed in the year 2002, namely R 56 343m (South African Reserve Bank, 2003) the total COA could have

been between 4.3% (R 2 401.2m / R 56 343m), and 5.4% (R 3 041.5m / R 56 343m) (Smallwood, 2004). The key issue relative to the COA is that ultimately, clients incur the COA as the COA is included in contractors' cost structures.

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 total quality management (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%).

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.

Construction Regulations

Clients are required to:

- Prepare and provide the Principal Contractor (PC) with H&S specifications;
- Provide the PC with any information that may affect H&S;
- Appoint each PC in writing;
- Ensure that the PC implements and maintains 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.

Role of clients

According to The Business Roundtable (1995) construction H&S can be successfully influenced by clients, however, clients have a legal and moral responsibility to, inter alia, warn contractors of any non-apparent hazards present on the site and to make sure contractors recognise and meet their contractual responsibility to work in a healthy and safe manner.

Importance of client involvement

Jeffrey and Douglas (1994) maintain clients play a critical role in construction H&S. H&S is complementary to clients' cost, quality and schedule requirements and therefore successful projects tend to be healthy & safe projects. The briefing of the

design team by the client is a critical phase in ensuring project H&S as deviations from the initial brief at a later date can be the catalyst that triggers a series of events from designer through to operatives that culminates in a site accident.

Client actions

The Business Roundtable (1995) recommends that clients take, inter alia, the following actions: become committed to H&S; support contractors' H&S efforts financially; include H&S as a criteria for pre-qualification; schedule H&S requirements prior to the bidding process; structure documentation to ensure equitable provision for H&S by contractors; require a formal H&S programme, the use of permit systems for potentially hazardous activities, the designation of a contractor H&S co-ordinator, and reporting and investigation of accidents; conduct H&S audits during construction, and adopt a partnering approach.

Benefits of client involvement

According to The Business Roundtable (1995) the benefits of client involvement are: lower construction costs; quality work; improved productivity; completion on schedule; reduced exposure to bad publicity resulting from accidents, and minimal disruption of the client's employees and facilities where work is in progress on existing premises.

The effect of client involvement

According to the Business Roundtable (1995) a study conducted by Stanford University determined that client involvement in contractor H&S resulted in contractors achieving accident rates below the industry average. This was concluded from the study that entailed dividing the clients into groups according to contractor accident rates, either below or above the industry average. The findings are summarised in Table 1.

Table 1: Nature and effect of client involvement in contractor H&S (The Business Roundtable, 1995).

Client H&S action	Frequency of client action / Contractor accident rate (%)	
	<Industry average	>Industry average
Require contractors to obtain work permits	100,0	0,0
Pre-qualified contractors	100,0	50,0
Conducted formal site inspections	100,0	0,0
Audit contractors	60,0	0,0
Use goal setting	100,0	15,0
Maintain contractor statistics	75,0	<40,0
Maintain a construction department	75,0	33,3
Stress H&S during pre-bid activities & site visits	66,6	33,3
Train contractors' supervisors & workers	>50,0	10,0

The benefits of client involvement

The Business Roundtable (1995) maintains the benefits of client involvement are: lower construction costs; quality work; improved productivity; completion on schedule; reduced exposure to bad publicity resulting from accidents, and minimal disruption of the client's employees and facilities where work is in progress on existing premises.

RESEARCH

Sample stratum and response

The sample stratum was comprised of fifty-five Shell contractors surveyed by means of a postal survey mailed by the researcher. Respondents were required to return the

survey questionnaires directly to the researcher – thirteen responses were received and included in the analysis if the data, which equates to a response rate of 23.6%.

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 importance of various parameters; potential contribution by various stakeholders and aspects / actions; extent of impact, contribution and need, and to rate various issues.

Findings

Table 2 indicates the importance of five parameters to Shell as perceived by contractors in terms of percentage responses to a range of 1 (not important) to 5 (very important), 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 can be deemed to perceive all the parameters as important to Shell. However, given that the mean scores for the top four parameters are $> 4.20 \leq 5.00$, the respondents can be deemed to perceive them to be between more than important to more than important / very important to Shell. Given that the mean score for schedule (time) is $> 3.40 \leq 4.20$, the respondents can be deemed to perceive it to be between important to more than important / more than important to Shell.

Table 2: Importance of project parameters to Shell as perceived by contractors.

Parameter	Response (%)						Mean score	Rank
	Unsure	Not ….…. Very						
		1	2	3	4	5		
Project health and safety	0.0	0.0	0.0	0.0	7.7	92.3	4.92	1=
Public health and safety	0.0	0.0	0.0	0.0	7.7	92.3	4.92	1=
Project quality	0.0	0.0	0.0	7.7	7.7	84.6	4.77	3
Cost	0.0	7.7	0.0	7.7	15.4	69.2	4.38	4
Schedule (Time)	0.0	0.0	0.0	38.5	15.4	46.2	4.08	5

Table 3 indicates the importance of the five parameters to contractors in terms of percentage responses to a range of 1 (not important) to 5 (very important), 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 can be deemed to perceive all the parameters as important. However, given that the mean scores for the three joint first-ranked parameters are $> 4.20 \leq 5.00$, the respondents can be deemed to perceive them to be between more than important to more than important / very important. Given that the mean score for schedule (time) and cost are $> 3.40 \leq 4.20$, the respondents can be deemed to perceive them to be between important to more than important / more than important.

Table 3: Importance of project parameters to contractors.

Parameter	Response (%)						Mean score	Rank
	Unsure	Not ….…. Very						
		1	2	3	4	5		
Project health and safety	0.0	0.0	0.0	0.0	0.0	92.3	4.62	1=
Public health and safety	0.0	0.0	0.0	0.0	0.0	92.3	4.62	1=
Project quality	0.0	0.0	0.0	0.0	0.0	92.3	4.62	1=
Schedule (Time)	0.0	0.0	0.0	23.1	7.7	61.5	4.08	4
Cost	0.0	7.7	7.7	7.7	0.0	69.2	3.92	5

The respondents were required to rate their H&S on a scale of very poor to very good using average as the industry benchmark. 92.4% of contractors rate themselves better than the industry – average (7.7%), good (46.2%), and very good (46.2%).

Respondents were also required to rate themselves in terms of their knowledge of H&S on a scale of minimal to substantial. 92.3% rate themselves above average – average (7.7%), above average (53.8%), and substantial (38.5%).

Table 4 indicates that the majority of respondents identified experience in terms of the source of H&S knowledge, followed by workshops. The remaining sources were identified by less than 50% of respondents.

Table 4: Source of H&S knowledge.

Source	**%**
Experience	69.2
Workshops	61.5
Conference papers	46.2
CPD seminars	30.8
Other	30.8
Tertiary education	23.1
Practice notes	15.4
Journal papers	7.7
Postgraduate qualifications	7.7
Magazine articles	0.0

Table 5 indicates the extent of impact of Shell's H&S requirements on respondents' shell project and organization H&S performance 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. It is notable that the impact on respondents' organization H&S performance was ranked joint first with shell project H&S performance.

Table 5: Extent of impact of Shell's H&S requirements on contractors' H&S performance.

Scope of impact	Response (%)						Mean score	Rank
	Unsure	Minor…… Major						
		1	2	3	4	5		
Shell project	0.0	0.0	7.7	30.8	23.1	30.8	3.83	1=
Organisation	0.0	7.7	7.7	7.7	38.5	30.8	3.83	1=

Improved housekeeping predominates in terms of the manifestation of the impact of Shell's H&S requirements on contractors' performance (Table 6). The other manifestations were identified by less than 50 % of respondents. However, between a third and half of respondents identified increased client satisfaction, enhanced environment, and increased productivity.

Table 6: Manifestation of the impact of Shell's H&S requirements on contractors' performance.

Manifestation	**%**
Improved housekeeping	53.8
Increased client satisfaction	46.2
Enhanced environment	38.5
Increased productivity	38.5
Reduced cost	15.4
Less rework	15.4
Less hassles	15.4
Enhanced schedule	7.7
Other	7.7

Table 7 indicates that quality predominates among project parameters negatively affected by inadequate or the lack of H&S.

Table 7: Negative effect of inadequate or the lack of H&S on project parameters.

Parameter	**%**
Quality	46.2
Client satisfaction	38.5
Environment	38.5
Schedule	30.8
Cost of construction	23.1
Productivity	23.1
Other	7.7
None	7.7

Table 8 indicates the potential contribution by various stakeholders to an improvement in construction H&S on Shell projects in terms of percentage responses to 'No' and a range of 1 (minor) to 5 (major), and in terms of a mean score ranging between 1 and 5. It is notable that with the exception of quantity surveyors the mean scores are all above the midpoint score of 3.00, which indicates that all the various stakeholders are deemed to have the potential to contribute to an improvement in construction H&S on Shell projects. It is notable that general contractors predominate. Furthermore, they are the only stakeholder with a mean score > 4.20 ≤ 5.00, which indicates that they are deemed to have the potential to make between a near major to near major / major contribution. Mean scores > 3.40 ≤ 4.20, indicate that the stakeholders, namely project managers, subcontractors, and architectural designers, are deemed to have the potential to make between a contribution to contribution / near major contribution – engineering designers fall on the cut point, namely 3.40. Mean scores > 2.60 ≤ 3.40 indicate that the stakeholders are deemed to have the potential to make between a near minor to near minor / contribution to an improvement. Given that the mean score for quantity surveyors is > 1.80 ≤ 2.60 they can be deemed to have the potential to make between a minor to minor / near minor contribution to an improvement.

Table 8: Potential contribution by various stakeholders to an improvement in construction H&S on Shell projects.

Stakeholder	Response (%)							Mean score	Rank
	Unsure	No	Minor ……...…….. Major						
			1	2	3	4	5		
General contractors	15.4	0.0	0.0	0.0	23.1	15.4	46.2	4.27	1
Project managers	15.4	0.0	0.0	7.7	30.8	7.7	38.5	3.91	2
Subcontractors	15.4	0.0	7.7	15.4	15.4	0.0	46.2	3.73	3
Architectural designers	15.4	15.4	7.7	0.0	0.0	23.1	38.5	3.45	4
Engineering designers	16.7	15.4	8.3	0.0	0.0	16.7	41.7	3.40	5
Manufacturers / Suppliers	15.4	15.4	0.0	7.7	15.4	15.4	30.8	3.27	6
Client (Shell)	15.4	7.7	0.0	7.7	46.2	0.0	23.1	3.18	7
Quantity Surveyors	15.4	23.1	7.7	7.7	15.4	15.4	15.4	2.45	8

Table 9 indicates the extent to which various aspects / actions can contribute to an improvement in construction H&S on Shell projects in terms of percentage responses to 'No' and a range of 1 (minor) to 5 (major), and in terms of a mean score ranging between 1 and 5. It is notable that with the exception of partnering all the mean scores are above the midpoint score of 3.00, which indicates that in general the aspects / actions are deemed to have the potential to contribute. It is notable that the top five ranked aspects / actions have a mean score > 4.20 ≤ 5.00, which indicates that they are deemed to have the potential to make between a near major to near major / major contribution. These include a project specific plan for quality and H&S, integration of design and construction in terms of H&S, and pre-qualification of contractors on quality and H&S. Mean scores > 3.40 ≤ 4.20, indicate that the aspects / actions ranked sixth to twelfth are deemed to have the potential to make between a contribution to contribution / near major contribution. These include contractor programming. Quality Management System during design and during construction, contractor H&S programme, prioritization / consideration by designers, Environmental Management System, and constructability reviews by designers. Mean scores > 2.60 ≤ 3.40 indicate that the aspects / actions ranked thirteenth to joint fifteenth are deemed to have the potential to make between a near minor to near minor / contribution to an improvement. These include client actions / contributions, optimum project schedule (time), choice of procurement system, and contract documentation. It is notable that 30.8% of respondents were unsure relative to the potential contribution of partnering. However, given that the mean score for partnering is > 1.80 ≤ 2.60 it can be deemed to have the potential to make between a minor to minor / near minor contribution to an improvement.

Table 9: Extent to which various aspects / actions can contribute to an improvement in construction H&S on Shell projects.

Aspect / Action	Response (%)							Mean score	Rank
	Unsure	No	Minor …… Major						
			1	2	3	4	5		
Project specific plan for quality	15.4	0.0	0.0	7.7	0.0	15.4	61.5	4.55	1
Integration of design and construction in terms of H&S	15.4	0.0	0.0	7.7	0.0	23.1	53.8	4.45	2=
Pre-qualification of contractors on quality	15.4	0.0	7.7	0.0	0.0	15.4	61.5	4.45	2=
Pre-qualification of contractors on H&S	15.4	0.0	7.7	0.0	0.0	23.1	53.8	4.36	4=
Project specific plan for H&S	15.4	0.0	7.7	0.0	7.7	7.7	61.5	4.36	4=
Contractor programming	15.4	0.0	0.0	0.0	23.1	30.8	30.8	4.09	6
Quality Management System (QMS) during design	15.4	0.0	7.7	7.7	7.7	15.4	46.2	4.00	7=
Quality Management System (QMS) during construction	15.4	0.0	0.0	23.1	0.0	15.4	46.2	4.00	7=
Contractor H&S programme	15.4	0.0	7.7	7.7	15.4	7.7	46.2	3.91	9
Prioritisation / consideration by designers	23.1	0.0	0.0	7.7	23.1	23.1	23.1	3.80	10
Environmental Management System (EMS)	23.1	7.7	0.0	7.7	7.7	23.1	30.8	3.70	11
Constructability reviews by designers	15.4	0.0	7.7	7.7	15.4	30.8	23.1	3.64	12
Client actions / contributions	15.4	0.0	7.7	7.7	30.8	23.1	15.4	3.36	13
Optimum project schedule (time)	16.7	7.7	0.0	16.7	16.7	25.0	16.7	3.20	14
Choice of procurement system	23.1	7.7	7.7	0.0	30.8	15.4	15.4	3.10	15=
Contract documentation	23.1	0.0	15.4	23.1	7.7	0.0	30.8	3.10	15=
Partnering	30.8	7.7	15.4	15.4	23.1	7.7	0.0	2.11	17

Table 10 indicates the contractors' need for H&S related continuing professional development / education in terms of percentage responses to 'No' and a range of 1 (minimal) to 5 (substantial), and in terms of a mean score ranging between 1 and 5. The following are notable: the general percentage 'Unsure' response; three of the aspects have mean scores below the midpoint score of 3.00, which indicates that in general the need relative thereto is less than moderate, and no aspects have mean scores > 4.20 ≤ 5.00. Mean scores > 3.40 ≤ 4.20 indicate that the need relative to the aspects can be deemed to be between moderate to moderate / major – the role of engineering designers, general contractors, project managers, and subcontractors. Mean scores > 2.60 ≤ 3.40 indicate that the need relative to the aspects can be deemed to be between fair to moderate / moderate – role of architectural designers and quantity surveyors. Mean scores > 1.80 ≤ 2.60 indicate that the need relative to the aspects can be deemed to be between minimal to fair / fair.

Table 10: Contractors' need for H&S related continuing professional development/education.

Aspect	Response (%)							Mean score	Rank
	Unsure	No	Minimal ……..… Substantial						
			1	2	3	4	5		
Role of engineering designers	25.0	0.0	8.3	8.3	8.3	0.0	50.0	4.00	1=
Role of general contractors	25.0	0.0	8.3	0.0	16.7	8.3	41.7	4.00	1=
Role of project managers	25.0	0.0	16.7	8.3	8.3	0.0	41.7	3.56	3=
Role of subcontractors	25.0	0.0	8.3	8.3	25.0	0.0	33.3	3.56	3=
Role of architectural designers	25.0	7.7	8.3	0.0	25.0	8.3	25.0	3.22	5
Role of quantity surveyors	25.0	7.7	16.7	8.3	0.0	25.0	16.7	2.89	6
Role of clients	25.0	15.4	8.3	8.3	16.7	8.3	16.7	2.56	7
Role of manufacturers/ suppliers	23.1	7.7	8.3	0.0	8.3	16.7	33.3	2.46	8

SUMMARY AND CONCLUSIONS

Contractors perceive project H&S to be more important to Shell than it is to them. Furthermore, both project H&S and public H&S, which are perceived to be equally important to Shell, are perceived to be more important than the other project parameters. Clearly, project H&S and public H&S are the primary Shell project parameters.

Contractors rated themselves higher than the industry in terms of H&S performance and knowledge of H&S. This rating together with the finding that Shell's H&S requirements contributed to an improvement in H&S on both Shell's projects and contractors' projects in general, leads to the conclusion that Shell has influenced their contractors' H&S and H&S performance. Although the percentage responses relative to many of the manifestations of such influence were below 50%, the influence did nevertheless manifest itself. Further, the low percentages may well be attributable to the lack of measurement and quantification of potential benefits.

The finding that experience, followed by workshops, predominates in terms of sources of H&S knowledge leads to the conclusion that H&S knowledge acquisition is informal.

Although quality predominates in terms of the negative effect of inadequate or the lack of H&S on project parameters, such effect is not solely constrained to quality. Consequently, it can be concluded that H&S has a synergistic effect on overall project performance.

With the exception of quantity surveyors all stakeholders are deemed to have the potential to contribute to an improvement in construction H&S on Shell projects. This finding underscores the relevance of the promulgation of the Construction Regulations; in particular, the client and designer related requirements and contributions.

The finding that project specific plan for quality and H&S, integration of design and construction in terms of H&S, and pre-qualification of contractors on quality and H&S predominate in terms of aspects / actions which can contribute to an improvement in construction H&S on Shell projects, also underscores the relevance of the promulgation of the Construction Regulations. In particular, the project specific H&S specification and plan for H&S, and the requirement that clients ensure that the principal contractor has made adequate allowance for H&S.

The role of engineering designers, and general contractors predominate in terms of the contractors' need for H&S related continuing professional development / education. This reinforces the need for holistic construction H&S education.

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