

AN EXPLORATORY STUDY ON THE IMPACT SIGNIFICANCE OF PROJECT STAKEHOLDERS ON CONSTRUCTION PROJECT HEALTH AND SAFETY (H&S)

Innocent Musonda¹ and Theodore Conrad Haupt²

¹ PhD Candidate, University of Johannesburg, Johannesburg, South Africa

² Professor, Mississippi State University, Mississippi State, USA

Correspond to innocentmusonda@gmail.com

ABSTRACT: Health and safety in the construction industry continue to fall behind many industries despite much effort to improve the status. A considerable amount of research has been conducted to try and contribute to addressing the problem of health and safety (H&S) in the construction industry. A number of studies have looked at the role of various construction project stakeholders and their contribution to H&S. However there is no clear identification of the extent to which various stakeholders could contribute and therefore influence the outcome of H&S on construction projects. In view of the above, the current Delphi study went a little bit further and sought to establish the impact significance of construction clients and designers on H&S. This paper will present findings from the study which is the impact significance of clients and designers on H&S consideration throughout the project life cycle.

Keywords: Clients, Contractors, Designers, Health and safety, Impact significance

1.0 INTRODUCTION

The issue of health and safety improvement in the construction industry has received much attention in recent years. This has been in part due to the introduction of major pieces of legislation, coupled with increased personal responsibility of senior managers and organizations for health and safety [1]. The other reasons include a need to develop good or better image of the construction industry [2] and in some ways to address the H&S record which in comparison to many industries is really undesirable. For larger multi-national organizations, the need for H&S improvement could be a corporate social responsibility issue and work at improving their H&S performance [3]

A number of ways to improve and promote H&S performance in the construction industry have been suggested. Some of the suggested methods to improve or manage H&S in the industry include designing for construction worker safety [4],[5], and [6]; continual improvement of safety management systems [7], addressing H&S culture [8], [9], [10], the model client framework [11], use of incentives and disincentives [12], multi-stakeholder involvement [13] and many other strategies that have not been mentioned above. However, although many ways of improving health and safety have been suggested, there has not been much study on approaches that advocate for a holistic approach to achieve a multi-stakeholder involvement and objective

identification of each party's capacity to influence H&S outcome and thus attain the desired H&S improvement in the industry.

This paper presents an analysis of impact significance on project H&S of two key stakeholders in the construction industry that is the clients and designers. Based on this analysis, the extent to which the stakeholders can influence project H&S performance and which stakeholder cultural aspects are essential to influence H&S performance will be established. These can then be used as an H&S assurance or leading indicator of a better performance and in so doing attain holistic incremental improvement of H&S in the long run.

The importance of stakeholders such as clients or owners and designers to health and safety has been recognized in many studies. Huang and Hinze [14] established that clients can influence health and safety performance and Smallwood [15] identified the influence of designers to be of importance to H&S. This paper however goes a little bit further and outlines clients and designers' impact significance to project H&S. The knowledge on impact significance of clients and designers indeed of all stakeholders is essential as this information can aid in formulating targeted strategies to assure H&S performance.

2.0 THE STUDY

A Delphi study method was used to explore the impact significance of the identified stakeholders on project H&S. The Delphi method was preferred to common survey methods as the current study was addressing the 'what could' kind of questions as opposed to the 'what is' kind of questions [16]. The Delphi methodology was also considered to be a much stronger methodology for its rigorous query of experts which is achieved through many iterations and feedback.

The Delphi study involved invited panellists and it retained 11 active members. This number of panellists was considered adequate based on what other Delphi studies have used and recommended. Delbecq, Van de Ven and Gustafson [17] suggest that 10 to 15 panellists could be sufficient if the background of the panellists is homogenous. A review by Rowe and Wright [18] indicates that the size of a Delphi panel has ranged from three to 80 in peer reviewed studies. Okoli and Pawlowski [19] and Skulmoski, Krahn and Hartman [20] also mention a panel size of about 10 to 18 members. Hallowell and Gambatese [21] suggest a minimum of eight panellists. Based on the above and the fact that the Delphi method does not depend on the statistical power [19], but rather on group dynamics for arriving at consensus among experts, a panel of 11 members was considered adequate.

The selection of panellists was based on criterion sampling. Panellists were selected for a purpose to apply their knowledge to a concept raised in the study based on the criteria that was developed from the research questions under investigation. A Delphi study does not depend on a statistical sample that attempts to be representative of any population. It is a group decision mechanism requiring qualified experts who have deep understanding of the issues [19] Therefore, one of the most critical requirements is the selection of qualified experts as it is the most important step in the entire Delphi process because it directly relates to the quality of the results generated [16] In view of the above, successful panel members had to meet at least four of the following criteria adopted from Skulmoski et al [20] and Hallowell et al [21]

- Knowledge and experience in construction health and safety;
- Knowledge and experience in construction project management;
- Have appropriate academic qualifications;
- Professional registration with a recognized built environment or health and safety registration body;
- Have published articles in peer reviewed journals, books and or conferences;

- Industry experience of at least five years;
- Capacity and willingness to participate;
- Sufficient time to participate;
- Effective communication skills

Panel members were identified from three sources. The first source was the CIB W099 register of members located on the CIB W099 website [22]. The CIB W099 is a working commission that was set up on royal appointment to enable researchers on construction health and safety in the world collaborate as well as protect health and safety. The second source was the conference proceedings of the CIB W099 from year 2005 to 2009. Individuals who had frequently appeared as authors or keynote speakers were identified as potential experts on the study. The third and last source was indentifying through references of individuals working in the area of health and safety in the local construction industry in Southern Africa.

The panel consisted of two members from South Africa, three each from United States of America (USA), and the United Kingdom (UK), one each from Singapore, Hong Kong, and Sweden. Of these one of the panellists had a Doctor of Science (DSC) Degree, six had a Doctor of Philosophy (PhD) degree, two had a Master of Science (MSc) degree, one had a Bachelor of Science (BSc.) degree and the last one had a Diploma in safety management. All the panellists specialized in construction safety. In terms of their current occupation, three of the panellists were employed by contracting organizations, one by a consulting organization, and six by Universities. All panellists held very senior positions in their organizations and were involved in community service.

The panel had a cumulative of 243 years of experience. The lowest number of years of experience was seven and the highest was 45 years. The calculated mode of years of experience was 15, the mean was 22.1 years and the median was 15 years. Experience was an important factor in determining who an expert was and therefore a minimum number of years was set to be five years. In terms of publications, 10 of the panellists had published in peer reviewed journals, conference proceedings and books. Between them, they had published 57 books and monographs, 19 chapters in books, 187 peer reviewed academic journals, 345 recent conference papers and 341 other publications comprising of articles in professional journals, technical reports, policy papers, expert witness documentation and key note addresses. In addition to their publication, the panel had led and managed 108 funded research projects. Three panellists served on editorial boards of 43 peer reviewed journals and conference proceedings. The bar chart labelled figure 1.0 below shows the contribution of panellists to the above mentioned publications.

Table 1.0: Panellists publications

Panel publications	No. of publications
Books and monographs	57
Chapters in books	19
Peer reviewed Journals	187
Peer reviewed Conference proceedings	345
Funded research	108
Other publications	341
Editorial board membership	43
Referee for journals	22
Referee for Conference proceedings	30

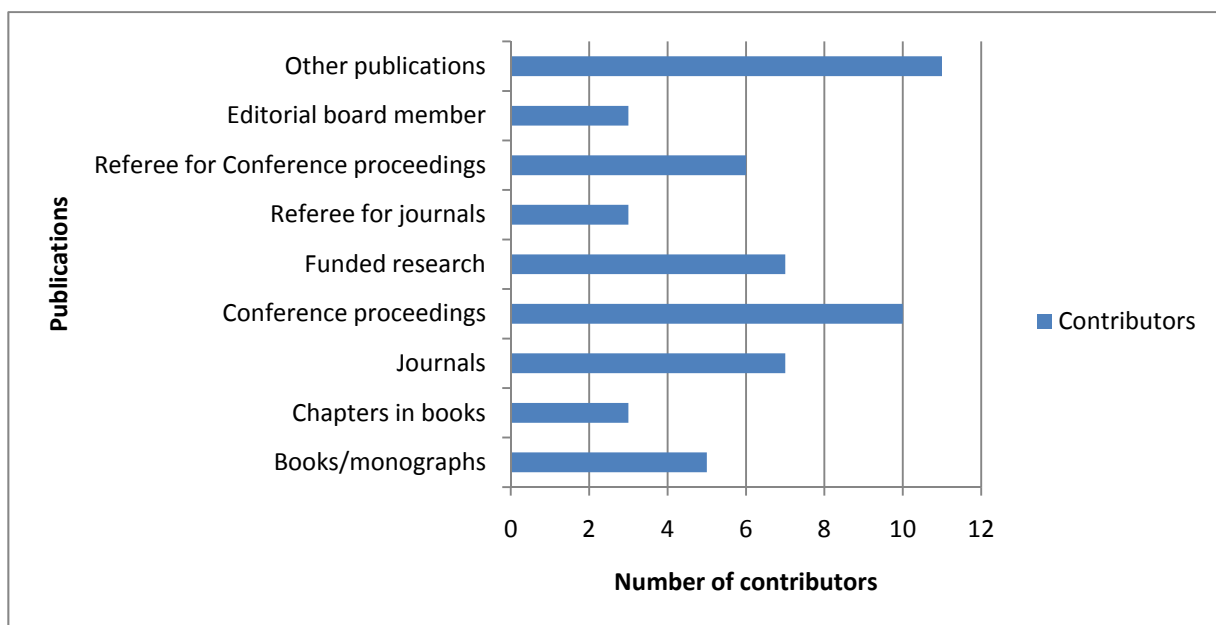


Fig. 1.0: Allocation of publications by panellists

The current Delphi study involved three rounds of an iterative process with the view of achieving consensus between the panel members on the impact significance of clients and designers on H&S consideration at various project phases. Panellists were requested to rate the probability that H&S would be considered at project phases as a result of clients and designers H&S cultural influence. The probability scale ranged from 1 to 10 representing 0 to 100%. Further, panellists were

requested to rate the negative impact that would result if a particular stakeholder’s cultural element was absent. The impact scale was based on a 10 point rating scale ranging from low to critical. This aspect indicated the severity of the culture or cultural element.

2.0 RESULTS

One of the aspects of project H&S and whose

performance has to be assessed is the extent to which H&S is considered or analyzed throughout the project life cycle. H&S consideration at project phases forms part of a positive H&S culture. The results reported in the current study are an evaluation of H&S consideration throughout the project life cycle due to clients and designers H&S culture influence. Apart from contracting organizations, clients and designers are key stakeholders to H&S improvement and thus their selection for this study. Results obtained from the above were used to conclude on the impact significance of clients and designers on project H&S culture. The following clients and designers H&S culture aspects were identified from literature and were individually used to assess the likelihood that H&S would be considered at various construction project phases as a result of these being apparent:

- Involvement
- Commitment
- Competence
- Leadership

The estimated likelihoods of H&S being considered at various project phases due to both clients and designers culture influence is presented in figure 2.0. In table 2.0, values in column 2 indicate the severity of each stakeholder’s cultural aspects on project H&S which were rated by the panel as negative impact values. This is the negative impact that would result if a particular cultural aspect was not apparent in a stakeholder. Values in column 3 of table 2.0 show the likelihoods of H&S

consideration throughout the project life cycle due to clients and designers cultural aspects’ influence.

According to the panel, the average likelihood that H&S would be considered due to client culture is 83%. Client culture’s influence was rated higher compared to that of designers which was pegged at 81%. With the clients’ H&S culture influence, H&S consideration was ‘very likely to occur’. In comparison to all other project phases, the panel estimated a much higher likelihood of H&S consideration at the construction stage. The likelihood was 95% due to clients influence and 85% due to designers influence. The consensus was that H&S consideration was ‘very likely to occur’ at the construction phase if clients and designers H&S culture aspects are apparent and therefore influence performance. Equally H&S consideration due to client culture influence at all project phases with the exception of procurement and design phase was above 80% and described as ‘very likely to occur’. The likelihood at the design and procurement phase of H&S consideration was just above 70% suggesting that consideration was ‘likely to occur’.

The consensus concerning designers’ culture influence on H&S consideration throughout the project life cycle was that the likelihood at all project phases was above 80% with the exception of the concept/initiation and the procurement phase. The panel estimated a likelihood of 73% that H&S would be considered at the concept/initiation phase and 80% at the procurement phase due to designers’ culture influence.

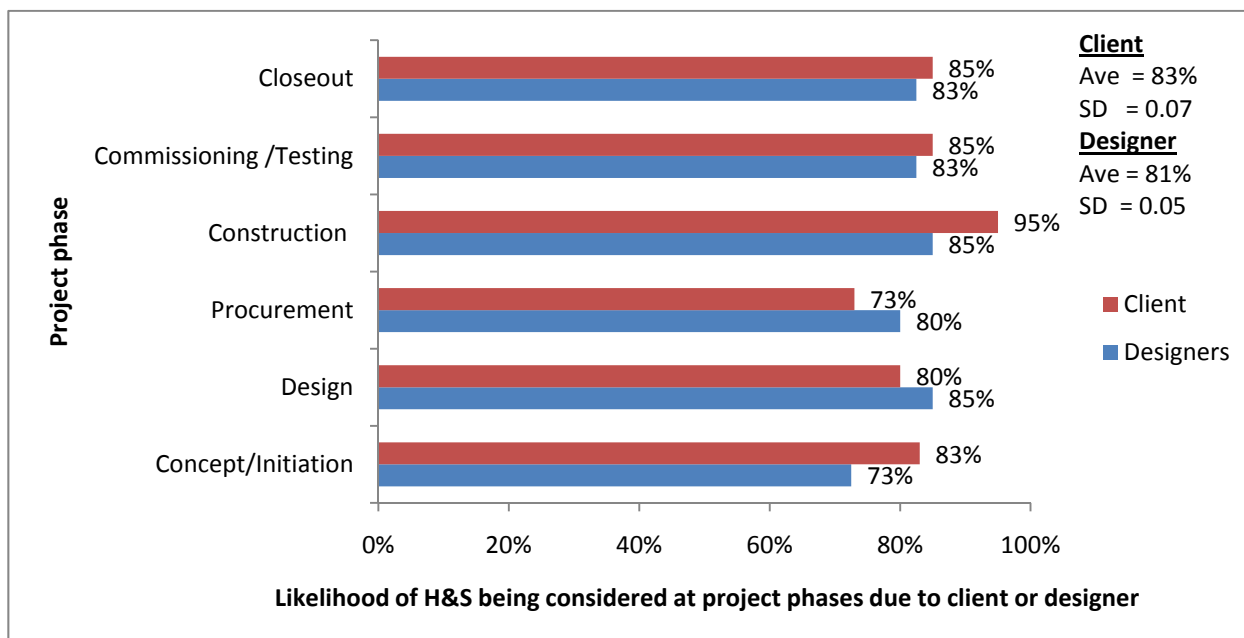


Fig 2.0: Likelihood of Health and safety consideration

The panel considered all clients, contractors and designers’ H&S cultural aspects to be critical to H&S

project culture. On a severity rating scale of 1-10 with the rating of 1 being low and 10 being critical, all stakeholders' cultural aspects were rated to be 8 and above. Table 2.0, column 2 shows the severity values for each of the stakeholders' H&S culture aspect. The calculated averages of severity for clients, designers and contractors top management H&S culture are 8.88, 8.75 and 9.38 respectively.

The impact significance of each stakeholder's H&S culture aspect's influence was obtained as a product of the estimated likelihood of H&S consideration throughout the project life cycle and the severity of the cultural aspect. This relationship is expressed in the equation 1.0. Column 4 in table 2.0 shows the values of the impact significances. Based on the impact significances of each stakeholder's H&S culture aspect, a rank was assigned. It was found that client involvement had a higher ranking in terms of impact significance for H&S consideration compared to client leadership.

Client leadership was ranked 7th with an impact significance of 6.72 whilst client involvement was rated to have an impact significance of 8.10. The client culture aspect with the highest impact significance was found to be client involvement while the designers' culture aspect with the highest impact significance was designer competence. The designer competence had an impact significance of 7.38. Clients and designers cultural aspects considered to be of lower impact significance on H&S consideration was found to be leadership for both stakeholders. The impact significance for client leadership was 6.72 whilst that of designers was found to be 6.96.

An aggregated average impact significance of clients and designers culture on H&S consideration was found to be 7.36 and 7.31 respectively. The overall client culture's impact significance was found to be higher than that of designers albeit marginally.

$$\text{Impact Significance} = \text{Likelihood factor} \times \text{Severity factor}$$

Eq. 1.0

Table 2.0: Severity, Likelihood and impact significance values of clients and designers culture aspects

Stakeholder elements (1)	Severity (2)	Likelihood of H&S consideration (3)	Impact significance (4)	Rank (5)
Client commitment	9	84%	7.59	2
Client involvement	9	90%	8.10	1
Client leadership	8.5	79%	6.68	7
Client H&S competence	9	79%	7.07	4
Designer commitment	9	78%	7.05	5
Designer involvement	9	78%	7.05	5
Designer leadership	8	87%	6.93	6
Designer H&S competence	9	82%	7.35	3

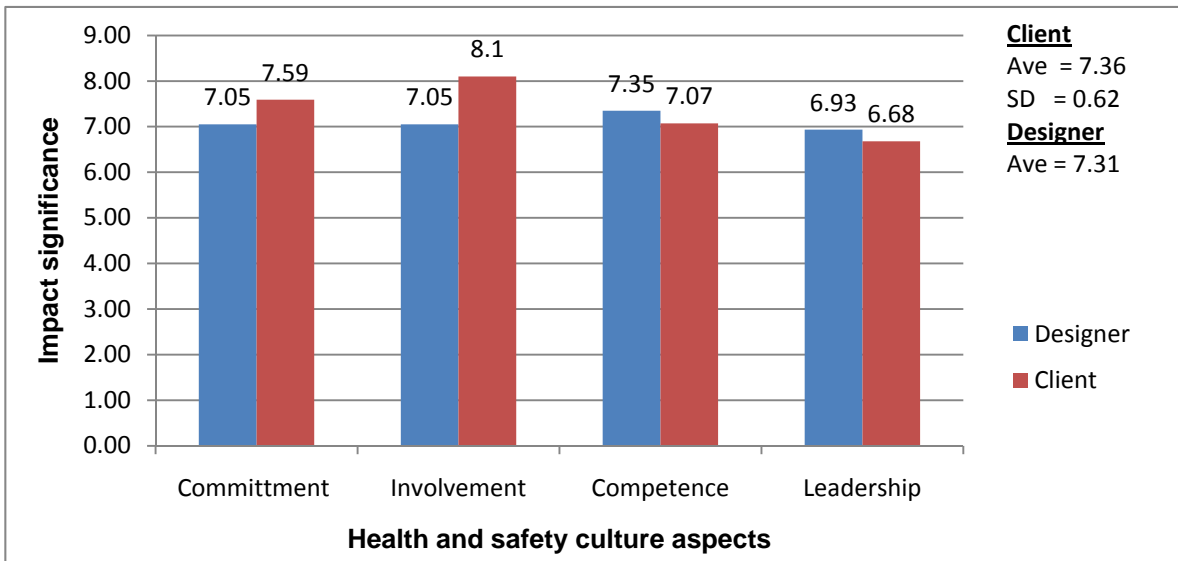


Fig. 3.0: Impact significances of clients and designers culture aspects on H&S consideration

3.0 DISCUSSION

Improving H&S performance on a construction project has to do with how or whether H&S has been considered throughout the project life cycle. H&S consideration entails H&S risk identification, analysis, design for H&S and development of a risk response strategy that ensures H&S for all on a project. The aspect of H&S consideration is therefore an important activity in improving H&S performance in a project. Therefore measures should be in place to ensure that H&S

consideration is done. The question however is, ‘how do we assure that H&S consideration is done throughout the project life cycle and thus influence project H&S culture?’

The current study was therefore a response in part to the above question and sought to determine the impact significance of clients and designers H&S culture influence on H&S consideration.

To make sense of the impact significance, likelihood and severity numbers, rating scales below were used to describe the determined impact, likelihood and severity.

Table 3.0: Impact significance and severity rating scale

0>1	1>3	3>5	5>7	7>10
Low	Minor	Moderate	Major	Critical

Table 4.0 Likelihood rating scale

0>20%	20>40%	40>60%	60>80%	80%>100%
Very unlikely	Unlikely	May occur 1/2 the time	Likely to occur	Very likely to occur

The consensus among panellists regarding the likelihood of H&S consideration as a result of client culture influence was an average of 83%. The difference between this likelihood and that resulting from the designer’s culture influence is minimal as designer’s

culture influence was determined to result in a likelihood of 81%. The panel determined that H&S consideration throughout the project life cycle was ‘very likely to occur’ with both clients and designers’ culture influence. This finding is in agreement with other studies that have

alluded to the fact that clients and designers can influence H&S performance [14]. The current finding however goes further and estimates the extent to which these stakeholders could influence H&S outcome and is more forward looking where as previous studies used lagging indicators to evaluate client influence.

The panel determined that the severity of clients and designers' H&S culture on H&S consideration was 'critical'. Panellists indicated that the negative impact on project H&S culture if clients and designers' culture aspects were not apparent for all cultural aspects was above 8.0.

The resulting impact significances to H&S consideration throughout the project life cycle ranged from 'major' to 'critical'. The suggestion was that both clients and designers culture would assure H&S consideration throughout the project life cycle. The client cultural aspect of involvement was rated to be more critical compared to other cultural aspects to H&S consideration. The suggestion was that in order to ensure H&S consideration throughout project life cycle, clients need to be actively involved in the process. The consensus was that client leadership and competence on H&S consideration throughout the project life cycle were not as critical as client involvement. Client commitment was ranked second with an impact significance of 7.56. Client commitment has to do with visible client actions such as provision of finance and necessary resources for H&S implementation, having an effective health and safety policy, goals and procedures. The finding that client involvement and commitment is more critical than leadership and competence on H&S consideration seems to be logical in that it would not help much if the client is knowledgeable on H&S and yet is not involved nor committed to it. However, it should be stated that the panel's rating yields impact significances of all clients' cultural aspects that do not vary significantly from each other. The standard deviation of clients' cultural aspects' impact significances was found to be 0.62. This is suggestive of the fact that there is an almost equal effect on H&S consideration due to client's cultural aspects' influence and therefore all of them are equally important.

Designers' competence was determined to have higher impact significance on H&S consideration compared to all other designers' cultural aspects. The impact significance was determined to be 7.35. This finding is also logical in that, designers who on construction projects provide professional advice to clients and actually lead the project team should be competent on matters to do with H&S if at all H&S consideration has to happen. As was the case with the client's cultural aspects' impact significances, the findings suggest an almost equal effect on H&S consideration. The standard deviation of designers' impact significances was found to be 0.35 which was actually much lower compared to

0.62 for client culture's impact significance.

It is interesting to note that H&S consideration was more likely to occur at the construction stage due to both clients and designers' H&S culture influence than at any other project phase. The likelihood of H&S consideration at the construction phase due to clients and designers culture was determined to be 95% and 85% respectively. This could probably be because that is the phase when the H&S risk is more apparent. Despite the above finding, the rating of H&S consideration at all the project phases was found to range from 'likely to occur, to 'very likely to occur' due to clients and designers H&S culture influence. The variability in likelihoods was very low. The standard deviation in likelihoods due to client culture influence was 0.07 whilst that of designers was 0.05.

3.0 CONCLUSION

Findings from the study reviewed the following:

- Clients H&S culture influence on H&S consideration throughout the project life cycle has a high impact significance;
- All clients H&S cultural aspects of involvement, commitment, competence and leadership have impact significance ranging from 'major' to 'critical';
- Designers' cultural influence on H&S consideration has a high impact significance which is described as critical.
- All designers H&S cultural aspects of involvement, commitment, competence and leadership have impact significance ranging from 'major' to 'critical'

Both clients and designers' culture influence would cause H&S consideration to 'very likely occur' with a likelihood of over 80%. The significance of this finding is that with the influence of these stakeholders, there is an assurance of a better H&S performance and thus may achieve the desired improvement. Positive clients and designers' culture could therefore be taken as leading indicators for a better H&S performance.

Although the findings do contribute to knowledge, this exploratory Delphi study is currently being verified using another study with a different method.

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