ASSOCIATION OF SCHOOLS OF CONSTRUCTION OF SOUTHERN AFRICA

Volume 11
Issue 1
ISSN 1994 – 7402
March 2018

Journal of Construction

AIMS AND SCOPE

The Journal Of Construction (JOC) is the official journal of the Association Of Schools Of Construction Southern Africa (ASOCSA). ASOCSA has committed itself to foster excellence in construction communication, scholarship, research, education and practice and the JOC provides the medium to achieve this commitment. JOC is at this stage a bi-annual refereed journal serving all stakeholders and participants in the building construction and civil engineering sectors.

JOC publishes quality papers written in a conversational style aiming to advance knowledge of practice and science of construction while providing a forum for the interchange of information and ideas on current issues. JOC aims to promote the interface between academia and industry, current and topical construction industry research and practical application by disseminating relevant in-depth research papers, reviews of projects and case studies, information on current research projects, comments on previous contributions, research, innovation, technical and practice notes, and developments in construction education policies and strategies. Some issues might be themed by topic.

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ADVISORY BOARD

Dear Construction Industry Stakeholders,

Issue 1, 2018

The positive sentiment created by the recent political changes has motivated many South Africans to take action to make a difference in this era of renewal in our country. As participants in the research sector we have the power to shape and improve the lives of the people of our country.

In his first state of the nation address our newly elected president, Cyril Ramaphosa made a request to the nation to lend a hand. This call to action echoes the thoughts of one of the United States' most remarkable presidents, John F Kennedy who so apply expressed this sentiment is his now famous inaugural address in January, 1961, with the simple words: “Ask not what your country can do for you — ask what you can do for your country." This is not only a call to action but also a call for introspection. Have we not become too reliant on what others can do for us? Do we not have a tendency to sit back and expect our political leaders or government to bring about change? It is time to take action, it is time to take the first step, no matter how small we view our contribution as the people of South Africa we have the opportunity to make a difference.

As researchers in the construction industry we have the ability to change the lives of many. Industry focused research can be the catalyst for change and improvement. Lack of service delivery, housing shortages, questionable construction safety measures and the impact on the sustainability of our planet are only some areas where research in the built environment can made strides to lend a hand.

We want to thank and congratulate the authors of the papers in the edition for lending a hand, for taking the first step through your contribution to became a champion of change.

Dr Hendrik Prinsloo
President
Associated Schools of Construction of Southern Africa
(ASOCSA)

JOURNAL OF CONSTRUCTION

Volume 1
Issue 11
ISSN 1994 - 7402

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EDITORIAL

The 1st issue of Volume 11 of the Journal of Construction (JoC) comprises four papers which cover various topics in construction discussed below.

Firstly, Prinsloo and Maritz discuss a decision support framework for extension of time claims for the GCC form of contract. Secondly, Kheni, Adraku and Boateng discuss the role of site managers in Ghana in improving health and safety performance in low- and lower-middle income countries. Thirdly, Van Eck and Burger investigate the use of focus groups as research method in the built environment. Finally, Monyane and Emuze look at controlling construction cost overrun in public projects in the Free State province of South Africa

A DECISION SUPPORT FRAMEWORK FOR EXTENSION OF TIME CLAIMS FOR THE GCC FORM OF CONTRACT

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ABSTRACT

Purpose

The main purpose of the study was to develop a user-friendly guideline to assist practitioners in the process of the assessment of extention of time (EOT) claims.

Design/ methodology/ approach

An action-research approach, a very specific qualitative approach, was followed to achieve the objectives of the study. The data gathered, as part of the action-research process, contributed to the objective of providing a decision-support tool that could be effectively utilised in practice. The participation of practitioners regularly involved in the assessment of construction-delay claims was of much value. Focus groups, consisting of industry practitioners, with specialist knowledge in the General Conditions of Contract (third edition, 2015) contributed to the development of the decision-support frameworks, and ultimately to the findings.

Finding

The main findings included the following aspects: EOT claim assessment criteria, components of the GCC decision-tree framework, sequence of decision-making for EOT claims and a decision support framework for the GCC form of contract.

Research limitations/ implications

A number of different claim-analysis models are currently being utilised in the industry. The purpose of the research is not to develop a new model, but rather to provide a decision tree framework to streamline and simplify the current claim-analysis process.

Practical implications

The assessment of EOT claims involves a sequential decision making process. Therefore, the guideline should be of assistance in the decision making.

What is original/ value of the paper

The decision framework provides guidance for the assessment of EOT claims. As a result it limits uncertainty and streamlines the assessment of EOT claims.

KEYWORDS:

Claims, Construction Contracts, Decision-trees, Extension of Time, General Conditions of Contract

1. INTRODUCTION

The main aim of any construction project is to finish within the time agreed upon, while still achieving the cost, time and quality objectives. However each project is subjected to various disruptions or delays which may be due to fault on the contractors' side or to unforeseen circumstances[1].

Many construction disputes can be linked to claims or potential claims. In recent decades, projects have become more time-constrained; and the ability to deliver a project on time is becoming increasingly important. There is an increasing emphasis on tight contracts, which are coupled with heavy liquidating damages or penalties for late completion[2]. Thus, it is becoming all the more important for a contractor, when faced with delays caused by the client or other factors, to ensure that the claim for an EOT is suitable in adjusting the contractual completion date. Otherwise, he would find himself subject to liquidating damages or penalties[3].

Most standard contracts contain provisions that list the relevant events that would enable the contractor to apply for an EOT. Unfortunately, there is no specific explanation with regard to the assessment of the claim; and this is often left to the professionals involved in the project. The

absence of clear guidelines is also one of the contributing factors to the late submission of claims, which, in turn, leads to the late assessment of claims by the contract administrator, especially when the responsibility in assessing the claim rests on the shoulders of a newcomer, or an individual with insufficient experience in dealing with such claims[4].

It has been established that current delay-analytical methods are to a large extent not effective as the methods are inaccurate, time-consuming and costly[5]. Although some studies were done internationally on the different delay methods[6, 4 ,7 ,8 & 3], no specific research studies to determine how to improve the effectiveness of delay analytical methods are available for the South African construction industry.
The main purpose of this study is to develop a framework with the use of a decision tree analysis to provide guidance for the assessment of delay claims when making use of the GCC form of contract. The framework would assist in providing a platform to standardise the assessment of delay claims. This approach will contribute to expediting the evaluation process; and it will limit the negative impacts associated with any prolonged process for concluding delay claims.

2. THE PROBLEM

Delays and disruptions to contractors' progress, often resulting in time and cost overruns, are a major source of claims and disputes in the construction industry. At the heart of the matter in dispute is often the question of the extent of each contracting party's responsibility for the delayed-project completion, and for the extra cost incurred. Various analytical methodologies have been developed over the years as aids to determine the extent of the delay. Whilst much has been written about delays and disruptions, there is limited information on the extent of use of these methodologies in practice, and their impact on the construction process[7].

Many problems are encountered in practice in the application, preparation and assessment of EOT claims. In many cases these problems might result in disputes. The lack of clear guidance on how to assess EOT claims can be seen as a major contributing factor to disputes[9].
The delay in dispute settlement has various negative effects on the project, as given below[10]:

- It hampers the project's progress when disputes arise during the execution stage;
- It is detrimental to the relationship between the owner and contractor; and
- It contributes to the cost-and-time overruns.

As a result of the standardisation, it would also contribute to an improved perception of fairness in the evaluation of delay claims, which would, in turn, hopefully lead to the reduction in claims being subjected to dispute resolution.

3. LITERATURE REVIEW

The evaluation of construction EOT claims is, to a large extent, influenced by the type of delay. The following types of delays are of importance in the evaluation of EOT claims.

Excusable delays

An inexcusable delay is defined as a delay caused by the contractor, or any aspect that is within the sphere of control of the contractor. The contractor would not be entitled to any additional time or compensation for this type of delay (Tumi, Omran & Pakir, 2009)[11].
An excusable delay, on the other hand, can be described as a delay caused by either of the following two factors[12,13&11]:

- Third parties or incidents beyond the control of the client and the contractor; and
- The client or the client's agents.

Critical delays

According to Pickavance[14], a delay in progress is not the same as a delay in completion. A delay in progress is a significant shift in the planned timing of a specific activity, or the activities that could occur at any time. Although the start and/or finish of the activity might differ from the original intent, it is irrelevant unless it ultimately impacts on the completion date. On the other hand, a delay in the completion date occurs only when the completion date has passed; and this can only be caused by a delay to the progress of an activity, which is in the critical path to completion. The criticality of a delay can be defined as follows in terms of the ultimate impact on completion:

1) Critical delay – a delay on the critical path of the project, and as a result the final completion date of the project would be delayed; and
2) Non-critical delay – a delay that is not on the critical path, and would therefore, not impact the overall completion date.[15]

Compensable delays

Compensation will have to be considered if a delay

is found to be excusable; and it should be established whether the delay can be defined as follows:

- Non-compensable delay – an excusable delay caused by factors beyond the control of the client and the contractor. Although most forms of contract make provision for the extension of the contract-completion date, the contractor will not receive compensation from the client; and
- Compensable delay – an excusable delay caused by the client or the client's agents. The contractual completion date will be extended; and the contractor will receive compensation from the client.[11]

4. RESEARCH METHODOLOGY

The steps followed in this study consisted of:

- To conduct a literature review to develop a preliminary decision support framework for the assessment of EOT claims;
- To substantiate the proposed decision support framework by using the GCC construction contract;
- Focus groups of key stakeholders to evaluate the decision support framework for assessment;
- Update the decision support framework to accommodate suggestions from focus groups; and
- Finalise the decision support framework as practical tool for assessment of EOT claims.

The first step in the action-research process was to conduct a literature review. The main objective of the literature review was to identify the key decisions required in the assessment of the construction-delay claim. The information, in terms of critical decisions identified during the literature-review process, was utilised as the input to develop a decision-tree for the assessment of EOT claims. The literature review also considered the most appropriate tool to utilise for decision support when assessing EOT claims. Decision trees were indentified as the most suitable tool.

A decision tree is a flowchart-like structure that shows the various outcomes from a series of decisions. It can be used as a decision-making tool, for research analysis, or for planning a strategy. A primary advantage of using a decision tree is that it is easy to follow and understand.[16]
Work on constructing decision trees from the data exists in multiple disciplines, such as statistics, pattern recognition, decision theory, signal processing, machine learning and artificial neural networks. Researchers in these disciplines, sometimes working on quite different problems, have identified similar issues and heuristics for decision-tree construction.[17]
Decision trees would be of great assistance as a guidance tool for the evaluation of EOT claims. One of the most significant objectives of the study was to produce a tool to simplify decision-making during the assessment of EOT claims. Decision trees can guide decision-making during the EOT process by providing a simplistic tool to assess claims; since decision trees are simplistic in nature.

The specific construction contract utilised for a project has a major influence on the process of assessing EOT claims. For a decision-tree to be effective as a decision-support tool, it should adhere to all the requirements, as set out in the construction contract relating to EOT claims.
The literature review focused to a large extent on a review of the relevant contract clauses dealing with EOT claims. The review was utilised to inform the development of decision-tree for the GCC contract. The decision-tree was substantiated by both drawing from the relevant contract clauses, as well as the relevant literature – especially when the contract provided no guidance on a specific matter.

With the overall objective of the study of developing a decision-support tool that could be used in practice in mind, it was considered essential to involve practitioners in the process of substantiating the decision trees. It was decided that focus groups would be the most appropriate tools to be utilised. Industry specialists would provide valuable input to further streamline the decision trees. The decision trees were updated with the comments and suggestions from the focus groups.

Participants for the GCC focus group were chosen on the basis of their level of knowledge of the specific form of contract. To ensure that meaningful participation of all the group members was possible, it was decided to keep the number of participants as low as possible. Care was also taken to choose members with diverse fields expertise. Separate focus groups for diffirent forms of construction contracts were arranged. Table 1 below provides information on the focus group participants and their level of experience.

Table 1 – Focus group – Universal decision tree framework, FIDIC & GCC

	Designation	Years of experience
1.	Engineer; Construction contract specialist	More than 40 years
2.	Quantity surveyor; Senior government project manager	More than 40 years
3.	Quantity Surveyor; Construction contract specialist	More than 20 years
4.	Attorney; Claims consultant	More than 30 years
5.	Quantity Surveyor; Construction Contract specialist	More than 40 years

In line with the action-research design, the participants were allowed to make suggestions in terms of improvements to the decision trees. The impact of the proposed changes was analysed with the group – to reach a point of group consensus in terms of any proposed changes.

5. DISCUSSION AND RESULTS

Decision tree framework

To be able to apply decision tree principles to EOT analysis it is necessary to identify the decisions taken as part of the evaluation process. The literature, focus groups and interviews identified the following essential decisions required when an EOT claim is to be analysed:

- Decision 1 – Were the contractual provisions complied with?
- Decision 2 – Was the delay excusable?
- Decision 3 – Was the delay critical?
- Decision 4 – Was the delay compensable?

Assess contractual compliance (step 1)

A number of clauses in the GCC refer to the right of the contractor to claim for EOT; but clause 10.1 deals specifically with the process to follow and compliance related matters.

According to clause 10.1.1, the contractor shall, within 28 days after the circumstance, event, act or omission – giving rise to such claim that has occurred, deliver to the employer's agent a written claim addressing a number of requirements. Should the contractor not be able to reasonably comply with the requirements within the 28 days; then clause 10.1.1.2.1 allows for a notification of the intention to make a claim to be submitted in writing.

The first decision in the decision tree would be to determine whether the contractor has complied with the 28 day provision to submit the claim. If the contractor did not submit a claim within the 28 day time bar; then second consideration would be to determine whether the contractor submitted a notification within the 28 days. If no claim or notification was provided within this time period; the claim would be rejected, as provided for in clause 10.1.4.

If a notification was submitted, the next decision would be to determine whether the contractor submitted the monthly updates, according to clause 10.1.1.3; while the circumstances are of an ongoing nature. Once the claim is submitted, it would also be required to verify whether the claim was submitted within 28 days after the delaying event.

Clause 10.1.4 dealing with the contractor's failure to comply with the notice period only provides for the claim to be rejected if the notice period of 28 days are not complied with or if the claim is not submitted within the required 28 days. Therefore non-compliance to the provision of clause 10.1.1.3 to provide updated particulars will not necessarily lead to the rejection of the claim. It is assumed that the impact of the failure to provide monthly updates would be taken into account when the impact of the delay is considered.
The decision tree will then consider whether the claim complied with the content requirements highlighted in clauses 10.1.1.1 – 10.1.1.1.4:

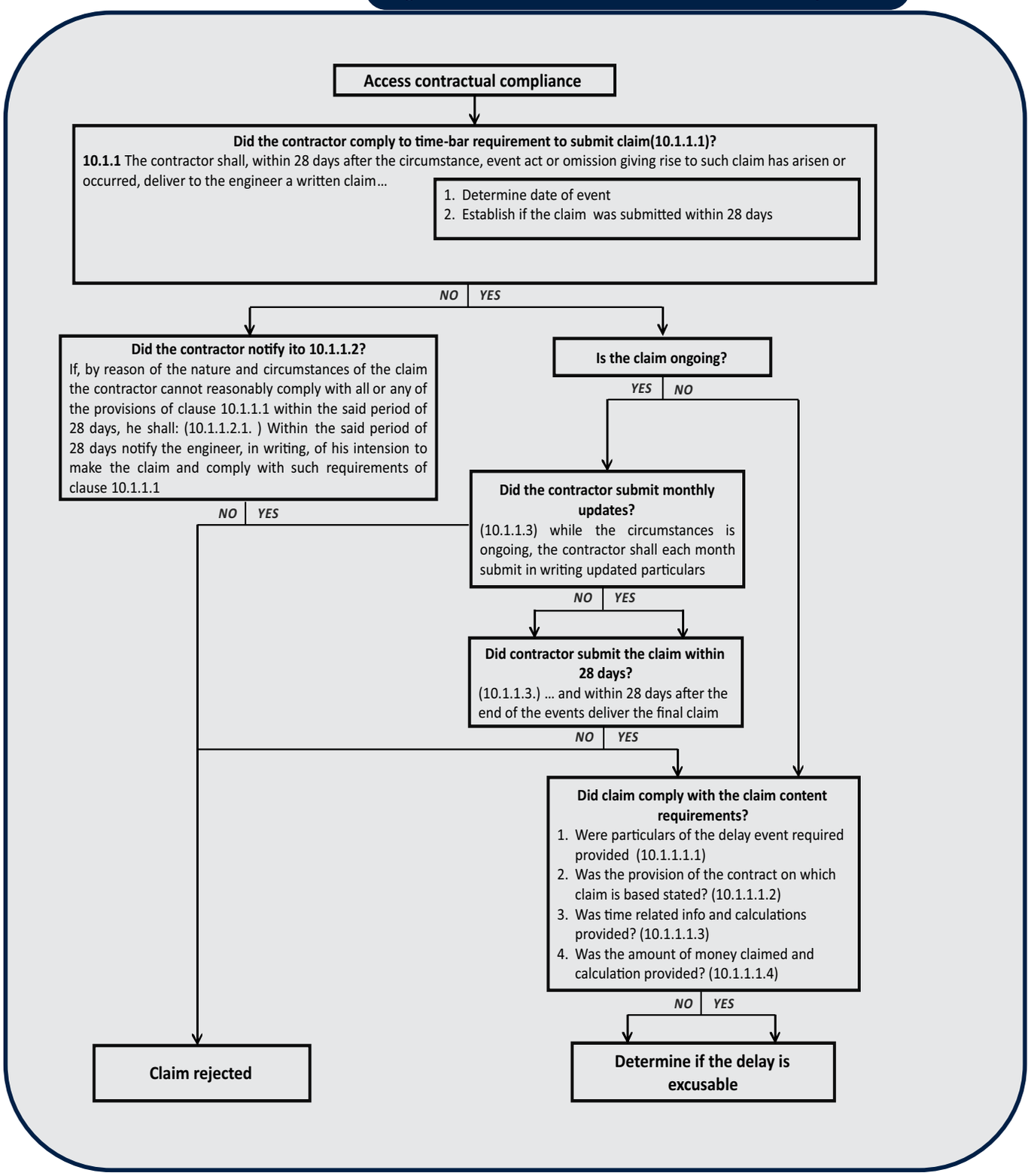
- Were the particulars giving rise to the claim provided? (10.1.1.1.1);
- Was the provision of the contract, on which the claim is based, stated? (10.1.1.1.2);
- Was the time related information and the calculations provided? (10.1.1.1.3); and
- Was the amount of money claimed and the calculation provided? (10.1.1.1.4).

If the required content information has not been provided it is likely to impact on the assessment of the claim. It is in the contractor's interest to provide sufficient information to substantiate the claim. The GCC does not make provision for the claim to be rejected outright if the required information is not submitted. However, the lack of information is likely to impact on the outcome of the assessment to determine whether the delay is excusable and critical. The next step in the decision tree process would be to investigate if the

delay was excusable. The contract compliance decision tree is provided in Figure 1 below.
Determine whether the delay is excusable (step 2)

The GCC makes provision, according to clause 5.12.1, for circumstances of any kind whatsoever, which may occur, which would, in fact, delay practical completion of the works. The circumstances referred to in clause 5.12.1 are to some extent governed by clause 5.12.2.

Figure 1 - Decision tree: GCC contract compliance



Clause 5.12.2 makes reference to the following circumstances: additional work, abnormal climatic conditions, any provision of the contract

which allows for an EOT or Any disruption, which is entirely beyond the contractor's control.

The overall objective of this part of the decision tree is to test whether the cause of the delay is excusable in terms of the conditions of the contract. The first question in the decision tree is to determine whether the delay is as a result of additional work, as provided for by clause 5.12.2.1. If this is the case, the delay would be deemed excusable.

The second consideration in the tree is to determine whether the delay is as a result of abnormal climatic conditions. If this is indeed the case, the delay would be viewed as excusable. Thirdly, if the delay is not as a result of these two causes, the decision tree would then consider whether the delay is as a result of any provision of these conditions which allows for an EOT, in accordance with clause 5.12.2.3. The following clauses summarised in Table 2 make provision for an EOT if the contractor is delayed as a result of the matter being addressed in the clause:

If the claim relies on one of these clauses, the decision tree would then test whether the provisions in the clause were met. If this was the case, the delay can be considered as excusable. If the provisions of the clause were not complied with, the claim would not be considered as excusable; and it could then be rejected on this basis.

If the cause of delay is not attributable to any of the possible causes of delay previously considered, the decision tree would then test the cause of the delay in terms of clause 5.12.2.4. This clause makes provision for an EOT for any disruption beyond the contractor's control.

The cause of the delay should be assessed to determine whether it was entirely beyond the contractor's control. In the assessment it would be necessary to consider what information was available to the contractor at the tender stage; and if provision could have been made to address the disruption. If the cause of the delay is viewed as something that was under the control of the contractor, the delay would not be considered excusable.

However, if it is found that the cause of the delay was beyond the contractor's control, the delay would be viewed as excusable. The next step will be to determine if the delay was critical. Refer to Figure 2 where the decision tree is provided.

Table 2 – GCC2015 – Clauses making provision for EOT

Clause number	Clause title
2.2.4	Adverse physical conditions
2.3.1	Technical data differing
2.4.2	Ambiguity in documents
4.7.1	Encountering fossils, etc.
4.8.2.2	Providing facilities to others
5.4.3	Delays in possession of site
5.9.6	Employer’s agent’s late instructions
5.10.1	Employer’s delays
5.11.2	Suspensions of the works
6.4.3	Delays in valuing variations
7.5.3	Employer’s agent’s late attendance
7.5.4	Late delivery of plant
7.5.5	Uncovering and openings
8.3.2	Excepted risk

Figure 2 - Decision tree: GCC contract compliance

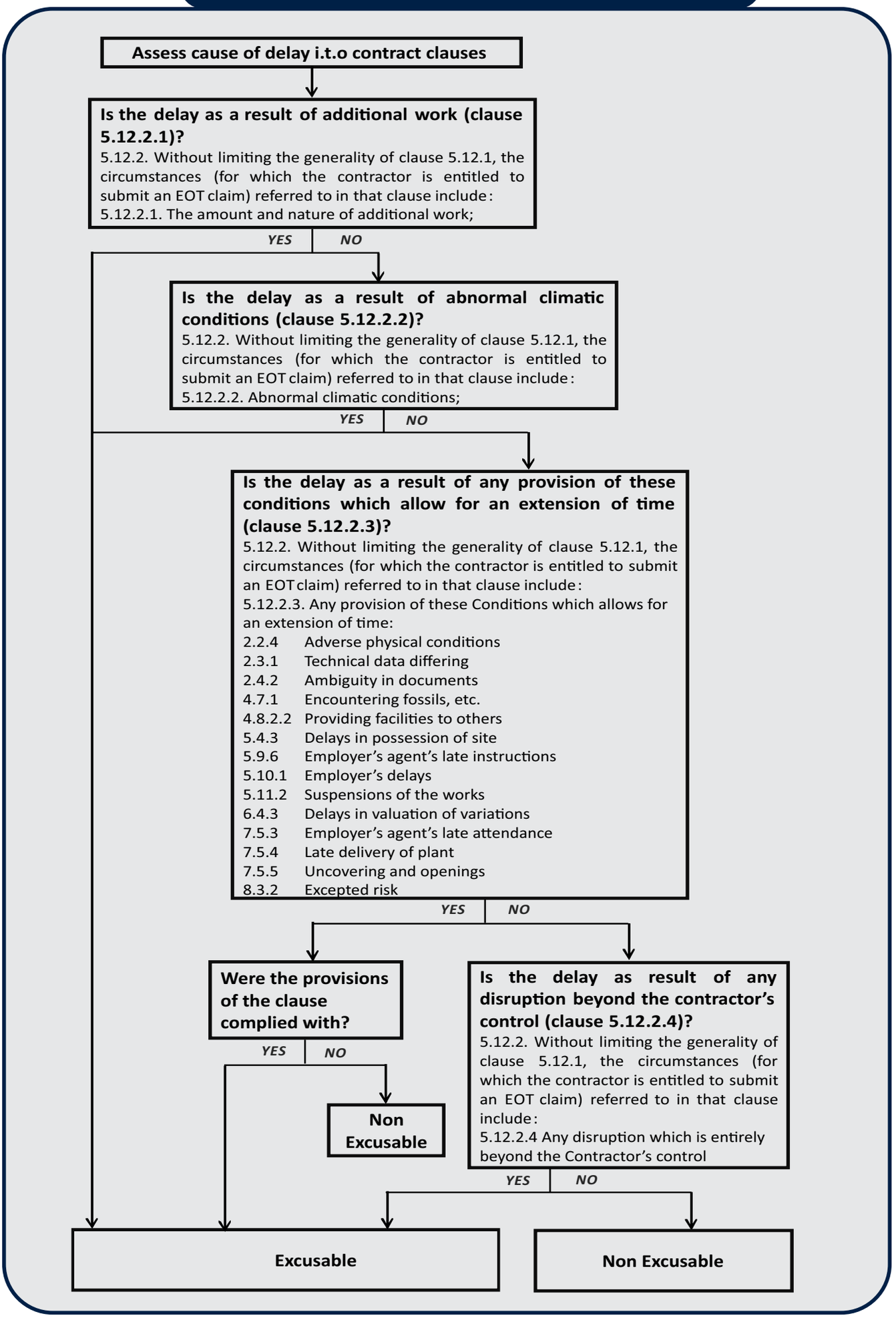
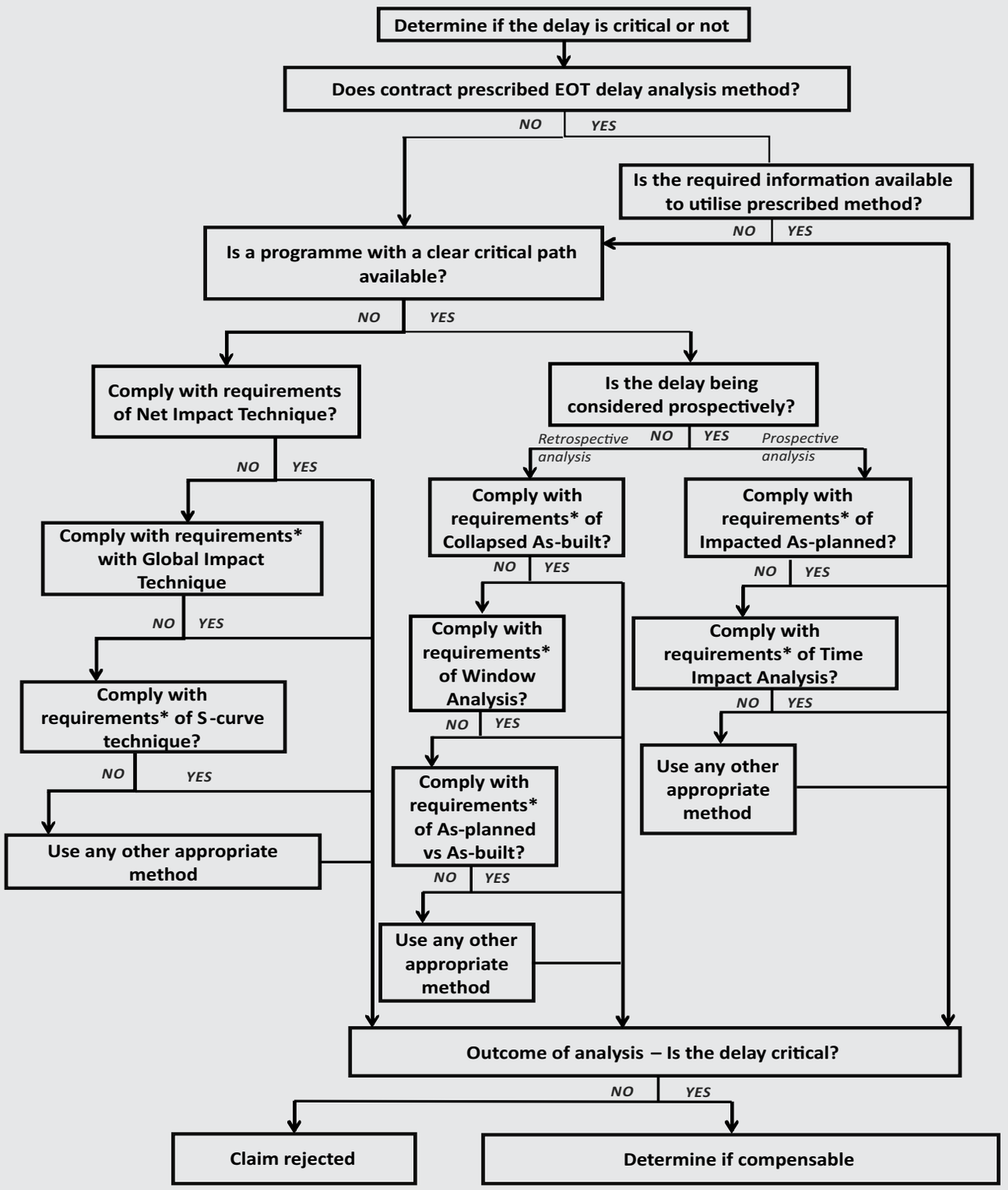


Figure 3 – Decision tree: GCC determine whether the delay is critical



Determine whether the delay is critical (step 3)

The GCC deals with the issue of criticality and the extension of the contract period in terms of clause 5.12. Clause 5.12.1 allows the contractor to claim for an EOT for any circumstances that would actually extend the practical completion of the works beyond the due completion date.

The clause makes reference to a delay in the practical completion, in other words a critical delay. The main objective of this part of the decision tree is to determine if the delay is critical. To determine if the delay is critical one of the delay analysis methods (DAMs) will have to be utilised.

A decision (refer to Figure 3) tree can be utilised to choose the most appropriate DAM for the specific delay.Should a DAM be prescribed in the contract, it should be determined if the required information is available to utilise the prescribed method. The GCC does not prescribe a specific DAM to be utilised for the assessment of EOT claims. The decision of the most appropriate DAM will be left to the employer's agent's discretion.

EOT delay analysis methods can be divided into two main categories: non-critical path methods and critical path methods. It would be preferable to utilise a critical path method; as this outcome would be conclusive whether the delay was critical or not. Unfortunately it is possible, in some instances that a programme with a clear critical path is not available; and a decision would have to be made with the limited information available. In such cases; the only alternative would be to utilise one of the non-critical path methods.

The second consideration in the decision tree would be to determine whether a programme with a clear critical path is available. If the response is positive the next consideration would be to decide on the most appropriate critical path method to utilise.

Braimah and Ndekugri (2008)[15] did a study on the factors that influence analysts' selection from these methodologies. Eighteen factors were identified through the literature review and pilot surveys; and then ranked on their relative importance, based on data collected in a nation-wide survey of UK construction organisations. The literature review identified the following factors summarised in Table 3:

Table 3 – Factors influencing the selection of DAM [adapted from (Braimah & Ndekugri, 2008)[15]]

Factor	Source literature						
	Bramble	Colin & Retik	Finke	Bubshait & Cunningham	Bramble & Callahan	SCL	Pickavance
Records availability	✓	✓	✓	✓	✓	✓	✓
Baseline Programme availability	✓			✓		✓	✓
Nature of baseline programme				✓	✓	✓	✓
Updated programme availability				✓	✓	✓	✓
Reason for the delay analysis	✓	✓				✓	✓
Applicable legislation		✓					
The form of contract		✓	✓			✓	✓
Cost of using the technique	✓			✓		✓	✓
Nature of the delaying events	✓				✓	✓	
Skills of the analyst	✓				✓	✓	
The amount in dispute	✓				✓	✓	
The number of delaying events			✓		✓		

The construction industry wide survey yielded the following results (summarised in Table 4) in terms of the relevant importance of the factors influencing the selection of the DAM:

Table 4 – Relevant importance of DAM selection factors [adapted from (Braimah & Ndekugri, 2008)

Selection factor	Overall	
	Importance index	Rank
Records availability	97.5	1
Baseline Programme availability	84.1	2
The amount in dispute	73.1	3
Nature of baseline programme	71.5	4
Updated programme availability	69.8	5
The number of delaying events	66.1	6
Complexity of the project	65.8	7
Skills of the analyst	65.3	8
Nature of the delaying events	64.6	9
Reason for the delay analysis	61.8	10
Type of contract	59.2	11
Cost of using the technique	58.0	12
Dispute resolution forum	54.4	13
Time of the delay	62.0	14
Size of project	50.9	15
Duration of the project	45.1	16
The other party to the claim	44.7	17
Applicable legislation	36.5	18

According to Braimah (2008)[7] the most commented upon DAMs are: As-planned vs As-built, Impacted as-built, Collapsed as-built and the Window analysis (time impact analysis). In the absence of any guidance from the contract, a decision on the most appropriate DAM should be made. In order to make this decision, it is proposed that the five most significant factors influencing the selection of DAMs should be utilised in the decision tree, in order to identify the most appropriate method: (refer to Table 4)

1. Records availability;
2. Baseline programme availability;
3. The amount in dispute;
4. Nature of baseline programme; and
5. Updated programme availability.

Table 4 below highlights the information required for four out of the five criteria for selection:

- Records availability;
- Baseline programme availability;
- Nature of baseline programme; and
- Updated programme availability.

Table 5 can be utilised as a tool to support decision making when considering the selection of the appropriate DAM as part of the decision tree.

The sequence or ranking for the testing of the different DAMs would be determined by the following process. It would be determined by the perceived level of adherence to the selection criteria, in order to successfully execute the specific DAM. It would be necessary to do a brief assessment of the information available and then to take a preliminary view on which one of the different DAMs would be the most appropriate in the light of the information available. In the decision tree, this DAM would be tested first. Should this DAM not comply with all the requirements, the DAM with the second highest level of perceived adherence to the requirements would then be considered in the decision tree. Should this DAM not comply with all the requirements, the DAM with the third highest level of perceived adherence to the requirements would then be considered in the decision tree. Finally, should this DAM also not comply with all the requirements, the DAM with the fourth highest level of perceived adherence to the requirements would then be considered in the decision tree.

To reach a final decision on which of the DAMs should be utilised decision trees can be employed to test adherence to the selection criteria.

Once the DAM has been decided upon, the delay would be analysed. The main outcome of the delay-analytical process would be to determine whether the delay is critical or not. If the delay is not critical, the delay would be rejected; but if the delay is critical, the next step in the decision tree process would be investigate whether the delay is compensable.

Determine whether the delay is compensable (step 4)

The GCC does not distinguish between delaying events, for which the contract value could be adjusted (compensable) and delaying events, for which the contract value would not be adjusted (non-compensable). Compensation related to EOT for practical completion is addressed in clause 5.12.3; and a relevant adjustment is made to general items:

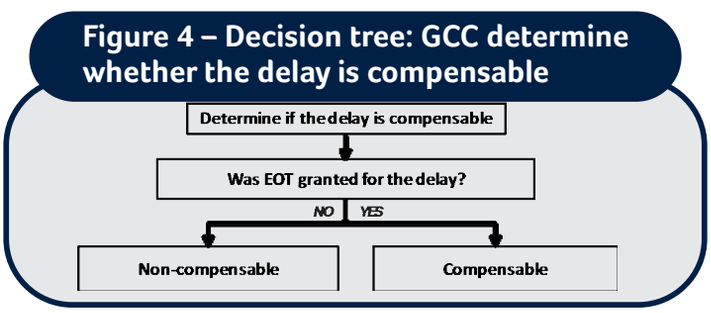
Table 5 – Requirements to utilise DAMs [adapted from [7]]

Record	Planned As Built	Impacted As Planned	Collapsed As Built	Window analysis
Important project information required for the application of DAMs				
Outline of delay events	❍	❍	❍	❍
Start dates of delay events	❍	❍	❍	❍
Finish dates of delay events	❍	❍	❍	❍
Activities affected by delays			❍	❍
Duration of delay events	❍	❍	❍	❍
Original planned completion date (or as extended)	❍	❍		❍
Actual completion date	❍		❍	❍
As-planned critical path(s)	❍	❍		❍
As-built critical path	❍		❍	
Updates critical or near critical path(s)				❍
Update or schedule revision dates				❍
Activity list with logic and lag	❍	❍	❍	❍
Main programming requirements of DAMs				
Baseline programme available	❍	❍		❍
Nature of baseline programme				
Available in CPM	❍	❍		❍
Includes all relevant activities	❍	❍		❍
Reasonable activity durations	❍	❍		❍
Reasonable activity relationships	❍	❍		❍
Activities defined in appropriate detail	❍	❍		❍
Relevant programmes updates for DAMs application				
Intermediate regular programme updates available				❍
Final updated programme available (as-built programme)	❍		❍	❍
TOTAL	**16**	**13**	**9**	**19**

5.12.3 If an EOT is granted, the contractor shall be paid such additional time-related general items, including for special non-working days, if applicable, as are appropriate regarding any other compensation, which may already have been granted in respect of the circumstances concerned.

According to this clause, if the contractor is granted an EOT, the delay is compensable. The decision tree to determine whether the delay is compensable is simplistic; as the only requirement would be to determine whether an EOT was granted. If an EOT was granted, the delay is compensable. (refer to Figure 4)

Figure 4 – Decision tree: GCC determine whether the delay is compensable



6. CONCLUSION

The decision trees proposed assist in the process to investigate the issues relating to contract compliance, in order to determine whether the delay is excusable, and to establish whether the delay was critical, as well as to address the issue of compensation. The decision trees would hopefully assist in eliminating uncertainty in the assessment process of EOT claims by providing clear guidelines.

It is possible that the decision trees could, to some extent, assist in the standardisation of the assessment of EOT claims. Standardisation would have a number of benefits. One of the significant benefits would be that this could possibly reduce the number of disputes in EOT claims.

The main benefit of the decision-support framework is that it would provide a guideline with clear and easy to follow steps to assess any EOT claims. This could be of assistance to practitioners that are responsible for the assessment of EOT claims on projects.

The decision-support framework would also provide insight for contractors into the process of the assessment of EOT claims. This would hopefully lead to a better understanding of what is required to substantiate EOT claims, and to better quality claims being submitted.

7. REFERENCES

1 Eizakshiri, F., Chan, P.W. & Emsley, M. 2011. Delays, what delays? A critical review of the literature on delays in construction. Management, 839:848.

2 Kumaraswamy, M.M. 1997b. Conflicts, claims and disputes in construction. Engineering, Construction and Architectural Management, 4(2):95-111.

3 Williams, T. 2003. Assessing extension-of-time delays on major projects. International Journal of Project Management, 21(1):19-26.

4 Yusuwan, N.M. & Adnan, H. 2013. Assessing Extension of Time Application in Malaysian Construction Industry: Views from Professionals. Procedia - Social and Behavioral Sciences, 105:54-63.

5 Farrow, T. 2007. Developments in the Analysis of Extensions of Time. Journal of Professional Issues in Engineering Education and Practice, 133(3):218-228.

6 Arditi, D. & Pattanakitchamroon, T. 2006. Selecting a delay analysis method in resolving construction claims. International Journal of Project Management, 24(2):145-155.

7 Braimah, N. 2008. An investigation into the use of construction delay and disruption analysis methodologies.

8 Yang, J.-B. & Kao, C.-K. 2012. Critical path-effect-based delay analysis method for construction projects. International Journal of Project Management, 30(3):385-397.

9 Danuri, M.M., Othman, M. & Lim, H.A.-R.C. 2006. Application and Assessment of Extension of Time Claims: Findings of Case Studies Conducted in Malaysia. Journal of Design and the Built Environment, 1(2).

10 Iyer, K.C., Chaphalkar, N.B. & Joshi, G.A. 2008. Understanding time delay disputes in construction contracts. International Journal of Project Management, 26(2):174-184.

11 Tumi, S.A.H., Omran, A. & Pakir, A.H.K. 2009. Causes of delay in the construction industry in Libya.14-15.

12 Alaghbari, W., Kadir, M. & Salim, A. 2007. Ernawati (2007)'The significant factors causing delay of building construction projects in Malaysia'. Engineering, Construction and Architectural Management, 14(2):192-206.

13 Hamzah, N., Khoiry, M.A., Arshad, I., Tawil, N.M. & Che Ani, A.I. 2011. Cause of Construction Delays - Theoretical Framework. Procedia Engineering, 20:490-495.

14 Pickavance, K. 2000. Delay and disruption in construction contracts. LLP.

15 Ndekugri, I., Braimah, N. & Gameson, R. 2008. Delay analysis within construction contracting organizations. Journal of construction engineering and management, 134(9):692-700.

16 Kattan, M.W. & Cowen, M.E. 2009. Encyclopedia of medical decision making. Sage.

17 Murthy, S.K. 1998. Automatic construction of decision trees from data: A multi-disciplinary survey. Data mining and knowledge discovery, 2(4):345-389.

IMPROVING HEALTH AND SAFETY PERFORMANCE IN LOW- AND LOWER-MIDDLE INCOME COUNTRIES: THE ROLE OF SITE MANAGERS IN GHANA.

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ABSTRACT

Purpose

The construction industry suffers from a considerable burden of site related injuries and ill health with Low- and Lower-Middle-Income Countries (LLMICs) experiencing a relatively high incidence of accidents and ill health. The paper assesses the role of site managers in improving health and safety standards on construction sites in LLMICs with a focus on Ghana.

Methodology

Survey questionnaires were developed and administered to a stratified random sample of 341 site managers in four regions of Ghana, namely; the Greater Accra, Ashanti, Western and Brong Ahafo regions. The overall response rate was 39%. The resulting data was analysed using Statistical Package for the Social Science (SPSS) version 21.0.

Findings

The findings of the study suggest that there is no significant correlation between most site managers' roles and health and safety standards observed on construction sites. For site managers' roles that have significant association with the safety standards on construction sites, the strength of the association was found to be weak. Key challenges in relation to health and safety management confronting site managers identified included; limited empowerment and accountability mechanisms, worker related factors, poor communication and participation in health and safety matters and imposed health and safety management systems by main contractors.

Research limitations/implications

The indicators of safety standards/performance of sites, that is accidents and injury rates, though objective measures may not necessarily reflect the state of health and safety on a construction site. Also, the approach adopted cannot reveal the underlying reasons for the findings stated above as to why site managers are constrained.

Practical implications

The paper provided evidence which could form the foundation for design of health and safety interventions aimed at improving site safety.

Originality/value of the paper

The current paper identifies potential obstacles that need to be overcome to enable site managers to perform their health and safety roles on construction sites.

Keywords: Construction health and safety; Low- and lower-middle-income countries; Site managers' role; Ghana.

1. INTRODUCTION

Low- and lower-middle-income countries (LLMICs) many of which include Sub-Saharan African (SSA) countries are projected to have very high industrial growth. Ghana for instance, is expected to record a growth rate of 19% with a significant contribution coming from oil production[1]. Consequently, the construction sector will play a more crucial role in socioeconomic development and physical infrastructure. Increasing industrialisation inevitably will be accompanied by rising occupational accidents and incidence of ill health as more workers will be exposed to levels of occupational hazards which hither to were absent or lower in occupations in Ghana. Consequently, more concerted effort is needed to effectively manage Health and Safety. Site managers must ensure site operatives have a positive health and safety attitude[2]. The responsibility for health and safety starts before construction, where site staff are recruited, site preparation takes place and planning of the works[3]. Site managers are responsible for monitoring progress, overseeing the delivery of materials and carrying out health and safety checks and addressing problems which could hold up work and cause health risks to

workers[3]. Notwithstanding the role of site managers in ensuring safe and healthy sites, their role has remained underexplored in health and safety research in Ghana. The objectives of this study were therefore to assess the impact of site managers' role on injury rates and near misses on construction sites in Ghana and to identify key challenges confronting them.

SITE MANAGERS' ROLE IN OHS

Occupational health and safety management places emphasis on a tripartite view in which government, companies and labour are responsible for OHS[4,5]. Site managers are the agents of construction companies on construction sites and have a significant role to play in ensuring safe and healthy working environment.

In large infrastructural projects which are likely to be funded from grants from foreign donors, health and safety management will be driven by economic factors, corporate values of the contractors which in most cases will be foreign, international health and safety standards as well as prevailing health and safety regulations. In projects where health and safety officers are not appointed, site managers will directly oversee health and safety issues on site. Other personnel; foremen, gang leaders and operatives contribute in diverse ways in ensuring construction sites are safe and healthy. While literature on the direct role or responsibility of site managers for health and safety matters is rare and under-discussed, the roles and responsibilities of site managers that are implicit in a cohort of studies are summarised in Table 1 below.

Table 1 Summary of roles of site managers implicit in studies.

Citation	Summary of research	OHS Role(s) of Site Managers
6	Investigated the influence of management commitment and supervisors involvement in	Health and safety training and supervision
7	Examined health and safety measures, enforcement mechanisms and challenges in health and safety management on project sites in Nairobi.	Health and safety training and supervision Compliance with OHS regulations
8	Examined the integration of safety planning and control in production planning and control and the impact on human error control	Health and safety planning and designing a safe job
9	Examined effectiveness of safety programmes. Found that job hazard analysis, jobsite inspections, accident investigations, safety record keeping enhances safety performance.	Health and safety planning and designing a safe job
10	Reviewed OHS in the UK.	Health and safety communication
11	Investigated the influence of employees' behaviours on OHS improvement	Health and safety communication
12	Propose and test a framework to foster safe work behaviour among workers on construction sites.	Encouraging safe behaviour
13	Study sought to develop a model to evaluate construction managers' perception of safety.	Review and assessment of OHS

Several challenges arise in the process of implementing health and safety measures on construction sites. In a study on assessment of effectiveness of health and safety interventions in LLMICs, it was found that it is difficult to ensure effective use of personal protective equipment and other measures such as safety education and training, preventive drugs and health examinations may not be effective in reducing occupational injuries and ill health[14]. A similar study conducted in Kenya identified challenges to health and safety as including; inadequate personal and protective equipment, poor maintenance of personal protective gear, lack of top management support in the management of health and safety on construction sites, inadequate enforcement mechanisms, inadequate welfare facilities, absence of health and safety committees and unawareness of health and safety matters among the workers[7]. Other challenges identified by researchers[15, 16] include inadequate resources and low socioeconomic status of workers.

2. METHODS

This study adopted a survey research design and a target population of site managers working with contractors registered with the Association of Building and Civil Engineering Contractors of Ghana (ABCECG) in four selected regions in Ghana. The number of construction firms totalled 680 across the four selected regions. The distribution of contractors in the regions comprised; Greater Accra 300, Ashanti Region 150, Western Region 150 and Brong Ahafo Region 80. A sample size selection table[17] was used to arrive at a sample size of 341. Based on the population of contractors for the four regions, the sample for each of the regions was arrived at as 151, 75, 75 and 40 for Greater Accra, Ashanti Region, Western Region and Brong Ahafo Region respectively. Stratified random sampling technique was used for the study.

The questionnaire was divided into three parts. The first part sought information on the background of respondents and information on accidents of their companies in the year 2014. The second section of the questionnaire asked the respondents to assess the extent to which they agree on health and safety roles they perform. The third section sought respondents' opinion on key challenges confronting site managers in the management of workers' health and safety on sites. A draft of the questionnaires was discussed with health and safety experts and the updated version piloted in a field setting with ten site managers chosen from one region of the country different from the study regions. A cover letter explaining the purpose of the pilot study was attached to each draft questionnaire administered. The cover letter requested the site managers to complete as well as critically assess the questionnaire items based on their expert opinions regarding the clarity of the questionnaire items. Further revision of the draft questionnaire was made based on the comments received. The pilot study took three weeks and was undertaken three months prior to the administration of the final questionnaire. The internal consistency of each factor was determined by examining each item inter-correlation and computing the Cronbach's Alpha. A minimum of 0.7 is generally recommended[18,19,20,21,22]. SPSS version 21.0. for Windows was used to analyse the data. The Kaiser-Meyer-Olkin (KMO) and Bartlett's test were used to check the degree of inter-correlation among the variables and the appropriateness of factor analysis[23]. The KMO value should be greater than an acceptable threshold of 0.5 and a value greater than 0.6 is mediocre, > 0.7 is middling, > 0.8 is meritorious and > 0.9 is marvellous for a factor analysis to proceed[24].

3. RESULTS

A total of 341 questionnaires were distributed to site managers of construction companies in the study regions. One hundred and thirty fours questionnaires were returned, out of which 132 were useable as follows: 29 questionnaires representing (73%) from Brong Ahafo region, 31questionnaires representing (21%) from Greater Accra region, 34 questionnaires representing (45%) from Ashanti region and 38 questionnaires representing (51%) from Western region[25,26,27].

4. DEMOGRAPHIC CHARACTERISTICS

A total of 109 males representing 83% took part in the survey while their female counterparts were 23 representing 17%.The age distribution of the respondents showed that 17 (12%) were younger than 30 years old, 59 (45%) respondents were between 30-39 years old, while 43 (33%) respondents were within ages 40-49 years. Thirteen (10%) respondents were older than 50

years. Age cohorts of workers play a significant part in the development of people's perceptions[28]. Thus, workers of different age cohorts have different strength and perceptions towards activities performed. This, in part, suggests that, majority of the respondents were matured enough to answer the questionnaire very well. Categorising the respondents according to their highest educational attainment, 41% representing 54 had Bachelor's Degree and 28% representing 37 had Higher National Diploma (HND). Also, 5% (4) of the respondents said they had postgraduate educational qualifications and 26% representing 35 had construction technician qualifications. Respondents with higher levels of education are likely to have better understanding of OHS responsibilities through academic training in their fields of study compared to those with lower level of educations.

The responses on working experience showed that 29% of the respondents had less than five years' experience as site manager, 31% had between 5-10 years of experience, 15% had experience exceeding 10 years but less than 15 years, 11% had 15-20 years' experience, while 14% had over 20 years working experience. The responses suggest that the respondents had fairly long experience on their job.

5. ACCIDENT PROFILE OF RESPONDENTS' PROJECT SITES

Accident profiles of the construction sites managed by the site managers was used as measure of the health and safety standard/ performance of the companies. Among the standards, minor injuries requiring less than one day off work recorded the sum of 608 accident cases with the range of 73 with a highest mean score of 4.61. On the other hand, minor injuries requiring 1-3 day off work also recorded the sum of 181 cases with the range of 12 and mean score of 1.37. Again, minor injuries requiring 4 or more days off work recorded the sum of 90 accident cases with the range of 6 and mean score of 0.68. Also, the number of fatal injuries recorded in the year 2014 was 48 with the range of 10 and mean value of 0.36. Finally, near misses recorded a total of 328 accident cases with the range of 24 and mean score of 2.48.

6. CORRELATION BETWEEN SITE MANAGERS' ROLES AND OHS PERFORMANCE

The test of association between site managers' roles and health and safety standards involved test of five (5) hypotheses using Pearson's correlation test at $P \leq 0.05$. The test involved five (5) health and safety standards (accident profiles) against seven (7) site managers' roles shown in Table 2.

Table 2: Results of Pearson correlation between Health and Safety standards and site manager's roles

	Designing a safe job	Encouraging safe behaviour	Effective Safety training	Safety communication	Health and safety planning	Compliance with Regulation	Assessment and review
Minor injuries requiring < 1 day off work	-0.055 (0.529)	-0.038 (0.667)	0.208* (0.017)	0.165 (0.059)	0.130 (0.137)	0.154 (0.077)	0.093 (0.287)
Minor injuries requiring 1-3 day off	-0.235** (0.007)	-0.186* (0.032)	0.006 (0.949)	-0.059 (0.502)	-0.070 (0.424)	0.007 (0.940)	-0.111 (0.203)
Minor injuries requiring = 4 days off work	-0.206* (0.018)	-0.267** (0.002)	-0.073 (0.406)	-0.172* (0.058)	-0.106 (0.226)	-0.108 (0.216)	-0.106 (0.228)
Fatal injuries	-0.113 (0.195)	-0.242** (0.005)	-0.219* (0.012)	0.086 (0.329)	-0.035 (0.692)	-0.136 (0.121)	-0.076 (0.384)
Near Miss	0.006 (0.942)	0.023 (0.790)	0.033 (0.711)	0.104 (0.234)	0.114 (0.195)	0.105 (0.232)	0.107 (0.221)

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

The first hypothesis tested the null hypothesis that there is no significant correlation between the standard "minor injuries requiring one day off work" and site managers' roles. The results revealed that, the standard "minor injuries requiring 1 day off work" is significantly associated with safety training (0.208*; 0.017) having the P-value below the bench mark of (0.050), hence the null hypothesis is rejected. The remaining 6 roles had their P-values greater than critical value of 0.050. The six roles included; designing a safe job (-0.055; 0.529), encouraging safe behaviour (-0.038; 0.667), safety communication (0.165; 0.059), health and safety planning (0.130; 0.137), compliance with regulation (0.154; 0.077) and assessment and review (0.093; 0.287). The null hypotheses that there is no significant correlation between minor injuries requiring one day off work and the other 6 site managers' roles are tenable. In view of this, the alternative hypothesis that there is a significant correlation is untenable.

The second hypothesis tested the null hypothesis that there is no significant correlation between the standard "minor injuries requiring 1-3 day off work" and site managers' roles. Minor injuries requiring 1-3 day off work was associated with health and safety roles of designing a safe job (-0.235**; 0.007) and encouraging safe behaviour (-0.186*; 0.032) having their P- values below the bench mark of (0.050), hence the null hypothesis that there is no significant correlation between the standard "minor injuries requiring 1-3 day off work" and site managers' roles was untenable. The alternative hypothesis that there is significant correlation was therefore tenable. Specifically, there exist significant but weak correlation between designing a safe job, encouraging safe behaviour and the standard "minor injuries requiring 1-3 day off work". The remaining 5 roles had their P-values greater than the threshold of 0.050. The five roles included; effective safety training (0.006; 0.949), safety communication (-0.059; 0.502), health and safety planning (-0.070; 0.424), compliance with regulation (0.007; 0.940) and assessment and review (-0.111; 0.203). The null hypothesis, in this case, is tenable.

The third hypothesis was to test the null hypothesis that there is no significant correlation between the standard "minor injuries requiring 4 days or more off work" and site managers' roles. The results showed that significant correlation exist between "minor injuries requiring four or more days off work" and two of the site managers' roles namely designing a safe job (-0.206*; 0.018) and encouraging safe behaviour (-0.267**; 0.002). The null hypothesis for these two site managers' roles is untenable. The alternative hypothesis that there is significant correlation is tenable. The remaining 5 site managers' roles have their P-values greater than the threshold value of 0.050 as follows; effective safety training (-0.073; 0.406), safety communication (-0.172*; 0.058), health and safety planning (-0.106; 0.226), compliance with regulation (-0.108; 0.216) and assessment and review (-0.106; 0.228), and hence the null hypothesis for these five site managers' roles is considered tenable and the alternative hypothesis that there is significant correlation is untenable.

The fourth hypothesis tested was the null hypothesis that there is no significant correlation between the standard "fatal injuries" and site managers' roles. The results suggest a significant but weak correlation exist between "fatal injuries" and encouraging safe behaviour (-0.242**; 0.005) as well as effective safety training (-0.219*; 0.012). The null hypothesis in relation to these two site managers' roles is untenable and the alternative hypothesis that there is a significant association is tenable. The values of the coefficients suggest the strength of the association in either case is weak; that is effective safety training, encouraging safe behaviour and "fatal injuries". The remaining 5 other roles had P-values greater than the threshold value of 0.050 namely; designing a safe job (-0.113; 0.195), safety communication (0.086; 0.329), health and safety planning (-0.035; 0.692), compliance with regulation (-0.136; 0.121) and assessment and review (-0.076; 0.384), and hence the null hypotheses in relation to these five site managers' roles are found to be tenable. The alternative hypotheses that there is significant correlation between 'fatal injuries' and the 5 site managers' roles is untenable.

The fifth test was the null hypothesis that there is no significant correlation between the standard "near misses" and site managers' roles. The test of the null hypothesis that there is no significant correlation between "near misses" and site managers' roles yielded; designing a safe job (0.006; 0.942), encouraging safe behaviour (0.023; 0.790), effective safety training (0.033; 0.711), safety communication (0.104; 0.234),

health and safety planning (0.114; 0.195), compliance with regulation (0.105; 0.232) and assessment and review (0.107; 0.221). Three of the site managers' roles namely; designing safe job, safety training and encouraging safe behaviour have significant but weak correlation with "near misses". The null hypothesis that there is no significant correlation between "near misses" and site managers' roles of; designing safe job, safety training and encouraging safe behaviour was found to be untenable and the alternative hypothesis tenable. The four other roles were not significantly correlated with "near misses".

7. CHALLENGES CONFRONTING SITE MANAGERS IN OHS MANAGEMENT

The KMO value was within an acceptable value of 0.805 and Bartlett test of sphericity showed overall significance of the correlation matrix at 0.000 level of significance. The communalities achieved were also 1.00. These measures indicate that the 15 variables were appropriate for the factor analysis. Principal components extraction with varimax rotation was carried out. The Kaiser criterion (eigenvalue >1) was employed in conjunction with evaluation of scree plots. The rotated component matrix indicates that 10 out of the original 15 variables could be the underlying themes of four main factors (using a cut-off point of 0.70) shown in Table 3 below.

Table 3: Rotated component matrix of challenges confronting site managers

Table 3: Rotated component matrix of challenges confronting site managers

Challenges to managing health and safety	Component			
	1	2	3	4
Health and safety management system imposed by management without consultation	.250	.227	.822	.035
Health and safety communication	.220	.277	.764	.091
Inadequate resources	.374	.452	.564	.013
Limited accountability mechanisms	.850	-.010	.196	.141
Words unsupported by practice	.505	.372	.500	.071
Health and Safety activities restricted to technical experts	.233	.597	.352	.013
High labour turnover	.820	.207	.066	.136
Extensive casual and temporary workforce	.845	.170	.063	.094
Inadequate training of employees in safety	.793	.170	.367	.046
Small firm with limited resources and unfamiliar with system concept	.072	.836	.073	.009
Hired labour working among multiple construction companies	.174	.875	.185	.038
Low literacy levels and poor perceptions of hazards	.143	.798	.341	-.031
Principal contractor simply requires sub-contractor to have safety management system	.230	-.108	-.461	.575
Principal contractor imposes health and safety management system on subcontractor	.270	-.046	.113	.853
Subcontractor's safety management system inconsistent with principal contractor's	-.177	.465	.405	.621

Rotation method: Varimax with Kaiser Normalisation, rotation converged in 6 iterations.

With respect to factor 1, limited accountability mechanisms emerged highest with a factor loading of 0.850, followed by extensive casual and temporary workforce (0.845), high labour turnover (0.820), inadequate training of employees in health and safety (0.793). Site managers, to a large extent, have very limited control over these issues on site and they are dependent on the extent of their empowerment. In regard, these issues were labelled as limited empowerment and accountability related factors. Factor 2 comprised hired labour working among multiple companies emerged highest with a loading of 0.875, followed by small firm with limited resources and unfamiliar with health and safety management system (0.836), and low literacy levels and poor perceptions of hazards (0.798). These factors are all fundamentally linked to worker related factors and labelled as such. The third factor comprised health and safety management system imposed by management without consultation with a loading of 0.822, followed by health and safety communication (0.764). The two variables relate to workers involvement in and communication on OHS matters and labelled as communication and participation in OHS matters. Factor 4 was labelled as principal contractor's imposed health and safety management system with a loading of (0.853). The variance explained suggested the contribution of the factors as follows; factor 1 accounted for 42.00% of the variance, factor 2 accounted for 15.41% of the variance, factor 3 8.810% of the variance and factor 4 6.814%. Together, the four identified factors accounted for 73% of the variance.

8. DISCUSSION

CORRELATION BETWEEN SITE MANAGERS' ROLES AND OHS PERFORMANCE

The results suggest that no significant association exists between site managers' roles and health and safety performance except health and safety training. Minor injuries requiring one day off work have significant but weak correlation with health and safety training of workers on construction sites. A plausible explanation may be that the attention given to health and safety training of workers by site managers may not be adequate and as a result workers would not have full information about construction site health and safety issues. This may lead to moderate or poor health and safety performance of construction sites. Although this finding tends to agree with the assertion that lack of adequate health and safety training contributes to site accidents due to poor knowledge of workers on health and safety issues[29], it is necessary to draw a caution that site managers' responses about their roles regarding health and safety may be exaggerated. Similarly, it was observed that the level of attention paid by site managers with respect to other aspects of their roles such as; designing safe job, encouraging safe behaviour, safety communication, health and safety planning, compliance with regulation as well as assessment and review of safety may be high, these roles were not associated with minor injuries requiring one day off work.

Also, the results suggests that the standard, "minor injuries requiring 1-3 days off work" had significant but weak correlation with two (2) roles performed by site managers, that is, designing a healthy and safe job and encouraging healthy and safe behaviour. Labour standards and health and safety regulations require employers (contractors) to ensure that construction sites are safe and healthy for workers to work within. Compliance with this requirement can be achieved through the design of jobs or their redesign after hazards are detected on sites[30, 9.] The extent to which such a role is accomplished could lead to reductions in accidents or improvements in health and safety performance of construction sites. This partly depends on the commitment of top management and site level management which includes site managers. The impact of healthy and safe design on health and safety performance can be considerable if the constructor is involved early in the procurement process. That notwithstanding, site managers, through their training are appreciative of healthy and safe systems of work and the extent to which they ensure healthy and safe systems of work depend on complex interrelated factors such as; personal motivation, pressure to comply with the law, time pressures, demands of the project and their empowerment to do so. Also, the association found between encouraging healthy and safe behaviour and injuries requiring 1-3 days off work is consistent with past literature[31]. The fact that there was no correlation between "minor injuries requiring 1-3 days off work" and the five other health and safety roles of site managers namely; effective health and safety training, health and safety communication, health and safety planning, compliance with regulation and assessment and review could be attributable to the interplay of the aforementioned complex factors influencing the degree to which site managers will exercise their role.

Again, the correlation between designing a healthy and safe job and encouraging healthy and safe behaviour and "minor injuries requiring four days or more off work" were found to be significant though weak. Though, site managers may try as they can to influence the behaviour of site operatives to achieve high health and safety performance, such achievements are mediated by workers' poor perception of compliance with health and safety requirements leading to negative behaviour and, consequently poor health and safety performance[32].Healthy and safe design of job will influence "minor injuries requiring four days or more off work" similar to "minor injuries requiring 1-3 day off work" as stated earlier. Interestingly, "minor injuries requiring four days or more off work" were found to have no association with other site managers' roles including; health and safety training, health and safety communication, health and safety planning, compliance with regulation and assessment and review. Plausibly, the level of priority accorded to these roles in comparison with other equally important roles such as ensuring project quality, completion of projective on schedule and within budget, environmental concerns may not be the same and therefore account for the lack of association between "minor injuries requiring four days or more off work" and these site manager's health and safety roles. Again, enforcement of health and safety laws in developing countries including Ghana is generally poor due to structural, logistical and resource constraints[7, 15, 33] and this could translate into lesser priority being accorded to site health and safety issues and less emphasis on site managers' health and safety functions.

The results suggest a significant but weak correlation between "fatal injuries" and two roles played by site managers namely encouraging healthy and safe behaviour and health and safety training. Fatal injuries can result if workers exposure to hazards is very high. Exposure to hazards can be minimised through proper use of personal protective equipment. Proper training is necessary to enable the correct use of personal protective equipment. The absence of effective training regime could lead to improper/lack of use of personal protective equipment. Again, a positive attitude is important in ensuring workers follow health and safety rules and healthy and safe procedures of work. Training and feedback, particularly geared at behavioural change have been shown to enhance health and safety performance[34, 35]. Additionally, encouraging healthy and safe behaviour will strengthen positive health and safety attitudes developed through training and feedback. In the present study there was no correlation between "fatal injuries" and five other roles of site managers namely; designing a healthy and safe job, health and safety communication, health and safety planning, compliance with regulation, and assessment and review.

Site managers' health and safety roles, namely; health and safety training, designing healthy and safe job and encouraging healthy and safe behaviour were found to have significant but weak correlation with "near misses". This result is consistent with the trend observed in which the previously stated three roles are significantly, albeit weakly correlated with the other four measures of OHS performance. Near misses can be averted if site workers are adequately trained and site activities are designed in a manner that the risk of accidents are minimal. Also, encouraging healthy and safe behaviour would similarly lead to significant reductions in near occurrences. The weak correlation between near misses and health and safety training, encouraging healthy and safe behaviour and designing healthy and safe job in the present study is, to some extent, consistent with findings of other studies in which there was no established empirical evidence of the effectiveness of health and safety training in similar settings[14].

9. KEY CHALLENGES TO MANAGING OHS

The factor extraction was under 4 components which were labelled as four major challenges. The results of the study revealed limited empowerment and accountability mechanisms as a key challenge facing site managers in the study. For OHS to be effectively managed, empowerment of the workforce to make health and safety decisions is necessary. Limited empowerment and accountability mechanisms will lead to less priority being accorded to OHS matters as generally observed in literature[36, 15, 14, 7]. Time pressures and cost control are often issues accorded a high priority on construction sites. In such situations and where enforcement of OHS law is lax, it is unlikely that site managers will accord OHS the desired level of priority. Worker related factors posed a challenge to site managers. Invariably, budget allocations for health and safety training are meagre and literacy levels of site workers are low coupled with the fact that hired labour need more time to adjust to the

work environment. Such a work environment will frustrate site managers' efforts in managing OHS. Shortage of skilled labour will mean that most site workers may not be competent enough in safe and healthy working procedures and thereby present a challenge to site managers. These and other characteristics of workers including age, have been shown to affect health and safety standards on sites[37].

Poor communication and participation in OHS matters was also a challenge facing the site managers. Given the low levels of unionisation in construction[7], it is unlikely that site workers would be adequately represented on safety committees or involved in safety matters. Health and safety communication is a skill that should be acquired but given the huge number of site workers with varied backgrounds, effectively communicating on safety matters can be a highly challenging task. Health and safety communication occurs at two levels; health and safety communication by site management which is vertical and lateral communication among site workers. Language barriers often exist between workers from different ethnic backgrounds who might not have acquired a second common language apart from their first language or 'mother tongue'. The fourth challenge identified was health and safety management systems imposed by principal or main contractors on subcontractors. In instances where subcontractors' workers may not be familiar with the health and safety culture of main contractor much effort has to be spent ensuring that workers develop the necessary healthy and safe attitudes and behaviours desired by the main contractor. Further qualitative research on these challenges is necessary to provide more insightful findings on the nature of these challenges and finding strategies to overcome them.

10. CONCLUSION

The findings of the correlation analysis suggest that site managers have very little or no impact on accidents on construction sites. This has implications for health and safety policy of contracting organisations. Further research need to be conducted using subjective measures such as workers perceptions about measures put in place to ensure construction sites are safe and healthy. Notwithstanding this limitation of the study, the findings suggest the need to strengthen site managers' health and safety roles. Further findings on challenges confronting site managers echo the need to empower site managers and site workers in matters relating to OHS.

11. REFERENCES

1 Filmer, D., & Fox, L. (2014). Youth Employment in Sub-Saharan Africa. Africa Development Series. Washington, DC: World Bank. doi:10.1596/978-1-4648-0107-5. License: Creative Commons Attribution CC BY 3.0

2 Bigelow, P., Gilkey, D., Greenstein, S., & Keefe, T. (1997). Development of an on-site, behavioural-based safety audit for the residential construction industry. Work, 11, 11-20.

3 Eaton, A., & Nocerino, T. (2000). The effectiveness of health and safety committees: Results of a Survey of Public Sector Workplaces. Industrial Relations, 39(2), 265-90.

4 Alli, B. O. (2008). Fundamental principles of occupational health and safety, 2nd Edition. International Labour Office – Geneva: ILO, 2008.

5 Leamon, T.B. (2001). The Future of Occupational Safety and Health, International Journal of Occupational Safety and Ergonomics, 7:4, 403-408.

6 Yule, S., Flin, R. & Murdy, A. (2007). The Role of Management and Safety Climate in Preventing Risk Taking at Work. International Journal of Risk Assessment and Management, 7 (2), pp. 137-151.

7 Muiruri, G., & Mulinge, C. (2014). Health and Safety Management on Construction Project Sites in Kenya, Engaging the Challenges, Enhancing the Relevance. XXV FIG Congress, Kuala Lumpur, Malaysia 16-21 June 2014. Accessed on June 24, 2016 from:http://www.fig.net/resources/proceedings/fig_proceedings/fig2014/techprog.htm

8 Saurin, T. A., Formoso, C.T., & Cambraia, F.B. (2007). Analysis of a safety planning and control model from the human error

perspective. Engineering, Construction and Architectural Management. Volume 12 (3) 283-298.

9 Arksorn, T., & Hadikusumo, B. H. W. (2008). Measuring effectiveness of safety programmes in the Thai construction industry. Construction Management and Economics, 26, 409- 421.

10 Baxendale, T., & Jones, O. (2000). Construction design and construction management safety regulations in practices- progress and implementation. International Journal of Project Management, Vol1 8, pp.33-40.

11 Sulastre, M.Z., & Ishmail, F. (2012). Employers' Behavioural Safety Compliance Factors toward Occupational, Safety and Health Improvement in the Construction Industry. Social and Behavioral Sciences, Vol. 36 pp. 742-751.

12 Evelyn, A. L. T., Florence, Y. Y. Y., & Derrick, S. Y. O. (2005). Fostering safe work behaviour in workers at construction sites. Journal of Engineering, Construction and Architectural Management, 12(4), 410-422.

13 Chen W.T., Lu S.C., & Wang, M. (2013). Measuring the perception of safety among Taiwan construction managers, Journal of Civil Engineering and Management 19(1) pp. 37-48, DOI: 10.3846/13923730.2012.734852.

14 Verbeek J. & Ivanov I. (2013). Essential occupational safety and health interventions for Low- and Middle-Income Countries: An overview of the evidence. Safety and Health at Work Vol. 4 77-83.

15 Kheni, N.A., Gibb, A.G.F. & Dainty, A.R.J. (2010). Health and Safety Management within SMEs in Developing Countries: A Study of Contextual Influences. Journal of Construction Engineering and Management. Vol.136 (10) 1104–1115.

16 Yankah, K (2012). Health and Safety management practices by building contractors in the Ashanti region, Ghana. Unpublished MSc. Dissertation, Faculty of Architecture and Building Technology, KNUST, Kumasi, Ghana.

17 Bartlett J.E., Kotrlik, J.W. & Higgins, C.C. (2001). Organizational Research: Determining Appropriate Sample Size in Survey Research. Information Technology, Learning, and Performance Journal, Vol. 19, No. 1 pp.43-50.

18 Nunnally, J.C. (1978). Psychometric Theory, 2nd Edition, McGraw-Hill, New York.

19 Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests, Psychometrika, 16, pp. 297-334.

20 Malhotra, M. K., & Grover, V. (1998). An Assessment of survey research in POM, from constructs to theory. Journal of Operations Management, Vol., 16, pp., 407-425.

21 Conca, F. J., Llopis, J., & Tari, J. J. (2004).Development of a measure to assess quality management in certified firms. Journal of Operational Research, Vol.

156, pp. 683-697.

22 Hair, J.F., Anderson, R. E., Tatham, R.L., & Black, W.C., (2006). Multivariate Data Analysis with Reading, Prentice-Hall, Englewood Cliffs, NJ.

23 Field, A. (2005). Discovering Statistics using SPSS for Windows, London: Sage.

24 Darren, G., & Mallery, P. (2006). SPSS for Windows Step-by-Step: A simple guide and reference, 13.0 update. 7th Ed. Allyn &

Bacon, Boston, MA.

25 Oladapo, A. A. (2005). An Investigation into the Use of ICT in the Nigerian Construction Industry, accessed on November 30, 2015 from: Http://Www.Itcon.Org/Data/Works/Att/2007_18Content.02391.Pdf

Economics, Vol. 20, pp. 13-19.

26 Idrus, A.B. & Newman, J.B. (2002). Construction related factors influencing choice of concrete floor systems, Construction Management and

27 Elhag T. M. S.,& Boussabaine A. H. (1999). Evaluation of Construction Costs and Time Attributes, Proceedings of the 15th ARCOM Conference. Vol. 2, Liverpool: John Moores University,pp 473-480.

28 Ferguson, A. E., & Mulwafu, W. O. (2004). Decentralisation, participation and access to water resources in Malawi. Retrieved on May 26, 2014 from: http://www.basis.wisc.edu

29 O'Toole, M. (2002). The Relationship between Employees' Perceptions of Safety and Organizational Culture. Journal of Safety Research, 33, 231-243.

30 Hughes, P., & Ferrelt, E. (2008). Introduction to health and safety in construction industry (3rd Ed.). New York: Butterworth-Heinemann, Imprint of Elsevier.

31 Johnson, S.E. (2003). Behavioural safety theory: Understanding the theoretical foundation. Journal of Professional Safety, 48 (10), pp.39-43.

32 Jamal-Khan, M.K. (2003). Determinants of Occupational Safety and Health Performance in Small and Medium Manufacturing Settings. Unpublished PhD Thesis. Sintok, Kedah; University Utara Malaysia.

33 Cotton, A. P., Sohail, M., & Scott, R.E. (2005). Towards improved labour standards for construction of minor works in low income countries. Engineering, Construction and Architectural Management, 12(6), 617–32.

34 Duff, A. R., Robertson O. T., Philips, R. A., & Cooper, M. D. (1994). Improving safety by the modification of behaviour. Journal of Construction Management and Economics, 12, 67-78.

35 Komaki, J., Heinzmann, A.T., & Lawson, L. (1980). Effect of training and feedback: Component analysis of behavioural safety program. Journal of applied psychology, 65(3), 261-70.

36 Mwombeki, F. K. (2005). Occupational health and safety challenges in construction sites in Tanzania. Proc., W99 Triennial Int. Conf.: Rethinking and Revitalizing Construction Safety, Health, Environment and Quality, Construction Research Education and Training Enterprises, Port Elizabeth, South Africa, pp778–789.

37 Che Hassan, C.R., Basha, O.J., & Wan Hanafi, W.H. (2007). Perception of Building Construction Workers towards Safety, Health and Environment, Journal of Engineering Science and Technology, 2(3), 271-279.

USE OF FOCUS GROUPS AS RESEARCH METHOD IN THE BUILT ENVIRONMENT

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ABSTRACT

Purpose

Conducting research requires the use of a suitable research method to ensure that the objectives of a research study are achieved. Focus group research is a qualitative research method whereby researchers will talk to people in order to deepen their understanding about a certain topic. Focus groups as research method have predominantly been used in marketing, social science and healthcare research. Little research was found on the use of focus groups as research method in the built environment specifically. The purpose of this research paper was to determine if the use of focus groups in the built environment will be an effective empirical research method.

Methodology

Focus group sessions were conducted to investigate the job satisfaction of generation Y quantity surveyors. The research participants selected were generation Y quantity surveyors between the ages 25 - 34. The size of the focus groups was between 8 - 10 participants. Data were collected through digital recordings of group discussions, taking of notes and observing the group's reaction and interaction. Upon completion of the focus group sessions the data was readily available for data analysis purposes.

Findings

It was found that the use of focus groups in the built environment has proven to be a successful empirical research method. Research participants contributed valuable, real time and in-depth research data that could be used effectively to answer the research questions. Planning and organising focus groups should not be underestimated as it is a time consuming process. Factors contributing towards the successful outcome when conducting focus groups are recruiting suitable research participants; making use of a skilled facilitator and the timing of when to host the focus group.

Research limitations

This research study was limited to generation Y quantity surveyors in South Africa between the ages of 25 - 34.

Value

This study is of value to researchers within the built environment as it indicates that the use of focus groups as qualitative research method can be a successful and effective in terms of empirical research.

Keywords: Focus Groups, Research Methodology, Built Environment, Quantity Surveying

1. INTRODUCTION

When conducting research it is necessary to apply a suitable research methodology to ensure that the set objectives of the study are achieved. Research can be conducted using qualitative or quantitative research methods or where required a combination of both these methods. Qualitative research can be associated with the basis word "quality" and quantitative research can be associated with the basis word "quantity"[1]. Quantitative research will for example require the use of surveys to obtain numerical or statistical data and qualitative research will for example require talking to people to deepen our understanding about a certain topic[1]. Focus groups as research method can therefore be

classified as a qualitative research method.

Focus groups as research method was borrowed from marketing research and incorporated into social sciences and have also become one of the most common qualitative research methods used in healthcare research. It has also been used by researchers in the social and behavioural sciences for more than 80 years[2,3,4]. Little research was found on the use of focus groups as research method in the built environment specifically.

The research topic under investigation for this study was the job satisfaction of generation Y quantity surveyors making use of focus groups as research methodology. This research topic required a research method that would be able to engage research participants face to face in order to obtain real-time conversations, opinions, insights, feelings, perspectives and attitudes currently relevant to this research topic. Generation Y is a socially connected generation and they enjoy working in groups[5,6].

The use of focus groups as research method related to these characteristics of generation Y. Applying a research methodology that generation Y could relate to was an effective way to obtain the required research data. Focus groups were thus selected as qualitative research method to investigate this topic. The purpose of this article was to determine if the use of focus groups within the built environment will be an effective empirical research method.

2. LITERATURE

A great strength of qualitative research is its potential to explore a topic in depth[7]. Qualitative research is a research method that collects research data by gaining rich insight and understanding of people's personal experiences, perceptions, beliefs, feelings, attitudes and meanings within the context of their circumstances[8,9,2,10,11].

Focus groups are a way of collecting data by engaging a small number of people in an informal group discussion[12,13,14]. The objective of focus groups is to acquire information based on the perceptions, beliefs, traditions and values of its participants[15]. Focus group research requires the researcher to engage themselves in other people's lives[16,3]. Literature found on various aspects relating to the effective use of focus groups is discussed below.

Focus Group Environment

The venue selected to host a focus group must be accessible to all participants, comfortable, private, quiet and free from distractions. Equally important is to make use of a good quality multi-directional external microphone to record the focus group session for analysing purposes[2]. This research made use of recordings for later data analysis.

Focus Group Size / Participants / Group Composition

The composition of a focus group is very important as it impacts on the quality of discussion. There is no best solution to group composition and the researcher will have to give consideration to how the group will interact with each other before selecting the group participants. Another factor to consider when selecting the number of participants is the contribution that each participant will be able to make. If each participant can provide a large amount of information about the topic it will be more effective to use a smaller group and vice versa[2,3].

The size of the focus group is closely related to recruitment conditions and research purposes[13]. It is usually better to over-recruit for a focus group than under-recruit and risk having to cancel the focus group session[2].

Research has indicated that there are various opinions regarding the size of a focus group. Some research indicates focus groups to be between 6 - 10 participants, others state that a focus group size can vary between 4 - 20 participants or be limited to 5 - 12 people to allow opportunity for full participation by all participants[3,4,10,13.]
The optimal size for a focus group is between 8 - 10 people although focus groups can also be conducted successfully using as little as 3 participants or as many as 14[2,11]. Despite the lack of consensus of the size of the focus group participants, this research study used between 8 – 10 people.

The purpose of the research topic will determine the composition of the focus group. Factors relating to the composition of a group are among other, age, gender, educational background and

experience and knowledge about the research topic. It is important to give thought to how the group will interact with each other when selecting research participants. Strangers are more likely to freely share their thoughts and opinions when among people they are unlikely to meet again[3].

Focus Group Facilitation

A highly skilled facilitator is the most important requirement for conducting a focus group successfully[10]. The facilitator of a focus group should guide the group discussion without joining in or leading it and is key to gathering rich and valid insights from participants[2,3].

The facilitator should refrain from expressing personal views as this may cue participants into what they think they should be answering rather than giving their honest opinions. It is important for the facilitator to not let the discussion be dominated by one person and to allow all participants the opportunity to express their views[2]. The facilitator used for this research study was a qualified educational psychologist and who has prior focus group facilitation experience.

Focus Group Duration

The duration of a focus group can be between 1 and 2 hours depending on the number of questions for discussion. It order to estimate the time needed for the focus group consideration should be given to the time needed to discuss each question. Enough time should be allowed to obtain in depth information. Equally important the intellectual capacity of research participants should not be strained and preferably focus groups sessions should not exceed 2 hours[3]. The focus groups undertaken in this research adhered to this.

Number of Focus Groups

The research question itself should guide researchers to decide how many focus groups are needed and why[17]. Fewer than two groups can raise a concern of true representation for adequate data collection. There are different opinions in this regard as some researchers suggest that several focus groups should be conducted, others suggest between three and twelve focus groups while some feel that even one focus group may well be enough[4]. The notion of saturation is a useful concept to apply and states that focus groups can end when no new information is gathered[4]. This study ended with two focus groups as the core information obtained from both these groups was similar and no new information was gathered.

3. METHODOLOGY

The research methodology refers to how the research was conducted in terms of when and where it took place, who was involved in the research and how the data collection process worked. It basically addresses the "who, when, where and what" aspects of the empirical research.

Sampling Method

For validity and saturation of data collection for this research study, two focus groups were conducted. The first focus group was conducted in Gauteng (Pretoria) and the second focus group was conducted in Kwazulu-Natal (Umhlanga). The selection criteria for these two provinces were firstly based on the quantity surveying (QS) statistics provided by South African Council for the Quantity Surveying Profession (SACQSP) which reflected that as at June 2015 Gauteng and Kwazulu-Natal were among the top three provinces holding the largest number of quantity surveyors per province. Secondly these provinces were selected because of their cultural and ethnic diversities which are a good representation of the various working professionals within the quantity surveying profession.

The target sample for this research study was generation Y quantity surveyors. The research sample included both professional quantity surveyors and candidate quantity surveyors. To ensure a diverse representation of research participants, the candidates where profiled according to gender, race and years of work experience. Each of these aspects may contribute to different viewpoints, perceptions, feelings, experiences and attitudes towards the workplace and job satisfaction. It was imperative that the group dynamic was representative of all these aspects to ensure a true and honest reflection of generation Y quantity surveyors as a whole. Research participants meeting the above mentioned profile aspects where selected at random and invited to attend the focus group.
Mainly quantity surveying firms were approached and consent was obtained to engage with their generation Y quantity surveyors. A total of 35 invitations to participate in the focus group

research were sent out of which 19 was accepted. One participant was unable to attend on the day which resulted in 8 participants for Gauteng and 10 participants for Kwazulu-Natal.

Sampling Size

To ensure group efficiency and effective data collection this research recruited between 8 and 10 people per focus group.

The Gauteng focus group comprised of the following profile aspects:

Gender	Race	Years' Experience
Male - 3	Black - 1	1 - 2 years = 2
Female - 5	White - 4	3 - 5 years = 3
	Indian - 3	6 - 10 years = 3

The Kwazulu-Natal focus group comprised of the following profile aspects:

Gender	Race	Years' Experience
Male - 7	Black - 3	1 - 2 years = 0
Female - 3	White - 3	3 - 5 years = 4
	Indian - 4	6 - 10 years = 5
		>10 years = 1

Both focus groups were considered to be balanced between the various profile aspects and thus representative of the relevant gender, race and experience levels required for data collection purposes for this research study.

Data Collection

Focus groups were structured as a half day workshop at a conference facility including tea time and lunch. The focus group sessions were facilitated by an independent facilitator with no bias towards the quantity surveying profession, any individual or company included in the research focus groups. The facilitator used for this research study is a qualified educational psychologist who has prior focus group facilitation experience. The time and contribution of each participant was considered valuable and the Association of South African Quantity Surveyors (ASAQS) and South African Council for the Quantity Surveying Profession (SACQSP) were approached and agreed to support this research by means of awarding continuing professional development (CPD) hours to each participant.

The focus group sessions were conducted according to the following sequence:

- Welcome and introduction;
- Discussion of first set of questions;
- Tea/coffee break;
- Discussion of second set of questions;
- Closing of session; and
- Lunch and departure.

The overall time engaging with research participants in a group discussion was 2.5 hours to 3 hours. Upon completion of these focus groups the required research data was collected and readily available for data analysis purposes.

The nine research questions/topics selected, held strong relevance to the research topic and ranged from general questions to more detailed questions. The first few discussion questions were more general in nature to get participants comfortable in the focus group environment and stimulate the group conversation in general. From there on the focus of the group discussion moved towards more in depth questions.

Each focus group was asked the same nine questions/topics for discussion. The responses received were spontaneous, real and honest contributions. All participants were given ample opportunity to share their opinions and ideas about the relevant questions/topics. In some instances discussion and opinions within the group were further stimulated and built on ideas and conversations of group members beyond the parameters of the initial question. This provided in-depth insight and understanding of the research topic at hand.

Response Rate

All participants invited to attend the focus group sessions were present on the day and participated, by willingly engaging in the group discussions.

Data Analysis

A good quality multi-directional external microphone was used to record the focus group session for data analysis purposes. These recordings also serve as detailed record of what was discussed and to refer back to should there be any uncertainties. Further to this the primary researcher took summarised notes of the main points that were discussed during the course of the focus group session. The researchers also observed from the background the facilitation process which allowed them to take note of the

effectiveness of this research method and interaction between participants. Making use of recordings, notes and observations, data was analysed in detail and answers formulated for each research question/topic.

Limitations

The research topic specifically refers to generation Y within the quantity surveying profession. Therefore the target sample for this research study was limited to generation Y quantity surveyors in South Africa. The research participants were limited to quantity surveyors born during 1981 to 1990 (between ages 25 and 34) as they, according to the SACQSP QS statistics as at June 2015, make up more than 90% of generation Y quantity surveyors[18]. The conducting of focus group sessions were delimited to two provinces only namely Gauteng and Kwazulu-Natal. Only one focus group session was held in each province. This study ended with two focus groups as the core information obtained from both these groups was similar and no new information was gathered.

Consent

A very important aspect of the empirical research was to obtain the necessary consent not only from individuals participating in the research but also consent from their employers. Consent is whereby employers and individuals willingly agree to participate in the research study. The first step was to obtain consent from employers. A letter of permission to participate in the research was then sent to employers of all potential research participants to gain the written approval and consent required.

The second step was to obtain individual consent from each research participant. To this extend an informed consent form was sent to each research participant accompanied by a research overview document explaining the details of the research study and research method.

Confidentiality of Information

Confidentiality of personal information as well as information shared must be handled with caution as this could influence group interaction. The confidentiality of information was explained to research participants as part of the research overview document prior to conducting the empirical research. Personal information of research participant as well as the companies they represent remained confidential at all times. Information provided by participants was only accessible to the prime researcher and research supervisor and was available for their exclusive use. The information provided by the participants will remain anonymous when results are published.

4. DISCUSSION OF FINDINGS

The planning and organising that goes into conducting focus groups should not be underestimated. Time is of the essence and it was found that to timeously plan and organise each detail of a focus group is key to the success thereof. The findings of applying focus groups as research method in the built environment are shared below.

Recruiting Research Participants

The most important aspect of a focus group is the research participants. Without them there is no focus group. The starting point of organising focus groups for this research study was thus the research participants. It is important to always consider the time of year when wanting to conduct focus groups as well as the availability of the potential participants during that time. Although there is never real down-time for construction professionals, the few months in the beginning and at the end of the year always seems to be “rush hour” for the quantity surveying profession. During this time QS companies want to get as much done as possible especially before the December builder's break.

This research study conducted focus groups in middle November 2015 and was able to secure enough participants but it did not come without a great effort and many last minute cancellations and substitutions. This is in line with literature that over-recruiting of research participants is necessary[2]. For the quantity surveying profession it will be better to consider conducting focus groups in the middle of the year or at a time that will be most suitable for the required research participants. Securing research participants is an on-going process and can take several weeks. This process should thus run in conjunction with other organisational activities as far as possible.

This research also found that in order to obtain

the interest and co-operation of potential research participants, or at least get them to consider participating, it was necessary to have a good benefit associated with the research study. In this case we were able to reward each participant with 4 hours category 1 Continuing Professional Development (CPD) which seemed to spark the required interest in this research study. It is therefore a good consideration to reward research participants with a benefit or reward that will be appealing to them. This will differ between each focus group depending on the type of participants and research question under investigation.

Obtaining a Suitable Venue

Quantity surveyors are considered to be construction professionals in the built environment and it was thus important to this research study to conduct focus groups of a high professional standard. It was decided to structure the focus group sessions as a half day workshop at a conference facility. The conference facility had to be professional, safe and easily accessible to participants. This research found that it was important to not only select a suitable venue but also to book such conference facilities well in advance. It is equally important to have research funding readily available because many conference facilities require upfront deposits to secure a booking.

Another consideration relating to the venue is how the time will be spent on the venue. People in general have a limited attention and concentration span it is therefore not effective to expose participants to a long duration of intellectual strain. This research allowed for sufficient comfort breaks and refreshments to increase the energy levels of the participants and found it to work very effectively. It was also observed that during the breaks research participants socially interacted with each other. This helped to create a relaxed focus group setting.

Facilitating a Focus Group

A highly skilled facilitator is the most important requirement for conducting a focus group successfully[10]. This research study appointed a skilled and independent facilitator who had no bias towards the quantity surveying profession, QS employers or QS employees involved in the research. The facilitator did have prior experience with conducting focus groups and thus had the required skill and knew how to successfully conduct the focus group sessions. It was imperative to arrange meetings with the facilitator prior to conducting the focus group sessions. These meetings allowed for ideas to be shared and the facilitator to get a clear idea of the research objectives and the most effective way to achieve those objectives. Combining the knowledge and skills of the prime researcher, study leader and facilitator made conducting of focus groups a group effort. It was important to ensure that all three team members had the same understanding of the purpose and objectives in mind.

Having a facilitator ran the focus groups allowed the prime researcher to take up a position of observing and taking note of not only the discussions, but also the reactions and interaction between participants. The prime researcher and study leader were both present during the focus group sessions, and were required to contribute to the group by explaining or clearly defining certain concepts or questions. The facilitator working in conjunction with the prime researcher and study leader ensured that there were never any uncertainties within the group as everything could be explained and clarified instantly. This partnership contributed to the successful facilitation of both focus groups. The validity and reliability of facilitation was enhanced by using the same facilitator for both focus group sessions.

It is important to consider the financial impact of involving a facilitator such as traveling, accommodation and facilitation fees. It was found that the financial expenditure outweighs the value a facilitator adds to the success of a focus group. This research strongly recommends the use of a suitable facilitator when conducting focus groups within the built environment.

Professionalism

Dealing with quantity surveyors as construction professional required not only the venue to be professional, but to also have professionalism in the smallest details. To this extend each seat at the focus group session was specially prepared for participants to ensure they feel welcomed and comfortable when arriving. Each seat was set up with water, mints, a writing pad and pen, a research participant guideline document and a

contact card with the details of the prime researcher. The research participant guideline welcomed and briefly outlined the proceedings of the day so that all participants were aware of the program for the morning.

It was found that to keep the focus group discussion interesting and stimulating required the use of interactive methods of data collection. In some instances research participants were requested to provide answers to questions by first writing down their thoughts, sentences or key words on pieces of coloured paper and to stick them up on the wall for all to see. This created a holistic view and gave everyone an equal opportunity to simultaneously express their opinion. These were then turned into a group discussion where all thoughts and aspects of the questions were discussed. This method was not only visual but helped participants to remember what was discussed and addressed in previous questions. It was found to be an effective method to facilitate the discussion process whilst keeping a holistic view of the overall research topic.

Effectiveness and Usability of Data

This research study found that focus group discussions delivered in-depth data that could be effectively utilised to answer the research questions of the topic under investigation. Valuable information was obtained as research participants were not limited to "yes/no" answers. Participants were given the opportunity to discuss questions in depth and to build on one another's thoughts and opinions. Research participants could also explain or elaborate on their viewpoints so that the meaning thereof was clear to all present. The use of focus group discussions have proven to deliver in depth data and insight into the thoughts of young quantity surveyors. Through a proper facilitation process the data obtained from the focus group discussions were usable and accurate.

5. VALIDITY AND RELIABILITY

Reliability of qualitative research can be thought of as the dependability of the procedures and data produced. Reliability also refers to the extent to which the results of the research are repeatable in different circumstances. Validity in turn is assessed in terms of how well the research tools measure the research topic under investigation[19].

This research study paid particular attention to ensure the validity and reliability of research data. It was important to conduct focus groups representative of the diversity within the quantity surveying profession. To this extend two focus groups were conducted and the number of participants for the first group were 8 and 10 for the second group. In addition to this the composition of both groups were multi-cultural, male and female and covered varied levels of work experience.

Reliability and validity of the focus groups were controlled as far as possible by using the same facilitator and following the exact same facilitation procedure and techniques to conduct both focus groups. An independent facilitator was used who had no bias towards the quantity surveying profession, any QS company or any research participant present at the focus group. The facilitator remained a neutral party throughout the entire research process.

Both focus groups were given the same questions for discussion. None of these discussion questions were made available to the research participants beforehand to ensure real-time contributions that were honest and objective. Both focus group sessions were also recorded electronically and notes were taken in addition thereto.

The aspects discussed above contributed to the validity and reliability of the data collected by making use of focus groups as qualitative research method.

6. CONCLUSION AND RECOMMENDATION

Existing literature indicated that the use of focus groups as research method in the built environment was not a very common research method. The purpose of this article was therefore to investigate how effective the use of focus groups as a research method will be in the built environment.

Making use of focus groups as research method in the built environment has proven to work successfully depending on the research topic under investigation. In-depth data were obtained which was sufficient to answer the research question at hand.

Conducting focus groups means gaining rich insight and understanding into the views and

perception of others. The main advantage of focus groups is that vast amount of data can be collected fairly quickly. The focus group participants for this research study were profiled according to gender, race and work experience and are considered representative of the diversity within the quantity surveying profession.

It is recommended that this method be used and tested in other areas of the built environment such as construction management, project management, engineering and architecture. This will further strengthen the results of this research study.

7. REFERENCES

1 Roach, T.J. 2014. Do it yourself focus groups. *Rock Products*, Vol. 117(3), p. 33-33, 2014.

2 Gill, P., Stewart, K., Treasure, E. & Chadwick, B. 2008. Methods of data collection in qualitative research: interviews and focus groups. *British Dental Journal*, Vol. 204(6), p. 291-295, 2008.

3 Redmond, R. & Curtis, E. 2009. Focus groups: principles and process. *Nurse Researcher*, Vol. 16(3), p. 57-69, 2009.

4 McLafferty, I. 2004. Focus group interviews as a data collecting strategy. *Journal of Advanced Nursing.* Vol. 48(2), p. 187-194. 2004.

5 Suleman, R. & Nelson, B. 2011. Motivating the millennials: Tapping into the potential of the youngest generation, *Leader to Leader*, Vol. 2011(62), p. 39-44, Fall 2011.

6 Axten, C. 2015. Millennials at Work, *Defense AT&L*, Vol. 44(2), p. 50-54, March/April 2015.

7 Wiley, C. 1997. What motivates employees according to over 40 years of motivation surveys, *International Journal of Manpower*, Vol. 18(3), p. 263-280, 1997.

8 Freeman, T. 2006. Best practice in focus group research: making sense of different views. *Journal of Advanced Nursing,* Vol. 56(5), p. 491-497, 2006.

9 Goldman, N. 2005. How to use a focus group. *The Credit Union Journal,* Vol. 9(45), p. 6-6, 2005.

10 Marelli, A.F. 2008. Collecting data through focus groups. *Performance Improvement,* Vol. 47(4), p. 39-45, 2008.

11 Sim, J. 1998, Collecting and analysing qualitative data: issues raised by the focus group. *Journal of Advanced Nursing,* Vol. 28(2), p345-352, 1998.

12 Onwuegbuzie, A.J., Dickinson, W.B., Leech, N.L. & Zoran, A.G. 2009. A qualitative framework for collecting and analysing data in focus group research. *International Journal of Qualitative Methods.* Vol. 8(3), p. 1-21, 2009.

13 Cheng, K. 2007. A study on applying focus group interview on education. *Reading Improvement,* Vol. 44(4), p. 194-198, 2007.

14 Morgan, D.L. & Spanish, M.T. 1984. Focus groups: A new tool or qualitative research. *Qualitative Sociology,* Vol. 7(3), p253-270, 1984.

15 Calderon, J.L., Baker, R.S. & Wolf, K.E. 2000. Focus groups: A qualitative method complementing quantitative research for studying culturally diverse groups. *Education for Life: Change in Learning and Practice.* Vol. 13(1), p. 91-95. 2000.

16 Milena, Z.R. Dainora, G. & Alin, S. 2008. Qualitative research methods: A comparison between focus group and in-depth interview. *Annals of the University of Oradea, Economic Science Series, Vol. 17(4), p. 1279-1283, 2008.*

17 Cleary, M., Horsfall, J. & Hayter, M. 2014. Data collection and sampling in qualitative research: Does size matter?. *Journal of Advanced Nursing*, Vol. 70(3), p. 473-475, 2014.

18 Van Eck, E. & Burger, M. 2015. Human Capital in QS Companies: Job Satisfaction of Generation Y Quantity Surveyors. *8th Annual quantity surveying research conference*, Bloemfontein 16-18 October 2015. Bloemfontein: Department of Quantity Surveying and Construction Management, p. 3

19 Roberts, P., Priest, H. & Traynor, M. 2006. Reliability and validity in research. *Nursing Standard*, Vol. (20)44), p.41-45, 2006.

Controlling Construction Cost Overrun in Public Projects in the Free State Province of South Africa

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Abstract

Purpose

The primary objective of this study is to identify major cuases of construction cost overruns in the Free State Province of South Africa in order to propose effective control measures.
Method: The study is based on positivism as a philosophy. The deducive approach influenced the use of semi-structured questionnaire for the survey research strategy. The questionnaire evolved from constructs and variables identified in the reviewed related literature.

Results

The results indicate that the most severe causes of cost overruns on public projects in the Free State are inadequate project planning, delays in issuing information to contractors and poor workmanship that produces defects, which are costly to rework on sites.

Value

The anticipated remedial measures include adequate pre-contract planning, proper implementation of projects, timely resolution of disputes and the elimination of poor workmanship on project sites. The practical implication of the findings is that better planning and timely issuing of information has benefits to the overall success of the project, epsecially in the public sector were acountability of resources is vital to the beneficiaries of the projects

Keywords: Construction, Cost Overruns, Public Projects, Public Sector, South Africa

1. INTRODUCTION

Cost overrun problem is a challenge facing the construction industry in developing countries [1]. The literature shows that the initial tender price is not what is finally paid in construction projects due to many influencing factors. Although cost overruns are typically prevented through design and cost contingencies [2], such control measures have failed to deliver on their intended purpose. The reason for the failure of such counter measures may not be far from the perception that initial cost estimates differs from actual development cost due to errors in the initial estimates [3].

An often-cited article that is more than a decade old on cost overruns reports that nine out of ten infrastructure projects in developing countries experience cost overrun [4]. The reports from the Middle East are not dissimilar from Southern Africa. For instance, the literature has shown that the construction industry in South Africa is not free from the occurrence of cost overruns [5]. Since cost overrun in projects is clearly a global phenomenon, removing the causes from source is crucial[6].

This paper is based on a research project, which address the factors responsible for the causes of construction cost overrun in the Free State province. The province was chosen based on the increasing number of public sector projects that are not completed within agreed performance parameters.

Just as a Nigerian study presents counter measures for preventing cost overruns, discovering the causes enabled the recommendation of some cost control measures for practitioners in South Africa [7]. In brief, this article commences with a concise synopsis of the problem before the research method that underpin the research findings is presented. The results and discussion of the findings provides a platform for the concluding remarks of the paper.

2. Literature Review

Cost overrun is sometimes called 'cost escalation', 'cost increase', and 'budget overrun'. Regardless

of the term used to call the phenomenon, both public and private sector projects exhibit similar patterns of cost overruns [8]. These patterns have ways of impacting cost management, cost estimates, cost control, magnitude of cost overrun, and its causes as explained in the following sub sections.

2.1 Project Cost Management

The management of costs in a project is a common thread that runs through the entire life of a project. It is cost and financial viability that make a project feasible and the project is not complete until the last payment and paperwork have been completed. The management of costs begins with the financial feasibility study, and then progresses to the costs that are required to purchase the resources needed by the project in the face of adequate cost control measures that are designed to ensure that all work that is done is properly completed [9]. For instance, the level of effectiveness of various cost management techniques implemented in large construction projects in South Malaysia show that the most effective technique of cost management was cash flow forecasting, tender estimating, and an elemental cost plan[10].

2.2 Accuracy of Cost Estimates

Various critical factors must be identified in order to estimate construction costs effectively. Factors that impact on various project stages (concept, design, tendering, and preconstruction stages) should be identified individually to improve estimation accuracy [11]. Because preliminary estimates influence subsequent cost management, the accuracy of preliminary estimation work is of critical importance. The conceptual cost estimate accuracy at the early stage of construction projects has been a major concern and focus of study for many decades. Cost estimates are often described as only approximations [9]. A transport infrastructure study discovered that costs are underestimated, and the situation cannot be explained by error alone [12]. Strategic misrepresentation appears to be a better explanation for it. The study notes that cost underestimation has not decreased over the past 70 years [12]. In other words, no learning that would improve cost estimate accuracy seems to take place.

Project cost control is a process of gathering, analysing, comparing and monitoring the costs of a project and reporting the results continuously during the development cycle of the project [13]. Cost control requires searching out the 'whys' of both positive and negative variances [14]. Cost control must be thoroughly integrated with the other control processes of scope changes, schedule and quality. Other risk associated with cost in construction projects is the activities below the natural ground level, which is linked to a geotechnical report of a site with respect to substructure design requirements [13]. This uncertain construction activity is, however, renowned as the most vital risk element in most construction projects. Cost control measures of projects can be mostly achieved right from the planning stage. Instead of tabulating cost for a specific design, target value design increases the value delivered to the owner by collaboratively designing to a “detailed estimate” based on a given cost target or the owners “allowable cost” [15].

2.3 Magnitude of Cost Overrun

Explanations of project underperformance in terms of optimum bias and strategic misrepresentation lead to high failure rates for projects as a consequence of flawed decision-making [16]. However, simply assuming that strategic misrepresentation and optimum bias are overarching actions, which lead to the unsuccessful delivery of social infrastructure projects is misleading, considering the complex array of conditions and variables that interact with one another during the procurement of a project[17].

2.4 Factors of Construction Cost Overrun

There are a number of factors, which may influence cost overrun. In South African construction, the causes of cost overrun related to the 2010 FIFA World Cup stadia have been articulated [18]. The top ten causes in order of importance include increase in material cost, inaccurate material estimates, shortage of skilled labour, client's late contract award, project complexity, increase in labour cost, inaccurate quantity take-off, difference between selected bid and the consultant's estimate, change orders by client during construction, and manpower shortage. In the Free State province, a study examined whether construction cost overrun is seen as a problem in the province through a survey research [5]. The study showed that cost overrun is a problem that needs to be addressed [5]. Furthermore, the research divided the factors on

cost overrun into three categories of very critical factors, critical factors and less critical factors [5]. Within the categories, scope changes made by the client appeared to have more influence. However, the design team has limited control over scope changes ordered by clients. Incomplete design at the time of tender, contractual claims and lack of cost planning and monitoring were cited to be major causes[5].

Cash flow and financial difficulties faced by contractors, contractors' poor site management and supervision, inadequate contractor experience, shortage of skilled site workers and incorrect planning and scheduling by contractors were significant factors affecting construction cost overrun in Malaysia [19]. A cost overrun research on road construction in the West Bank of Palestine discovered that the top five influencing factors from consultants' view were material price fluctuation, insufficient time for estimation, experience in contracts, size of contract, and incomplete drawings [20]. The effects of the causes identified indicate the selection process of choosing the best contractor was poor and also impact on three of the vital outcomes of the project, which are time, cost and quality.

In Ghana, the factors influencing the time and cost overruns in telecom construction projects were 14 [21]. The top five factors included price fluctuations, ineffective cost control systems, lack of coordination of design, scope changes, inadequate review of drawings and contract documents. All the causes mentioned by these authors have negative impact upon the project performance.

2.5 Performance Implications of Cost Overrun

Measuring success of projects has been attributable to norms such as cost performance, time performance, quality standards, and achieving health and safety[22].

As in South Africa, cost performance of construction projects in Malaysia is a critical issue that should be mitigated [23]. The need to mitigate cost overrun extend to almost all developing countries. For example, the factors affecting costs in Pakistan are the most crucial criteria for assessing the success of a project [24]. In a Pakistani study, it was concluded that:

a) Poor project management drawn from management factors is the key factor affecting the construction costs; this shows that the project manager and his/her teams are in urgent need of improving the performance graph as far as the construction industry of Pakistan is concerned.

b) Delay in the involvement of the contractor In the design stage design factor is the second most important factor affecting the construction cost; which reveals just how critically this area needs the attention of the authorities.

c) Poor performance of work management factor is the third most crucial factor with a definite potential for affecting the construction cost.

d) The top three location factors are political unrest in the area, followed by remote location and unforeseen ground conditions.

e) The top three design factors are delay in the involvement of contractor during design stage followed by buildability / constructability and incomplete drawings.

f) The top three management factors are poor project management followed by poor performance of work and poor cost control.

The decision to build is never an easy one and the cost of building is an influencing factor on the client's final decision whether to proceed or halt the project. However, all construction projects face similar problems of improving their cost performance. Construction projects are unique, and they tend to assume a greater dimension of complexity as they increase in size. Cost is clearly a constraint that hampers project progress since it results in the loss of huge amounts of profit to the contractor and other affected parties [23]. Given that poor cost performance has a negative impact on the construction industry, there is a need to tackle the issues from source [25]. Poor cost performance has detrimental effects on the economy of the country, delays the services so desperately awaited by the community, cause significant unease among taxpayers [2]. It can also undermine client's confidence on the project team and tarnish the image of the industry.

3. Research Method

The fieldwork for this research entails the use of a questionnaire survey to interrogate the issues. The questionnaire was sent out by email and hand delivered where possible to 62 professionals in the Free State province of South Africa. The target population is the quantity surveying (QS) profession based on the cost mandated roles on public sector building projects in the Free State province. The QS professionals were employed in the public and private sector. The data were thus collected through a purposive sample. The respondents are members of the Association of South African Quantity Surveyors (ASAQS), who were executing projects in the Free State province at the time of the survey. At the expiration of the survey period, responses were received from 44 QS professionals. This number constitute 71% response rate.

The reviewed literature on cost overrun in construction led to the compilation of open and close-ended questions.
Approximately 54 causes of cost overruns in all three phases of the project life cycle namely planning/design, implementation and completion, phases were identified in the literature. In addition, the reviewed literature led to the identification of 53 remedial cost control measures in the same project phases. The elicited responses relative to cost overrun were based on a 5-point Likert scale, where 1 represented 'not frequent cause' and 5 represented 'extremely high frequent cause'. For the remedies of cost overruns, the 5-point Likert scale ranged from 1 (not effective) to 5 (very effective). In the Likert scale an 'unsure' option was provided, should a respondent be in doubt concerning a question. Mean scores (MSs) were calculated for each statement to enable an interpretation of the percentages relative to each point on the scale.

The descriptive statistical method was used to compute the rank of MSs. The procedure used in analysing data was intended to establish the relative importance of the various factors that contribute to causes of construction cost overrun, effects of overrun, and effective counter measures. There are three steps used in analysing the data namely calculating the Relative Importance Index (RII), ranking of factors in each project cycle based on RII, and determining the degree of correlation on ranking the factors between the two groups. The data collection and method of analysis used were values of Spearman's rank correlation.

Values in the range $0 \leq \tau \leq 1.0$ indicate good agreement, whereas values near –1 or in the range $0 \geq \tau \geq -1.0$ imply disagreement on the factors ranked by professionals. Reliability tests were conducted to check the stability and consistency of the analysed data. The test carried out was the Cronbach alpha that is widely accepted, in which data are considered low level when the Cronbach alpha score is less than 0.3, which is indicative of the fact that data are not reliable and therefore cannot be accepted [6]. Reliability is high level when the Cronbach alpha is more than 0.7, where it indicates that the inner consistency of the indices table is at a high level and can be readily accepted [6].

Table 1 clearly indicates a strong correlation between all stages of the project. It may be stated that there was a strong correlation among respondents from all 3 phases of the causes of cost overrun and an increase in correlation among respondents' answers with the remedies for the same phases. The correlation coefficient was above 0.7; therefore, the findings of the causes and remedies indicate association.

The correlation scores of the design phase indicate these changes from 0.75 from respondents' ratings of the causes of cost overrun to 0.78 that pertains to remedies for cost overrun. This also indicates a high positive correlation between causes and remedies. In the construction phase, there was a near perfect correlation among respondents. The correlation is a high positive correlation in this stage of construction. This, as was previously indicated, showed a near perfect correlation matrix score among respondents of the survey.

The Cronbach alpha of all the project phases also showed a strong development from the causes of cost overrun to the remedies of the cost control measures that may be put in place: based on the Cronbach alpha (0.914 to 0.943) of the design phase, followed by (0.934 to 0.955) of the construction phase, and then (0.908 to 0.897) of the completion phase (Table 2).

Table 1: Correlation matrix

		DesignSC	ConstrSC	CompletSC	DesignSR	ConstrSR	CompletSR
DesignSC	Pearson Correlation	1	.736	.619	.492	.489	.349
	Sig. (2-tailed)		.000	.000	.001	.001	.020
	N	44	44	44	44	44	44
ConstrSC	Pearson Correlation	.736	1	.796	.290	.338	.290
	Sig. (2-tailed)	.000		.000	.057	.025	.056
	N	44	44	44	44	44	44
CompletSC	Pearson Correlation	.619	.796	1	.270	.241	.277
	Sig. (2-tailed)	.000	.000		.076	.115	.069
	N	44	44	44	44	44	44
DesignSR	Pearson Correlation	.492	.290	.270	1	.857	.738
	Sig. (2-tailed)	.001	.057	.076		.000	.000
	N	44	44	44	44	44	44
ConstrSR	Pearson Correlation	.489	.338	.241	.857	1	.790
	Sig. (2-tailed)	.001	.025	.115	.000		.000
	N	44	44	44	44	44	44
CompletSR	Pearson Correlation	.349	.290	.277	.738	.790	1
	Sig. (2-tailed)	.020	.056	.069	.000	.000	
	N	44	44	44	44	44	44

Table 2 : Cronbach alpha

Project Phase	Cronbach alpha	
	Causes	Remedies
Design	0.91	0.94
Construction	0.93	0.95
Completion	0.91	0.89

4 Findings

The results obtained from the responses are presented from Table 3 to 5. Table 3 depicts the respondents' rating of the causes and cost control remedies of cost overrun during the design phase of the project life cycle. It is notable that all causes in the category have MSs > 2.50, which indicates that respondents identify the causes as falling between near minor causes to a moderate cause. Table 3 indicates the remedial cost control measures in the category of MSs >3.2, which indicates that remedies can be deemed to be near moderate to near major. Table 2 indicates inadequate planning as the most critical cause of cost overrun in the province. Lack of experience of project location

is listed as the minor cause of cost overrun in the province. The remedy that is listed as most effective is that of the design being completed at time of tender,

and proper experience of project location as the least effective remedial cost control measure in minimising the re-occurrence of cost overruns.

Table 3: Ranking of factors and cost control measures in the design phase

Factors	MS	Rank	Remedial cost control measures	MS	Rank
Inadequate planning	4.0	1	Completed designs at time of tender	4.70	1
Incomplete design at time of tender	3.70	2	Adequate project preparation, planning	4.60	2
Lack of co-ordination at design phase	3.70	2	Adequate pre-contract project co-ordination	4.50	3
Procurement and non-related procurement related factors	3.60	3	Adequate pre-contract budget	4.40	4
Pre-contract budget constraints	3.50	4	Adequate co-ordination at design phase	4.30	5
Lack of pre-contract contract co-ordination	3.40	5	Adequate time provided for, instead of fast tracking, projects	4.10	6
Ignoring items with abnormal rates during tender evaluation, especially items with provisional quantities	3.40	5	Comprehensive project planning	4.10	6
Technical omissions at design stage	3.20	6	Appointment of highly experienced technical consultants	4.00	7
Lack of experience of technical consultants	3.00	7	Attending to procurement and non-related procurement related factors	3.90	8
Increased costs to crash activity time arising out of political pressure	2.90	8	Resolving items with abnormal rates during tender evaluation, especially items with provisional quantities	3.80	9
Some tendering manoeuvres by contractors, such as frontloading of rates	2.80	9	Effective geological conditions survey	3.80	9
Difference between actual geological conditions and the original survey	2.70	10	Minimum changes at design stage	3.60	10
Lack of experience of project type	2.70	10	Scrutinising frontloaded rates at time of tender	3.50	11
Lack of experience of project location	2.50	11	Proper experience of project type	3.30	12
			Proper experience of project location	3.20	13

Table 4 presents the respondents' rating of the causes and remedies of cost overrun in the construction phase of the project life cycle. It is notable that all causes in the category have MSs > 2.30, which indicates that the causes may be deemed to be more of a moderate cause to a near major cause. However, the table further indicates that the remedies are in the category of MSs > 1.50, which indicates that the causes may be deemed to be more of a least effective remedy.

Table 4 indicate that the most critical cause of cost overrun in the construction phase is 'additional work requested by client'; the minor cause of cost overruns as indicated by the respondents is site/poor soil conditions. The remedy that is considered very effective is 'controlled owners' requests'. The least effective remedy as indicated on the list is controlled changes made due to modifications by other organisations.

Table 4: Ranking of factors and cost control measures in the construction phase

Factors	MS	Rank	Remedial cost control measures	MS	Rank
Additional work at owners' request	4.70	1	Controlled owner's request	4.90	1
Contractor's unstable financial background	4.10	2	Minimum changes in owner's brief	4.80	2
Delays in issuing information to the contractor during construction stage	3.90	3	Timely issuing of information to the contractor during construction stage	4.70	3
Delays in decision making by government, failure of specific coordinating	3.70	4	Timely decision making by government, failure of specific coordinating	4.50	4
Contractual claims, such as, extension of time with cost claims	3.50	5	Timely improvements to standard drawings during construction stage	4.50	4
Delays in costing variations and additional works	3.50	5	Comprehensive cost planning / monitoring during pre-and-post contract stage	4.40	5
Changes in owner's brief	3.50	5	Consistent cost reporting during construction stage	4.00	6
Monthly payments difficulties from agencies	3.50	5	Provision for monthly payments	4.00	6
Poor contractor management	3.50	5	Timely decisions by the supervising team in dealing with the contractor's queries resulting in delays	3.90	7
Delay in construction, supply of raw materials and equipment by contractors	3.40	6	Timely costing of variations and additional works		
Improvements to standard	3.40	6	Provision for change order	3.70	8

Factors	MS	Rank	Remedial cost control measures	MS	Rank
drawings during construction stage			owing to legislative change or policy change	0	
Omissions and errors in the bills of quantities	3.30	7	Provisions for changes made by the contractor	3.70	8
Labour cost increased due to environment restrictions	3.30	7	Adequate provision for prime cost and provisional sums adjustments	3.60	9
Indecision by the supervising team in dealing with the contractor's queries resulting in delays	3.20	8	Adequate provision for contractual claims, such as, extension of time with cost claims	3.60	9
Lack of cost reports during construction stage	3.20	8	Minimum errors in the bills of quantities	3.60	9
Materials cost increased	3.10	9	Proper project implementation	3.60	9
Inadequate review	3.10	9	Proper contractor management	3.60	9
Re-measurement of provisional works	3.10	9	Adequate experience of local regulations	3.50	10
Adjustment of prime cost and provisional sums	3.00	10	Provisions for materials price escalations	3.40	11
Fluctuations in the cost of building materials	3.00	10	Adequate re-measurement of provisional works	3.40	11
Logistics due to site location	2.90	11	Timely supply of raw materials and equipment by contractors	3.40	11
Labour unrest	2.90	11	Adequate review	3.10	12
New information on existing site conditions	2.90	11	Providing sufficient site / soil conditions information	3.10	12
Lack of cost planning / monitoring during pre-and-post contract stage	2.8	12	Adequate planning of logistics to site location	3.10	12
Weather conditions	2.80	12	Provision for labour unrest	3.00	13
Lack of experience of local regulations	2.80	12	Contingency for new information on existing site conditions	3.00	13
Changes made by the contractor	2.70	13	Adequate provision for unpredictable weather conditions	2.90	14
Changes made due to modifications by others	2.60	14	Adequate provision for labour cost increased due to environment restrictions	1.50	15
Change order owing to legislative change or policy change	2.60	14	Controlled changes made due to modifications by other organisations	1.50	15
Site / poor soil conditions	2.30	15			

Table 5 depicts the respondents' ratings of the causes and remedy of cost overrun during the completion phase of the project life cycle. It is notable that all causes in the category have MSs > 2.20, which indicates that the causes are near minor to a moderate cause in this context. Additionally, Table 4 illustrates the respondent's ratings of the remedial cost control measures to have MSs > 2.50, which points out those remedies are between least effective remedy to effective remedy.

It is noteworthy that the most important cause of cost overrun indicated in Table 4 is late contract instruction after practical completion and the minor cause of cost overrun appear to be errors in bills of quantities. The most effective remedy is good workmanship and the least effective is provision for artificial disasters.

Table 5: ranking of factors and cost control measures in the completion phase

Factors	MS	Rank	Remedial cost control measure	MS	Rank
Late contract instruction after practical completion	4.50	1	Good workmanship	4.50	1
Poor workmanship	4.30	2	Timely resolving of disputes	4.30	2
Delay in resolving disputes	3.80	3	Timely contract instruction after practical completion	4.20	3
Delay in final account agreements	3.50	4	Timely final account agreements	3.80	4
Design failures	3.30	5	Comprehensive safety plan	3.00	5
Works suspended due to safety reasons	3.200	6	Adequate designs	2.80	6
Artificial disasters	2.10	7	Minimum errors in the bills of quantities	2.50	7
Errors in the bills of quantities	2.00	8	Provisions for artificial disasters	2.50	7

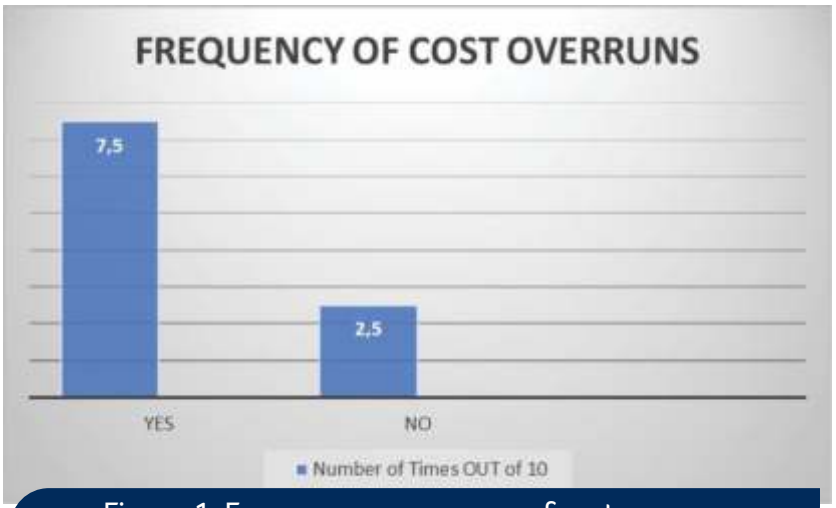

Figure 1: Frequency occurrence of cost overrun

According to the response from Figure 1, the frequency of cost overrun is 7.5 times out of 10 among public sector building projects in the province. This clearly shows that public sector building projects in the province frequently encounter cost overruns. The respondents regard the frequency of cost overrun as a performance problem for the construction industry in the sector. Majority (82%) of the respondents answered "Yes" to this question. This simply means that the sampled QS professionals in the province have to change the way projects are delivered, contribute to the delivery of services that are so desperately needed by the community and enhance the image of the industry in the process

5. Discussion

In the design phase, inadequate planning was listed as a major cause of cost overrun, and is a finding supported by past research work [5, 26]. It clearly shows that it could be that professionals are being rushed by the client to start the project without enough time to prepare design and cost estimates properly. This is the time where major budget commitments of up to 80% of the project are discussed and crucial to the success of the projects. Projects that are started with unclear scope are bound to experience cost overrun. Scope changes often allow individuals to repeat inappropriate practices, such as taking short cuts and not following due process [17]. When planning fallacy is the basis of commencing a project, managers make decisions based on optimism rather than on a rational weighting of gains, losses, and probabilities - risks[27].

The impact of completed designs at the time of tender is that it regulates the unnecessary additions that the client could exploit due to incomplete designs. Finalisation of the design gives the project team a framework for what to expect from the project. The monitoring of the project's progress may be easily handled since one very important aspect such as the design has been finalised. Following on this factor is that of project preparation and planning. Projects that are better prepared and adequately planned often are completed with minimal disruptions or unnecessary expenses. The public sector could also play a vital part in rolling out of infrastructure projects if innovation can be implemented when executing projects.

The most critical cause of construction cost overrun in the construction phase is additional work requested by client. The earlier research work done confirms this case [13, 26]. The professionals have no total control over what the client wants. The remedy that is considered very effective is 'controlled owners' requests'. When the project is taken from pillar to post, it creates a reactive approach to solving a problem. Clients, as much as they are owners of the projects, sometimes need to be educated about their role in a project situation. While clients have the right to be fully involved in their own investments, the degree to which that happens needs to be clarified.

In the completion phase, late contract instruction after practical completion is ranked very high by the respondents as a major cause of cost overrun. Issuing a late contract instruction at this stage of the project indicates lack of proper planning during the design stage. After practical completion, it is anticipated that the client will take possession of the site. One of the aspects of project success is completion to the right quality. The lack of quality management during the planning process is evident from the perceptions of the respondents. The planning gaps made variation orders, request for information, site instructions, and non-conformances a common feature of a project.

6. Conclusions and Further Research

The execution of public construction projects significantly contribute to the growth of an economy and the need for it is vital in South Africa. But the final project cost of infrastructure has been a concern. At the root of such concern is the identification of causes and counter measures required to assure cost certainty in projects. This research aligns with this need by assessing the perspective of quantity surveyors that are directly involvement in cost management and control issues related to public sector projects in South Africa.

Major causes perceived by the respondents include poor planning and avoidable change orders from clients and their agents. While these causes appear generic when synthesized with the relevant literature, it should be noted that planning is seen as a major problem in the South

African context by the respondents.

The issue of cost overrun occurrence in a project is not necessarily only a negative action with detrimental effect to the construction projects. If the initial estimate is wrong, then cost overrun has not really occurred. In other words, if estimators deliberately misinform the client about the estimate of the projects, based on the bias of pursuing the project to commence or if there are deliberate errors by the estimators then such cannot be regarded as a cost overrun on the project. Cost management of projects plays a major role in achieving the success of the entire projects. Construction sector is evolving, and projects are getting even more complex, yet the cost management remains the same. Quantity surveyors have to keep abreast with the ever-changing world of construction, if they are to remain relevant. It is up to the QS profession to come up with alternative ways of managing costs in a construction project, since it is their speciality area.

The study also indicates that in order to minimise cost overrun, projects should implement cost control measures as early as possible in the project. Such controls should include the completion of design before tender calls are made in the case of traditional procurement method. When the project is already at the implementation stage, it is equally important to limit the number and magnitude of scope changes (change orders) and monitoring the quality of workmanship on site simultaneously.

In other words, counter measures for the control of cost should begin at project inception and only end at the close of a project. Further studies are however required to give additional depth to the nuances perpetrating the cost overrun phenomenon in the province of Free State in South Africa since this study only explored the perceptions of quantity surveyors. Insights to be gained in such studies should unravel the rationale behind some of the decisions made by project actors that unintentionally increase project cost in the province.

7. References

1 Chimwaso, D.K. (2001) An evaluation of cost performance of public projects: case of Botswana, Available from:http://buildnet.csir.co.za/cdcproc/docs/2nd/chimwaso_dk.pdf. [Accessed 27 July 2012]

2 Love, P.E.D., Singh, C.P., Wang, X., Irani, Z. & Thwala, D. (2014) Overruns in transportation infrastructure projects, *Structure and Infrastructure Engineering,* Vol. 10(2), pp. 141–159.

3 Altshuler, A.A. & Luberoff, D.E. (2003) *Mega-projects: the changing politics of urban public investment*. Washington DC, USA: Brookings Institution Press.

4 Flyvbjerg, B., Holm, M. & Buhl, S. (2003) How common and how large are cost overruns in transport infrastructure projects? *Transport Reviews,* Vol. 23(1), pp. 71-88.

5 Ramabodu, M.S. & Verster, J.J.P. (2010) An evaluation of cost overruns in public sector projects: in the Free State province of South Africa. In: *Proceedings of the 5th Built Environment Conference*, 18-20 2010, Durban.

6 Memon, A.H., Rahman, I.A., Abdullah, M.R. & Abdu Aziz, A.A. (2010) Factors affecting construction cost in Mara large construction project: Perspective of Project Management Consultant. International Journal of Sustainable Construction Engineering & Technology, Vol. 1(2), pp. 41-54.

7 Aibinu, A.A. & Odeyinka, H.A. (2006) Construction delays and their causative factors in Nigeria. *Journal of Construction Engineering and Management*, 132(7), pp. 667–677.

8 Koushki, P.A, Al-Rashid, K. & Kartam, N. (2005) Delays and cost increases in the construction of private residential projects in Kuwait. *Construction Management and Economics*, Vol. 23(2), pp. 285-294.

9 Carruthers, M., Steyn, H., Basson, G., du Plessis, Y., Kruger, D., Pienaar, J., Prozesky-Kutschke, B., van Eck, S. and Visser, K. (2008) *Project Management: A multi-disciplinary Approac*h, 2 edition, Pretoria: FPM Publishing.

10 Aziz, A.A.A., Memon, A.H., Rahman, I.A., Qbal, L., & Nagapan, S., (2012) Cost management of large construction projects in South Malaysia, IEEE Symposium on Business, Engineering

and Industrial Applications.

11 Cheng, M.Y., Tsai, H.C. & Hsieh, W.S. (2009) Web-based conceptual cost estimates for construction projects using Evolutionary Fuzzy Neural Inference Model, Journal of Automation in Construction 18 (2009) 164–172.

12 Flyvbjerg, B., Skamris Holm, M.K. & Buhl, S.L. (2002) 'Underestimating cost in public works. Error or Lie?', *Journal of the American Planning Association*, 68(3), pp. 279–295

13 Dibonwa, P. (2008) Identifying causes and remedies for cost overruns in Botswana's public construction projects. MSc Dissertation, University of Witwatersrand.

14 Keong, W.W. (2010) A study into effectiveness of project cost control in overcoming cost overruns for turnkey project in Malaysia. MSc Dissertation, Heriott-Watt University.

15 Rubrich, L. (2012) An introduction to Lean Construction: Applying Lean construction organizations and processes. Fort Wayne, IN: WCM Associates LLC.

16 Flyvbjerg, B., Garbuio, M. & Lovallo, D. (2009) Delusion and deception in large infrastructure projects: two models for explaining and preventing executive disaster, *California Management Review*, Vol. 51(2), pp. 170-193.

17 Love, P.E.D. (2011) Plugging the gaps between optimum bias and strategic misrepresentation and infrastructure cost overruns, The Twelfth East Asia-Pacific Conference on Structural Engineering and Construction, Procedia Engineering 14, pp. 1197-1204.

18 Baloyi, L. & Bekker, M. (2011) Causes of construction cost and time overruns: The 2010 FIFA World Cup stadia in South Africa, Acta Structilia 18(1), pp. 51-67.

19 Abdullah, M.R., Abdul Rahman, I. & Abdul Aziz, A.S. (2010) Causes of Delay in MARA Management Procurement Construction Projects. *Journal of Surveying, Construction & Property*, Vol. 1(1), pp. 54-66.

20 Mahamid, I. & Bruland, A. (2011) Cost overrun causes in road construction projects: consultants' perspective. In: *Proceedings of the 2nd International Conference on Construction and Project Management*, Singapore: IACSIT Press.

21 Danso, H. & Antwi, J.K. (2012) Evaluation of the factors influencing time and cost overruns in telecom tower construction in Ghana, *Civil and Environmental Research*, Vol. 2(6), pp. 15-25.

22 Memon, A.H. (2013) Structural Modelling of cost overrun factors in construction industry, PhD Thesis, University Tun Hussein Onn Malaysia.

23 Ali, A.S. & Kamaruzzaman S.N. (2010) Cost performance for building construction projects in Klang Valley, *Journal of Building Performance,* Vol. 1(1), pp. 110-118.

24 Farooqui, R.U., Umer, M. & Hussain, E. (2012) Factors affecting construction cost in the Pakistani construction industry. *In: Proceedings of the 3rd International Conference on Construction in Developing Countries (ICCIDC–III)*, July 4-6, 2012, Bangkok, Thailand.

25 Sharma, S. & Goyal, P.K. (2014) Cost overrun factors and project cost risk assessment in construction industry - A state of the art review. International Journal of Civil Engineering, Vol. 3(3), pp. 139-154.

26 Ameh, O.J., Soyingbe, A.A. & Odusami, K.T. (2010) Significant factors causing cost overruns in telecommunication projects in Nigeria, *Journal of Construction in Developing Countries*, Vol. 15(2), pp. 49–67.

27 Flyvbjerg, B. (2011) Over budget, over time, over and over again: managing major projects. In: PWG Morris, JK Pinto and J Soderlund (eds.) *"The Oxford handbook of project management"*. Oxford: Oxford University Press.

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Table 1 Components of expenditure

Component	Expenditure (%)
Cleaning works	40,9
Mechanical services	37,7
Building works	13,6
Civil works	7,8
Total	100,0

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[2] Stone, P.A. (1980) *Building Design Evaluation: Costs -in-use*. E & FN Spon, London.

[3] Barrett, S. (1981) "Implementation of public policy." In *Policy and Action*, Barrett, S. and Fudge, C. (eds), Chapman & Hall, London, 1-33.

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