

A Comparative Study of Causes of Change Orders in Public Construction Project in Nigeria and Oman

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Abstract

The construction process is a complex one and is associated with various changes. These changes usually lead to issuance of change order. Identifying the causes of change order is vital in order to avoid potential changes in future project. The research aimed at comparing change order in construction project in Nigeria and Oman, vis-à-vis the causes, effect, benefits and remedies. This was meant to compare the scenario of change order in both countries and subsequently determine areas for improvement in Nigeria. Questionnaire survey was used to elicit information. The questionnaires were analysed using Relative Importance Index. The result indicated that the “client’s additional works and modification to design” were the most important causes of change order in both Nigeria and Oman, the most important effects of change order are “variations result in claims and disputes” in Nigeria while “delay in completion date of project and cost overruns” were the most important effects in Oman. The contractors were believed to be the party benefiting the most from change order. It was recommended that “a specialized Quantity Surveyor/ cost controller and project manager should be assigned to large construction project” in Nigeria while in Oman “registration of the consultant company should be reviewed to reflect its technical capabilities” was the most important remedy.

Keywords: changes, change order, cost overruns, delay time, Nigeria, Oman.

INTRODUCTION

The construction industry involves complex processes which are prone to changes. These changes are inevitable and more often than none, it occurs during the construction process. Sun et al, (2004) defined changes in construction as modification or alteration to pre-existing conditions, assumptions or requirement while Parker (2001) described change as work, state, process or methods that deviate from original construction plan and specification.

As a result of changes, change orders are issued to modify the original scope or design (Alnuami et al 2010). Most of change order issued during construction has significant impact on cost and time of project and in worst case could lead to delay, abandonment of project and disputes which are common in developing countries. The Nigerian construction industry is not left out as project are characterised by cost overrun and time overrun due to changes which has resulted in delay (Aibinu and Jagboro, 2002).

To avoid this scenario, the research investigated the causes, effects, benefits and remedies of change orders in Nigeria and compare the result with that of Oman. This was meant to compare the scenario of change order in both countries as the economies of both countries depend on oil which has led to their Government investing in construction sector. The

result will aid to identify areas for improvement and how to alleviate the effect of change order in Nigeria. The research also sought the professional views of clients, consultant and contractors on ways of remedying the problem of change order through suggested remedies highlighted in the questionnaire. The suggested remedies will be helpful to the professionals in the construction industry as it will assist them to take necessary action at the appropriate time.

LITERATURE REVIEW

Changes in construction has continually create attention from participant. Many literatures have identified effects changes has on projects. Ayodele and Alabi (2010) have identified variation of project scope as one of the causes of abandonment of construction project in Nigeria. Apolot et al (2010) studied the causes of delays and cost overruns in Uganda’s public construction projects and found out that change of work scope was the major causes of delay and cost overruns. Haseeb et al (2011) also investigated the causes and effects of delay in large construction projects in Pakistan, among the five causes identified, client change in specification was included. Alwi and Hampson (2003) ranked design changes as the major causes of delay in building construction projects.

Hsieh et al (2004) reviewed recorded change orders in 90 metropolitan public work projects completed before the year 2000 in Taipei, Taiwan, based on the database, the chains of event were identified and the causes of change orders were categorised into main divisions, “technical and administrative”. They believed that categorising the change order causes will reveal how their impacts will affect project cost and schedule. Sun and meng (2009) developed two taxonomies for change order causes and change effects. This was done through the review of different journals. They classified causes of change order into external causes, organization causes and project internal causes while that of effect are “time effect”, “cost effect”, “relationship and people effect”.

Alnuami et al (2010) investigated the causes, effects, benefits and remedies of change orders on public construction projects in Oman, they divided the causes of change order into client related, consultant related, contractor related and others. They concluded that client’s additional works and modification to design were the most important factors causing change orders, followed by non-availability of construction manuals and procedures. Agreeing with Alnuami et al (2010), Ibn-Homaid (2011) also concluded that change of the project scope due to additional diminution or enhancement in client requirement was the most frequent, important and severe causes of change orders.

The nature and impact of variation orders on overall project performance were investigated by Ndiokubwayo and Haupt (2009), clients were identified as the most predominant sources of variation orders due to unclear briefing and changing requirement. Zawawi et al (2010) reviewed different literatures and case studies on causes, effects and controls of change orders. Based on the review, they recorded that changing plans by the owners through generating conflicting design documents or through change in design afterwards are the main causes of change orders. The most significant causes of variation orders are change in plan by owner, substitution of materials by owner and changes of design by consultant (Mohammed et al 2010), the clients were identified as the major source of variation orders in building projects. Al-jishi and Marzoug (2008) also concluded that the owner is the major source of changes and that most changes are architectural. Change of plans and materials substitution were the first causes of change in large buildings.

Warhoe and Giammalvo (n.d) proposed that the introduction of scope changes during or after the performance of work will result in synergy between cause and effect that will multiply the negative impact of changes during a project. Ibbs (n.d) measured the impact project change has on

construction labour productivity, the results of this comparison clearly demonstrate that increasing amounts of project change will have significant and progressively worsening impact on labour productivity.

Al-Sedairy (2001) developed a change management model for analyzing, managing and optimizing the construction organization’s productive performance. Stare (2011) developed a project risk and change management model. The model was divided into two parts- risk management and formal change management. The model was tested against empirical quantitative research in 137 Slovenian enterprises. The result revealed that foreseeing changes reduces project delay and cost increase, while it has no impact on extra work.

Hanna et al (2002) used a hybrid approach to quantify the impact of change orders on construction projects using statistical regression and fuzzy logic. They stated that the methodology provides substantial improvement compared to traditional statistical models. They believed that the model improves the prediction accuracy and is capable of integrating fuzzy knowledge into quantitative data. Ibbs et al (2001) proposed a comprehensive project change management system for managing project change. The system was founded on five principles: promote a balanced change culture, recognize change, evaluate change, implement change and continuously improve from lesson learned. An artificial neural network model to manage change orders through all phrases of a project was developed by Yitmen and Soujeri (2010). The model consists of two main components: identifying the adverse effects of change orders on project performance and probability of dispute. This was meant to estimate the influence change order has on project performance and disputes resolution.

Questionnaire Survey

Questionnaire was used to elicit information on the causes, effect, benefit and remedies of change order on construction project. The questionnaire was adapted from Alnuami et al (2010); the questionnaire was divided into four sections. Section I and II contain information on the causes and effect of change order while section III and IV comprises of questions on benefit and remedies of change order in construction project. A five point Likert scale ranging from 1 (strongly agree) to 5 (No comment) was adopted for the questionnaire. The causes of change order were categorised into four groups: Client related, Consultant related, Contractor related and others. However, the causes of change order highlighted may not cover all the causes, but effort was made to highlight substantial causes of change order.

A total of 65 questionnaires were distributed to professionals in the construction industry, i.e. 15 Client, 20 Consultant and 30 Contractor. Only one set of questionnaire was given to each client, Consultant and Contractor. 44 questionnaires were returned and valid for analysis representing 68%, i.e. 10 Client (67%), 11 Consultant (55%) and 23 Contractor (76%).

Relative Importance Index (RII) was used for the analysis. It was calculated using the equation

$$RII = \frac{\sum W \times 100}{Hs} \quad (1)$$

Where W = Weighting factor by respondent ranging from 1 to 5, H = Highest weight, S = Sum of all respondent's responses ranging from strongly disagree to No comment. Standard deviation was also calculated for the relative importance to determine the dispersion of relative importance values around the mean

DISCUSSION OF FINDINGS

Table 1 shows the RII and ranks for the client, consultant, contractor and overall respondent. All the three parties ranked "owner instruct additional works" as first with the overall RII value of 72.73 and SD value of 12.85. Despite the ranking, there is deviation or disagreement among the three parties that "owner instructs additional works". "Owner instructs modification to design" received the third rank by the consultant and the contractor, while the client ranked it fourth. This cause received the second

ranking in the overall rank with SD value of 9.52. The contractor uses gray areas in general conditions to request variations to the contract received the third rank while the client ranked this cause fourth, the consultant second and the contractor fifth. The SD value 9.52 implies that there is little agreement among the three parties.

There are four causes with SD value above 10

Owner instructs additional works SD = 12.85

Owner fails to make decision or review documents at right time = 11.34

The contractor misuses variations instructions = 10.57

Poor communication between relevant government unit and owner = 10.43

This implies that there are major disagreements among the three parties on the importance of the causes. This is obvious as client will always blame contractor for misusing variations order while contractor will always blame owner for instructing additional works. The three parties ranked "owner instructs additional works" as first. The additional work is majorly as a result of not carrying out proper feasibility studies and survey of work before commencement of work. The results confirms with Alnuaimi et al (2010) in which they concluded that the most important causes of variation order is owner instructs additional works.

Effect of change orders

Table 3: Ranking Effects of Variations

Effect	RII	Rank
Variations would result in claims and disputes	70.00	1
Delay in completion date of project	69.09	2
Cost overruns	69.09	2
Most contractor incur additional cost due to variations	66.36	4
Adversely affect the performance and moral of labour	59.55	5
Adversely affect work quality	59.55	5

Table 3 shows the overall opinion of respondent on effect of change order. "Variations would result in claims and disputes" was ranked as the most important effect of change order with RII value of 70.00. This is true as claims will arise from one party to another as a result of misinterpreting or misunderstanding change order and eventually lead to disputes.

Delay in completion date of projects was ranked second along with cost overruns (RII value of 69.09). This is as expected as delay in time will automatically affect the cost of the project. Change in design, scope of work or rework will affect the time and cost of a project. The time spent in making decision or in carrying out rework will increase the

time frame and also the cost of rework will increase the total cost of the project.

The least important factors ranked were "adversely affect work quality" and "adversely affect the performance and moral of labour" with RII value of 59.55. This is as expected as attention is not given to quality of work and the performance and moral of labour, yet these factors are very important, as duration of project increases, the quality of work reduces because contractor will have other contract work to attend to, so also the performance and moral of labour will be affected if they are asked to carry out rework or additional works

Table 4: Benefiting Parties from Change Orders

Benefiting Parties	RII	Rank
The contractor would benefit the most from variations	58.63	1
The consultant would benefit the most from the variations	51.36	2
The owner would benefit the most from the variations	49.55	3
None of the three parties would benefit from variations	42.27	4

The overall respondent on parties benefiting from change orders (Table 4) ranked the contractor as the party benefiting most from variations (RII value 58.63), the consultant was ranked the second with RII value of (51.36), and the client the third with RII value of (49.55). Few people agree that none of the parties benefit from variations (RII= 42.27). This is logical as the three parties would benefit one way or

the other. As a result of change in plan, unit measurement, increase in time duration, the contractor will benefit from it, the consultant will also benefit as he will claim for redesign and increase in the time frame of the project. The owner will benefit since he/she will finally have what he/she desired, but monetary wise, may not necessarily benefit.

Table 5: Ranking Remedies for change orders

Remedies	RII	Rank
A specialized quantity surveyor/ cost controller and project manager should be assigned to large construction projects	71.36	1
A standard document should be developed to establish the stages/steps from the start of the project until completion and close out	69.09	2
A common learning database system should be shared among all governmental units	68.18	3
No design engineer shall be allowed to practice without having a professional license	67.27	4
The general conditions should be reviewed and updated	66.81	5
A construction procedure manual should be established and implemented	65.45	6
Permanent standards shall cover all construction regulations and permits required for construction project in Nigeria	64.54	7
Registration of the consultant company should be reviewed to reflect its technical capabilities	63.64	8

Table 5 presents the remedies for change order; the most important remedy was “a specialized quantity surveyor/ cost controller and project manager should be assigned to large construction project”. This can be attributed to the effect change order has on a project as cost overrun was identified as the second most important effect of change order. This can be linked directly to the causes of change order, as “owner instructs additional work” and “owner instructs modification to design” were ranked first and second. This depicts that the Quantity Surveyor has a major role to play when it comes to advising the

owner on the effect of change order on the overall cost of the project. The second and third important remedies are “a standard document should be developed to establish the stages/ steps from the start of the project until completion and close out” and “a common learning database system should be shared among all governmental units” with RII value of (69.09) and (68.18) respectively. These remedies emphasises the need for the implementation of the National Building Code in which the duties of each professionals are specified and the standard documents required for every project is mentioned.

Comparison with Previous Research in Oman

Table 6: Causes of change order: comparison between Nigeria and Oman

Rank	(Causes) Nigeria	Causes (Oman)
1	Owner instructs additional works	Owner instructs additional works
2	Owner instructs modification to design	Owner instructs modification to design
3	The contractor uses the gray areas in general conditions and request variations to the contract	Non availability of construction manual and procedure for project construction in Oman
4	Natural growth of the project was not anticipated at the design stage	Non availability of engineering Licensing for engineers in Oman to maintain the quality of consultancy services
5	Owner fails to make decision or review documents at the right time	Poor communication between relevant government units and owner

Table 7: Effects of change order: comparison between Nigeria and Oman

Rank	Effect (Nigeria)	Effect (Oman)
1	Variations would result in claims and disputes	Delay in completion of date of project
2	Delay in completion of date of project	Variations would result in claims and disputes
3	Cost overruns	Cost overruns
4	Most contractor incur additional cost due to Variations	Adversely affect the performance and moral of labour
5	Adversely affect the performance and moral of labour	Most contractor incur additional cost due to variations
6	Adversely affect work quality	Adversely affect work quality

Table 8: Benefiting parties from change order

Rank	Benefiting Parties (Nigeria)	Benefiting parties (Oman)
1	The contractor would benefit the most from variations	The contractor would benefit the most from variations
2	The consultant would benefit the most from variations	The consultant would benefit the most from variations
3	The owner would benefit the most from Variations	The owner would benefit the most from variations
4	None of the parties would benefit from Variations	None of the parties would benefit from variations

Table 9: Remedies for change order

Rank	Remedies (Nigeria)	Remedies (Oman)
1	A specialized quantity surveyor/cost controller and project manager should be assigned to large construction projects	Registration of the consultant company should be reviewed to reflect its technical capabilities
2	A standard document should be developed to establish the stages/steps from the start of the project until completion and close out	A standard document should be developed to establish the stages/steps from the start of the project until completion and close out
3	A common learning database system should be shared among all government units	A common learning database system should be shared among all government units
4	No design Engineer shall be allowed to practice Without having a professional license	A specialized quantity surveyor/cost controller and project manager should be Assigned to large construction projects
5	The general conditions should be reviewed and Updated	No designed Engineer shall be allowed to practice without having a professional License

Table 6 and 7 show the comparison between the results of this study and results found in Alnuami et al (2010) research in Oman of the causes, effect, benefit and remedies of change order. The factors highlighted in Oman were used directly for the research in Nigeria, this was meant to compare construction scenario in Nigeria and Oman and subsequently determine areas of improvement in the Nigeria construction industry if the need arise.

The first two reasons for causes of change order in Nigeria and Oman are the same, "owner related". This implies that clients should carry out a thorough feasibility study before the design stage. This result is in line with Al-jishi and Marzoug (2008) in which client were identified as the most frequent source of

change order. Comparison between the effects of change order shows that the first three most important effects are the same though ranked differently. In Nigeria, variation will result in claims was ranked first while in Oman delay in completion date of project was ranked first. The suggested remedies that was ranked first was "A specialized quantity surveyor/ cost controller and project manager should be assigned to large construction projects" while "Registration of the consultant company should be reviewed to reflect its technical capabilities" was ranked first in Oman. These suggested remedies are consultant related and it shows how far consultant could prevent changes during construction.

"A standard document should be developed to establish the stages/steps from the start of the project

until completion and close out” was ranked second in Nigeria and Oman, the actual needs in Nigeria is the implementation of the standard document- National Building Code-. This shows the gap between Nigeria and Oman although both are referred to as developing countries, Nigeria has gone ahead to have a standard document but has not yet implemented it.

CONCLUSION AND RECOMMENDATION

This study investigated the causes, effect, benefit and remedies of change order in Nigeria and compare it with that of Oman. It was concluded that the major causes of change orders in Nigeria and Oman are those related to client and the major reason is that owner request for additional works. The effects of these changes have resulted in claims and disputes, time overrun and cost overrun in both Nigeria and Oman. The study also identified the contractor as the most benefiting parties of change order in Nigeria as most respondents believed that the contractor uses gray areas in general conditions and request variations to the contractor. The contractor was also ranked as most beneficiary of change order in Oman. The following are recommended to improve the management of construction project in Nigeria.

- Implementation/enforcement of National Building Code
- Review of contractor's/ consultant's registration should be carried out periodically to ascertain their professional competency
- Client should carry out proper feasibility study and survey before the design stage. Proper costing of the project should be done by the Quantity Surveyor and contract sum should not be assumed as stated by respondents orally in the course of filling the questionnaire.

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APPENDIX

Table 1: causes of change order

Causes	Client Respondent RII	Rank	Consultant respondent RII	Rank	Contractor respondent RII	Rank	Overall respondent RII	Rank	SD
Owner instructs additional works	74.00	1	74.55	1	71.30	1	72.73	1	12.85
Owner instructs modification to design	62.00	4	65.45	3	66.09	3	65.00	2	09.52
The contractor uses the gray areas in general conditions and request variations to the contract	62.00	4	67.27	2	62.61	5	63.64	3	09.52
Owner fails to make decisions or review documents at the right time	54.00	13	60.00	6	66.96	2	62.27	4	11.34
Natural growth of the project was not anticipated at the design stage	74.00	1	56.36	13	59.13	10	61.82	5	08.79
Design errors	56.00	10	58.18	9	65.22	4	61.36	6	08.53
Unilateral decisions made by owner without proper considerations to contract	50.00	16	65.45	3	62.61	5	60.45	7	09.80
Failure by the consultant to provide adequate and clear information in the tender documents	46.00	18	60.00	6	58.26	12	60.00	8	09.91
Poor communication between relevant government units and the owner	58.00	7	65.45	3	53.92	19	60.00	8	10.43
Unrealistic design periods	52.00	14	56.36	13	61.74	7	58.18	10	09.47
Non availability of construction manual and procedure for project construction in Nigeria	68.00	3	49.09	19	57.39	19	57.73	11	06.61
Owner's needs during the design stage are unclear or not well-defined	44.00	19	60.00	6	60.86	8	56.81	12	06.72
Unrealistic construction schedule	56.00	10	58.18	9	54.78	17	56.36	13	07.66
Low consultancy fee or less experienced designers	58.00	7	50.91	17	56.52	15	55.45	14	06.50
Non availability of overall project planning	60.00	6	50.91	17	54.78	17	55.00	15	07.98
Non availability of records of similar project in Nigeria	40.00	21	58.18	9	59.13	10	54.54	16	04.92
Poor project management by contractor	56.00	10	54.54	15	53.91	19	54.54	16	08.07
Failure by consultant to perform design and supervision effectively	58.00	7	52.73	16	60.87	8	54.09	18	07.46
The contractor misuses variations Instructions	52.00	14	58.18	9	53.04	20	54.09	18	10.57
Non availability of qualified Engineer from the owner side	50.00	16	49.09	19	56.52	15	53.18	20	05.67
Consultant's supervisors do not have collective experience about construction projects in Nigeria	44.00	19	40.00	23	51.30	21	46.82	21	07.76
The design and the construction criteria are outdated and do not suit the present construction technology	40.00	21	47.27	21	46.96	22	45.45	22	08.67
Non availability of engineering licensing for engineers in Nigeria	34.00	23	43.64	22	44.34	23	41.82	23	09.81

Table 2: Extract of the five most important causes of change order

Rank	Client's respondents	Rank	Consultant's respondents	Rank	Contractor's respondents
1	Owner instructs additional works	1	Owner instructs additional works	1	Owner instructs additional works
1	Natural growth of the project was not anticipated at the design stage to the contract	2	The contractor uses the gray areas in general conditions and request variations	2	Owner fails to make decisions or review documents at the right time
3	Non availability of construction manual and procedure for project construction in Nigeria	3	Owner instructs modification to design	3	Owner instructs modification to design
4	Owner instructs modification to design	3	Unilateral decisions made by owner without proper considerations to contract	4	Design errors
4	The contractor uses the gray areas in general conditions and request variations to the contract	3	Poor communication between relevant government units and the owner	5	Unilateral decisions made by owner without proper considerations to contract