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THE STRATEGIES FOR MITIGATING THE IMPACTS OF CHANGE ORDER ON PERFORMANCE OF BUILDING CONSTRUCTION PROJECTS

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Abstract

Change occurs frequently in building construction projects and with attendant impacts on various indices of performance. Many strategies existed to be put in place to checkmate the effects in such a way to maximising beneficial ones. The study, therefore, assesses these strategies with the aim of maximising the benefit of desirous changes. The study employed descriptive and survey research method. A total of 104 returned and acceptable structured questionnaires were used for data analysis through descriptive and inferential statistics. The result reveals "compliance with all requirements by statutory authority", "review of grey areas in contract documents", "efficient communication system between construction participants", "team efforts between parties to contact" and "all changes to design documents are checked and review for justification" as the most effective strategies to mitigate the effects of change order. The study concludes that having effective procedure for the administration of change order and implementation of required strategies for its mitigation is key to smooth project delivery with less or no disputes. Therefore, Government ministries and departmental agencies are enjoined to put in place a mechanism for managing changes with proper strategies to mitigate the effects on performance.

Keywords: Building, Change Order, Construction Project, Management, Performance

Introduction

Change in building construction project takes place to improve functionality, enhance quality standard and achieve organisational goals or objectives. Until construction product is deemed to serve the purpose for which it was conceived, then its delivery is not a success. Tuloli *et al.* (2021) admitted that change order has implicit negative effect on project schedule and cost in terms of overrun but often lead to work improvement. Anees *et al.* (2012) posited that effective and efficient management of change is crucial to the success or otherwise of project delivery. Therefore, project performance, a measure of successful delivery, is the outcome of construction process satisfying the purpose and intent of both the client and the end users. All such events on construction project that culminate in alteration of the initial project scope, execution time, budgeted cost and quality standard is understood as change (Ibbs *et al.* 2007). Change in construction projects especially building is common, it takes place at any of the stages and on any activity, hence, expected to be managed effectively. There are negative effects of neglecting changes. These include orderly sequence of work is affected, productivity adversely impacted, and subsequently results to delay in schedule and cost overrun (Anees *et al.* 2012). Though, change in all aspects of construction project is inevitable, effort should be made to manage it in such a way to prevent or reduce negative consequences.

Previous study by Olasunkanmi and Oladokun (2019) reveals some of the causes of changes to be: change in designs; change of plans by owners; poor communication system among construction participants; substitution of materials or procedure and owner's change of schedule. These factors leading to change come with attendant benefits and penalties. Many participants (designers, consultants, constructors or contractors) apart from the client play different roles in construction processes to justify their interests. These roles eventually lead to changes in form of assumption by the designer; non-availability of complete information to the consultants; and personal experience of the contractor. These aforesaid constitute change and rework which are implemented by one or combination of the following: adding, deleting, replacement. As much as the client who is a principal stakeholder in construction project desires a successful project delivery, more emphasis is placed in reducing negative effects associated with change. Doing this would require that some measures or strategies would be put in place by all stakeholders in ensuring the benefit is maximised while penalties/negative consequences minimised.

According to Ndihokubbwayo and Haupt (2009), physical manifestation of construction rework is mostly accompanied with the demolition of what has already been built, however, the impact is greater and direct on the construction performance than the change option. The inability of the clients to envisage the end product of their request often lead to change, hence, a degree of change should be expected. These changes are commonly referred to as change orders (Anees, 2012). Luke and Farkey (2018) explained the three main types of change order in construction projects, but no matter the type, it must be managed to maximise the benefit and reduce the detriments. Many researchers across the world have either worked or review the impacts of change order in one form or the other (Alaryan *et al*., 2014; Oyewobi *et al.*, 2016; Karthick *et al*., 2015; Parchamijalal and Shahsavand,2016; Mohammed and Elshaikh, 2017), but the common submission has always been that effort must be put in place to checkmate negative effects.

Measures/strategies must be put in place to control change at the early stage of building construction project to avert serious disruption that late changes may cause during construction (Ibbs *et al.* 2001). Changes such as changing resource availability, environmental conditions, contractual structures and relations were observed to occur frequently in construction (Arain and Pheng, 2005), while Motawa (2005) concluded that they may results to plans that are to some extent incomplete or to unrealistic forecast. Lazarus and Clifton (2001) suggested that change management should be done to maximise the benefits and minimise the penalties but most importantly to ensure equitable distribution of the two.

There are both detrimental and beneficial changes in building. However, beneficial and important change may come with a prize of delay in project schedule; re-estimation of the work statement and extra demand of equipment, materials, labours and overtime. Furthermore, construction programme of works, health and safety plans may also be negatively impacted with some leading to issues and disputes. It is essential to have a formalised change management process through which issues arising from changes are resolved, this helps to avoid big number of claims and disputes. According to Dubaisi (2000), there is a great benefit for all the project participants in the area of reduction in the costs and risks if the administration process of change order is improved, it also encourages more trustful relationship.

Construction team are encouraged to take advantage of all such change/variation that are beneficial whenever opportunity arises (Arian and Low; 2005). Every reason for amendment in a building construction project usually results to change or variation due to some factors. Early brainstorming as much as

possible can minimise these changes/variations, otherwise, can be implemented if beneficial. Recognition of the potential effect of change by the project management team helps to reduce its negative impact on the project. There are strategies to be adopted by clients/developers and contractors whenever changes in the project with cumulative effects occur to avoid or reduce disputes (Hanna and Swanson, 2007). These strategies vary from place to place and dependent on both projects' nature and environment.

The study by Serag *et al.* (2010) concluded that it is very rare to complete construction project these days without change order that almost often results in 5-10% increase in the contract price. This corroborated the earlier study on 15 different projects in Kuwait where only one (1) project was completed with net omissions in variation (Duaij *et al*., 2007). Some other researchers have also found similar result where no project was completed without variation especially time and cost overrun **(**Arcila, 2012; Sindhu Vaardini *et al.*, 2016 and Abdel-Hafeez *et al.*, 2016).

Project performance improvement is the ultimate reason for change management process. Until the expectation of the owner/client/developer is met or fulfilled, performance is not attained. Building construction projects are sponsored by individuals, private firms, organisations, non-governmental organisations (NGOs), government agencies (on behalf of government) or directly by government itself and are known as owner/client/developer. They give approval for change/change order/variation while the constructor/contractor implement the agreed change and enforced by the consultant through some laid down procedures that may carry along some end users. The act of project meeting the objectives, purposes and intents for which it was conceived is termed performance. The performance objectives are usually stated upfront and project completion assessment is based on them. They are sometimes contained in the contract specification, though may not be together in one document. This forms the yardstick to determining the level of performance of the project by the project participants.

Therefore, given the aforementioned background, the specific objective of the study is to assess the control strategies undertaken by construction participants in checking or reducing the effect of change order on performance of building construction projects. The difference in opinion of the construction participants thus tested by the hypothesis postulated. It says: there is no significant difference in the perception of construction participants on the control strategies undertaken to check the impacts of change order on the performance of building construction projects. The outcome of the study shall ensure effort be put in place by the construction project team to integrate these strategies into change order administration procedure. Through this, a high-performance level can then be maintained and sustained while implementing the change order management process.

Review of Related Literature

Concept definitions (change, variation and change order)

Change, from an engineering perspective, is any alteration regardless of the scale, type or magnitude, to a part, drawing or software after the completion of the design process and life cycle of a product (Jarrett *et al*., 2011). It may be in the form of modification to the form, fit and/or in part with a variation in mode of interactions and dependencies of the constituent element of the product (Jarrett *et al*., 2011). However, Ibbs *et al*. (2007), believed any action in construction project that results to variation in the initial project scope, delivery schedule, cost and quality is termed change. The effect may either be on the product or the related documentation to the product. Changes are categorised by Mottawa *et al.* (2007) based on time (anticipated/emergent, proactive/reactive,

pre-fixity/post-fixity); need (elective/required, discretionary/non-discretionary, preferential/regulatory) and effect (beneficial/neutral/disruptive).

The terms; variation, change and change order have been used alternately by some authors. The clarity given by Keane *et al.* (2010) is that variation or change is any type of departure from an initial agreement on a defined scope or schedule of work. Meanwhile, change order is an official document that authorises the change with regards to the agreement contained in the contract document and thus automatically forms part of the project documentation (Keane *et al.*, 2010). Charoenngam *et al.* (2003) concluded that change order is an empowering document given by client/developer authorising implementation of change on a construction project. This is different from change request which represent a request for change or variation from the contractor/constructor while the order represents the client/developer's authorised instruction for it. The process of change order may sometimes be complex; it may require the involvement of construction team in substantial amount of information. The process, according to Charoenngam *et al.* (2003) involves the information being properly sent, checked, corrected, approved, requested, clarified, transmitted or submitted.

Change management process and control

Variation management and change management are two terms commonly used in the literature. Arain and Pheng (2007) believed that multiple projects participants are often involved in the resolution of variation that takes place in the entire project's life cycle. This emphasises the need to have a good communication and documentation system that enhances speedy decision-making in the entire project life cycle; thus, a pointer to any management system's capacity for effectiveness (Charoenngam *et al*., 2003; Arain and Pheng, 2007). A need for proactive attention to variation so as to reduce detrimental ones at the early stage of construction project is suggested by Motawa (2005) for its greater likelihood of being successful.

Initiation of action at the design phase is considered by Arain (2008) as the appropriate time. At the design stage, effecting changes consumes less resource compared to engaging in on site change because the benefits or effect of change accrues over time (Arain and Pheng, 2005). Ibbs *et al.* (2001) opined that to manage variation/change order effectively, there is need to have a proper understanding of not only the root cause but their potential downstream effect also, especially in project planning and forecasting (Isaac and Navron, 2009). Expectation of variation is normal in projects; hence, project managers are advised in the literature to stand up, accommodate, adapt and maximise the benefit of variation when and where possible (Ibbs, 1997). Another suggestion by Ibbs *et al.* (2001) is the use of previous projects as baseline for learning lessons and optimising future decisions. The purpose of this type of management is not to eliminate all project changes but rather to reduce the negative effects of essential changes to the barest minimum while at the same time avoiding unnecessary ones (Sun *et al.*, 2006).

Project performance

Performance in general term is considered as an evaluation of how well individuals, groups of individuals in organisations have done in pursuit of a specific objective (Ankrah and Proverbs, 2005). In construction project, it is a continuous review of the efficiency and importance of such project. According to Armstrong and Baron (1998), a robust action plan towards delivering continuous success to organisations by enhancing the performance of people working within such organisation through team capacity building and individual contributor is termed performance management. The achievement of project goal is through team effort as numerous participants contribute towards its realisation. Therefore, Soetanto (2002)

defines performance strictly as a participants' (clients, architects or contractors) contribution to the execution of the task required to complete the project. Ankrah and Proverbs (2005) viewed performance from two perspectives; that which relates to the business performance of the contractor and the other relating to the performance on projects.

Construction management researchers seldom consider business performance of the contractor but are usually measured by financial results and ratios, productivity figures and comprehensive self-assessment tools. However, the emphasis of researchers on performance in the construction industry have been on project performance (Soetanto 2002; Xiao and Proverbs, 2003). Whereas, construction project in most cases is usually an important business endeavour regarded as a significant investment by the client. The client is the principal stakeholder in the construction process, the delivery of project on time, to specification and within budget best describe good performance. Others are; providing good service, satisfaction of workers, health and safety and achieving reasonable life-cycle costs. Added to these yardsticks is meeting customer expectations as client satisfaction and customer welfare became imperative. Another measure of success as projects are accomplished is the level of satisfaction derived by the project team working together. Project performance provides information on project traction with early warning of problems that might get in the way of achieving project objective thereby enabling management of expectations. A secondary benefit is information that can be used to improve the planning and performance of future projects.

According to Luu *et al.*, (2008), "Performance measurement is the heart of ceaseless improvement". The main objective of performance evaluation is to assist managers and members of the organisation in developing the direction traction and speed of their organisation (Cokins 2006). Conclusively, different indices such as cost, time, quality, client satisfaction, and business satisfaction known as performance indicators are used to assess the performance of construction projects (Cheung *et al.*, 2004).

Methodology

Data collection

The research method adopted by the study were exploratory and descriptive survey approach with questionnaire used as an instrument of gathering data. The study population is made up of four (4) categories of respondents among the stakeholders in building construction industry in Akwa Ibom State. Lack of access to data on the construction participants in the study area constituted the barrier to ascertaining the population frame of the study. Therefore, the sampling technique used was purposive based on the judgement of the researcher. This selective or subjective sampling employed was due to the units to be investigated and the focus is on a particular feature of the population of interest, which enabled the research question to be answered.

Purposive sampling was used to select the respondents among the construction stakeholders in the study area based on their level of education and experience in the industry as adjudged by the researcher. The targeted respondents are the client's organisation, the contractors' organisation, the consultants and others (project team (for non-profit making organisation or NGOs), community liaison officers (for community-based projects)). Primary data for the work were obtained by distributing a total of 125 questionnaires across the three senatorial districts of the state to the respondents to sample their opinions as shown in Table 1.

Well structured, cross-sectional questionnaires numbering 125 were distributed for data gathering while 104 were received with valid response and used for data analysis. Uyo has 61 respondents, Eket with 28 and Ikot Ekpene with 15 respondents. As shown in Table 1, of the total distributed,

Uyo has a share of 58.7%, Eket and Ikot Ekpene has 26.9% and 14.4% respectively.

Table 1: Order of allocation in the study area

District of operation	Administered per district	Returned per district	% per district
Uyo	66	61	58.7
Eket	35	28	26.9
Ikot Ekpene	24	15	14.4
Total	**125**	**104**	**100**

Some questionnaires were distributed directly to respondents and others through the chosen research assistants. The questionnaires were divided into two sections. Section one captured the respondent's characteristics such as sex, educational qualification, stake in the projects, professional affiliations, membership status of professional body (if any), years of experience, senatorial district where project is domiciled, project owner type, type of construction, contract type and others. While the second parts sought the perception of construction participants on control strategies undertaken to check the effect of change order.

Measures

Scales of measurement used for the study were nominal, interval and ordinal scales. The respondents' characteristics in the first section were accessed using both nominal and interval scales while ordinal scale of measurement was used for the second section. The ordinal scale was on a five point-likert scales of 5-very large extent; 4-large extent; 3-medium extent; 2-small extent and 1-very small extent. The respondents were asked to rate the extent at which control strategies undertaken reduces the effect of change order on building construction projects. Likert scale was used in the study to measure respondents' perception of the concept under investigation. Note, the five-point scale used excluded neutral response category and deemed appropriate. The respondents were considered to possess requisite knowledge and experience about the subject matter under scrutiny (Shiu *et al.* 2009).

Variables

In order to achieve the objective of the study and provide answer to the research question, the extant variables were extracted from the literature as developed by previous researchers. Anees (2012) and Anees *et al.* (2012) already used variables that serves as control strategies, they were initially twenty-three in number but were modified into eighteen to suit the peculiarity of the study area. The variables are as shown in Table 2.

Table 2: Control strategies to reduce the effect of change order

1	Work Breakdown Structure (WBS) or other technique is used to track cost of changes
2	All changes to design document are checked and reviewed for justifications
3	Pricing of change order considers indirect effect also
4	The scope of change order is made clear
5	Change order is negotiated by knowledgeable person
6	Change order approval is timely
7	The procedures for handling change order is clear from the beginning.
8	Appropriate approval in writing
9	Review of grey areas in contract document
10	Team effort between parties
11	Freezes the design
12	Contractor's efficiencies/competencies evaluation before contract
13	Comply with all requirement by statutory authority
14	Efficient communication system
15	Lesson learned system
16	Detail and adequate investigation
17	Keeping systematic site record
18	All check for changes before issue of contract

Data analysis

Statistical Package for Social Science (SPSS) version 17 was used for preliminary data analysis (basic descriptive and inferential statistics). Respondents' characteristics were analysed descriptively, ranking of perceptions and opinions done with relative agreement index (RAI). Relative agreement index of factors' rating for each group of respondents (clients, consultants, contractors and others) was computed and ranked. Based on the approach used by other researchers (Aibinu and Jagboro, 2002; Cheung *et al*., 2004; Ugwu and Haupt, 2007) for similar studies, computation and ranking of weighted average of each factor for all groups was carried out, this represents perception of the group. RAI for the study was calculated from the mean scores gotten from each group of respondents using the equation (1)

$$RAI = \sum w \div AN \quad (1)$$

Where w = weighted average given to each factor by the respondents; it ranges from 1 to 5

A = the highest weight (which is 5 for this study

N = the total number of respondents (975 for this study)

RAI = relative agreement index.

Kruskal Wallis (H) test was conducted for both hypothesis testing and to determine the significant variations/differences in the perception and the extent of agreement on how the control strategies adopted reduces the effect of change order.

Research hypothesis

The research hypothesis postulated based on the research question and objective states thus: there is no significant difference in the perception of construction participants on the control strategies undertaken by construction participants to check the impacts of change in building construction projects.

Sample characteristics

Construction stakeholders (both internal and external) were identified as the major participants in construction projects through a pilot study. Hence, the structured questionnaire as instrument of data collection was administered on construction participants across the three senatorial districts in the state. Table 3 shows the group of respondents covered by the study, the total number of questionnaires distributed, the quantity returned and used for the study as well as the corresponding percentage returned from each location.

Table 3: Return rate of questionnaire administered

Group of Respondents	Administered	%	Returned	%
Clients	25	20	18	17.3
Consultant	40	32	35	33.6
Contractor	45	36	39	37.5
Others	15	12	12	11.5
Total	**125**	100	**104**	100

Return rate of questionnaires is displayed in Table 3. It shows an average response rate of eighty-two percent (82%). One hundred and twenty-five (125) questionnaires were sent in the order of; twenty-five (25) for clients, forty –five (45) for contractors, forty (40) for consultants and fifteen (15) for others (project team (for non-profit making organisation such as churches), community liaison officers (for community based public projects)), one hundred and four (104) were received in the following order; clients (18), contractors (39), consultants (35) and others (12). The high rate of response recorded is essentially due to the incentives given to the research assistants and availability of professional colleagues in these locations. Therefore, a total of 104 questionnaires

representing eighty-two percent (82%) were used for the study.

Results and Discussions

The characteristics of the respondents whose perception were investigated such as sex, educational qualifications, stake in the projects, professional affiliation, membership status, years of experience used for the study were evaluated and presented in Table 4. Also, project characteristics the respondents were involved in such as construction type, contract type and project ownership type were also evaluated.

It is noteworthy that, the presence of women or female gender in the Nigeria construction industry is similar to other African nation as rightly pointed out by Verwey (2008), Haupt and Fester (2012). As shown in Table 4, while female participants are 9.6%, male counterparts are 90.4%. Most respondents were male and possessed mostly HND and BSc as minimum qualification, this was more than required an educational qualification adequate to understand the implication of the research work. Majority of the respondents (74%) are core construction professionals (that is Architects, Builders, Engineers and Quantity surveyors) with membership status ranging from associate to fellow as the highest, this indicates the level of proficiency in construction work. In terms of work experience, about 76% of the respondents have acquired the necessary experience, having between or more than 10 years' experience, hence were conversant with happenings in the industry. The result also revealed that the project handled by the respondents were majorly private and government owned and 86% of them are new building projects and the contract were awarded mostly in lump sum.

Table 4: Descriptive results of respondents' characteristics

Features	Sub features	N	%
Sex	Male	94	90.4
	Female	10	9.6
	Total	**104**	**100**
Educational Qualification	OND	2	1.9
	HND	26	25.0
	BSc	34	32.7
	PGD	11	10.6
	MSc/Mtech	12	11.5
	PhD	11	10.6
	Others	8	7.7
	Total	**104**	**100**
Stake in the project	Client	18	17.3
	Consultant	35	33.7
	Contractor	39	37.5
	Others	12	11.5
	TOTAL	**104**	**100.0**
Professional affiliation	NIA	26	25.0
	NIOB	19	18.3
	NSE	20	19.2
	NIQS	12	11.5
	NITP	2	1.9
	NIESV	2	1.9
	Others	23	22.1
	TOTAL	**104**	**100.0**
Membership status	Technician	1	1.0
	Licenciate	13	12.5
	Associate	38	36.5
	Graduate	32	30.8
	Corporate	4	3.8
	Fellow	16	15.4
	TOTAL	**104**	**100.0**
Years of experience	1-5yrs	13	12.5
	6-10yrs	30	28.8
	11-15yrs	18	17.3
	16-20yrs	18	17.3
	Above 20yrs	13	12.5
	Others	12	11.5
	TOTAL	**104**	**100.0**
Senatorial district of operation	Uyo	61	58.7
	Eket	28	26.9
	Ikot-ekpene	15	14.4
	TOTAL	**104**	**100.0**
Project owner type	Private	54	51.9
	Government	38	36.5
	NGOs	11	10.6
	Others	1	1.0
	TOTAL	**104**	**100.0**
Type of construction	New	89	85.6
	Addition	3	2.9
	Renovation	7	6.7
	Rework	1	1.0
	Others	4	3.8
	TOTAL	**104**	**100.0**
Contract type	Unit price	43	41.3
	Lump sum	54	51.9
	Actual cost plus profit margin	7	6.7
	TOTAL	**104**	**100.0**

Strategies for mitigating the impacts of change order.

In order to achieve the study objective, construction participants were asked to rank their opinions on the strategies employed to checkmate the impact of change order. Table 5 shows the display of perception of construction participants on control strategies undertaken to check the effect of change order with relative agreement indexes calculated and ranked. The result reveals the following control strategies as being widely used to check the effect of change order: Comply with all requirements by statutory authority; Review of grey areas in contract documents; Efficient communication system; Team efforts between parties to contract; All changes to design documents checked and reviewed for justification.

Table 5: Perception of control strategies undertaken to check the impacts of change order by construction participants

S/N	Control strategies	Clients N=18		Consultants N=35		Contractors N=39		Others N=12	
		RAI	Rank	RAI	Rank	RAI	Rank	RAI	Rank
1	Comply with all requirement by statutory authority	0.934	1st	0.880	3rd	0.882	2nd	0.884	2nd
2	Team effort between parties	0.888	2nd	0.892	2nd	0.764	5th	0.600	15th
3	Review of grey areas in contract document	0.934	1st	0.898	1st	0.830	3rd	0.816	3rd
4	Change order approval is timely	0.878	4th	0.732	8th	0.698	8th	0.634	13th
5	All changes to design document are checked and reviewed for justification	0.866	5th	0.882	5th	0.770	4th	0.734	8th
6	Efficient communication system	0.866	5th	0.864	4th	0.758	6th	0.800	4th
7	Contractor's efficiencies/competencies evaluation before contract	0.844	7th	0.726	10th	0.682	9th	0.938	1st
8	WBS/Other technique used to track cost of changes	0.800	8th	0.714	12th	0.682	9th	0.566	16th
9	Detail and adequate investigation	0.734	9th	0.742	7th	0.636	14th	0.634	12th
10	Clear procedure for handling changes from beginning	0.722	10th	0.692	13th	0.682	9th	0.534	17th
11	Keeping systematic site record	0.688	11th	0.726	10th	0.620	14th	0.634	12th
12	All delays checked before issue of contract	0.656	12th	0640	17th	0.948	1st	0.666	11th
13	Lesson learned system	0.656	12th	0.662	16th	0.584	17th	0.700	9th
14	The scope of change order is made clear	0.656	12th	0.760	6th	0.744	7th	0.700	9th
15	Change order negotiated by knowledgeable person	0.612	15th	0.732	8th	0.672	12th	0.766	6th
16	Pricing of change order considers indirect effect also	0.600	16th	0.686	14th	0.666	13th	0.766	6th
17	Appropriate approval in writing	0.500	17th	0.688	15th	0.606	16th	0.800	4th
18	Freeze in design	0.356	18th	0.360	18th	0.442	18th	0.434	18th

Further analysis conducted reveals the different perceptions of major construction participants based on their relative agreement indexes as shown in Table 6. The top five strategies as viewed by each participant are collated and display in the table. Two strategies, review of grey areas and compliance with all requirements by statutory authority are common to all the participants, the third strategy, team efforts between parties are common to clients, consultants and contractors with others

taking exception to it. Efficient communication system as a control strategy is common to the clients, consultants and others while contractors share different view.

Table 6: Most effective control strategies by each construction participants.

The clients	The Consultants	The Contractors	Others
Review of grey areas in contract document	Review of grey areas in contract documents	All day check before issue to contract	Contractors' efficiencies /competencies evaluation
Comply with all requirements by statutory authority	Team effort between parties to contracts	Comply with all requirements by Statutory authority	Comply with all requirements by statutory authority
Team effort between parties to contracts	Comply with all requirements by statutory authority	Review of grey areas in contract document	Review of grey areas in contract document
Change order Approval is timely	Efficient communication system	All changes are checked and review for justification	Efficient communication system
Efficient communication system	All changes are checked and review for justification	Team effort between parties to contracts	Appropriate approval in writing

Test of hypothesis

A definite statement needs to be made on the various control strategies/measure undertaken by construction participants to check/reduce the impacts of change on building construction projects, so the following hypothesis must be tested to achieve this.

Ho: There is no significant difference in the perception of construction participants on the control strategies undertaken by construction participants to check the impacts of change in building construction projects.

Also, for this hypothesis testing, the confidence level is set at 95% significance and the decision rule is as follows; if the p-value is < 0.05, null hypothesis is rejected while the alternative is accepted, if the p-value is > 0.05, alternative hypothesis is rejected while the null is accepted. The result of Kruskal Wallis test conducted is as displayed in Table 7 and reveals that fourteen (14) variables have p-value > 0.05 and as such are not significant, hence the null hypothesis is accepted. On the other hand, four (4) variables with p-values< 0.05 are significant and as such null hypothesis is rejected and alternative accepted. The interpretation of the result is that construction participants believe there is no difference among the fourteen (14) variables as control strategies to check the impacts of change in building construction projects. They considered four (4) variables to be significant and there is difference among them as control strategies.

Table 7: Variation in perception of construction participants on control strategies undertaken to check the impacts of change order

S/N	Control strategies	Respondent designation				Chi sq	Sign	Re
		Client (N=18)	Consultant (N=35)	Contractor (N=39)	Others (N=12)	DF=3		
		Mean rank						
1	Comply with all requirement by statutory authority	56.67	52.80	50.79	50.92	0.689	0.876	NS
2	Team effort between parties	62.94	63.79	46.90	22.13	23.125	0.000	S
3	Review of grey areas in contract document	62.50	57.49	47.12	40.46	7.425	0.060	NS
4	Change order approval is timely	73.03	50.80	47.99	41.33	11.822	0.008	NS

5	All changes to design document are checked and reviewed for justification	63.94	56.00	47.69	40.75	6.554	0.088	NS
6	Efficient communication system	63.22	60.53	41.45	48.92	12.621	0.006	NS
7	Contractor's efficiencies/competencies evaluation before contract	63.39	49.24	42.96	76.67	15.451	0.000	S
8	WBS/Other technique used to track cost of changes	64.08	54.47	50.45	36.04	6.979	0.073	NS
9	Detail and adequate investigation	59.25	60.49	44.58	44.83	7.533	0.057	NS
10	Clear procedure for handling changes from beginning	58.00	54.44	53.76	34.50	5.386	0.146	NS
11	Keeping systematic site record	55.47	60.96	45.45	46.29	6.208	0.102	NS
12	All delays checked before issue of contract	54.97	47.76	55.22	53.79	1.533	0.675	NS
13	Lesson learned system	57.14	55.99	43.77	63.75	6.528	0.890	NS
14	The scope of change order is made clear	42.03	56.46	54.94	48.75	3.519	0.318	NS
15	Change order negotiated by knowledgeable person	41.83	57.33	50.24	61.75	4.802	0.187	NS
16	Pricing of change order considers indirect effect also	41.72	55.19	50.58	67.08	6.165	0.104	NS
17	Appropriate approval in writing	43.11	56.44	48.94	66.67	5.952	0.114	NS
18	Freeze in design	47.17	45.47	58.19	62.50	5.998	0.112	NS

N-Frequency; S-Significant; NS-Not significant; Re-Remark

Discussion

In assessing the control strategies undertaken by construction participants to check, reduce or minimised the effect of change order, respondents were asked to rank the various control measures put in places that will checkmate change orders effect. Findings of this research revealed that on a general basis, "comply with all requirements by statutory authority" and "review of grey areas in contract documents" are the leading strategies by all the construction participants for checkmating change order effect, others are: "efficient communication system between construction participants"; "team efforts between parties to contact" and "all changes to design documents are checked and review for justification". Checking through the submissions of different construction participants' opinion, they all share these common views that compliance with all requirements by statutory authority, review of grey areas in contract documents and team efforts between parties to contracts are the most effective strategies to mitigate the effects of change order.

Previous study by Olasunkanmi and Oladokun (2019) had established many factors responsible for change leading to change order in the study area. The outcome of this research is in contrast to that of Alzara, (2022) where the top five factors that mitigated the effect of change order were listed as "All parties should study the project well and coordinate among themselves before starting the project"; "A specialised consultant with experience in the project should be present"; "Periodic reviews of project requirements should be conducted as needed"; "There should be no reliance on the specifications of similar projects, and spatial considerations for each project should be considered"; "Software should be used to share data and business developments among all project parties" and "The use of change orders in the project should be minimised" (with the last two factors exacting same effect on project performance).

Conclusion and Recommendation

This study has established among others that quality standard was the primary driving force for change order in the study area. Moreover, cost overrun (increase in initial project cost) and time overrun (delay in delivery time) are the most prevalent effect change order has on building construction projects. Furthermore, the study would also assist construction participants in taking proactive measures or control strategy for reducing or checkmating the effects of change order in building construction projects.

The findings of the study lead to the following recommendations that will enhance project performance by improving change order process and administration.

i. There is need for adequate enlightenment that will emphasise both the negative and positive effect of change orders on the building and construction project performance in general.
ii. The requirement of statutory authorities should be understood and considered adequately before embarking on the project. All agencies of Government should collaborate to set out these requirements for the designers (consultants) and the contractors. The end users of construction project should be carried along to identify their specific need, thereby affording the design team enough time to articulate the needs and draw a concise specification for the project.
iii. All ambiguity in construction contract should be identified and sorted out by all parties to the contract. Engaging construction professionals with expertise in contract administration and interpretation, especially by the contractors will help to avoid all such disputes arising as a result of change order.
iv. There should be synergy among the construction participants on the best way to make use of change order to the benefit of the projects. An organized means of communication is essential through periodic meetings and engagement by all concerned.
v. Periodic coordination plans should be implemented among all parties to make the best use of change orders.
vi. With the client having a precise vision of what to expect and the extent of project execution, it becomes easier to know the desirability or not of the change order. This enables smooth incorporation/review and implementation of change order. Also selecting the project consultant is not a herculean task.

Reference

Abdel-Hafeez, M. M., El- Attar, S. S. and Abdel-Hafez, W. A. (2016). Factors leading to cost overrun occurrence in construction projects. *Port Said Engineering Research Journal*, 20(1), 71-77.

Alaryan, A., Beltagi, E., Elshahat, A. and M. D. (2014). Causes and effects of change orders on construction projects in Kuwait. *International Journal of Engineering Research in Africa*, 4, 1–8.

Al-dubaisi, A. H. (2000). Change Orders in Construction Projects in Saudi Arabia. M.Sc. Thesis. The College of Graduate Studies, KFUPM. Dhahran, Saudi Arabia.

Alzara, M. (2022). Exploring the impacts of change orders on performance of construction projects in Saudi Arabia. *Advances in Civil Engineering*, ID 5775926, 11 pages. doi.org/10.1155/2022/5775926.

Anees, M. M. (2012). Evaluation of Change Management Efficiency of Construction's Contractors. M.Sc. Thesis, College of Engineering and Technology, Arab Academy for Science, Technology and Maritime Transport AASTMT, Cairo, Egypt.

Anees, M. M., Mohamed, H. E. and Abdel Razek, M. E. (2012). Evaluation of change management efficiency of

construction contractors. *Journal of Housing and Building National Research Center (JHBRC*), 8, 77-85.

Ankrah, N. A. and Proverbs, D. (2005). A framework for measuring construction project performance: overcoming key challenges of performance measurement, In Khosrowshahi, F. (Ed.) *Proceeding of the 21st Annual ARCOM Conference*, London.

Aibinu, A. A. and Jagboro, G. O. (2002). The effects of construction delays on project delivery in Nigeria construction industry. *International Journal of Project Management*, 20(8), 593-599.

Arcila, S. (2012). Avoiding Cost Overrun in Construction Projects in UK, Master Thesis, The University of Warwick, UK.

Armstrong, M. and Baron, A. (1998). *Performance Management; The New Realities*. Institute of Personnel and Development, London, 466p.

Arain, F. M. (2008). I. T.-Based approach for effective management of projects change: a change management system (CMS). *Advanced Engineering Information*, 22(4), 457 - 472.

Arain, F. M. and Pheng, L. S. (2005). The potential effect of variation orders on institutional building, *Projects Facilities*, 23(11/12), 496 - 510.

Arian, F. and Low, S. (2005). Strategic management of variation order for institutional building: leveraging on information technology. *Project Management Institute*, 36(4), 27 - 41.

Charoenngam, C., Coquinnco, S. T. and Hadikusumo, B. H. W. (2003). Web-based application for managing change order in construction projects. *Construction Innovation: Information, Process, Management*, 3, 197-215.

Cheung, S., Suen, H., and Cheung, K., (2004), *PPMS:* A Web-based construction project performance monitoring system. *Automation in Construction*, 13, 361–376.

Cokins, G. (2006). Performance Management, *In: Adkins. T. C. (Ed), Case Study in Performance Management: A Guide from the Experts.* John Wiley and Sons, New Jersey, 272Pp.

Duaij, J., Awida, T. and Kollarayam, A. (2007). Performing value analysis on construction project variation orders. *Journal of Cost Engineering*, 49(6), 23 - 27.

Hanna, A. and Swanson, J. (2007). Risk allocation by law - cumulative impacts of change orders. *Journal of Professional Issues in Engineering Education and Practices*, 133(1), 60 - 66.

Haupt, T. and Fester, F. (2012). Women owned construction enterprises: a South African assessment. *Journal of Engineering, Design and Technology*, 10(1), 52-71. https://doi.org/10.1108/17260531211211881.

Ibbs, C. (1997). Quantitative impacts of project change: size issues. *Journal of Construction Engineering and Management*, 123(3), 308 - 311.

Ibbs, C. W., Wu, C. K. and Kwak, Y. H. (2001). Project change management system. *Journal of Management in Engineering*, 17(3), 159 - 165.

Ibbs, W., Nguyen, L. and Lee, S. (2007). Quantified impacts of project change. *Journal of Professional Issues in Engineering Education and Practice*, 133(1), 45 -52.

Isaac, S. and Navron, R. (2009). Modeling building projects as a basis for change control. *Automation in Construction*, 18(5), 656 - 664.

Karthick, R., Malathi, B. and Gunasekaran, U. (2015). Study on change order impact on project lifecycle. *International Journal of Engineering Research and Technology*, 4, 691–695.

Lazarus, D. and Clifton, R. (2001). *Managing Project Change: A Best Practice Guide*, CIPRIA (556), London. UK.

Luke, S. and Farkey, J. (2018). *The Basics of Change Orders*, ABA Forum Constr. Law, Memphis.

Luu, V. T., Kim, S. and Huynh, T. (2008). Improving project management performance of large contractors using benchmarking approach. *International Journal Project Management*, 26, 768 - 769.

McLeod, S. A. (2008). *Likert scale*. Retrieved from https://www.simplypsychology.org/likert-scale.html.

Mohammed, H. A. S. and Elshaikh, E. (2017). Factors causing variation orders in building projects in khartoum State-Sudan. *IJESRT International. Journal. Engineering. Science. Research. Technology*. 6.

Motawa, I. (2005). A systematic approach to modelling change processes in construction projects. *Australian Journal of Construction Economics and Building*, 5(1), 23-31.

Ndihokubbwayo, R. and Haupt, T. (2009). Variation orders on construction projects: value adding or waste. *International Journal of Construction Project Management, (IJCPM)* 1(2), 1-17.

Olasunkanmi, O. F. and Oladokun, M. G. (2019). Evaluating causes of change in building construction projects. *Journal of Contemporary Research in the Built Environment*, 3(2), 101-120.

Oyewobi, L.O., Jimoh, R., Ganiyu, B.O. and Shittu, A.A. (2016). Analysis of causes and impact of variation order on educational building projects. *Journal of Facilities Management*, 14(2), 139-164. https://doi.org/10.1108/JFM-01-2015-0001.

Parchamijalal, M. and Shahsavand, P. (2016). The decision matrix approach to dealing with delays in construction projects. *Proceedings of the International Conference on Management and Dynamic Economics*, Iran, May, 2016.

Serag, E., Olufa, A., Malon, L. and Radwan, E. (2010). Model for quantifying the impact of change order on project cost for U.S. roadwork construction. *Journal of Construction Engineering and Management*, 136(9), 1015 - 1027.

Shiu, E., Hair, J.F., Bush, R. and Ortinau, D. (2009). *Marketing Research.* European edition. McGraw-Hill, Berkshire.

Sindhu Vaardini, U., Karthiyayini, S., Ezhilmathi, P. (2016). Study on cost overruns in construction projects –a review. *International Journal of Applied Engineering Research*, 11(3), 356-363.

Soetanto, R. (2002). Modeling Satisfaction for Main Participants of the Construction Project Coalition: A Study of Mutual Performance Assessment. PhD. Thesis, University of Wolverhampton, Wolverhampton.

Sriprasat L, E. (2000). Assessment of cost control system: a case study of the construction organisations. M.S Thesis, Asian Institute, of Technology, Bangkok.

Sun, M., Fleming, A., Senaratne, S., Motawa, I. and Yeoh, M. L. (2006). A change management toolkit for construction projects. *Architectural Engineering and Design Management*, 2(4), 261 - 271.

Tuloli, M. Y., Utiarahman, A. and Palilati, M. P. (2021). Analysis of causes and impact of variation order in the education building project in Gorontalo Province. *IOP Conference Series: Materials Science and Engineering*, 1098(2). Article ID 022065.

Ugwu, O. O. and Haupt, T. C. (2007). Key performance indicators and assessment methods for infrastructural sustainability – a South Africa construction industry perspective. *Building and Environment*, 42(2), 665-680.

Verwey, I. (2008), Women helping women: outcome of a South African pilot project. *Journal of Engineering, Design and Technology*, 6(2), 162-177. https://doi.org/10.1108/17260530810891298.

Xiao, H. and Proverbs, D. (2003). Factors influencing contractor performance: an international investigation. *Engineering Construction and Architectural Management*, 10(5), 322-332.