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EVALUATING CAUSES OF CHANGE IN BUILDING CONSTRUCTION PROJECTS

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ABSTRACT

Purpose: Change in building construction project is inevitable and can occur at any stage, it has different source and reason due to involvement of many participants. Therefore, the study gives insight into causes of these changes and its consequences on building project performance.
Design/methodology/approach: Descriptive and survey research method was used to evaluate the perception of construction participants and stakeholders to evaluate significant causes of change and effects of change order on performance of building construction projects. 125 well structured, cross-sectional questionnaires were distributed and data obtained were analysed using descriptive, relative importance index and Kruskal-Walis tests.
Findings: Feedback from the respondents revealed the most significant causes of change in building construction projects to include change of plans by owners followed by change in design, poor communication among the construction participants, owners' financial difficulties and owners' change of schedule. Further findings on the effect of change order on the performance of building construction projects shows that on the general notes, cost overrun is the most prevalent effect followed by quality standard enhanced, time overrun, additional money for contractor overhead and work-on-hold (in descending order).
Research limitation/implications: This study is limited in scope to all such building construction projects in the study area (public buildings, commercial, hospital and others), also restricted to the opinion of 104 participants who duly completed and return their questionnaire. It has found that managing changes at project level is a critical problem faced by the construction industry. An understanding of the causes of change (that leads to change order) would be helpful for building construction professional and participants in managing change/variation orders.
Practical implications: Introduction of change management procedure in the contract document will enhance smooth delivery of building projects with less disputes. The change will be managed to maximise the benefit and minimise penalties. It is also recommended that the Ministries (federal and state) in charge of housing should establish or have a well-defined system of managing changes in Government building construction projects rather than abrupt calling for unjustified variation by their contractors or suppliers.
Originality/value: The study highlighted and established changes in building construction projects and the effects of change order on performance only in Akwa Ibom state.

Keywords: Change; change order; variation; management; construction projects.

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1. INTRODUCTION

Changes are very common and likely to occur at any stage of building construction projects. Managing changes effectively is crucial to the success of building construction project delivery as negligence of it has negative effect on orderly sequence, adversely impacting productivity and accordingly causing schedule delays and cost overruns (Anees Mohamed and Abdel Razek, 2012).

All the major participants in the building construction projects (owners/clients, designers, consultants, constructor or contractors) play different roles in construction processes that culminate in changes. These can be demand for amendment by the client's organisation, incomplete information available to the consultants, assumption by the designer, and personal experience of the contractor, all constitute change. Both change and re-work are done in the form of either 'adding', 'deleting' or 'replacement'. However, in construction, change option is the more general one given the same problem and different behavioural pattern. Ndihokubbwayo and Haupt (2009) argued that construction has a physical manifestation, therefore, construction rework is usually accompanied with the demolition of what has already been built, and it has a bigger direct impact on the construction performance than the change option.

Change in building construction projects can be expected, but the potential for cost and schedule consequences of these changes must be understood by those directing the change. Those consequences involved not only the work package/element for which the change is directed but other work packages and overhead functions as well. It is difficult for the clients to visualise the end product they requested hence, a degree of change should be expected. According to Anees (2012), these changes are commonly referred to as change orders. A motivation for the interest in change control is the recognition that late changes during construction may cause serious disruption (Ibbs, Wu and Kwak, 2001). Changes such as changing resource availability, environmental conditions, contractual structures and relations often occur in construction (Arain and Pheng, 2005) and according to Motawa (2005) may lead to incomplete plans and to some degree of unrealistic forecast.

Construction project change will never fade or vanish and is not expected to disappear, therefore the best option is to manage them to prevent negative consequences. There are many sources and causes of change, and in the thought of Lazarus and Clifton (2001), are to be managed to maximise the benefit, minimise the penalties, and ensure that both benefits and penalties are distributed equitably. Important and necessary change may lead to consecutive delays in project schedule, re-estimation of the work statement and extra demand of equipment, materials, labours and overtime, health and safety plans may also be adversely affected. There is a need to have a formalised change management process through which issues arising from changes are resolved to avoid big number of claims and dispute. A1-Dubaisi (2000) revealed in the study that improving the administration process of change orders is beneficial in reducing the cost and risk for all the project participants and encouraging a more trustful relationship. Serag, Olufa, Malone and Radwan (2010) stated that the change orders are very common in almost every construction project nowadays, often resulting in increases of 5-10% in the contract price.

There are beneficial change/variation and the project team should be able to take advantage of it when opportunity arises (Arian and Low, 2005). The need for amendment in a construction project may necessitate changes due to various factors. Studying the problem collectively as early as possible can minimise changes/variation

but if beneficial, variation can be made. The potential effect of variation must be recognised by project management team in order to minimise their adverse impact to the project. Hanna and Swanson (2007) suggested some strategies that the client /developer and the contractor can undertake whenever there are variations (Changes) which have cumulative impacts in the project to reduce disputes. A study on 15 different projects in Kuwait by Duaij, Awida and Kollarayam (2007) showed that no construction projects were completed without variation/change orders; only one (1) project was completed with net omissions in variation. This result is in line with most of the previous researchers' statement that no projects can be completed without variation.

Building construction projects are sponsored/financed mainly by individuals, private firms, government agencies (on behalf of government) or directly by government itself. These categories (of people, individuals, firms or agencies) are referred to as owner/client. The approval for change/change order/variation comes from the client while the implementation of agreed change is done by the constructor/contractor and enforced by the consultant through some laid down procedures that may carry along some end users. Clients, constructors/contractors, consultants and others (project team (for non-profit making organisation such as churches) community liaison officers(CLO) for community based projects) are the major participant in building construction projects with varying degree of roles and different levels of effectiveness in change management processes. Developing a framework will allow the process to run smoothly and all encumbrances to enforcing and implementing change order will be checked, reduced or totally eradicated.

The aim of the paper is to evaluate the causes of change in building construction projects that leads to change order. In other to achieve this aim, the objectives are to: first, evaluate the significant causes of change in building construction projects and second, determine the effects of change order on the performance of building construction projects. Two hypotheses were postulated to validate the findings of this study. The first hypothesis states that there is no significant difference in the perception of construction participants on significant causes of change in building construction projects. The second states that there is no significant difference in the perception of construction participants on the effect of change order on the performance of building construction projects. The outcome of these hypotheses will give an insight into the significant cause of change in building construction projects. It will also enable the construction stakeholders to understand the effect of change order on performance of building projects.

2. LITERATURE REVIEW

This literature review is done based on the research objectives developed for the purpose of this study. Classification of changes by different author/contributor, nature, sources, causes of change and effect of change order were reviewed.

2.1. Concepts definitions and distinctions

2.1.1. Defining change

Change in a broad engineering sense has been defined by Jarrett, Eckert, Caldwell and Clarkson (2011) as a modification made to part, drawing or software that have

already been released during the product design process and life cycle, regardless of scale or type. A change may encompass any modification to the form, fit and/or in part; moreover, it may lead to a variation in interactions and dependencies, of the constituent elements of the product (Jarrett, Eckert, Caldwell and Clarkson, 2011). On a construction project a change is understood as an event that results in an alteration of the projects original scope, execution time, cost and/or quality of work (Ibbs, Nguyen and Lee, 2007). This may be either to the product or to the related documentation. Changes may be categorised by time (anticipated/emergent, proactive/reactive, pre-fixity/post-fixity); need (elective/required, discretionary/non-discretionary, preferential/regulatory) or effect (beneficial/neutral/disruptive) (Mottawa, Anumba and Pena-Mora, 2007).

2.1.2. Distinguishing variations and change orders

While the terms 'Variation', 'Change' and 'change order' are used interchangeably by some authors, in strict terms a 'Variation' or 'Change" is any type of deviation from an agreed upon, well-defined scope or schedule of works (Keane, Sertyesilisik and Ross, 2010) and a 'Change Order' is that formal document that provides authorisation relative to the contractual agreement and which becomes part of the projects documentation (Keane, Sertyesilisik and Ross, 2010). A 'Change Order' is thus an order given by the employer and authorising a variation (Charoenngam, Coquinnco and Hadikusumo, 2003). A 'Change request' denotes the request for a variation, while the order characterises uses the employer - authorized instruction for it. The change order may be complex as it may require the construction team to engage with a substantial amount of information, which needs to be appropriately "sent, checked, corrected, approved, requested, clarified, transmitted or submitted" (Charoenngam, Coquinco and Hadikusumo, 2003).

2.2. Classification of changes

Change is defined as "the act or an instance of making or becoming different, an alteration or modification" (Concise Oxford Dictionary, 1990). There are many different reasons and sources for change which will never fade or vanish. Since change will never disappear as it has become part of construction project, the best option is to manage them to prevent negative consequences. The changes are to be managed to maximise the benefits, minimise the penalties, and ensure that both benefits and penalties are distributed equitably (Lazarus and Clifton, 2001).

Change management occurs in construction at two levels: organisational and project level (Erdogan, Anumba, Bouchlaghem and Nielsen, 2005). Throughout a project, construction organisations are faced with many changes most of which are design changes (DCs). Project changes (PCs) are inevitable even if there had been detailed studies during the design development and prior to the construction stage. When change occur at the project level, the focus is on trying to cope with the changes that occur in the project due to internal or external reason. Several reasons for change at project level from the literature are summarised according to Erdogan, Bouchlaghem and Nielsen, (2005) in Table 2.1.

Table 2.1: Classification of changes

ACCORDING TO	PROJECT CHANGES (PCs)	
Type of impact (CII 1994)	BENEFICIAL CHANGES Reduce cost, schedule or degree of difficulty	DETRIMENTAL CHANGES Reduce owner value have neglect impact on the project
Need for change (CII 1994)	REQUIRED CHANGES Implemented to meet the objectives or regulatory/legal/safety /engineering requirement/ standards	ELECTIVE CHANGE Enhance the project but are not required to meet the original objectives
Initiation Nature/Responsiveness of change (Burnes 1996)	EMERGENT/REACTIVE CHANGES Unplanned, unexpected. The response is after the occurrence	ANTICIPATED/ACTIVE CHANGES Expected before it occurs, therefore necessary actions are taken

2.3. Nature and sources of change

According to literatures, reasons for change are categorised under two main headings: External reason and internal reasons. External Reasons are the factors that occur outside the project and they cannot be controlled by the organisation. Internal reasons result from the changes in project. The reasons in the literature are summarised in Table 2.2.

Although the specific change reasons for each level differ at some point, the big picture is the same. Project level Change Management (CM) is about coping with the changes in the project and taking the necessary actions to minimise loss and if possible increase the profit.

Table 2.2: Reasons for changes at project level

	EXTERNAL REASONS	INTERNAL REASONS
Reasons for Project changes (Kast and Rosenweig 1974) (Kitchen and Daly 2002) (Lazarus and Clifton 2001)	Changes (Cs) regarding economic and financial Issues. Changes in environmental issues Changes in ecological issues Technology Cs Cs in the standard and regulations Political changes Force majeure	Cs in the organisational culture Cs in the system of project planning. Cs in the project plan execution. Cs in the overall change control system Cs in the documentation system In effective decision making Design improvement Unexpected weather condition Design error Designer change of mind Changed design parameters. contract disputes Cs in the project

2.4. Project change management (PCM)

Project changes are considered to be any additions, deletions, or other revisions to project goals and scope whether they increase or decrease the project cost or schedule

(Ibbs, Wu and Kwak, 2001). Lazarus and Clifton (2001) Widens this definition and define the change in a construction project as anything that affects: The scope requirements or brief for the project; The capital cost, whole-life cost or value of the project; The times required to design or construct the project; The project team relationships and appointment; Project – associated risk allocations or scope; The form of procurement.

The changes in projects are primarily due to rework, variations (Changes orders), or unexpected events such as industrial action and inclement weather (Love, Itolt, Shen, Li and Irani, 2002). The main causes of rework are design changes (DCs), construction changes and design errors (Love and Li 2000). Design changes (DCs), also referred to as engineering changes (ECs) are defined as changes and/or modification in forms, fits, functions, materials, dimensions of products and constituent components (Huang, Yee and Mak, 2001).

The ECs are one of the biggest problems both in the construction and manufacturing industries. Three kinds of ECs are specified in the manufacturing industries depending on when they occur in the design process: ECs during initial design; ECs after the initial design period; ECs during the major reconstruction of a product (Rouibah and Caskey 2003). The first two kinds are also observed in the construction industry as a change in design development and change after design development namely pre-fixity change and post – fixity change respectively (Lazarus and Clifton 2001). The impact of the changes accruing early in the design process is not very large. The second type, ECs after the initial design period cause greater disruption since the production has already started. The third type of ECs in the manufacturing industry refers to the development of versions and variant of the product is not observed in the construction industry, since construction projects are one off projects.

The most common reasons and sources for the change orders in the construction can be summarised as : changed requirement of the employer; Design errors such as mistaken quantity estimates, planning mistakes, inadequate arrangement of contract interfaces, inconsistency between drawings and site conditions, citation of inadequate specifications and etc.; Un foreseen conditions regarding the site conditions or administrative aspects such as change of work rules/regulations, change of decision making authority, special needs for project commissioning and ownership transfer, neighbourhood pleading (Hsieh, Lu and Wu, 2004; Cox, Morris, Rogerson and Jared, 1999; Love et al., 2002).

2.4.1. How to handle changes in construction projects

Lazarus and Clifton (2001) divide the effects of the changes within the project team into two as direct effects and indirect effects. Direct effects are easily feasible compared to indirect effects. Directs effect of change within the project team may be need to review their work, change their project information and outputs, update their communication to the others, expend additional time and cost implementing the change, reorganise and schedule their work methods, production schedules and deliveries, introduce acceleration measures to maintain the project programme. Potential indirect effects include: increased coordination failures and errors, increased waste in the process from abortive work and out of sequence working, reduction in productivity, quality of the product and profit, uncertainty and consequently lower morale.

Most of the studies in the literature provide guidelines for how to manage changes. The principles of effective (CM) model set by CII (1994) are as follows: Promote a

balanced change culture; Recognise change; Evaluate change; Implement change; Continuously improvement from lessons learned. This model and the algorithms based on these principles are also published by Ibbs, Wu and Kwak (2001)

Reviewing these principals and algorithms, Lazarus and Clifton (2001) proposed separate CM procedure for changes during design development, urgent post fixing changes and non-urgent post fixity changes. The EPSRC – funded research project 'Managing change and Dependency in Construction' developed a toolkit enabling users to project a rich description of the change event. The toolkit blends change prediction and CM with knowledge management concept and work flow approach (EPSRC, 2005). Love et al. (2002) Investigates the CM through a system dynamics perspective and suggests that the dynamics of a project system should be evaluated and monitored by the project managers in accordance with the following functions: planning for being proactive; organizing; commanding; controlling.

Since most of the PCs are DCs, the design process requires more attention. Therefore, another approach in literature aimed at leading the companies to implement concurrent engineering to improve communication and handle changes quickly. Concurrent engineering and Design and Build approaches are believed to be more successful in minimising the number of design changes or coping with them during the construction stage provided that they have a well-built communication system and focus on the customer needs (Moore and Dainty, 1999; Faniran, Love, Treloar and Anumba, 2001; Lau, Mak and Lu, 2003).

2.5. Systemising changes in construction project

Systemising changes could be performed by causes or consequences of the changes in projects. Research by Nahod (2012) resulted in seven main causes of change (Table2.3).

Table 2.3: Cause of changes

S/N	CAUSES OF CHANGES	% OF CHANGE	SOURCE OF CHANGE
1	Investors' change requests caused by additional recognised need for a project	25%	Project Stakeholders
2	Partially incomplete project documentation	21%	Project Stakeholders
3	Change of technology caused by lack of availability of designed technology in the market	18%	Project Conditions
4	Lack concrete construction material in region caused by high or low current demand	12%	Project Conditions
5	Lack of financing for the timely completion of a project	10.5%	Project constraints
6	Contractors change request for easier operations higher income, within the allowable limit of the projects	8%	Project Stakeholders
7	Project documentation alignment with new regulations adopted in the period between project design and realisation	4%	Project Conditions
8	Others	1.5%	

The main cause of construction changes are investors requirements for higher standards in relation to those planned to be realised in the execution phase of a construction project. All stakeholders are fully dedicated to a project and its details only in the execution phase, when they see alternatives to achieving the goals.

Incomplete documentation is a cause of change due to poor or neglected coordination on the part of all of the projects stakeholders. Deadline for partial design are too ambitious, while synchronisation of all parts of a project is replaced with a buffer to enable timely project deliverables. This buffer is usually used for making up for lost times, instead of for synchronisation that is subsequently neglected. So documentation is ultimately composed of unadjusted parts and does not form the logic of the whole project. Investors sometimes
change their priorities or for other reasons redirect to financing, so a project can end up being cancelled due to a lack of funds.

Table 2.4: Causes of changes by main stakeholders

INVESTOR	DESIGNER	CONTRACTOR	PROJECT MANAGER
Designer are insufficiently involved in the project and don't elaborate it in detail	Investors often changes input for the projects	Design documentation is incomplete	Investors disclaims liability because he is not in the profession, but wants to impact on project management
The market is chaotic and incomprehensible	The investor under-estimates the importance and the time required for design	The investor has a new ideas during the realisation phase	
Contractors only care about earnings and neglect the quality	The contractor does not examine the bidding documents sufficiently		

The analysis of the consequences of change on project realisation must be performed quickly and effectively, and certainly before making a final decision of change approval. If this analysis is not adequate, it can have a negative impact in the project (Nahod, 2012). According to Nahod (2012), the consequences of changes are divided into six groups: Change in the project scope, which manifests as additional works; Indirect impact on other parts of the project; Time extension; Cost overruns; Negative impact on the quality of performed works; Change in the engagement of resources on the project.

It is clear that investors' requirements impact additional works the most (in 83% of project with scope changes) (Nahod, 2012). Undermining the harmony of the whole project is usually the result of execution as a whole an increase in expenditure's and negative effects on the quality of the work for the realisation of the project. In practice this means temporary suspension of works on the project due to lack of funds to complete the project. Incomplete project documentation, according to research conducted, mainly results in changes in the engagement of resources and consequently invokes organisational changes in the phase of realisation.

Nahod (2012) submitted that scope management is one of the angles of the project management triangle, which means that together with time and cost it represent one of the most significant constraints and focuses on the project. There can be no project success without a systematically and professionally appointed system for managing the scope.

3. RESEARCH METHODOLOGY

The quantitative descriptive survey approach which involves the use of structured questionnaires was employed in this study. The population of the research consist of four categories among the stakeholders in building construction industry in Akwa Ibom State namely: the client's organisation, the contractors' organisation, the consultants and others (project team (for non-profit making organisation), community liaison officers (for community based projects)). The non-availability of access to data on the construction participants in the study area made it difficult to ascertain the population frame of the study.

The sampling technique used was purposive also known as Judgemental, selective or subjective sampling because the units to be investigated were based on the Judgement of the researcher. The main goal of this technique was to focus on a particular characteristic of the population that was of interest, which also help to provide answers to research question. Therefore, a total of 125 questionnaires were distributed to sample the opinion of respondents across the three senatorial district of the state to obtain primary data for the work.

The questionnaire was divided into four sections. The first section (A) of the questionnaire identified the general characteristics of the respondents. The second section (B) focused on the description of the nature of building project in which the respondent is involved and general question about change order. The third section (C) listed out the significant causes of change in building construction project. The fourth section (D) highlighted the effects of change order on performance of building construction project.

Distribution of questionnaire was considered the most suitable method to collect primary data for the study, hence a five-point Likert scale questionnaire was developed to provide the respondents ease of answering the questions as per their level of agreement and ranking (McLeod, 2008). The Likert scale follows the format of: 1) Strongly Disagree; 2) Disagree; 3) Moderate; 4) Agree; 5) Strongly Agree for level of agreement; 1) Very Low; 2) Low; 3) Moderate; 4) High; 5) Very High for level of ranking.

4. RESULTS AND DISCUSSION OF FINDINGS

4.1. Characteristics of the respondents

The characteristics of the respondents 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 4.1. Also project characteristics the respondents were involved in such as construction type, contract type and project ownership type were also evaluated.

According to the result shown in Table 4.1 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 indicate 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 4.1: Descriptive results of respondents' characteristics

Features	Sub features	N	%
	Male	94	90.4
Sex	Female	10	9.6
	Total	104	100
	OND	2	1.9
	HND	26	25.0
	BSc	34	32.7
Educational Qualification	PGD	11	10.6
	MSc/Mtech	12	11.5
	PhD	11	10.6
	Others	8	7.7
	Total	104	100
	Client	18	17.3
Stake in the project	Consultant	35	33.7
	Contractor	39	37.5
	Others	12	11.5
	TOTAL	125	100.0
	NIA	26	25.0
	NIOB	19	18.3
	NSE	20	19.2
Professional affiliation	NIQS	12	11.5
	NITP	2	1.9
	NIESV	2	1.9
	Others	23	22.1
	TOTAL	104	100.0
	Technician	1	1.0
	Licenciate	13	12.5
Membership status	Associate	38	36.5
	Graduate	32	30.8
	Corporate	4	3.8
	Fellow	16	15.4
	TOTAL	104	100.0
	1-5yrs	13	12.5
Years of experience	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
	Uyo	61	58.7
Senatorial district of operation	Eket	28	26.9
	Ikot-ekpene	15	14.4
	TOTAL	104	100.0
	Private	54	51.9
Project owner type	Government	38	36.5
	NGOs	11	10.6
	Others	1	1.0
	TOTAL	104	100.0
	New	89	85.6
	Addition	3	2.9
Type of construction	Renovation	7	6.7
	Rework	1	1.0
	Others	4	3.8
	TOTAL	104	100.0
	Unit price	43	41.3
	Lump sum	54	51.9
Contract type	Actual cost plus profit margin	7	6.7
	TOTAL	104	100.0

4.2. Causes of change in building construction projects

A set of selected causes of change as peculiar to the study area are presented to the respondents, these causes are presumed to lead to change order, Table 4.2 shows a display of result with their relative important indexes and rank.

Table 4.2: Perception of most significant causes of change by construction participants

S/N	List variables	Clients N=18		Consultants N=35		Contractors N=39		Others N=12	
		RII	Rank	RII	Rank	RII	Rank	RII	Rank
1	Change in design	0.912	**1**	0.772	**3**	0.810	**2**	0.700	**7**
2	Change of plans by owners	0.856	**2**	0.846	**1**	0.856	**1**	0.900	**1**
3	Poor communication system among construction participants	0.812	**3**	0.778	**2**	0.758	**5**	0.809	**3**
4	Substitution of materials	0.800	**4**	0.714	**5**	0.764	**4**	0.700	**7**
5	Owners change of schedule	0.800	**4**	0.738	**4**	0.744	**6**	0.734	**5**
6	Errors and omissions in design	0.788	**6**	0.738	**4**	0.728	**7**	0.666	**8**
7	Owners financial difficulties	0.744	**7**	0.714	**5**	0.806	**3**	0.784	**4**
8	Contractor financial difficulties	0,734	**8**	0.652	**9**	0.652	**12**	0.850	**2**
9	Contractor desire to improve his financial condition	0.712	**9**	0.640	**11**	0.620	**15**	0.716	**6**
10	Weather condition	0.688	**10**	0.572	**19**	0.662	**10**	0.416	**16**
11	Technology change	0.666	**11**	0.658	**8**	0.616	**16**	0.484	**18**
12	Lack of coordination between consultant and contractor	0.666	**12**	0.668	**6**	0.616	**16**	0.616	**10**
13	Safety consideration	0.634	**13**	0.646	**10**	0.564	**21**	0.350	**19**
14	Inadequate soil	0.600	**14**	0.618	**13**	0.580	**19**	0.466	**15**
15	investigation Value engineering	0.600	**14**	0.646	**10**	0.656	**11**	0.584	**11**
16	Inadequate site inspection	0.566	**16**	0.622	**12**	0.594	**18**	0.484	**14**
17	Differing site condition	0.566	**16**	0.652	**9**	0.648	**13**	0.416	**16**
18	Conflicts between contract document	0.556	**18**	0.668	**6**	0.672	**9**	0.400	**17**
19	Ill-defined scope of work	0.512	**19**	0.662	**7**	0.676	**8**	0.400	**17**
20	Ill-defined project objectives	0.512	**20**	0.606	**14**	0.626	**14**	0.500	**13**
21	Communual/youth disturbances	0.500	**21**	0.600	**15**	0.620	**15**	0.634	**9**
22	New government regulation	0.422	**22**	0.588	**17**	0.570	**20**	0.216	**22**
23	Land acquisition matter	0.412	**23**	0.418	**21**	0.390	**23**	0.516	**12**
24	Unavailability of	0.388	**24**	0.594	**23**	0.600	**17**	0.266	**21**
25	equipment	0.378	**25**	0.582	**18**	0.594	**18**	0.300	**20**
26	Defective workmanship Unavailability of skill	0.356	**26**	0.548	**20**	0.488	**22**	0.300	**20**

From the Table, the relative important indexes show the top five (5) significant causes of change order (overall) as follows: Change of plans by owners; Change in design; Poor communication system among construction participants; Owners financial difficulties; Owners change of schedule

Table 4.3 shows the causes of change in descending order for each participant (clients, consultants, contractors and others) as extracted from Table 4.2.

Table 4.3: Top five significant causes of change by each construction participants

The clients	The consultants	The contractors	Others
Change in design	Change of plans by owner	Change of plans by owner	Change of plans by owner
Change of plans by owners	Poor communication system among construction participants	Change design	Contractor financial difficulties
Poor communication system among construction participants	Change in design	Owners financial difficulties	Poor communication system among construction participants
Substitution of materials or procedure	Owners financial schedule	Substitution of materials and procedure	Owners financial difficulties
Owners change of schedule	Errors and Omissions in design	Poor communication system among construction participants	Owners change of schedule

4.2.1. Test of hypothesis one on significant causes of change in building construction projects

The hypothesis earlier postulated need to be tested to be able to make any definite statement on the perception of construction participants on the level of significance of various causes of change. The confidence level is set at 95% to achieve this with significance level at 0.05. If the p-value is less than or equal to 0.05, the null hypothesis is rejected and the alternative is accepted. Otherwise the null hypothesis is accepted and the alternative rejected.

Kruskal Wallis test was conducted to determine whether or not there is variation in the perception of construction participants on the significant causes of change in building construction projects in the study area. The result is presented in Table 4.4. As shown in the table, fifteen (15) variables have p-values greater than 0.05 and are not significant. For these variables (with p-value > 0.05), the null hypothesis is accepted and according to construction participants, there is no significant difference on their being the significant causes of change. However, eleven (11) variables have p-values less than 0.05 and are therefore significant with null hypothesis rejected and alternative accepted. This by implication means, for these variables, the construction participants believe there exist reasonable difference on their being the significant causes of change in building construction projects.

Table 4.4: Variation of the perception of construction participants on level of significance of causes of change in building construction projects

S/N	Causes of change	Respondent designation				Chi sq	Sign	R
		Client (N=18)	Consultant (N=35) Mean rank	Contractor (N=39)	Others (N=12)	DF=3		
1	Substitution of Materials and Procedure	60.06	47.87	54.86	47.00	2.819	0.420	NS
2	Conflicts between Contract Document	44.03	58.67	59.19	25.46	15.318	0.002	S
3	Change of Plans by Owners	52.06	50.56	51.86	60.92	1.405	0.704	NS
4	Owners Change of Schedule	59.06	51.16	50.87	51.88	1.137	0.768	NS
5	Ill-defined Scope of work	39.83	58.96	60.40	27.00	16.98	0.001	S
6	Contractor Desire to Improve His Financial Condition	59.50	50.74	48.15	61.25	3.009	0.379	NS
7	Errors and Omission in Design	59.22	52.10	53.47	40.42	3.106	0.376	NS
8	Contractor Financial Difficulties	57.97	47.96	48.17	71.63	7.444	0.059	NS
9	Unavailability of Skills	34.94	65.54	56.44	28.00	23.328	0.000	S
10	New Government Regulation	41.47	62.73	59.27	17.21	26.249	0.000	S
11	Safety Consideration	57.78	61.73	51.47	21.00	18.395	0.000	S
12	Technology Change	58.39	58.19	54.17	21.67	15.669	0.001	S
13	Owners Financial Difficulties	51.75	46.67	57.17	55.46	2.548	0.460	NS
14	Ill-defined Project Objectives	41.00	56.11	58.18	40.75	6.8995	0.075	NS
15	Change in Design	71.14	47.54	54.58	32.25	15.449	0.001	S
16	Lack of Coordination between Consultant and Contractor	54.75	55.67	49.47	49.71	1.046	0.790	NS
17	Value Engineering	49.08	53.56	55.54	44.67	1.773	0.621	NS
18	Differing Site Condition	46.58	59.14	57.55	25.58	14.160	0.003	S
19	Unavailability of Equipment	35.67	61.81	61.65	20.83	27.201	0.000	S
20	Defective Workmanship	34.14	60.86	62.01	24.75	24.788	0.000	S
21	Weather Condition	63.31	47.81	59.58	26.96	15.136	0.002	S
22	Inadequate Soil Investigation	48.56	60.24	52.88	34.58	7.783	0.051	NS
23	Inadequate Site Inspection	50.64	58.97	52.38	36.79	5.502	1.390	NS
24	Poor Communication System among Construction Participants	57.67	52.11	49.26	56.42	1.320	0.724	NS
25	Communal/Youth Disturbances	41.75	53.03	55.62	56.96	3.141	0.370	NS
26	Land Acquisition Matter	52.81	51.81	48.64	66.58	3.606	0.307	NS

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

4.3. Effect of change order on performance of building construction projects

The second objective determined the effect of change order on performance of building construction projects. Before determining the effect of change order, three major performance indicators (cost, time or schedule and quality) among others were presented to respondents as primary driving factor for change order in the questionnaire and fifty-one percent (51%) chose quality. Further investigation conducted on project cost and schedule(time) overruns reveals the following as shown in Table 4.5. Sixty-one percent (61%) of the respondents agreeing that the percentage cost overrun for the project is between 0-5% and 6-10% while thirty percent (30%) goes for between 16-20% and above 20%. On the other hand, fifty-four percent (54%) believe 10-20% schedule overrun is prevalent, thirty percent (30%) says less than 10% delay is experienced on the project delivery time while 21-50% delay is experienced by 11% of the respondents.

Table 4.5: Percentage cost and schedule overrun

Percentage cost overrun	Frequency	Percent	Percent cum	Percent schedule overrun	Frequency	Percent	Percent cum
No Idea	3	2.9	-	No idea	2	1.9	-
Below 0%	7	6.7	9.6	Less than 10%	31	29.8	31.7
0-5%	20	19.2	28.8	10-20%	56	53.8	85.5
6-10%	33	31.7	60.5	21-50%	11	10.6	96.1
11-15%	10	9.6	70.1	Above 50%	3	2.9	99
16-20%	16	15.4	85.5	Others	1	1.0	100
Above 20%	15	14.4	99.9	Total	104	100.0	100
Total	104	100.0	99.9				

Table 4.6 summarises the perception of the respondents who participated in the survey on the prevalent effects of change orders on various performance indices of building projects. Relative importance indexes were calculated and ranked accordingly, the top five most prevalent effects in descending orders are as follows: Cost Overrun (increase in project cost); Quality Standard Enhanced; Time Overrun (delay in completion schedule); Additional Money for Contractor Overhead; Work-on-hold.

Further analysis of respondents' opinions and views based on different construction participant's perception are as shown in Table 4.7 It is evident that all the construction participants have four (4) of the top five prevalent effect common, cost overrun, quality standard enhanced, time overrun and additional money for contractor overhead. Clients, consultants and contactors also believed work-on-hold is among the top five while others (project team and CLO) share a divergent view on this by saying it is disputes between parties to contract that ranked fifth.

4.3.1. Test of hypothesis two on the effect of change order on performance of building construction projects

In order to ascertain if the variation in the effects of change order on performance of building construction projects is significant or not, the second hypothesis was postulated as stated. In testing this hypothesis, the confidence level is also set at 95% significance and the decision rule is; if the p-value is < 0.05, null hypothesis is rejected and the alternative is accepted.

Table 4.6: Perception of the effects of change order on performances by construction participants

S/N	Effect of change order	Clients N=18		Consultants N=35		Contractors N=39		Others N=12	
		RII	Rank	RII	Rank	RII	Rank	RII	Rank
1	Quality standard enhanced	0.856	1	0.748	3	0.728	3	0.800	2
2	Additional money for contractor overhead	0.778	2	0.720	4	0.672	5	0.784	3
3	Cost overrun	0.374	3	0.822	1	0.806	1	0.884	1
4	Time overrun	0.666	4	0.778	2	0.770	2	0.666	4
5	Work-on-hold	0.666	4	0.714	5	0.718	4	0.584	6
6	Disputes between parties to contract	0.522	6	0.674	7	0.652	7	0.634	5
7	Professional reputation of one or more parties to the contract adversely affected	0.500	7	0.698	6	0.666	6	0.416	9
8	Complaints of one or more parties to contract	0.484	8	0.634	8	0.626	9	0.434	8
9	Demolition and rework	0.484	8	0.634	8	0.642	8	0.416	9
10	Additional health and safety equipment	0.444	10	0.554	10	0.534	12	0.316	12
11	Additional specialist equipment and personnel	0.388	11	0.612	9	0.620	10	0.384	10
12	Degradation of health and safety	0.378	12	0.526	11	0.558	11	0.316	12
13	Time reduction	0.356	13	0.394	13	0.416	15	0.450	7
14	Decrease productivity	0.334	14	0.526	11	0.518	13	0.334	11
15	Degradation of quality standard	0.312	15	0.486	12	0.508	14	0.234	14
16	Optimum cost reduction	0.312	15	0.348	14	0.390	16	0.284	13

N: Frequency; RII-Relative importance index

Table 4.7: Prevalent effects of change order based on construction participants' perceptions.

The Clients	The Consultants	The Contractors	Others
Quality Standard enhanced	Cost overrun	Cost overrun	Cost overrun
Additional Money for contractors overhead	Time Overrun	Time Overrun	Quality standard enhance
Cost overrun	Quality standard enhance	Quality standard enhance	Additional Money for contractors overhead
Time Overrun	Additional Money for contractors overhead	Work-on-hold	Time Overrun
Work-on-hold	Work-on-hold	Additional Money for contractors overhead	Disputes between parties to contract

Kruskal Wallis test was conducted to ascertain the difference on the perception of construction participants on the effect of change order on performance of building construction projects. The result is shown in Table 4.8. According to the table, seven (7) variables have p-values greater than 0.05 and are not significant therefore null hypothesis is accepted and alternative rejected. However, nine (9) variables are significant with p-values less than or equal to 0.05, hence the rejection of null hypothesis while alternative is

accepted. The implication of this is that, those seven (7) variables with p-value > 0.05, the construction participants believe there is no difference on their having effect on performance as a result of change order while the nine (9) variables with p-value < 0.05, according to construction participants, believe there is difference on their having effect on performance as a result of change order.

Table 4.8: Variation on the perception of construction participants on effects of change order on performance of building construction projects

S/N	Effect of change order on performance	Respondent designation				Chi sq	Sign	R
		Client (N=18)	Consultant (N=35)	Contractor (N=39)	Others (N=12)	DF=3		
			Mean rank					
1	Time overrun	41.22	58.19	56.17	40.92	6.575	0.087	NS
2	Cost overrun	39.83	56.14	51.65	63.63	5.988	0.112	NS
3	Disputes btw parties to contract	37.64	57.69	55.04	51.42	6.025	0.110	NS
4	Additional specialist equipment/personnel	30.67	60.26	62.63	29.71	24.508	0.00	S
5	Complaints of one or more of the parties to the contract	37.94	60.86	58.29	31.13	15.522	0.001	S
6	Quality standard enhanced	67.81	49.47	46.38	58.25	7.937	0.047	NS
7	Professional reputations adversely affected	35.97	63.83	59.03	23.04	25.585	0.000	S
8	Additional health and safety equipment	43.53	60.39	57.88	25.46	16.102	0.001	S
9	Degradation of quality standard	35.17	59.59	62.83	24.25	25.013	0.000	S
10	Decrease productivity	34.08	60.91	58.78	35.17	16.215	0.001	S
11	Additional money or contractor overhead	61.69	51.90	45.55	63.04	5.674	0.129	NS
12	Work-on-hold	49.06	55.53	56.53	35.75	5.476	0.140	NS
13	Demolition and rework	41.47	57.99	58.74	32.75	11.062	0.011	NS
14	Optimum cost reduction	48.17	52.01	58.28	41.63	3.993	0.262	NS
15	Time reduction	46.36	51.99	53.72	59.25	1.596	0.660	NS
16	Degradation of health and safety	34.72	58.57	63.45	25.88	24.362	0.000	S

4.4. Discussion of findings

The result of findings on the most significant causes of change in building construction projects reveals that change of plans by owners was ranked by the respondents as the most significant cause of change followed by change in design, poor communication among the construction participants, owners' financial difficulties and owners' change of schedule. The implication of this is that within the study area, change of plans by clients is the prevalent factor or cause leading to change order.

This result is in agreement with the submissions of Hsieh, Lu and Wu (2004); Love, Holt, Shen and Li (2002); Cox, Morris, Rogerson and Jared (1999); that change requirements of the owner is the most common reason and source leading to change order. The result is contrary to the previous research conducted by Anees, Mohammed and Abde Razek (2013) in Egypt where the top five causes leading to change order are lack of coordination between contractor and consultant, errors and omissions in design, value engineering, change in design and change of plans by owners (in descending order). Also the outcome of the research on findings on perceptions of different construction participants on causes of change is in variant with the submissions of Anees, Mohammed and Abdel-Razek (2013), this is largely due to different research area, location, environment with different mentality and perception to contract issue/system. Careful examination of the results of findings of Enshassi, Arain and Al-Raee (2010) revealed different pattern of thoughts and perceptions, this is due to the fact that the research is conducted in a war prone area of Gaza strip. Conclusively, the research environment, location and study area has a great influence on the causes leading to change order.

Findings on the effect of change order on the performance of building construction projects shows that on the general notes, cost overrun is the most prevalent effect followed by quality standard enhanced, time overrun, additional money for contractor overhead and work-on-hold (in descending order). This outcome is in tandem with the result of Anees, Mohammed and Abdel-Razek (2013). The effect of change order is prevalent on the three (3) main building project performance indicators; increase in project cost, delay in delivery time or schedule and quality standard enhanced. Further investigation of the opinions of different building construction stakeholders (clients, consultants, contractors and others) is in agreement with the above findings. They all agree that cost overrun, time overrun and quality standard enhanced are the major performance indicators being affected by change order.

5. CONCLUSION

Changes within building construction projects are inevitable, but should be kept to a minimum and when they do occur, should be managed to maximise the benefit and minimise the penalties. This paper has reviewed the findings of a literature on change and change management concepts in constru ction. It has found that change management occurs at the project level and at the organisational level, change management is a critical problem faced by the construction industry.

The most significant causes of change leading to change order in the study area as set out in the specific objectives of the study have been highlighted and presented. An understanding of the causes of change would be helpful for building construction professional and participants in assessing change/variation orders.

The effects of change order on performance are complex and influenced by numerous interrelated factor. Quality standard was regarded as the primary driving force for change order in the study area, cost overrun (increase in initial project cost) and time overrun (delay in delivery time or schedule) are the most prevalent effect change order has on building construction projects.

6. RECOMMENDATIONS

The various body regulating construction professionals' activities will need to do more in the area of public enlightenment and campaign to educate private construction and consulting firms on the need to have a formal system/procedure for handling and managing changes, and also incorporating change order clause in their contract system. The Ministry (federal and state) of Housing should establish or have a well-defined system of managing changes in Government building construction projects rather than abrupt calling for unjustified variation by their contractors or suppliers.

There is also a need to establish a comprehensive database that includes unit price, contractor/constructor, supplier and specification, which should be updated periodically. This will enhance the awareness of construction participants and professionals across the entire construction industries on the knitty-gritty of change order implementation and procedure.

Also, the adoption and inclusion of the developed framework in the project/construction management practice will enhance smooth implementation of change order as change request form would have formed part of the contract document, hence disputes/issues that may have arisen over project contract is avoided.

The findings from the study would also be valuable for all construction professionals and participants in general.

REFERENCES

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.

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, Cain, 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 (HBRC*), (8): 77-85.

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.

Arain, F. M. and Pheng, L. S. (2007). Modeling for Management of Variation in Building Projects, Engineering Construction and Architectural Management, 14 (5): 421 - 433.

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.

Burnes, B. (1996). No. Such Thing as...a "One Best Way" to Manage Organisational Change, *Management Decision*, 34 (10): 11 - 18.

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.

Concise Oxford Dictionary (1990) 8ed, ed R. E. Alien.

Construction Industry Institute (CII), (2011). Benchmarking and Metrics. Available at: file:///D:/computer%20data%2011-1 2011/master%20thesis/Paper1/master%20thesis-/reference/USED/33/Construction%20Industry%20Institute.htm> (accessed January, 2011). .

Construction Industry Institute (CII) (1994) Project Change Management, special Pub. 43 - 51.

Duaij, J., Awida, T. and Kollarayam, A. (2007). Performing Value Analysis on Construction Project Variation Orders*, Journal of Cost Engineering,* 49 (6): 23 - 27.

EPSRC, Engineering and Physical Sciences Research Council Industrial Report (2005) Managing Changes In Construction Projects.

Erdogan, B., Anumba, C., Bouchlaghem, D. and Nielsen, T. (2005). Change Management in Construction: The Current Context, 21st Annual Conference, Association of Researchers in Construction Management (ARCOM), (2): 1085 - 1095.

Faniran, O. O., Love, P. E. D., Treloar, G. and Anumba, C. J. (2001). Methodological Issues in Design-Construction Integration, *Logistics Info Management,* 14 (5/6): 421 - 426.

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.

Hanna, A., Camlic, R., Peterson, P. and Lee, M. (2004). Cumulated Effect of Project Changes for Electrical and Mechanical Construction*, Journal of Construction Engineering and Management,* 130 (6): 762 - 771.

Hester, W., Kuprenas, J. and Chang, T. (1991) "Construction Change and Change Orders: Their Magnitude and Impact", Austin: Construction Industry Institute (CII).

Heywood, C. and Smith, J. (2006). Integrating Stakeholders During Community FM's Early Project Phases. Facilities, 24 (7/8): 300 - 313.

Hsieh, T., Lu, S. and Wu, C. (2004). Statistical Analysis of Causes of Change Order In Metropolitan Public Works, *International Journal of Project Management,* 22: 679-686.

Huang, G. Q., Yee, W. Y. and Mak, K. L. (2001). Development of A. Web-based System for Engineering Change Management, Robotics and Computer Integrated Manufacturing, 17: 255 - 267.

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.

Jarratt, T. A. W., Eckert, C. M., Caldwell, N. H. M. and Clarkson P. J. (2011). Engineering Change: An Overview and Perspective on the Literature, *Research in Engineering Design,* 22 (2): 103 - 124.

Jauad, R., Bin Abdukader, M. R. and Abang Ali, A. A. (2009). Variation Orders in Construction Projects*, Journal of Engineering and Applied Sciences,* 4(3: 170-176.

Keaned, P., Sertyesilisik, B. and Ross, A. (2010). Variation and Change Orders on Construction Projects, *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction,* 2 (2): 89 -96.

Kitchen, P. J. and Daly, F. (2002). International Communication during Change Management, *Corporate Communications*, 7 (1): 46 - 53.

Lau, H. Y. K., Mak, K. L. and Lu. M. T. H. (2003). A Virtual Design Platform for Interactive Product Design and Visualisation, *Journal of Material Processing Technology,* 139: 402 - 407.

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

Lee, S., Hanna, A. and Loh, W. (2004). Deasion Treu Approach to Classify and Quantify Cumulative Impact of Change Orders on Productivity, *Journal of Computing in Civil Engineering ASCE*, 18/2: 132 - 144.

Love, P. E. D. and Li, H. (2000). Quantifying the Causes and Cost of Rework In Construction, *Construction Management and Economic*, 18: 479 -490.

Love, P. E. D., Itolt, G. D., Shen, L. Y., Li, H. and Irani, Z. (2002). Using System Dynamics to Better Understand Change and Rework to Construction Project Management Systems, *International Journal of Project Management,* 20:425-436.

McLeod, S. (2008). Simply Pychology. [Online] Available at: https://www.simplypsychology.org/likert scale.html [Accessed 04 08 2019].

Motawa, I. (2005). A Systematic Approach to Modelling Change Processes in Construction Projects, *Australian Journal of Construction Economics and Building*, 5 (1): 23-31.

Motawa, I. A., Anumba, C. J., Led. S. and Pena-Mora, F. (2007). An Integrated System for Change Management in Construction, *Automation in Construction,* 16 (3): 368 - 377).

Nahod, M. M. (2012). Scope Control through Managing Changes in Construction Projects, Ph.D. Thesis, Construction Management Department, Faculty of Civil Engineering, Croatia.

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.

Odusami, K. and Olusanya, O. (2000). Clients Contribution to Delay on Completion Cost Housing Projects in Nigeria: The Quantity Survey of Nigeria, *Journal of Construction and Management*, 2 (1): 81 - 86.

Rouibah, K. and Caskey, K. R. (2003). Change Management in Concurrent Engineering from A Parameter Perspective, Computers in Industry 50: 15-34.

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.

Users' Guide (2005). Understanding and Monitoring the Cost - Determining Factors of Infrastructure Project.