

**CHANGE ORDER PROCESS MODEL FOR THE NIGERIAN CONSTRUCTION
INDUSTRY**

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ABSTRACT

If building working drawings were perfect and unambiguous, late changes that often take place during construction and habitually causing grave disruption to the project will minimise. Identifying changes and anticipating their penalty can help project teams allay these negative impacts. As a result, a change process model has been proposed to improve this modus operandi, the existence of such process is imperative in order to accomplish the contractual responsibility of cost, time and quality. The methodology involved extensive literature review of existing change order management model. The paper assess how the existing contract provision for change management combined with the utilization of BIM can reduce the impact of changes and manage change from project initiation to project closure. The paper concludes that there isn't a specific change management procedure obtainable in the Nigerian construction industry; therefore diligently following the steps laid down in each stage of the model will help mitigate the negative impact of change orders.

KEYWORDS: Building Information Modelling, Change Order, Change Management, Process Model, Virtual mock-ups

1.0 INTRODUCTION

Late changes that often take place during construction and habitually causing grave disruption to the project would be minimised if building working drawings were perfect and unambiguous. But because during the development stage of every construction project, many judgment have to be based on assumptions, partial information and individual understanding of the construction professional (Hao, Shen, Neelamkvavil & Thomas, 2008). According to Ibbs, Nguyen and Lee, (2007) deficient information of project variables at the early stages of projects leads to not enough understanding of future situation. As a result, it lead to inaccurate estimates arising from vagueness in project parameter (Motowa, 2005). Therefore change is unavoidable, since changes will not vanish; the best choice is to manage them to thwart negative penalties. A research conducted in the United Kingdom in 2004 by the

Engineering and Physical Science Research Council (EPSRC) indicated that no widely accepted change management toolkits, functions or modus operandi is currently being engaged to manage change suitably and to lessen their impact on time and cost. Thorough reviews of literature have shown a growing literature on the modelling of change processes, change management systems and the impact of changes on various aspect of project delivery with particular consideration on cost, time quality and labour productivity. Charoenngam, Coquinco, and Hadikusumo, (2003) presented a web-based project and change order management system (COMS) specifically developed for dealing with changes in construction projects. The Internet was used in this system because of the advantage of delivering information in an accurate and timely manner. A change order procedure based on traditional methods was developed to facilitate the conduct of COMS through workflows. They concluded that the advantages of adopting this technology in the change order management process are "prompt delivery of documents to the addressed to construction participants; usage of a standard set of forms for each activity in the facilitation process; the mean to know if the other party has read the sent document; record keeping through a common database and proper management of documents". Lee and Pena-Mora (2005) used system dynamics to build dynamic project models to assist planning and control of construction projects. These dynamic project models captured several non-value adding change iterations. The simulation is demonstrated using a case study in road and, bridge construction, and many change option/policy implications were summarized based on this case study. Sun, Senaratne, Fleming, Motowa and Yeoh (2006) developed a change management toolkit from their research titled "Managing Change and Dependency (MCD) in Construction projects." The MCD change management toolkit includes a change dependency framework, a change prediction tool, a workflow tool and a knowledge management guide. The toolkit sought to address two areas of project change management namely: predicting change and reacting to change by rescheduling workflows. On their own part, Ipek and Ömer (2007), cited in Hao et.al, (2008) investigated requirement and design relationships that enable traceable requirement in architectural design. They developed a prototype system called Design Track and used LEED requirement as a case study. Motowa, Anumba, Lee and Pena-Mora (2007) presented some preliminary results on proactive change management through an integrated change management system composed of a fuzzy logic-based change prediction model and a system dynamics model based on the dynamic planning and control Methodology (DPCM). Similarly, Isaac and Navon (2008) have proposed a change control tool (CCT) which creates

requirement traceability through links between client requirements and the building design. They believe that numbers of changes, or the impact of changes, can be controlled by capturing client requirements accurately at the beginning of the project, and through the requirement traceability that is built up afterwards. Arain and Pheng (2007), based on the principles of effective change management, developed a theoretical model for management of change orders, which has three steps - screening, choice of promising alternatives and dominance building. Arain (2008) presented a knowledge -based decision support system (KBDSS) thereafter, which consists of two main components: a knowledge-base and a controls selection shell for selecting appropriate controls. This gives project managers accurate and timely information for design and a user-friendly system for analyzing and selecting the control for change orders. Most recently, Stare (2011), developed a project risk and change management model that is divided into two elements: risk and formal change management. The model handles expected change through the risk management method while all formal requests are dealt with through a formal change management process. While all the above studies, to diverse extents helped with the better perception of change orders management, there are some limitations to their applicability in the Nigerian situation:.

(i) All of the studies were carried out outside Nigeria. Although construction projects globally share some general features, there are also some country specific conditions.

(ii) All the studies focused on the use of complex ICT applications in managing change orders in developed construction systems. They did not consider the degree of difficulty of using these applications in developing country like Nigeria where the usage of ICT software is still low due to irregular power supply and high cost of ICT software and hardware.

These explanations underlie the rationale for this paper. Its aim is to develop a project change management process which supports a project team in anticipating and evaluating changes thus reducing the disrupting effect of accidental changes in the Nigerian Construction Industry

2.0 Literature Review

Change in construction occurs at two levels: organisation and project level. Change at the organisational level deals with managing how to introduce make improvements to the organisation effectively and efficiently whereas at the project level, the focus is on trying to

cope with the modification that occur in the project due to internal and external reason. This paper focuses on changes at project level.

2.1 What is Change and Change Order

A change is an amendment or addition in respect to the original plans, specification or other contract credentials. A change order is a directive from an employer approving an alteration (Park 2002). The Engineering and Physical Science Research Council (EPSRC) (2004) defined change as amendment to pre-existing situation, notion and basic information or prerequisite (project or client) and include work, time, cost and method of performance.

2.2 Taxonomy of Change orders

The nature of a change order can be determined by referring to both the rationale for their incidence and subsequent effect, degree of severity, and their necessity. There are two types of change orders according to Arain and Pheng (2005) namely: beneficial and detrimental. A beneficial change order is one issued to advance the quality standard, reduce cost and schedules or amount of complicatedness in a project and as a result it optimizes the client's benefits against the resources input by eliminating unwanted costs from the project. Kelly (2002), in addition says a change is beneficial if it is initiated to improve the client's value. According to Kelly (2002), clients value system element include time, capital cost, operating cost, environment, exchange or resale aesthetic/esteem and fitness of purpose. A detrimental change order is a change order that harmfully impacts the client's value or project performance (Arain & Pheng, 2005).

Also, a change that occurs at some stage in a project can be gradual or radical depending on the degree of severity (Cao, Clarke & Lehaney, 2000). A gradual change happens bit by bit over a prolong period of time and its strength is low. Such changes often occur during the design development stage where decisions are fine-tuned and refined little by little. Radical changes occur more often at post - design development and construction phases, they are sudden, remarkable, and have a marked effect. Another way to view project change is through their necessity. According to Lazarus and Clifton (2001), from this perspective project changes can be categorize as elective change and required changes. An elective change is where one may choose whether or not to execute a change, and a required change is where there is no choice but to change. The taxonomy of project changes are summarized in Table 1

Table 1: Taxonomy of Project Changes

According to	PROJECT CHANGES (PCs)	
Type of impact	<u>Beneficial Changes</u>	<u>Detrimental Changes</u>
	Reduce cost, schedule or degree of difficulty	Reduce owner value, have negative impact on the project
Need for Change	<u>Required Change</u>	<u>Elective Changes</u>
	Implemented to meet the objectives or regulatory /legal/safety/engineering Requirements/standards	Enhance the project, but are not required to meet the original objectives
Initiation Nature / Responsiveness of change	<u>Emergent/Reactive Changes</u>	<u>Anticipated/Proactive Changes</u>
	Unplanned, unexpected. The response is after the occurrence	Expected before it occurs, therefore necessary actions are taken.

Source: Erdogan ,Amumba, Bouchlaghem & Nielsen, (2005)

2.3 Causes of changes

Changes in construction industry can be caused by diverse sources at different points of the work. The cause of change may start off from external and internal concerns that may occur during the growth phase of project. Internal changes may be due to design change, design errors, omission, weather conditions, inappropriate site condition, unsatisfactory ground condition, (Arain & Pheng, 2006). External causes are set off because of

- (i) Changes in the client's need, polices or taste
- (ii) Government decision's and policy change
- (iii) A nation's economic environment
- (iv) Economic condition of stakeholders
- (v) A nation's political situation
- (vi) Technological change

2.4 Effect of change

Construction projects in Nigeria have suffered deleteriously as a consequence of extensive changes, which result in cost and time overruns, disputes, arbitration, litigation and

even the abandonment of projects. This negatively impacts on the efficiency of the Nigerian construction industry (NCI) (Ade-Ojo, & Babalola, 2013; Ijaola & Iyagba, 2012; Aibinu & Jagboro, 2002; Odeyinka & Yusuf, 1997). In addition to this direct effect of project change, project changes also have indirect effects which in the end have impact on project cost and schedules. According to Sun, et al., (2004) these indirect effects include; need for communicating change to all project members, dispute and blaming amongst project partners, loss of efficiency due to reprogramming, loss of tempo, lop-sided gangs and speeding up, change in cash flow, monetary costs, loss of income, increased threat of coordination failures and errors, lower confidence of work force and loss of float, therefore increased sensitivity to further delays.

2.5 Change Management Process

According to Zhao, Lv, Zuo and Zillante (2009) change management is one of the project management practices that determine problems when change occurred in a project or lessen change that may occur and upset the movement of the project. Also Hwang and Low (2012) outlined the process of change management to encompass four indispensable principles (i) to identify changes (ii) to evaluate changes (iii) to implement changes and (iv) to learn from past experiences. In other words a change management process should seek to anticipate possible change, identify change that is before now occurred, arrange for pre-emptive measure and synchronize changes across the entire project stakeholders, which can be achieved by an integrated solution for coordinating everything involved for the purpose of the change. In sum an effective change management process has to look into the cost, time and quality considerations for the project.

2.5.2 Change management in Nigerian construction industry

Currently a change management system is non-existent in the construction industry. Project changes are managed by using various contract provisions as well as by intuition by the construction team. The commonly used approach when changes are required is shown below

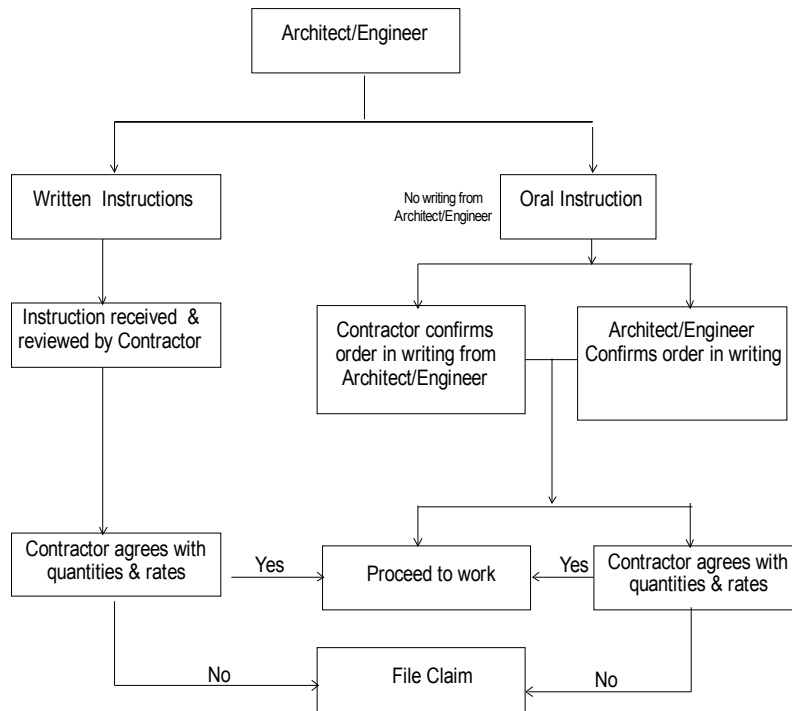


Figure 1: Change Order Procedure in Nigeria

Source: Modified and Adapted from Charoenngam, Coquinco, & Hadikusumo, (2003)

This paper proposes an approach for coping with changes in construction projects in Nigeria, by using the contract provision for change management and Building Information Modelling (BIM) to manage change request in a project life cycle based on the following assumptions:

- (i) The model would might not eliminated changes but minimize change orders, because building contract has clauses for changes.
- (ii) The Nigerian construction industry will continue to use FIDIC and Standard Building Contract with Quantities or its variants.
- (iii) The procurement route for building owner will continue to be majorly the design bid and build (DBB).

3.0 Research Methodology

This paper is part of a larger study which already exposed the absence of a change management method for building project in Nigeria. The methodology involved building on existing literature to create change management process.

4.0 Result

The proposed process model is divided into four stages of project life cycle as described by the project management institute for a project: initiation, planning, execution

and closure as depicted in Figure 2 in order to cater for peculiar issues in the Nigeria construction industry that warrant changes in project.

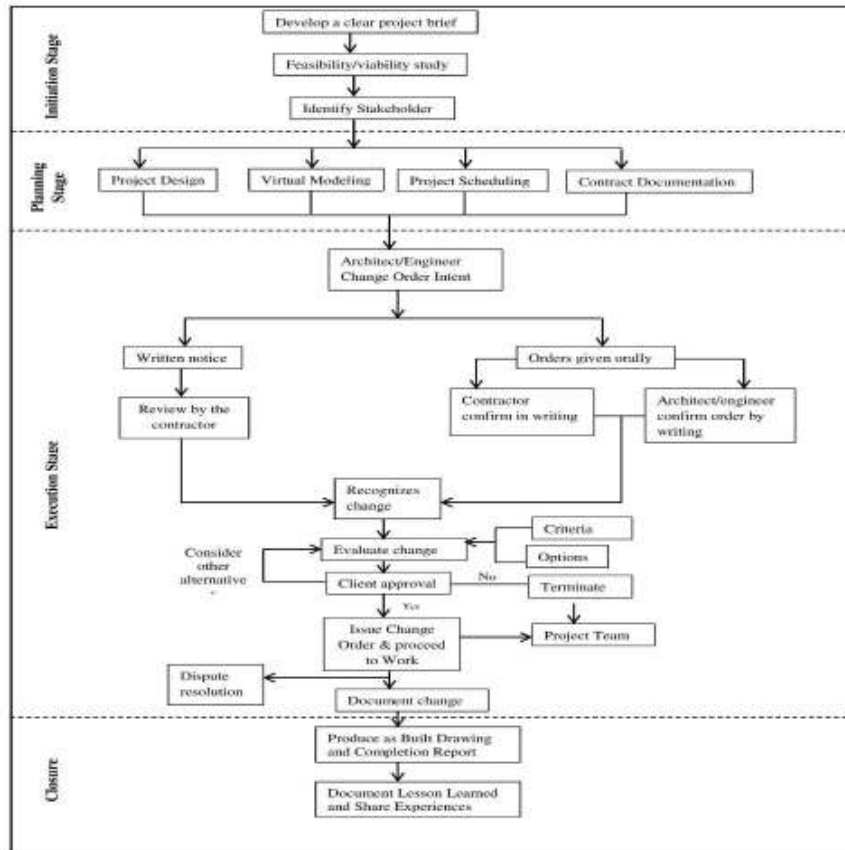


Figure 2: Proposed Change Management Process Model for the Nigerian Construction Industry
 The model stages are as detailed below:

Project Initiation Stage – Preparation of clear project brief, conducting credible feasibility and viability study, and stakeholder identifications.

Project Planning Stage - Project design, virtual modelling, project scheduling, and contract documentation.

Project Execution Stage - Change order intent (goal), recognize, evaluate, approve, document and implement change.

Project Closure Stage: production of built drawings & shop drawings, project completion report, document lesson learned, and share experiences.

5.0 Discussion

This paper has proposed a change management process for Nigeria based on existing literature. Managing changes at these stages are amplified more thoroughly in the following paragraphs.

Project Initiation

This stage provides the necessary requirement for project start-off. According to project Management Institute (2004), project initiation consists of those processes required to define a new project in terms of the project scope and the initial financial resources. Stakeholders who will influence the project outcome are also identified. In addition, the expectation of the client in relation to the 'iron triangle' (cost, time, and quality) are made explicit at this stage, in the form of project brief. These combined factors become performance dimensions of project risk and efficiency.

Feasibility study at this stage is crucial, because it seeks to justify what is developed and at what cost (viability analysis). During this stage, the project management team must identify internal and external stakeholders to determine their project requirements and expectations to manage them. Undertaking these steps during project initiation, will minimize changes in building construction projects in Nigeria due to: error and omission in BOQ, change of scope by client, change of specification and so on arising from an unclear project brief ; lack of a feasibility study and stakeholder management.

Project Planning

The main objective of this stage is to enable the project team to establish the scope of the project, define and refine the objectives, develop the course of action required to attain these objectives, and create project documents for implementation. What this model proposed is that after the project design by the architect, based on the information from stage one, there should be a virtual presentation of the building to all relevant professionals. This collaboration of the relevant professional, architect, and owner enables creative input by them and eliminate change orders that result from lack of clear and through brief because visualization provides a better understanding of what the final product will look like and Building Information Modelling (BIM) is a great visualization tool that can be used in this way, as it provides a three dimensional (3D) virtual representation of the building. Virtual mock-ups help in decision making regarding functionality of the space and building aesthetics, including:

- (i) Clash detections - which help the project team to see the 3D relationships of components and resolve conflicts early.
- (ii) The BIM also acts as a database for data about the project.

(iii) During the construction phase BIM models benefit the contractor by providing a virtual reference of the project.

As proposed in this model, at this planning stage, project scheduling comes next to virtual modeling. Based on adequate information and feasibility study, a realistic construction schedule can be done. A construction schedule devoid of last minute work acceleration to achieve completion within a desperately unrealistic time frame would be avoided. This would greatly minimize change due to schedule, specification and space alteration by clients and consultants.

The last step in the planning stage is the documentation of the contract. In construction, the key contract document prepared during the planning's stages are the pre-tender and post-tender contract documents. The post-tender contract document is more of priority as the contractor will work with it at the project executions stage. It comprise of.

- (i) Condition of contract (particular/general)
- (ii) Trade preambles and specification
- (iii) Bills of Quantities
- (iv) Contract drawings (architectural, structural and services drawing)
- (v) Schedules.

It is also important that the building owner and consultant have another look at of the post-tender contract documents to ensure that they are devoid of errors, omission and ambiguities so that construction changes originating from the same are minimized or avoided, as this helps avoid conflict between the content of contract documents. If the steps above are followed strictly during the project planning stage, it will minimize changes arising from ambiguity in project parameters such as: error and omission in Bills of Quantities change in specification change of scope etc.

Project Execution

The requirement of Project Management Institute (2004)), at this stage is quite explicit. It consists at the project execution stage, of processes to complete the work defined in the project management plan, and according to project specification. This stage also involves organizing people and resources as well as performing and integrating the activities of the project in accordance with the project management plan. So, the project is ready to start, the contractor has signed the contract and is ready to take possession of site.

In construction projects, this stage starts with the client giving the contractor possession of site, and the project time-line begins. This means the contractor gets the working space to start the project, sets up the site, and brings materials and equipment to site. The first and most important step for successfully managing changes at this stage entails identifying and recognizing the need for change by the supervising officer (Engineer or Architect). The FIDIC and SBC/Q condition of contract empowers the supervising officer to issue instructions to the contractor according to the following:

- (i) Increase or decrease of the quality of work in the contract
- (ii) Omission of work not necessary
- (iii) Change of the character, quality of the work.
- (iv) Change the levels, lines, positions and dimensions of any part of the work
- (v) Execution of additional work for the completion of works
- (vi) Change of construction timing sequence for the works.

It is quite enlightening to note that issuing change order timing is of core at this stage because the earlier a change is identified the lower its negative impact will be. The next step of successful change order management at the project execution stage is to evaluate the change order. This must be done in a timely manner to determine whether the change shall be detrimental or beneficial to the project. The client and the supervising officer can make informed decisions using value engineering, cost analysis and duration analysis techniques whether to adopt or reject a proposed change or consider other options. Whatever decisions are reached must be communicated to the project team members. It is important to note here that early notification affords all parties to more effectively control the cost and reduce a negative impact of change.

If the change is approved by the client the next step in the project, execution stage is to issue a change order instruction, and the contractor commences the implementation or execution of the change order, in line with the scope and specification provided. Next step is a valuation of the change order in accordance with the contract provision. It is advised here that change order valuation by client be done in conjunction with the contractor's Quantity Surveyor as this allows for good communication, trust building, and easy negotiation of change order worth. In the event that the parties are unable to reach an agreement on the terms of the change order, the contractor's solution might be to seek for a dispute settlement through appropriate statutory channels relevant to the construction industry. For example, the

SBC/Q, Section 9 provides for mediation, adjudication and arbitration to resolve any disputes, and FIDIC provides for disputes Adjudication Boards (DABs).

The last step in the management process of change order at the project executions stage is the documentation of change. This is vital and must be consistent, systematic, and done through the entire change process. Comprehensive documentation enables the contractor to substantiate his claim and the client to assess the contractor's submission. The study believes if these steps are diligently complied with, it will minimize time and cost overruns projects that arise from change orders.

Project Closure

In the project life cycle, project closure means to formally complete the project, phase or contractual obligations, to finalize all project activities (Project Management Institute, 2004). It also signifies the beginning of the Defect Liability Period and therefore any change order issued at this stage by the client stands null and void and is of no contractual value to the contractor. At this stage, a project completion report must be prepared by the consultants, or in-house project team. The project completion report including the technical report of the work written with appropriate headings and the final accounts should highlight the impact of the varied works.

Lessons learned are also documented at this stage. These capture priceless unstated knowledge and experience of team members during change events. This information is then made available to project stakeholders and considered when planning or implementing future projects.

6.0 Merits of the Change Management Process Model

Analysing the results of interviews on this subject, indicate the following merit of the process model for the construction industry in Nigeria. The process model will help the project management team to:

- (i) Improve change identification, appraisal and forecast method throughout the life cycle of projects.
- (ii) Implement an effective change control system in an orderly style.
- (iii) Assess the probability of the project change incidence during initiation phase and defining a control system over the project section that have high sway on the project.

(iv) The model provides a data base for project stakeholders when planning or implementing future projects.

7.0 Conclusion

This paper has introduced a change management process in four steps, developed for use in the Nigerian Construction Industry. As presented in the paper, there proposed process model incorporates aspects of other research work on change processes in the construction industry. This makes the change process model relevant in Nigeria. The paper presented the principles of how the process model works from project initiation to project closure. The result of the study evidently depicted the necessity for a practical easy to adopt method for change order management for the Nigerian construction industry. No study was found in the local context proposing a proactive change management system that would lead to minimize the negative impacts of change orders. This study believes that if the steps in each stage are diligently followed these negative impacts of change order will be greatly minimized.

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