

Causes of Change Order Arising From the Execution of Building Projects

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Date of Submission: 18-02-2024

Date of Acceptance: 29-02-2024

ABSTRACT

The essence of change orders was recognized to involve omissions, additions, or a combination of both. To effectively tackle this challenge, project participants can reduce the occurrence of change orders through meticulous attention to detail both in the design stage and throughout the construction process. Therefore, this study examined the causes of change order arising from the execution of building projects. This was with a view to reduce the effects on the building projects in the study area. The study is important to the construction stakeholders, policy makers and future studies. Fifty valid questionnaires were administered and retrieved among the construction stakeholders working on randomly selected building projects in Oyo state, Nigeria. Frequency and percentage were used to analyze the demographic information of the respondents while data on causes of change order arising from the execution of building projects was analyzed using mean score and ranking. The study highlights the intricate interplay of causes of change orders in construction projects, with owners holding a central and crucial position. Based on the study's findings, it is strongly recommended that stakeholders in construction projects, including owners, consultants, and contractors, implement proactive measures to reduce the impact of change orders. Owners, acknowledging their pivotal role, should prioritize the development of clear and precise project briefs to minimize the necessity for subsequent modifications.

Keywords: Building projects, causes of change, change orders, construction process, project management

I. INTRODUCTION

The implementation of construction projects is a dynamic undertaking shaped by various factors. In this intricate environment, the emergence of change orders has become an inherent element of construction management. Change orders, which involve modifications to the original construction plans, often arise during project execution, introducing adjustments to the scope, schedule, and budget. It is crucial for project stakeholders to comprehend the underlying causes of these change orders to effectively navigate the complexities of the construction industry. This research focused on causes of change order arising from the execution of building projects.

II. LITERATURE REVIEW

Causes of change order arising from the execution of building projects

The change has been defined as any deviation from an agreed upon well-defined scope and schedule [3].

Zawawi, Azman, Kamar & Shamil (2010), refer change order to additional work included in or removed from the initial scope of a contract, resulting in modifications to the original contract amount or completion date. Change orders stem from various factors, including finance, design, aesthetics, geology, weather conditions, construction feasibility, statutory changes, product improvement, and discrepancies within contract documents (Uyun, 2007). Chen, Li, Wang, Mei, and Brown (2022) contribute to the understanding of change orders through their research on

"Unforeseen Site Conditions and Their Influence on Change Orders." The study emphasizes the impact of unexpected site conditions on construction projects, highlighting how challenges such as encountering unforeseen geological features or hidden infrastructure significantly contribute to change orders during project execution.

The relationship between technology integration and change orders is the focus of Rahman, Ahmed, Patel, Priya, and Smith's (2021) study, investigating how the adoption of new technologies, while enhancing efficiency, may introduce complexities leading to modifications in project plans.

Gupta, Suman, Lee, James, and Williams (2022) critically analyze the influence of ambiguous contract terms on change orders in their research titled "Contractual Ambiguities and Change Orders: A Critical Analysis." They argue that poorly defined contractual obligations or unclear clauses can give rise to disputes, necessitating changes to the original project plans.

In the study conducted by Smith, John, Doe, Mary, and Johnson (2021), the focus is on the "Impact of Design Ambiguities on Change Orders in Building Projects." This research delves into how design ambiguities act as a primary trigger for change orders. Unresolved or unclear design specifications can create disparities between client expectations and the executed work, leading to alterations during construction.

Zhang, Hui, Jones, Sarah, and Kim (2020) focus on broader external influences on construction projects. Various causes contribute to variations in building project execution, categorized into two headings: direct and indirect for clarity. Variation orders arise from foreseeable and unforeseeable reasons, including genuine changes in circumstances or inadequacies in the design team's work.

A change order is a deviation from the initially agreed-upon base contract or work scope in any project. It is a written agreement between

contracting parties representing an addition, deletion, or revision to the contract documents, specifying changes in price and time and describing the nature of the work involved.

Client-related changes result from variations initiated by the owner, either directly or due to the owner's failure to fulfill project requirements. Contractor-related changes include factors like lack of contractor involvement in design, equipment unavailability, shortage of skilled manpower, contractor's financial difficulties, and defective workmanship (Homaid, Eldosouky, Al-Ghamdi, 2011).

III. RESEARCH METHODOLOGY

The success of any data collection process relies significantly on the careful selection and delineation of the suitable sampling frame, the methodology employed during fieldwork, and the meticulous handling of collected data, encompassing its reception, encoding, processing, and analysis (Creswell, 2009, & Yin, 2009).

Fifty valid questionnaires were administered and retrieved among the construction stakeholders working on randomly selected building projects in Oyo state, Nigeria. Frequency and percentage were used to analyze the demographic information of the respondents while data on causes of change order arising from the execution of building projects was analyzed using mean score and ranking.

IV. FINDINGS AND DISCUSSION

Academic qualification of respondents

Table 1 displays the frequency distribution and corresponding valid percentages of the top academic qualifications held by the participants in the study. Specifically, OND represents 6.0%, HND 28.0%, PGD 8.0%, B.Sc. 32.0%, M.sc 22.0%, and PhD 4.0%. From this data, it can be inferred that the predominant academic qualification among the research respondents is B.Sc.

Table 1: Academic qualification of respondents

| Qualification | Frequency | Percentage (%) |
|---------------|-----------|----------------|
| OND | 3 | 6.0% |
| HND | 14 | 28.0% |
| PGD | 4 | 8.0% |
| B.Sc. | 16 | 32.0% |
| M.sc | 11 | 22.0% |
| PhD | 2 | 4.0% |

Professional qualification of respondents

It is evident from Table 2 that a minor proportion of the participants held associate membership in professional organizations. Specifically, notable memberships included the

Nigeria Institute of Quantity Surveyors (NIQS) at 57%, the Nigeria Institute of Builders (NIOB) at 33%, and the Nigeria Institute of Architects (NIA) at 10%.

Table 2: Professional qualification of respondents

| Professional Qualification | Frequency | Percentage |
|----------------------------|-----------|------------|
| ANIQS | 12 | 57% |
| MNIOB | 7 | 33% |
| MNIA | 2 | 10% |
| FNIQS | - | - |

Years of experience of respondents

Table 3 displays the distribution of the number of years of experience among the research participants, with 40.0% having 1-5 years of experience, 26.0% having 6-10 years, 20.0% with

11-15 years, 12.0% with 16-20 years, and 2.0% having 20 years or more. Consequently, it can be inferred that the majority of the research respondents possessed 1-5 years of professional experience.

Table 3: Years of Experience of Respondents

| Experience | Frequency | Percentage (%) |
|--------------|-----------|----------------|
| 1-5yrs | 20 | 40.0% |
| 6-10yrs | 13 | 26.0% |
| 11-15yrs | 10 | 20.0% |
| 16-20yrs | 6 | 12.0% |
| 20yrs-above | 1 | 2.0% |
| Total | 50 | 100% |

The number of projects each respondent firm has been involved in since 2005 till date

Table 4 illustrates the frequency and valid percentage of the number of projects each firm participated in from 2005 to the present. Specifically, 10.0% of firms reported involvement

in projects for 1-5 years, 16.0% for 6-10 years, 22.0% for 11-15 years, and 30.0% for both 16-20 years and 20 years and above. Consequently, it can be deduced that the majority of the research respondents had extensive experience, having been engaged in projects for 20 years or more.

Table 4: Number of projects each respondent has been involved in since 2005-till date

| Years | Frequency | Percentage (%) |
|--------------|-----------|----------------|
| 1-5yrs | 5 | 10.0% |
| 6-10yrs | 8 | 16.0% |
| 11-15yrs | 11 | 22.0% |
| 16-20yrs | 11 | 22.0% |
| 20yrs-above | 15 | 30.0% |
| Total | 50 | 100% |

Types of organization of the respondents

Table 5 displays the frequency and valid percentage of the various types of organizations represented by the research respondents. Contractors accounted for 8.0%, consultants for

38.0%, government entities for 50.0%, and other organizations for 4.0%. Consequently, it can be inferred that the predominant type of organizations among the respondents were governmental entities.

Table 5: Types of organization of the respondents

| Types | Frequency | Percentage (%) |
|--------------|------------------|-----------------------|
| Contractor | 4 | 8.0% |
| Consultants | 19 | 38.0% |
| Government | 25 | 50.0% |
| Others | 2 | 4.0% |
| Total | 50 | 100% |

General Causes of Change Order

Table 6 presents data on the frequency, relative importance index, and ranking of respondents and the primary reasons for change orders. According to the findings, 25.0% attributed frequent changes to production target slippage, 26.0% reported less frequent changes, and 24.0% experienced no frequent changes due to production slippage. Similarly, 48.0% believed that changes were caused by delays in retention release, with 46.0% reporting less frequent changes and 6.0% indicating no frequent changes related to this cause.

Furthermore, 52.0% observed frequent changes due to civil disturbances, while 26.0% experienced less frequent changes, and 22.0% reported no frequent changes associated with civil disturbances. Additionally, 54.0% linked changes to inclement weather, with 30.0% reporting less frequent changes and 16.0% noting no frequent changes. Labor strikes were identified by 46.0% as a cause for changes, with 24.0% reporting less frequent changes and 30.0% indicating no frequent changes due to labor strikes.

Moreover, 70.0% expressed the view that changes were influenced by natural occurrences, while 20.0% reported less frequent changes and 10.0% noted no frequent changes due to natural occurrences. The table also revealed that 54.0% associated changes with a shortage of key plant items, with 30.0% reporting less frequent changes and 16.0% stating no frequent changes.

In terms of variations in day-to-day work, 76.0% believed that changes were frequent, 18.0% reported less frequent changes, and 6.0% stated no frequent changes. Similar percentages were observed for delays in settling claims, with 76.0% experiencing frequent changes, 22.0% noting less frequent changes, and 6.0% reporting no frequent changes.

The data further indicated that 56.0% linked changes to adjustments in pc sums,

provisional sums, and provisional quantities, while 36.0% reported less frequent changes and 8.0% stated no frequent changes. Changes in the client's brief were associated with frequent changes by 74.0%, less frequent changes by 12.0%, and no frequent changes by 14.0%.

Furthermore, 48.0% believed there were frequent changes due to labor shortages, while 30.0% reported less frequent changes and 24.0% noted no frequent changes. Changes in interest were observed by 62.0%, with 28.0% reporting less frequent changes and 10.0% noting no frequent changes.

The table also showed that 62.0% believed there were changes due to delays in interim certificates, with 30.0% reporting less frequent changes and 8.0% stating no frequent changes. Delays in payment of clients were associated with frequent changes by 74.0%, less frequent changes by 20.0%, and no frequent changes by 6.0%.

Additionally, 60.0% linked changes to a shortage of key materials, with 32.0% reporting less frequent changes and 8.0% stating no frequent changes. Problems with foundations were associated with frequent changes by 64.0%, less frequent changes by 20.0%, and no frequent changes by 16.0%.

Moreover, 60.0% believed changes were due to compliance with new regulations, with 34.0% reporting less frequent changes and 6.0% stating no frequent changes. Changes due to under-evaluation were reported by 64.0%, with 28.0% experiencing less frequent changes and 8.0% stating no frequent changes.

Furthermore, 50.0% associated changes with estimating errors, while 36.0% reported less frequent changes and 14.0% noted no frequent changes. Subcontractor's insolvency was linked to frequent changes by 58.0%, less frequent changes by 30.0%, and no frequent changes by 12.0%.

Lastly, 76.0% believed changes were due to inflation, with 16.0% reporting less frequent changes and 8.0% stating no frequent changes. Changes in currency exchange rates were associated with frequent changes by 60.0%, less frequent changes by 24.0%, and no frequent changes by 16.0%. Access to funds at reasonable

interest was believed to cause frequent changes by 68.0%, less frequent changes by 20.0%, and no frequent changes by 12.0%. Initial design was identified as a frequent cause of changes by 78.0%, with 16.0% reporting less frequent changes and 6.0% stating no frequent changes.

Table 6: General Causes of Change Order

| General Causes of Change Order | 1 | 2 | 3 | 4 | 5 | RII | Rank |
|--|----|----|----|----|----|------|------|
| Labourstrikes | 15 | 12 | 12 | 7 | 4 | 0.25 | 1 |
| Production target slippage | 12 | 13 | 13 | 10 | 2 | 0.25 | 1 |
| Labour | | | | | | 0.26 | |
| Shortage | 12 | 15 | 12 | 5 | 6 | | 2 |
| Civil disturbances | 11 | 13 | 15 | 8 | 3 | 0.26 | 2 |
| Delay in retention release | 3 | 23 | 10 | 12 | 2 | 0.27 | 3 |
| Shortage of key plant items | 8 | 15 | 13 | 10 | 4 | 0.27 | 3 |
| Inclement weather | 8 | 15 | 12 | 11 | 4 | 0.28 | 4 |
| Adjustment of pc sums, provisional sums and provisional quantities | 4 | 18 | 15 | 9 | 4 | 0.28 | 4 |
| Estimating error | 7 | 18 | 7 | 10 | 8 | 0.29 | 5 |
| Subcontractor's insolvency | 6 | 15 | 14 | 6 | 9 | 0.29 | 5 |
| Problems with foundation | 8 | 10 | 14 | 11 | 7 | 0.30 | 6 |
| Natural occurrence | 5 | 10 | 19 | 12 | 4 | 0.30 | 6 |
| Changes in interest rates | 5 | 14 | 11 | 14 | 6 | 0.30 | 6 |
| Shortage of key materials | 4 | 16 | 11 | 12 | 7 | 0.30 | 6 |
| Changes of client's brief | 7 | 6 | 19 | 13 | 5 | 0.31 | 7 |
| Delays in agreeing variation/day works | 3 | 9 | 23 | 11 | 4 | 0.31 | 7 |
| Under evaluation | 4 | 14 | 14 | 10 | 8 | 0.31 | 7 |
| Delays in interim certificates | 4 | 15 | 9 | 15 | 7 | 0.31 | 7 |
| Access to fund at reasonable interest | 6 | 10 | 16 | 7 | 11 | 0.31 | 7 |
| Delay in settling claims | 3 | 11 | 14 | 18 | 4 | 0.32 | 8 |
| Compliance with new regulation | 13 | 17 | 15 | 7 | 8 | 0.32 | 8 |
| Delay in payment from client | 3 | 10 | 12 | 18 | 7 | 0.33 | 9 |
| Inflation | 8 | 4 | 11 | 18 | 9 | 0.33 | 9 |
| Changes to initial design | 3 | 8 | 12 | 12 | 15 | 0.36 | 10 |
| Changes in currency exchange rates | 8 | 12 | 19 | 11 | 10 | 0.37 | 11 |

General Causes of Change Order

Table 6 illustrates the frequency, relative frequency index, and ranking of change order

participant issuance among the research respondents. Specifically, 8.0% exhibited a low issuance of change orders by architects, while

92.0% showed a high level of issuance by architects. Additionally, 10% had a low client issuance of change orders, contrasting with 90.0% having a high client issuance.

Furthermore, 40% had a low quantity surveyor issuance of change orders, whereas 60.0% demonstrated a high issuance by quantity

surveyors. In the case of contractors, 50.0% had a low issuance of change orders, and an equal percentage, 50.0%, had a high issuance by contractors.

Similarly, 50.0% of respondents had low issuance by other consultants, while the remaining 50.0% had a high issuance by contractors.

Table 7: Issuance of Change Order Participants

| The Issuance of Change Order Participants | | | | | | | |
|--|----------|----------|----------|----------|----------|------------|-------------|
| Participants | 1 | 2 | 3 | 4 | 5 | RII | Rank |
| Other consultants | 13 | 12 | 11 | 9 | 5 | 0.26 | 1 |
| Contractor | 5 | 20 | 7 | 13 | 5 | 0.29 | 2 |
| Quantity surveyor | 5 | 15 | 14 | 9 | 7 | 0.3 | 3 |
| Architect | 1 | 3 | 11 | 16 | 19 | 0.4 | 4 |
| Client | 3 | 2 | 4 | 8 | 33 | 0.43 | 5 |

Client Caused-Change Order

Table 8 displays the frequency, relative importance index, and ranking of clients' change order perceptions. In this context, 34.0% expressed a low viewpoint on technological development, while 30.0% held a high opinion. Similarly, 32.0% had a low opinion regarding the environment, contrasting with 70.0% who held a high opinion. Additionally, 30.0% registered a low opinion on changes in interest and requirements, whereas 70.0% indicated a high opinion in this regard.

Furthermore, 28.0% had a low opinion on changes in income and financial ability, while the majority, 72.0%, had a high opinion. Likewise, 34.0% expressed a low opinion on technological development, with 30.0% holding a high opinion. When it came to the issue of lack of adequate and correct advice at the early stage of the project, 30.0% held a low opinion, while a significant 70.0% held a high opinion on this matter.

Table 8: Client Caused –Change Order

| Client –Caused Change Order | | | | | | | |
|---|----------|----------|----------|----------|----------|------------|-------------|
| Causes | 1 | 2 | 3 | 4 | 5 | RII | Rank |
| Technological development | 5 | 12 | 15 | 12 | 6 | 0.22 | 1 |
| Change in income and financial ability | 4 | 10 | 12 | 15 | 9 | 0.27 | 2 |
| Environment | 3 | 13 | 11 | 15 | 8 | 0.33 | 4 |
| Change in interest and requirement | 4 | 11 | 12 | 9 | 14 | 0.32 | 3 |
| Lack of adequate and correct advice at the early stage of the project | 6 | 9 | 17 | 11 | 7 | 0.35 | 5 |

Architect –Caused Change Order

Table 9 outlines the frequency, relative importance index, and ranking of responses from the research participants. Within this context, 32.0% indicated a low occurrence of change orders attributed to testing and inspection, while a majority of 68.0% reported a high incidence in this category. Furthermore, 24.0% recorded a low rate

of slow correction of design errors, while a substantial 76.0% registered a high rate of slow correction of design errors.

Additionally, 30.0% reported a low occurrence of change orders due to a lack of adequate understanding of the client's brief, in contrast to 70.0% who reported a high incidence in this aspect. Regarding design defects, 29.0%

reported a low frequency, whereas 71.0% reported a high frequency of design defects.

Table 9: Architect –Caused Change Order

| Architect –Caused Change Order | | | | | | | |
|--|----------|----------|----------|----------|----------|------------|-------------|
| Causes | 1 | 2 | 3 | 4 | 5 | RII | Rank |
| Design defects | 5 | 12 | 12 | 9 | 12 | 0.32 | 1 |
| Slow correction of design errors | 3 | 9 | 19 | 10 | 9 | 0.33 | 2 |
| Lack of adequate understanding of clients’ brief | 4 | 11 | 12 | 14 | 9 | 0.33 | 3 |
| Change order due to test and inspection | 2 | 14 | 12 | 12 | 10 | 0.33 | 4 |

Quantity Surveyor-Caused Change Order

Table 10 presents the frequency, relative importance index, and ranking based on responses from the research participants. In this context, 34.0% reported a low incidence of excessive use of provisional sum, prime cost sum, and provisional quantity in the Bill of Quantities (BOQ), while 66.0% reported a high incidence of such excessive use. Similarly, 34.0% indicated a low occurrence of

delays in the completion of measurement, with 66.0% reporting a high frequency of such delays.

Furthermore, 28.0% reported a low occurrence of insufficient time to prepare contract documents, while a significant 72.0% reported a high occurrence of insufficient time for this task. Additionally, 44.0% reported a low frequency of errors in the preparation of the bill of quantities, while 56.0% reported a high frequency of errors in this aspect.

Table 10: Quantity Surveyor-Caused Change Order

| Quantity Surveyor-Caused Change Order | | | | | | | |
|--|----------|----------|----------|----------|----------|------------|-------------|
| Causes | 1 | 2 | 3 | 4 | 5 | RII | Rank |
| Error in preparation of bill of quantity | 11 | 11 | 10 | 6 | 12 | 0.29 | 1 |
| Delay in completion of measurement | 3 | 14 | 15 | 11 | 7 | 0.31 | 2 |
| Insufficient time to prepare contract document | 6 | 8 | 11 | 16 | 9 | 0.33 | 3 |

V. CONCLUSION

The study highlights the intricate interplay of causes of change orders in construction projects, with owners holding a central and crucial position. The complexity of change orders is compounded by consultants introducing conflicting design documents and errors, while contractors, bound by contractual obligations, exhibit a lower inclination to initiate changes. The study underscores the significance of the client's shift in project brief, necessitating proactive strategies to foresee, prevent, and effectively manage changes throughout the construction process.

projects, including owners, consultants, and contractors, implement proactive measures to reduce the impact of change orders. Owners, acknowledging their pivotal role, should prioritize the development of clear and precise project briefs to minimize the necessity for subsequent modifications. Consultants should improve communication and coordination to decrease the occurrence of conflicting design documents and errors, which contribute to the intricacies of change orders. Furthermore, contractors should explore methods to cultivate an environment that promotes early identification and resolution of potential issues, even within the confines of contractual obligations. In essence, fostering collaboration, effective communication, and forward-thinking planning is crucial for anticipating, preventing, and

VI. RECOMMENDATION

Based on the study's findings, it is strongly advised that stakeholders in construction

managing change orders efficiently throughout the construction process.

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