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Design error: Its effects on building projects delivery period

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Abstract

Within the construction industry, design errors are an inevitable occurrence stemming from misapplied or inaccessible information. This study assessed the effects of design error on building projects delivery period. To achieve this goal, the study scrutinized literature from various authors and gathered primary data through a structured questionnaire. Out of the ninety-three questionnaires distributed among contractors, skilled labours, unskilled labours and industry professionals, eighty were returned, coded, and analyzed using descriptive statistics, percentiles, and mean item scores. The study concludes that design errors greatly extend construction timelines, disrupt workflows, cause procurement delays, hinder commissioning and testing, and adversely affect the execution of future projects. These disruptions result in higher costs and reduce the overall quality and efficiency of construction activities, emphasizing the crucial need for better design accuracy and management within the construction industry. The study recommends enhancing design review processes, leveraging collaborative project management tools, establishing clear change management protocols, strengthening supplier relationships, implementing rigorous quality assurance measures, and prioritizing team training. These actions are proposed to mitigate the impact of design errors on construction projects, aiming to reduce delays, enhance communication, and improve overall project efficiency.

Keywords: Building projects; Delivery period; Design errors; Procurement delays; Quality assurance

1. Introduction

Design constitutes a critical stage in construction projects, profoundly influencing their outcomes. Errors in design not only disrupt the construction process but also hinder project development, affecting the quality of construction work and leading to cost overruns and delays. Additionally, design errors can contribute to engineering failures, posing risks such as accidents and loss of life. It is imperative to take preventive measures to minimize these errors. It is crucial to acknowledge that design serves as the cornerstone of construction, and design errors have historically been responsible for numerous catastrophic accidents resulting in tragic loss of life and injuries to workers, as well as significant project delays. Design errors encompass mistakes, omissions, and conflicts in design, representing deviations from the intended specifications due to factors like imprecision and measurement variations resulting from human error or mechanical flaws. Musa and Obaju (2016) characterize design error as the inability to execute a specific design aspect within a given timeframe.

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2. Literature review

2.1. Effects of design error on building projects delivery period

Designers lacking extensive knowledge may produce inaccurate designs, resulting in poor-quality work that inflates project costs and timelines, ultimately leading to project failure (Walker, 2009). Furthermore, design errors significantly contribute to the increased costs and timeframes of social infrastructure projects and can lead to engineering failures, posing risks such as accidents and loss of life (Love, Lopez, Edwards & Goh, 2012).

Design errors can profoundly impact project performance, leading to failures, construction rework, time and cost overruns, and even loss of life. Recent studies reveal that newly discovered omissions or errors account for approximately one-third of a project's contract value. For instance, a study in Australia estimated that design errors incurred direct and indirect costs of 6.85% and 7.36% of the contract value, respectively (Lopez & Love, 2012).

Weaknesses in design often result in underutilized facilities, contract addendums that surpass the original budget, additional projects for project completion, and delays in project execution. These issues not only hinder business processes but also compromise the usability of investments. Previous research highlights the adverse effects of design errors on project performance, including increased rework, time, and resource expenditures (Han, Love & Pena-Mora, 2013).

Despite strict regulations and standards, design errors persist within the design process, inevitably impacting project management efficiency and effectiveness (Love, 2009). They contribute significantly to rework, cost overruns, schedule delays, and unsafe environments, further deteriorating project performance (Yogen, 2014).

These challenges contribute to a substantial portion of failures in construction projects, estimated to range between 80% and 90% (Robert, 2016). Design errors represent an inevitable issue with detrimental effects on project management efficiency and effectiveness (Iness, 2004).

Engineering failures, which can account for up to 10% of total investment in new buildings and structures, incur not only direct costs but also less tangible environmental and social costs (Musa, 2016; Love, 2016).

3. Methodology

The effectiveness of any data collection process relies on various pivotal factors, such as identifying suitable respondents, establishing an appropriate sampling framework, executing fieldwork procedures, and managing collected data, including reception, encoding, processing, and analysis (Creswell, 2009 & Yin, 2009).

In this study, a blend of primary and secondary data sources was utilized. Primary data were acquired through a meticulously structured questionnaire, exclusively focusing on construction sites in Ondo State, Nigeria. Through random sampling techniques, ninety-three (93) valid questionnaires were distributed among construction professionals involved in projects within the study area, including contractors, skilled laborers, unskilled laborers, and other professionals. Subsequently, eighty (80) responses were obtained for analysis.

Demographic details of the respondents were analyzed using frequency and percentage calculations, while data regarding the effects of design error on building projects delivery period were analyzed through mean scores and ranking.

4. Finding and discussion

A total of ninety-three (93) questionnaires were circulated among Contractors, Skilled Laborers, Unskilled Laborers, and Professionals within the study area. From these, eighty (80) completed questionnaires were collected and used for analysis, indicating an 86% response rate.

Table 1 Questionnaire distributed and retrieved

No of administered Questionnaire	No retrieved	% of retrieval
93	80	86

Source: Author 2024

Table 1 offers a comprehensive breakdown of the quantity of questionnaires gathered from various organizations forming the study population. It furnishes valuable insights into the distribution of responses acquired from each distinct organization, facilitating a thorough comprehension of the sample's composition and representation.

Table 2 Years of experience in the construction industry

Classification	Frequency	Percent
1-5	26	32.5
6-10	46	57.5
11-20	8	10
Total	80	100

Source: Author 2024

Table 2: showing the demographic characteristics of the respondents.

The respondents' experience in the construction industry varies across different ranges. Approximately 32.5% of respondents reported having 1-5 years of experience, indicating a relatively recent entry into the field. A majority, constituting 57.5%, indicated a range of 6-10 years of experience, suggesting a significant portion with a moderate level of expertise gained over several years of work in construction. Furthermore, 10% of respondents each reported having 11-20 years of experience, representing a subset with more extensive and potentially varied experience within the construction industry. This distribution provides valuable insights into the diversity of experience levels among the respondents, which can influence their perspectives and contributions to the study.

Table 3 Academic qualification of respondents

Classification	Frequency	Percent
ND	4	5.00
HND	49	61.25
BSC	20	25
PGD	2	2.5
Others	5	6.25
Total	80	100

Source: Author 2024

The respondents in the study display a varied educational background, with a notable emphasis on practical and theoretical knowledge in construction-related disciplines. Specifically, 61.25% hold Higher National Diploma (HND) qualifications, indicating a prevalent level of technical expertise, while 25% possess Bachelor of Science (BSc) degrees, representing broader academic backgrounds. Additionally, 5% have National Diploma (ND) qualifications, 2.5% hold Postgraduate Diplomas (PGD), and 6.25% fall into the "others" category. This diverse educational landscape underscores the multidimensional expertise and perspectives present within the respondent pool, enriching the study's analysis and findings.

Table 4 Area of specialization in construction work

Classification	Frequency	Percent
Contractor	7	8.75
Skilled labour	30	37.5
Unskilled labour	19	23.75
Professional	24	30.00
Total	80	100

Source: Author 2024

The study explores the diverse roles of respondents within the construction industry. It reveals a varied distribution across different specializations: 8.75% identify as Contractors, 37.5% as Skilled Laborers, 23.75% as Unskilled Laborers, and 30.00% as Professionals. This spectrum underscores the multifaceted nature of the construction workforce, with each role contributing uniquely to project success.

Table 5 Effects of design error on building projects delivery period

Effect of design error on delivery period	**Mean**	**Rank**
Extended construction time due to rework and corrections	3.61	1st
Disruption in workflows	3.36	2nd
Delays in procurement and delivery of specialized components or system	3.25	3rd
Delays in commissioning and testing of building system	3.23	4th
Negative impact on future projects	3.20	5th
Increased time required for redesigning and reengineering	3.14	6th
Additional time needed for resolving conflicts and coordination problems	3.14	6th
Additional time required resolving errors	3.11	8th
Resource reallocation	3.11	8th
Increased worksite tensions	3.09	10th
Inadequate utilization of equipment	3.09	10th
Loss of productivity	2.99	12th
Extended project duration due to redesign	2.96	13th
Lengthened project duration due to the need for additional inspection and testing	2.96	13th
Material wastage	2.94	15th
Additional time required for addressing post-construction design errors and deficiency	2.93	16th
Increased time spent on value engineering exercises to rectify errors	2.85	17th
Safety concern	2.84	18th
Increased time and effort	2.81	19th
Communication challenges	2.70	20th

Source: Author 2024

The study assessed the effects of design error on building projects delivery period using a Likert scale ranging from 1 to 5, with 5 indicating the highest degree of influence (primary cause) and 1 indicating no influence (not a cause).

Table 5 displays the average scores provided by respondents regarding the effects of design error on building projects delivery period. These aspects encompass prolonged construction duration due to rework and corrections, disruptions in workflows, procurement and delivery delays for specialized components or systems, setbacks in commissioning and testing of building systems, adverse effects on future projects, increased time for redesigning and reengineering, resolution of conflicts and coordination issues, error rectification, resource redistribution, heightened worksite tensions, inefficient equipment utilization, productivity losses, project duration extension due to redesign, prolonged duration due to additional inspection and testing needs, material wastage, post-construction error rectification, increased time invested in value engineering for error rectification, safety concerns, and amplified communication challenges.

5. Conclusion

The study concludes that design errors greatly prolonged construction duration, disrupt workflows, cause procurement delays, hinder commissioning and testing, and adversely affect the execution of future projects. These disruptions result in higher costs and reduce the overall quality and efficiency of construction activities, emphasizing the crucial need for better design accuracy and management within the construction industry.

Recommendation

The study recommends enhancing design review processes, leveraging collaborative project management tools, establishing clear change management protocols, strengthening supplier relationships, implementing rigorous quality assurance measures, and prioritizing team training. These actions are proposed to mitigate the effects of design errors on construction projects delivery period, aiming to reduce delays, enhance communication, and improve overall project efficiency.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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