VOL. 09 NO. 4,
AUGUST, 2025
E-ISSN 3026-9210
P-ISSN 3026-815X

African Scholar Publications & Research International
www.africanscholarpub.com

Journal of Built Env. & Geological Research (JBEGR)

Cross-Disciplinary Coordination and Its Impact on Working Drawings and Specifications in the Nigerian Construction Industry

Jegede Praise; Aguiyi Ogochukwu Frances; Osemobor Samuel Osemudiamen; Adewumi Bamidele Jonathan; & Ogunnaike Adekunle Owolabi

Department of Architecture, College of Environmental Science and Management, Caleb University, Imota, Ikorodu, Lagos, Nigeria
Corresponding Author: ogochukwu.aguiyi@calebuniverity.edu.ng
DOI: https://doi.org/10.70382/ajbegr.v9i4.029

Abstract

The construction industry operates as a multidisciplinary environment where effective collaboration between professionals such as architects, engineers, quantity surveyors, and contractors is essential to the successful delivery of construction projects. Central to this collaboration are working drawings and specifications. In Nigeria, these documents are frequently undermined by poor cross-disciplinary coordination, leading to drawing inconsistencies, project delays, and reduced construction quality. This study investigates the perceived challenges, frequency, and implications of coordination-related issues in working drawings and specifications within the Nigerian construction industry. Grounded in the Integrated Design Process (IDP) theory and the Design Coordination Model, the study adopted a quantitative descriptive survey design. Data were collected via a structured questionnaire distributed to 600 purposively selected construction professionals across Nigeria, with 539 valid responses retrieved (89.83% response rate). The instrument explored demographic characteristics, coordination challenges, and perceived impacts on documentation quality. Descriptive statistics, mean scores, and Relative Index (RI) values were used to analyze the data. Findings revealed a high frequency of coordination issues, with over 75% of respondents agreeing that these problems significantly affect the accuracy, clarity, and usability of working drawings. While working drawings are often used to resolve interdisciplinary conflicts, their delayed coordination process frequently results in adjustments, ambiguities, and inefficiencies. The study concludes that poor cross-disciplinary coordination remains a

critical bottleneck in achieving high-quality construction documentation. It recommends early-stage coordination workshops, regular drawing reviews, use of integrated design tools (e.g., BIM), and the development of industry-wide coordination standards.

Keywords: Building Information Modelling (BIM), Coordination, Construction Documentation, Design Integration, Interdisciplinary Collaboration, Specifications, Working Drawings.

Introduction

The construction industry is a complex, multi-disciplinary sector that requires the collaborative effort of professionals from diverse fields, including architecture, structural engineering, mechanical and electrical services, quantity surveying, and project management (Alugbue, Otuonuyo, Adewumi, Onamade & Asaju, 2024). Central to the execution of any building project are the working drawings and specifications (technical documents that serve as the primary communication tools among these disciplines) (Adewumi, Onamade, David-Mukoro, Bamiloye, Otuonuyo, Chukwuka & Oru, 2025). These documents detail the design intent, construction methods, material choices, and overall expectations for the project. However, in practice, the effective integration of information from various disciplines often presents coordination challenges, which can significantly impact the accuracy, efficiency, and quality of construction deliverables (Emesiobi, Otuonuyo, Adewumi, Asaju & Onamade, 2024). In Nigeria, the construction industry is witnessing a growing concern regarding the coordination of working drawings and specifications due to increasing project complexities, fragmented professional roles, and poor communication channels. The industry's traditional approach to design and documentation (often siloed and sequential) tends to promote errors, omissions, and inconsistencies across project documents (Agbaxode, 2022). This cross-disciplinary misalignment not only compromises the integrity of the drawings but also causes frequent site alterations, cost overruns, and schedule delays. Working drawings, ideally, should be the output of a well-synchronized design process; yet they often reflect the disjunctions and gaps among professionals (Owolabi, Harry, Adewumi, Onamade & Alagbe, 2024).

Cross-disciplinary coordination refers to the structured collaboration and information exchange among various disciplines involved in a construction project (Nwulu, Elete, Omomo, Akano & Erhueh, 2023; Alugbue et al, 2024). When properly managed, such coordination enhances the comprehensiveness and accuracy of working drawings, reducing ambiguities, overlaps, and rework. However, its implementation in the Nigerian context is fraught with challenges, ranging from inadequate design management systems to limited digital integration (e.g., Building Information Modelling, BIM), and a lack of standardized protocols for multidisciplinary collaboration (Olaiya, Fadugba & Lawan, 2024; Adewumi, Onamade, Asaju& Adegbile, 2023). These challenges make it imperative to investigate the extent to which cross-disciplinary

coordination influences the quality of working drawings and specifications in Nigeria's construction projects (Adewumi, Asaju, Bello, Atulegwu, Ibhafidon David- Mukoro, Otunonuyonuyo & Ogimyemi, 2025a).

Problem Statement

Despite the critical role that working drawings and specifications play in ensuring successful project delivery, the Nigerian construction industry continues to experience a high incidence of coordination-related issues during the pre-construction and construction phases (Olaseni, 2019; Adewumi, Onamade, Onyikeh, Otuonuyo, Alagbe, Adegbile & Dayomi, 2023). These issues manifest as conflicting information between architectural and engineering drawings, late design changes, unclear scope of works, and misinterpretation of specifications on-site (Owolabi et al, 2024; Emesiobi et al, 2024). The root cause often lies in poor interdisciplinary collaboration during the design development stage (Kaygan, 2023). While several studies have focused on construction management, few have specifically examined how cross-disciplinary coordination (or the lack thereof) affects the production and performance of working drawings and specifications in Nigeria. Consequently, there is a knowledge gap regarding the nature, frequency, and implications of coordination challenges across disciplines, and how these affect the technical quality and usability of project documents (Abdulfattah, Abdelsalam, Abdelsalam, Bolpagni, Thurairajah, Perez & Butt, 2023; Adewumi et al, 2025b). Understanding these dynamics is essential to improving drawing standards, minimizing errors, and promoting integrated project delivery. This study, therefore, seeks to explore the challenges and benefits of cross-disciplinary coordination in the development of working drawings and specifications, using data from practicing professionals in the Nigerian construction industry.

Therefore, in order to address the problem, this study was guided by the following specific objectives, which were explored using survey data analyzed through Likert-scale responses; that is,

i. Evaluation of the challenges and perceived solutions in cross-disciplinary coordination of working drawings; and
ii. The examination of the frequency and type of coordination issues encountered in working drawings and their implications on project delivery.

LITERATURE REVIEW

Conceptual Review

Working drawings and specifications are critical documents that translate design intent into construction reality (Bisharat, 2025; Adewumi et al, 2025). These documents are used to communicate spatial layouts, materials, methods, and technical standards required for successful execution. Within the context of the construction industry, especially in complex building projects, these documents must be collaboratively developed by a team of professionals, each contributing discipline-specific input (Tadesse, 2021; George, Adewumi,

Otuonuyo, Oyewole, Oparrinde & Yusuf, 2025). This necessitates cross-disciplinary coordination which is a process that involves deliberate interaction, information exchange, and alignment between architects, engineers, quantity surveyors, services consultants, and other stakeholders (Adewumi et al, 2023). Coordination, in this context, refers to the synchronization of design elements across multiple disciplines to prevent clashes, redundancies, and omissions (Krishnan, 2025). Inadequate coordination leads to discrepancies in drawings, misinterpretation of specifications, and costly rework during construction. Working drawings must not only reflect the individual contributions of each discipline but also integrate them into a coherent and constructible package (Bisharat, 2025). Specifications further support these drawings by detailing material choices, workmanship standards, performance criteria, and quality controls. Therefore, poor coordination undermines both the clarity and constructability of these outputs (Iroha, Watanabe & Satoshi, 2024; Adewumi et al, 2025a). Conceptually, the goal of cross-disciplinary coordination is to ensure design coherence, improve communication flow, reduce conflicts in documentation, and support timely decision-making. Coordination can be manual (via physical meetings and markups) or digital (via CAD layering protocols or Building Information Modelling - BIM) (de Souza, Fialho, Ferreira, Fabricio & Codinhoto, 2023). In developed economies, digital tools have improved coordination efficiency. However, in Nigeria, much of this process remains manual or semi-digital, often resulting in fragmented drawing sets and incomplete specifications (Asaju, Adewumi, Onamade &Alagbe, 2024; Oru, Adewumi& Asaju, 2024).

In regions such as the United Kingdom, the United States, and Singapore, the adoption of Building Information Modeling (BIM) has transitioned from a novel technology to a standardized protocol for cross-disciplinary coordination. The UK's BIM Level 2 mandate, for instance, requires a collaborative environment where all project stakeholders contribute to a shared digital model, fundamentally transforming the production and integration of working drawings and specifications (Azhar, 2017; Succar & Kassem, 2021). This process facilitates automated clash detection, ensuring that conflicts between structural, architectural, and MEP (Mechanical, Electrical, and Plumbing) systems are resolved virtually long before construction commences, thereby significantly reducing on-site rework and documentation errors.

Theoretical Review

This study is anchored on the Integrated Design Process (IDP) Theory and the Design Coordination Model, both of which emphasize the importance of collaboration and communication among various disciplines during the design and documentation stages of construction projects.

Integrated Design Process (IDP) Theory

The Integrated Design Process (IDP) is a collaborative approach to design development that was formalized and promoted by the Canada Mortgage and Housing Corporation (CMHC) in the early 2000s (Rankohi, Smith, Lizarralde, Bourgault & Pellerin, 2023). The theory

postulates that project outcomes improve significantly when all key stakeholders (including architects, engineers, consultants, and contractors) are involved early and continuously throughout the design process (Farkhondehpay, 2024). Unlike traditional linear design methods, IDP promotes simultaneous input and shared decision-making, allowing the team to anticipate and resolve coordination issues before they manifest in working drawings or on-site execution.

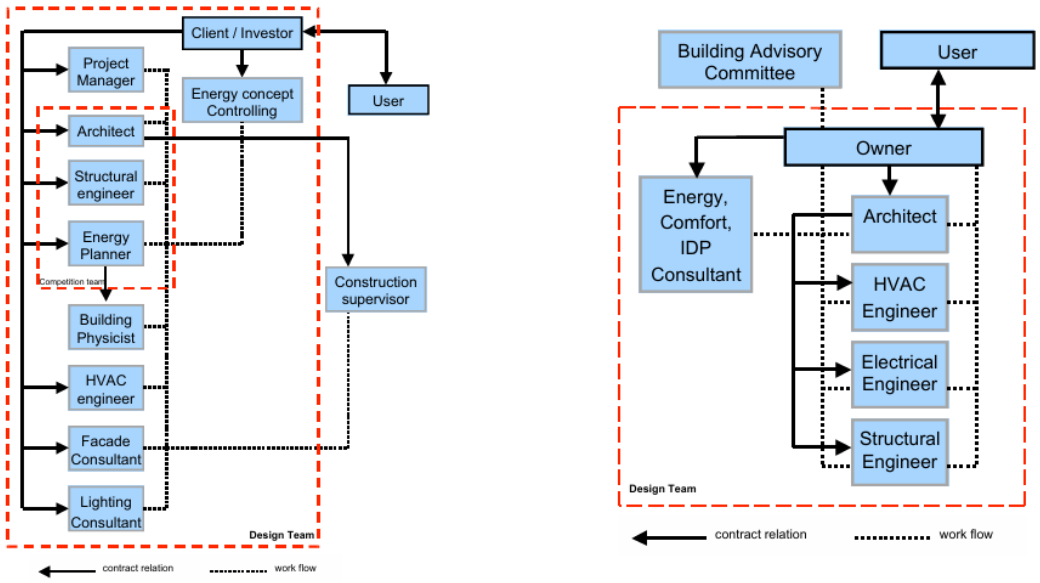


Figure 1: Two management structure diagrams for (left) Deutsche Post and (right) Yukon Territories administration
Source: Larsson (2009)

The core premise of IDP is that design should not occur in professional silos. Rather, interdisciplinary teams should engage in iterative feedback loops where decisions in one discipline (e.g., structural layout) are cross-checked against the implications for others (e.g., HVAC routing or architectural space planning) (Larsson, 2009). This method supports the co-creation of working drawings and specifications that are coherent, constructible, and aligned with overall project objectives. In relation to the current study, IDP is directly relevant as it addresses the root cause of many coordination problems identified in the Nigerian construction industry, namely, fragmented professional contributions and poor interdisciplinary communication. When working drawings are prepared without early and active input from all disciplines, the result is often conflicting details, missing components, and frequent revisions.

Design Coordination Model

The Design Coordination Model, formulated by Anumba, Baldwin, and Newnham (1997), provides a structured framework for managing design information and ensuring alignment

between various disciplines involved in a construction project (Pradeep, Yiu, Zou & Amor, 2021). The model identifies three core dimensions of design coordination: communication management, interface management, and information integration (Ng, Graser & Hall, 2023). It emphasizes that successful coordination is not only about exchanging drawings or data, but about aligning the objectives, workflows, and deliverables of each discipline in a unified manner.



Figure 2: The importance of Design Coordination in ITSM implementation
Source: Hurkadli (2023)

According to the model, effective coordination requires structured communication protocols (e.g., regular design review meetings), a clear delineation of responsibilities (to manage interfaces), and centralized platforms for integrating information (e.g., shared digital environments) (Hurkadli, 2023). The model also acknowledges the impact of organizational culture and leadership in enabling or hindering coordination processes (Nguyen & Mougenot, 2022). The relevance of this model to the study lies in its direct application to the production and management of working drawings and specifications. In the Nigerian construction context, many design teams lack structured coordination protocols, resulting in drawings that are not fully aligned or integrated. This leads to increased ambiguity on site and costly corrective measures.

Empirical Review

Several studies have explored the relationship between coordination practices and the quality of construction documentation. Taiwo, Morakinyo, Yusuff & Oyeniyi (2025) identified poor communication and lack of integration among consultants as key reasons for drawing errors in Nigerian construction projects. Sujan (2020) linked project delays and cost overruns to misaligned documentation arising from weak inter-professional coordination. Hassanain, Adewale, Al-Hammad & Sanni-Anibire (2018) assessed the impact of building services

coordination on drawing accuracy and found that inadequate input from MEP consultants during the early design stages caused significant inconsistencies in final documents. Their research also emphasized the need for early-stage interdisciplinary collaboration. Chahrour, Hafeez, Ahmad, Sulieman, Dawood, Rodriguez-Trejo & Dawood (2021) highlighted how BIM has revolutionized design coordination by allowing simultaneous access and clash detection among consultants. However, they also noted that the tool's effectiveness depends on organizational willingness and a culture of collaboration. In a related study, Olaseni (2019) found that Nigerian professionals often work in silos, leading to late-stage revisions and discrepancies in drawings. The study reported that over 60% of construction professionals had experienced repeated coordination-related changes during construction, particularly due to misaligned architectural and structural drawings. While some firms attempt to mitigate this through coordination meetings and drawing review sessions, these efforts are often irregular or poorly documented.

Research Gap

Although coordination has been widely discussed in construction management literature, most existing studies in the Nigerian context have focused broadly on project delivery outcomes, delay factors, or communication breakdowns. Few have specifically addressed how coordination challenges manifest within working drawings and specifications, which are the foundational documents guiding construction. Moreover, studies that do touch on design coordination often focus on architectural and engineering drawings without a holistic view that includes specifications and the roles of non-design professionals such as quantity surveyors. Additionally, the existing empirical data is largely anecdotal or limited to case studies, with a lack of systematic analysis using perception-based survey tools such as Likert scales. This study fills a critical gap by quantitatively assessing professional perceptions of cross-disciplinary coordination as it affects the production, accuracy, and effectiveness of working drawings and specifications. It also examines both the nature of coordination challenges and the perceived effectiveness of current resolution strategies, using real-world insights from practitioners across disciplines in Nigeria.

METHODOLOGY

This study employed a quantitative descriptive survey research design to examine the impact of cross-disciplinary coordination on the quality of working drawings and specifications within the Nigerian construction industry. The target population comprised construction industry professionals across Nigeria (contractors, architects, engineers, land surveyors and others). These professionals were selected because of their direct involvement in the development, review, or use of working drawings and specifications across different project stages. A total of 600 structured questionnaires were distributed using purposive and convenience sampling techniques. These methods ensured the inclusion of respondents with relevant experience in project documentation and coordination, while also allowing practical

access to participants across multiple states and professional associations. Out of the 600 distributed questionnaires, 506 were completed and returned, representing a high response rate of approximately 84.33%, which provided a robust dataset for quantitative analysis.

The use of purposive and convenience sampling techniques was strategically employed to navigate the practical constraints of the study while ensuring the collection of relevant and high-quality data. Purposive sampling was essential to target professionals with direct, hands-on experience in the development and coordination of working drawings and specifications, thereby ensuring that the respondents possessed the specific expertise required to provide meaningful insights on the research topic. Concurrently, convenience sampling was necessitated by the geographically dispersed nature of the target population across Nigeria and the challenges associated with obtaining a comprehensive, randomized sampling frame from all professional bodies and firms. This approach allowed for efficient access to a large and diverse pool of qualified practitioners through professional networks, association directories, and industry conferences. While acknowledging that this combination of non-probability sampling methods may limit the absolute generalizability of the findings to the entire population, the large sample size (N = 506) and high response rate help to mitigate selection bias and enhance the robustness and credibility of the results for the study's analytical purposes.

Data was collected using a structured, self-administered questionnaire designed to elicit professional insights on the extent, challenges, and perceived effectiveness of cross-disciplinary coordination in the preparation of working drawings and specifications. The questionnaire was divided into three sections: Section A (Collected demographic and professional background information of respondents, such as discipline, years of experience, and region of practice), Section B (Focused on respondents' perceptions of coordination challenges and solutions in the preparation of working drawings) and Section C: Explored the frequency and impact of coordination issues on drawing accuracy, completeness, and project outcomes. Items in Sections B and C were rated on a 5-point Likert scale, where 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree. This scaling method allowed for a standardized assessment of agreement levels across key issues related to coordination in construction documentation.

Responses were coded and analyzed using descriptive statistical tools, including frequency counts, percentages, mean scores, and Relative Index (RI). The Relative Index (RI) was computed using the formula:

$$\mathrm{RI} = \frac{\Sigma(\mathrm{W})}{\mathrm{A} \times \mathrm{N}}$$

Where: W = weighting given to each response option (1–5), A = highest possible weight (5), N = total number of respondents

RI values, ranging from 0 to 1, were used to rank the importance or agreement level of individual items, as presented in the two major perception tables (Tables 1 and 2). This ranking facilitated the identification of key coordination issues affecting the quality and usability of

working drawings and specifications. In order to ensure content validity, the questionnaire underwent expert review by seasoned academics and construction professionals specializing in architecture, engineering design, project documentation, and construction management. Their feedback led to refinements in item phrasing, clarity, and structure. A pilot test was also conducted with 20 professionals, drawn from the same population but excluded from the main analysis. This helped assess the internal consistency of the Likert-scale items and eliminated ambiguities, further strengthening the instrument's reliability.

RESULTS AND DISCUSSION

Demography of Respondents

Table 1 presents the demographic profile of the 506 valid respondents who participated in this study on cross-disciplinary coordination and its impact on working drawings and specifications in the Nigerian construction industry. The demographic variables analyzed include age, gender, marital status, educational level, firm type, professional discipline, and years of experience working with construction drawings.

Table 1: Demography of Respondents

S/N	Age	Frequency	Percent (%)
Age			
1	Less than 20 years	26	5.14
2	21 - 30 years	210	41.50
3	31 - 40 years	160	31.62
4	41 - 50 years	79	15.61
5	51 years & above	31	6.13
Gender			
1	Female	361	71.34
2	Male	145	28.66
Marital Status			
1	Single	226	44.66
2	Married	245	48.42
3	Divorced	19	3.75
4	Widow/Widower	13	2.57
5	Others	3	0.59
Educational Level			
1	Below First Degree	78	14.47
2	First Degree (HND/BSc.)	128	23.75
3	Master's Degree	196	36.36
4	Doctorate Degree	65	12.06
5	Others	72	13.36

Type of Firm			
1	Sole Proprietorship	207	40.91
2	Partnership	120	23.72
3	Limited Liability	112	22.13
4	Corporation	48	9.49
5	Public Liability Company	19	3.75
Years of dealing with Working Drawings			
1	0 - 5 years	148	29.25
2	6 -10 years	200	39.53
3	11 -15 years	107	21.15
4	16-20 years	33	6.52
5	Above 20 years	18	3.56
Profession in the Construction Industry			
1	Contractor	28	5.53
2	Architect	345	68.18
3	Engineer	86	17.00
4	Land Surveyor	29	5.73
5	Others	18	3.56

Source: Authors (2025)

The age profile indicates that the majority of respondents fall within the 21–30 years age group (41.50%), followed by those between 31–40 years (31.62%). A smaller proportion are aged 41–50 years (15.61%) and 51 years and above (6.13%), while only 5.14% are below 20 years. This reflects a workforce that is relatively youthful but includes a healthy proportion of mid-career professionals. The predominance of younger professionals suggests that the industry is attracting newer entrants, which may have implications for the adoption of modern coordination tools and digital documentation practices. According to Aasen & Klakegg (2023), the influx of younger professionals can contribute to innovation and adaptability within construction project teams, particularly in embracing collaborative technologies. The gender distribution reveals that 71.34% of respondents are female, while 28.66% are male. This is a notable finding given that previous literature often identifies construction as a male-dominated industry (Oyewole, 2021). The high female participation in this study could be attributed to the increasing involvement of women in architectural and design-related fields within Nigeria, especially in academia and consulting firms. It also suggests a shift towards more inclusive participation in professional decision-making processes related to construction documentation.

Most respondents are either married (48.42%) or single (44.66%), with a small percentage being divorced (3.75%), widowed (2.57%), or classified as "others" (0.59%). Marital status may indirectly reflect the level of career stability and responsibility among respondents. As suggested by Cochis, Mattarelli, Bertolotti, Scapolan, Montanari & Ungureanu (2021), family

life can influence work-life balance and professional engagement, especially in collaborative design teams. The respondents are generally well-educated, with 36.36% holding a Master's degree, and 23.75% possessing a first degree (B.Sc./HND). A smaller portion have Doctorate degrees (12.06%), while 14.47% reported educational qualifications below a first degree. This high educational attainment reinforces the credibility and relevance of the data collected, as the majority of respondents are sufficiently qualified to comment on complex issues such as drawing coordination and interdisciplinary collaboration. As noted by Kim, Lee & Cho (2022), educational level plays a significant role in professionals' ability to engage in high-level coordination processes and use of design technologies.

The majority of respondents work in sole proprietorships (40.91%), followed by those in partnerships (23.72%), limited liability firms (22.13%), and a smaller share from corporations (9.49%) and public liability companies (3.75%). This distribution suggests that a significant portion of construction professionals operate within smaller, independent practices, which may face greater coordination challenges due to limited organizational structure and access to digital collaboration tools. According to Cisi & Sansalvadore (2022), small firms often lack the resources for formalized coordination processes, making interpersonal communication and informal networks critical to successful collaboration. In terms of experience dealing with working drawings, 39.53% of respondents reported 6–10 years, 29.25% have 0–5 years, while 21.15% have 11–15 years. Only a small percentage have more than 15 years of experience. This distribution highlights a workforce with a mix of early-career and moderately experienced professionals, which is consistent with the earlier age demographic. Importantly, the fact that over 60% of respondents have more than 5 years of relevant experience enhances the reliability of their responses regarding coordination practices. As observed by Alshamayleh, Raje, Amlus & Bataineh (2024), experience significantly influences the ability to identify and manage coordination risks in construction documentation.

The professional distribution shows that architects dominate the respondent pool (68.18%), followed by engineers (17.00%), land surveyors (5.73%), and contractors (5.53%), with others making up 3.56%. This is expected, as architects typically play a central role in initiating and coordinating working drawings across other disciplines. The strong architectural representation offers deep insight into the coordination issues from a design leadership perspective, although it also suggests a need to interpret the findings with consideration for potential discipline-specific biases. Nonetheless, the presence of engineers and contractors adds valuable multi-disciplinary input that enriches the study's conclusions.

Analysis of Results by Objectives

Evaluate the challenges and perceived solutions in cross-disciplinary coordination of working drawings

Table 2 presents respondents' views on the challenges and potential solutions associated with cross-disciplinary coordination in the development of working drawings within the Nigerian construction industry. The analysis is based on a 5-point Likert scale, and responses were

ranked using both Mean Scores and Relative Index (RI) to identify the most agreed-upon statements.

Table 2: Respondents' Perception of Cross-Disciplinary Coordination Challenges and Solutions in Working Drawings

S/N	Challenges and Solution in Cross- Disciplinary Coordination	Level of Agreement using the Likert Scale					Total (Ef)	Efx	Mean Score (Efx/Ef)	Relative Index (RI)	Rank
		1	2	3	4	5					
1	Coordination among disciplines improves the quality of working drawings.	21	20	96	191	178	506	2003	3.958	0.792	7
2	Working drawing effectively addresses the needs of all involved disciplines.	13	25	98	248	122	506	1959	3.872	0.774	2
3	Cross- disciplinary coordination issues are often resolved in the working drawings.	14	21	103	253	115	506	1952	3.858	0.772	1
4	I find that working drawings facilitate effective communication between different disciplines.	11	24	101	237	133	506	1975	3.903	0.781	3
5	The involvement of multiple disciplines enhances the accuracy of working drawings.	12	27	108	224	135	506	1961	3.875	0.775	4

Source: Authors (2025)

The highest-ranked item, with a mean score of 3.858 and RI of 0.772, is the statement that "Cross-disciplinary coordination issues are often resolved in the working drawings". This suggests that many professionals recognize working drawings as a platform where inter-professional discrepancies are detected and addressed. This is consistent with the assertion by Oliveira, Olsen, Malki-Epshtein, Mumovic & D'Ayala (2022) that working drawings serve as a key coordination tool in multi-disciplinary projects, often functioning as the final point of integration for architectural, structural, and service designs. However, resolving issues at the drawing stage (rather than during early design collaboration) may indicate a reactive rather than proactive approach to coordination, which can still leave room for inefficiencies or delays.

Closely following in rank is the perception that "Working drawings effectively address the needs of all involved disciplines" (Mean = 3.872; RI = 0.774; Rank 2). This supports the argument that when coordination is well-managed, working drawings can successfully unify input from various consultants. Ghosh & Karmakar (2025) emphasize that such integration is

vital for avoiding conflicts during construction and for delivering coherent documentation packages. This perception indicates a growing appreciation among Nigerian professionals for the role of inclusive design development in documentation quality.

The third-ranked statement "Working drawings facilitate effective communication between different disciplines" received a mean score of 3.903 and RI of 0.781. This affirms the communication function of working drawings, which act as both technical reference and coordination tool across disciplines. The high level of agreement is in line with the views of Kurwi, Demian, Blay & Hassan (2021), who noted that working drawings bridge design intent and construction implementation, provided they are produced through collaborative and iterative processes. The finding highlights the importance of drawing clarity, completeness, and consistency in fostering interdisciplinary understanding and reducing site-level confusion.

Furthermore, the statement "The involvement of multiple disciplines enhances the accuracy of working drawings" achieved a mean of 3.875 and RI of 0.775 (Rank 4). This reflects widespread acknowledgment among professionals that integrated design input leads to more accurate, detailed, and constructible drawings. It supports the concept of Integrated Design Process (IDP), which emphasizes that multidisciplinary engagement during the design stage leads to higher-quality documentation outputs. As argued by Yap, Lim, Skitmore & Gray (2022), when professionals coordinate effectively, their diverse expertise complements one another, reducing omissions and technical contradictions in construction documents.

Surprisingly, the lowest-ranked item (though still with a relatively high agreement score) is the belief that "Coordination among disciplines improves the quality of working drawings" (Mean = 3.958; RI = 0.792; Rank 7). Despite being ranked lowest, the mean and RI scores remain significantly high, indicating a general consensus that quality is positively impacted by effective coordination. This may reflect that while professionals agree with the statement, they see it as more of a general truth rather than a challenge or solution specific to their everyday experiences. It may also imply that the practical implementation of such coordination remains inconsistent, as highlighted by Iroha, Watanabe & Satoshi (2024), who found that systemic barriers often prevent ideal coordination practices from being consistently realized in Nigerian projects.

While the findings indicate a strong professional consensus in Nigeria on the value of cross-disciplinary coordination, they also reveal a distinctive reactive pattern in its application when contrasted with global best practices. The high ranking of the statement that coordination issues are "often resolved in the working drawings" suggests a detection-and-correction model centered on the drawing production phase. This aligns with traditional, sequential design processes still common in many developing economies. However, this approach stands in contrast to the proactive, prevention-oriented models increasingly standardized in developed nations. In regions with mature BIM adoption and Integrated Project Delivery (IPD), such as the UK and US, the primary goal is to resolve clashes through continuous collaboration and virtual modeling before they are formalized in the working drawing set (Azhar, 2017; Succar & Kassem, 2021). The Nigerian professionals' high agreement that multidisciplinary

involvement enhances accuracy (Rank 4) conceptually mirrors the core principle of the Integrated Design Process (IDP) prevalent globally. Yet, the fact that resolution happens predominantly at the drawing stage indicates that this multidisciplinary input is often incorporated later in the process rather than from the outset. This creates a critical divergence: where global leaders use digital platforms to prevent conflicts iteratively, the Nigerian practice, as reflected in these results, often relies on the working drawing package itself as the primary venue for conflict resolution, a method that can be less efficient and more prone to the omissions and delays noted by Iroha et al. (2024). Therefore, the results demonstrate that while Nigerian professionals intellectually endorse global ideals of integration, the operational reality remains anchored in a traditional, document-centric coordination method, highlighting a significant area for process evolution.

Examine the frequency and type of coordination issues encountered in working drawings and their implications on project delivery

Table 3 presents the respondents' perceptions regarding the prevalence and consequences of coordination issues in working drawings. Using mean scores and relative index (RI) values, the table provides insight into how frequently coordination problems occur, how they are managed, and their perceived effect on drawing quality and project outcomes.

Table 3: Perceived Frequency and Impact of Coordination Issues in Working Drawings

S/N	Frequency and Type of Coordination Issues	Level of Agreement using the Likert Scale					Total (Ef)	Efx	Mean Score (Efx/Ef)	Relative Index (RI)	Rank
		1	2	3	4	5					
1	Coordination issues are common in the working drawings I review.	12	33	113	241	107	506	1916	3.787	0.757	3
2	Working drawings frequently require adjustments due to coordination issues.	13	32	109	253	99	506	1911	3.777	0.755	2
3	Coordination problems in working drawings are resolved in a timely manner.	5	30	129	264	78	506	1898	3.751	0.750	1
4	The type of coordination issues encountered in working drawings affects project outcomes.	20	26	113	231	116	506	1915	3.785	0.757	5
5	The frequency of coordination issues impacts the overall quality of working drawings.	12	23	104	238	129	506	1967	3.887	0.777	6

Source: Authors (2025)

The highest-ranked item is the statement that "The frequency of coordination issues impacts the overall quality of working drawings", with a mean score of 3.887 and a Relative Index (RI) of 0.777. This suggests that respondents strongly agree that repeated coordination problems significantly diminish the quality of final documentation. Poorly coordinated drawings often contain inconsistencies, errors, or ambiguities that can affect buildability, accuracy, and compliance with design standards. According to Heaton, Martin, Chadee, Milling, Dunne & Borthwick (2022), unresolved coordination issues are among the leading causes of change orders and delays on construction sites, especially when conflicting information in drawings leads to confusion during execution.

The second-highest item, "Working drawings frequently require adjustments due to coordination issues" (Mean = 3.777; RI = 0.755), indicates that adjustments to documentation are common practice in the industry. This finding aligns with Olaseni (2019), who observed that late-stage design revisions are widespread in Nigerian projects due to lack of early-stage multidisciplinary input. The need for repeated adjustments not only extends project timelines but also exposes contractors and consultants to increased risk and cost uncertainty.

Interestingly, "Coordination issues are common in the working drawings I review" also ranks highly (Mean = 3.787; RI = 0.757; Rank 3), supporting the view that the occurrence of coordination problems is not incidental but systemic. This reveals a recurring theme in the Nigerian construction industry, where cross-disciplinary collaboration is often informal, fragmented, and reactive. Alsuhaibani, Han & Leite (2022) similarly found that coordination lapses were among the leading contributors to drawing inconsistencies and incomplete specifications on-site. This pattern suggests a need for structured and consistent coordination processes to be institutionalized within project workflows.

One of the most telling findings is the relatively lower ranking of the statement "Coordination problems in working drawings are resolved in a timely manner", which received the lowest mean score of 3.751 and RI of 0.750 (Rank 1). Although the difference in scores is marginal, this response indicates that timely resolution of coordination problems remains a challenge. Delayed resolution can lead to on-site confusion, cost escalation, and loss of stakeholder confidence. Liu, Lyndon, Holl, Johnson, Bilimoria & Stey (2021) note that delayed decision-making and unresolved documentation conflicts are key indicators of weak communication frameworks within interdisciplinary teams.

Another important response is that "The type of coordination issues encountered in working drawings affects project outcomes" (Mean = 3.785; RI = 0.757; Rank 5). This reflects the understanding that the nature of the coordination issue (whether spatial conflicts, misalignment of building systems, or ambiguous specifications) has varying levels of impact on cost, time, and construction quality. This aligns with the findings of Adewoyin, Onyeke, Digitemie & Dienagha (2025), who emphasized that coordination challenges, if not detected early, ripple through project execution and often require significant remediation effort.

Taken together, the data suggest that coordination issues in working drawings are not only frequent but consequential, affecting both the documentation process and overall project

delivery. Although professionals are aware of the need for coordination and are often forced to adjust for it, the process of timely detection and resolution remains suboptimal. This reinforces the importance of structured coordination protocols, such as joint review sessions, digital modeling tools (e.g., BIM), and early-stage interdisciplinary workshops, as proposed in the Design Coordination Model by Anumba et al. (1997).

The findings on the frequency and impact of coordination issues reveal a significant misalignment between prevalent practices in Nigeria and the evolving standards of global best practice. The high prevalence of adjustments and the systemic nature of coordination problems (Ranks 2 & 3) are characteristic of a traditional, document-centric and reactive project delivery method, which has largely been superseded in more mature construction industries. In developed economies, the adoption of Building Information Modeling (BIM) and mandated collaborative protocols like the UK's PAS 1192 series are specifically designed to drastically reduce the frequency of such issues by resolving them in a virtual, collaborative environment long before the working drawing stage (Azhar, 2017; Succar & Kassem, 2021). The challenge of timely resolution (Rank 1) is particularly telling; in global contexts, this is mitigated through structured processes like Common Data Environments (CDEs) and Clash Detection runs, which enforce resolution within defined timelines and workflows. The strong agreement that these issues impact quality and outcomes (Ranks 5 & 6) is a universal truth in construction; however, the key difference lies in the response. Whereas the Nigerian experience, as captured here, often involves managing these impacts through costly and time-consuming adjustments, global best practice focuses on pre-emption through early stakeholder involvement (as per IDP theory) and digital integration. Thus, while the consequences of poor coordination are universally acknowledged, the Nigerian industry's experience, characterized by frequent, systemic, and slowly resolved issues, underscores a critical gap in the adoption of the proactive, process-oriented, and technology-enabled coordination frameworks that define high-performing global projects.

CONCLUSION AND RECOMMENDATIONS

This study set out to examine the challenges and impacts of cross-disciplinary coordination on the development of working drawings and specifications within the Nigerian construction industry. Specifically, the study aimed to (1) assess professional perceptions regarding coordination-related challenges and solutions, and (2) evaluate the frequency and effects of coordination issues on the quality and accuracy of construction documentation. The findings revealed a broad consensus among industry professionals that effective coordination improves communication, drawing quality, and the accuracy of documentation. Respondents acknowledged that working drawings are central tools in resolving inter-disciplinary issues and facilitating alignment among architectural, engineering, and construction inputs. However, while the importance of coordination was recognized, several persistent challenges were identified. These include frequent adjustments to drawings due to misalignment between disciplines, delayed resolution of drawing conflicts, and the negative impact of such issues on

project outcomes and drawing quality. The results further highlighted that coordination problems are common and systemic, not isolated incidents. Although working drawings often serve as a resolution point for inter-disciplinary issues, this typically happens at a late stage in the documentation process, leading to inefficiencies, delays, and compromised quality. These insights affirm the relevance of theories such as the Integrated Design Process (IDP) and Design Coordination Model, which advocate for early and structured collaboration among stakeholders to improve project documentation outcomes.

In light of these findings, the following recommendations are proposed to enhance cross-disciplinary coordination and improve the quality of working drawings and specifications in Nigeria:

i. Institutionalize Early-Stage Coordination Workshops: Design teams should adopt mandatory pre-documentation coordination workshops involving all relevant professionals. This will promote early detection of conflicts and alignment of design objectives across disciplines.
ii. Adopt Integrated Design and Documentation Frameworks: Firms should integrate tools and workflows that encourage simultaneous input from all disciplines, such as Building Information Modelling (BIM), shared drawing platforms, and centralized communication systems.
iii. Implement Regular Drawing Review Protocols: Establishing scheduled drawing review sessions throughout the design process—rather than only at finalization—can help prevent late-stage revisions and facilitate timely resolution of coordination issues.
iv. Train Professionals in Coordination Techniques: Continuous professional development programs should be introduced to train architects, engineers, and other consultants in collaborative documentation practices, digital integration tools, and communication management.
v. Encourage Multi-Disciplinary Firm Structures or Alliances: Professional collaboration can be enhanced through the formation of design-build teams or multi-disciplinary consultancy alliances that naturally support integrated workflows and shared accountability for documentation.
vi. Policy Support and Industry Guidelines: Regulatory bodies such as ARCON, COREN, and NIQS should develop standard coordination protocols and enforce compliance as part of the project approval and documentation process.

While this study provides valuable insights into coordination practices in Nigeria's construction industry, it also opens up several avenues for future inquiry:

i. Comparative studies across public and private sector projects to evaluate differences in coordination efficiency.
ii. Impact analysis of digital coordination tools (e.g., BIM, shared cloud platforms) on real-time conflict resolution in working drawings.

iii. Case studies of best-practice firms successfully managing cross-disciplinary collaboration in large-scale projects.
iv. Cost and time implications of poor coordination in construction documentation across different project types and locations.

This study affirms that cross-disciplinary coordination is not merely a procedural concern but a strategic imperative for improving construction documentation, minimizing design errors, and enhancing overall project performance in Nigeria's built environment.

REFERENCES

Aasen, A. F., & Klakegg, O. J. (2023). Human resilience and cultural change in the construction industry: communication and relationships in a time of enforced adaptation. *Frontiers in Built Environment*, *9*, 1287483.

Abdulfattah, B. S., Abdelsalam, H. A., Abdelsalam, M., Bolpagni, M., Thurairajah, N., Perez, L. F., & Butt, T. E. (2023). Predicting implications of design changes in BIM-based construction projects through machine learning. *Automation in Construction*, *155*, 105057.

Adewoyin, M. A., Onyeke, F. O., Digitemie, W. N., & Dienagha, I. N. (2025). Holistic offshore engineering strategies: Resolving stakeholder conflicts and accelerating project timelines for complex energy projects.

Adewumi BamideleJ., Onamade, Akintunde., Asaju, Opeyemi, A. & Adegbule, Micheal, B.O, (2023). Impact of Architectural Education on Energy Sustainability in Selected Schools of Architecture in Lagos Megacity. Caleb International Journal of Development Studies, 6(2), 209-218.

Adewumi Bamidele J., Asaju Opeyemi, A., Bello, Ahmed O., Atulegwu Akudo E., Ibhafidon Osesesele F., David- Mukore, Kessena D., Otuonuyo George A., & Ogunyemi Olaoye.G.(2025a) The Role of Specifications in Material Selection for Architects. Jigawa Journal of Multidisciplinary Studies (JIMS), 8(1), 74-89

Adewumi, B. J., Onamade, A. O., David-Mukoro, K. D., Bamiloye, M. I., Otuonuyo, G. A., Chukwuka, O. P., & Oru, T. O. (2025). Quality Reassurance in Construction Project: Leveraging Specifications for Standards and Testing Materials/Workmanship. *International Journal of Research and Innovation in Social Science*, *9*(3), 1662-1672.

Agbaxode, P. D. K. (2022). *A Framework to Improve Design Documentation Quality Using Integrated Project Delivery (IPD) Approach* (Doctoral dissertation, University of the Witwatersrand, Johannesburg (South Africa)).

Alshamayleh, H. Z., Raje, H. M. T. A. A., Amlus, M. H. B., & Bataineh, M. J. (2024). Towards Efficient Construction Projects: Addressing Team Coordination and Risk Management in Jordan: Higher Model Imperial Study. *Journal of Ecohumanism*, *3*(8), 7999-8016.

Alsuhaibani, A., Han, B., & Leite, F. (2022). Investigating the causes of missing field detected issues from BIM-based construction coordination through semistructured interviews. *Journal of Architectural Engineering*, *28*(4), 04022028.

Alugbue, W. K., Otuonuyo, G. A., Adewumi, B. J., Onamade, A. O., & Asaju, O. A. (2024). Impact of Specification on Construction Administration for Project Management Within Lagos Megacity. *International Journal of Research and Innovation in Social Science*, *8*(3s), 4664-4680.

Bamidele J. Adewumi, Akintunde O. Onamade, Felix A. Onyikeh, George A. Alagbe, Micheal B.O, Adegbile & Matthew A. Dayomi (2025b). Who Benefits? A deep Drive into the Social and Economic Impact of Cooperative Housing Estates in Lagos Megacity. UNIABUJA Journal of Engineering and Technology, 2(1), 104-117.

Bisharat, K. A. (2025). *Construction graphics: A practical guide to interpreting working drawings*. John Wiley & Sons.

Chahrour, R., Hafeez, M. A., Ahmad, A. M., Sulieman, H. I., Dawood, H., Rodriguez-Trejo, S., ... & Dawood, N. (2021). Cost-benefit analysis of BIM-enabled design clash detection and resolution. *Construction Management and Economics*, *39*(1), 55-72.

Cisi, M., & Sansalvadore, F. (2022). Formalized business networks in SMEs and structural relations for their governance. *Journal of Small Business & Entrepreneurship*, *34*(3), 295-312.

Cochis, C., Mattarelli, E., Bertolotti, F., Scapolan, A. C., Montanari, F., & Ungureanu, P. (2021). How perceptions of work-life balance and technology use impact upon creativity in collaborative spaces. In *Digital Transformation and Human Behavior: Innovation for People and Organisations* (pp. 217-234). Springer International Publishing.

Daniel O. George, Bamidele J. Adewumi, George A. Otuonuyo, Aanuoluwa A. Oyewole, Faruq O. Oparinde & Olamilekan A. Yussuf (2025). Emperical Review of Energy Efficiency in Mixed-Used Development in Victoria Island, Lagos State. UNIABUJA Journal of Engineering and Technology, 2(1), 35- 42.

de Souza, M. P., Fialho, B. C., Ferreira, R. C., Fabricio, M. M., & Codinhoto, R. (2023). Modelling and coordination of building design: an experience of BIM learning/upskilling. *Architectural Engineering and Design Management*, *19*(1), 74-91.

Emesiobi, P. M., Otuonuyo, G. A., Adewumi, Bamidele J., Asaju, Opeyemi, A., & Onamade, A. O. (2024). Specification: A Key Tool for Efficient Facility Management in Lagos Megacity. *International Journal of Research and Innovation in Social Science*, *8*(11), 2717-2727.

Farkhondehpay, R. (2024). Beyond Shelter: A Multi-Stakeholder Approach to Canada's Housing Crisis. *Urban and Regional Planning*, *9*(3), 58-70.

Ghosh, B., & Karmakar, S. (2025). Digitalized Document Management System for Construction Claims and Disputes to Enhance the Smoothness of Advanced Construction Projects Using the Building Information Modeling Integrated Framework. *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction*, *17*(1), 04524038.

Hassanain, M. A., Adewale, B., Al-Hammad, A. M., & Sanni-Anibire, M. O. (2018). Factors affecting building services' coordination during the design development and review stages. *Built environment project and asset management*, *8*(1), 64-77.

Heaton, R., Martin, H., Chadee, A., Milling, A., Dunne, S., & Borthwick, F. (2022). The construction materials conundrum: practical solutions to address integrated supply chain complexities. *Journal of Construction Engineering and Management*, *148*(8), 04022071.

Hurkadli R. (2023). Design Coordination. *ITSM Documents & Templates*. https://www.itsm-docs.com/blogs/itil-fundamentals/design-coordination

Iroha, E. V., Watanabe, T., & Satoshi, T. (2024). Flawed Institutional Structures: Project Managers Underutilized in Nigeria's Construction Industry. *Buildings*, *14*(3), 807.

Kaygan, P. (2023). From forming to performing: Team development for enhancing interdisciplinary collaboration between design and engineering students using design thinking. *International Journal of Technology and Design Education*, *33*(2), 457-478.

Kim, J., Lee, H., & Cho, Y. H. (2022). Learning design to support student-AI collaboration: Perspectives of leading teachers for AI in education. *Education and information technologies*, *27*(5), 6069-6104.

Krishnan, N. (2025). Advancing multi-agent systems through model context protocol: Architecture, implementation, and applications. *arXiv preprint arXiv:2504.21030*.

Kurwi, S., Demian, P., Blay, K. B., & Hassan, T. M. (2021). Collaboration through integrated BIM and GIS for the design process in rail projects: Formalising the requirements. *Infrastructures*, *6*(4), 52.

Larsson N. (2009). The Integrated Design process: History and Analysis. *International Initiative for a Sustainable Built Environment (iiSBE)*, 1-16.

Liu, P., Lyndon, A., Holl, J. L., Johnson, J., Bilimoria, K. Y., & Stey, A. M. (2021). Barriers and facilitators to interdisciplinary communication during consultations: a qualitative study. *BMJ open*, *11*(9), e046111.

Ng, M. S., Graser, K., & Hall, D. M. (2023). Digital fabrication, BIM and early contractor involvement in design in construction projects: A comparative case study. *Architectural Engineering and Design Management*, *19*(1), 39-55.

Nguyen, M., & Mougenot, C. (2022). A systematic review of empirical studies on multidisciplinary design collaboration: Findings, methods, and challenges. *Design Studies*, *81*, 101120.

Nwulu, E. O., Elete, T. Y., Omomo, K. O., Akano, O. A., & Erhueh, O. V. (2023). The importance of interdisciplinary collaboration for successful engineering project completions: A strategic framework. *World Journal of Engineering and Technology Research*, *2*(3), 48-56.

Olaiya, B. C., Fadugba, O. G., & Lawan, M. M. (2024). Building Information Modeling (BIM) Implementation and Practices in Construction Industry: A Review.

Olaseni, I. O. (2019). Advancing Building Engineering Through BIM-Driven Collaboration in Complex Infrastructure and High-Rise Construction Projects.

Oliveira, S., Olsen, L., Malki-Epshtein, L., Mumovic, D., & D'Ayala, D. (2022). Transcending disciplines in architecture, structural and building services engineering: a new multidisciplinary educational approach. *International Journal of Technology and Design Education*, 1-19.

Opeyemi A. Asaju., Bamidele J. Adewumi., Akintunde O. Onamade., & Oluwole A. Alagbe (2024). Environmental Impact of Energy Efficiency of Architectural Studio in Selected Tertiary Institutions in Lagos Mega-City, Nigeria. Gwn-Multidisciplinary Journal of Sustainable Development, 2(1), 29-37.

Oru, T.O., Adewumi, B.J & Asaju, O. A, (2024). A Comparative Study on Improving Energy- Efficiency in Multi- Apartment Residential Buildings. EKSU Journal of the Management Scientists, 3(1), 225- 267.

Owolabi, T. O.S, Harry, E.G, Adewumi, B.J, Onamade, A.O, & Alagbe, O.A (2024). Ensuring Quality in Construction Project: The Role of Specifications as Quality Assurance Tools. *Anchor University Journal of Science and Technology*, 5(2), 181-191.

Oyewole, B. F. (2021). *An assessment of discrimination against women in the Nigerian construction industry*. University of Johannesburg (South Africa).

Pradeep, A. S. E., Yiu, T. W., Zou, Y., & Amor, R. (2021). Blockchain-aided information exchange records for design liability control and improved security. *Automation in Construction*, *126*, 103667.

Rankohi, S., Smith, D., Lizarralde, G., Bourgault, M., & Pellerin, R. (2023, May). Barriers to the Implementation of Integrated Design Processes—The Case of the Construction Industry in Quebec, Canada. In *Canadian Society of Civil Engineering Annual Conference* (pp. 83-96). Cham: Springer Nature Switzerland.

Sujan, S. F. (2020). *A Holistic and Systemic Model of Collaboration in the AED Industry*. The University of Liverpool (United Kingdom).

Tadesse, N. S. (2021). *Multidisciplinary Collaboration in the Current Architecture, Engineering, and Construction Education of Ethiopia* (Master's thesis, Izmir Institute of Technology (Turkey)).

Taiwo, R. O., Morakinyo, K. O., Yusuff, I. O., & Oyeniyi, S. A. (2025). Project Stages Interface among Construction Professionals in Lagos State, Nigeria. *Local Engineering*, *3*(1), 31-40.

Yap, J. B. H., Lim, B. L., Skitmore, M., & Gray, J. (2022). Criticality of project knowledge and experience in the delivery of construction projects. *Journal of Engineering, Design and Technology*, *20*(3), 800-822.