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Architects Perceptions and Challenges in Embracing Modular Construction in Lagos' Growing Urban Landscape

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ABSTRACT

The rapid urbanization of Lagos, Nigeria, has created a pressing need for innovative and efficient construction methods to meet the city's growing demand for housing and infrastructure. Modular construction, which involves the prefabrication of building components off-site for on-site assembly, presents promising solutions to reduce construction time, enhance quality control, and promote environmental sustainability. However, the adoption of this method in Lagos remains limited due to various contextual challenges. This study investigates architects' perceptions of modular construction in the context of Lagos's expanding urban landscape, focusing on the potential benefits and obstacles to its implementation. A mixed-method approach was used, combining quantitative data from structured questionnaires with qualitative insights from open-ended responses. Key findings indicate that architects see modular construction as a viable solution to Lagos's housing crisis and urban sprawl, highlighting advantages such as lower labor costs, efficient land use, and sustainability. Nonetheless, significant challenges persist, including high initial costs, limited availability of materials, regulatory hurdles, cultural resistance, and logistical difficulties related to transportation. The study emphasizes the necessity for supportive policies, improved infrastructure, local supply chain development, and training programs to enhance the acceptance and adoption of modular construction. Recommendations are provided to address these challenges, aiming to facilitate a smoother integration of modular construction into Lagos's urban development strategies. By offering a comprehensive understanding of architects' perspectives, this research provides valuable insights into the potential role of modular construction in shaping the future of Lagos's built environment.

Keywords: Modular Construction, Architects' Perceptions, Urbanization, Construction Challenges, Lagos Built Environment.

I. INTRODUCTION

Lagos, Nigeria, is one of Africa's fastest-growing cities, noted for its rapid urbanization and increasing population (Oluwaseun & Comte, 2024). This growth has intensified challenges such as severe housing shortages, escalating construction costs, inefficiencies in project delivery timelines, and heightened environmental concerns (Oluwaseun et al, 2024; Afolabi, Akinbo, & Akinola, 2019). These issues have created an urgent need for innovative construction methods that are cost-effective, time-efficient, and sustainable (Bertram, Fuchs, Mischke, Palter, Strube, & Woetzel, 2019; Ali, Kineber, Elshaboury, & Daoud, 2024). Among the emerging solutions, modular construction stands out as a promising alternative (Gabriel, Ishirugi, & Soeiro, 2023; Picard, Blanchet, & Bégin-Drolet, 2022).This method involves prefabricating building components off-site and assembling them on-site, offering significant benefits such as reduced construction time, lower labor costs, enhanced quality control, and minimized environmental impact (Picard et al,2022). Despite its global success and potential to address critical challenges, the adoption of modular construction in Lagos remains limited. Architects, as key stakeholders in shaping the built environment, play a crucial role in influencing the adoption of new construction technologies (Murtagh, Achkar, & Roberts, 2017; Bello, Khan, Idris, & Awwal, 2023; Olatunji,

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Olaniran, & Ogunyemi, 2023).. Their perceptions, knowledge, and professional experiences often determine the feasibility and acceptance of innovative approaches. However, the extent of their awareness, understanding, and willingness to adopt modular construction in Lagos has not been thoroughly explored. This gap in knowledge forms the basis of this study, which investigates architects' perceptions and the challenges they face in embracing modular construction in the dynamic and complex urban landscape of Lagos (Ali et al2024).

This study aims to explore architects' perceptions of modular construction and the challenges they encounter in its implementation in Lagos. The objectives are as follows:

1. to assess the level of awareness and familiarity architects in Lagos have with modular construction.
2. to identify the perceived benefits and opportunities modular construction presents in addressing Lagos' urbanization challenges.
3. to investigate the barriers architects face in adopting modular construction, including economic, regulatory, logistical, and cultural factors.
4. to provide actionable recommendations for promoting the adoption of modular construction in Lagos' construction industry.

This study makes a significant contribution to knowledge by addressing a critical gap in understanding the intersection of professional architectural practice and the adoption of modular construction in Lagos. It highlights the unique challenges associated with implementing modular construction in one of Africa's most rapidly urbanizing cities, contextualizing its findings to Lagos' socio-economic, infrastructural, and cultural landscape (Afolabi et al,2019). By focusing on the perceptions of architects, this study underscores the importance of professional insights in driving technological adoption and innovation within the construction industry. Furthermore, it proposes practical recommendations to address identified barriers, thereby offering a roadmap for fostering the integration of modular construction in Lagos and similar urban centers.

Ultimately, this research contributes to the global discourse on sustainable urban development by providing a nuanced understanding of the opportunities and challenges of modular construction in an African context. By bridging the gap between architectural practice and innovative construction methods, this study paves the way for more efficient, sustainable, and adaptable solutions to the pressing demands of urbanization (Pesce & Bagaini, 2019).

II. LITERATURE REVIEW

2.1 An Overview of Modular Construction

Modular construction is an innovative building method that involves the off-site fabrication of building components or modules. These modules are then transported to the construction site and assembled to create the final structure (Gabriel, Ishirugi,Advisor, Augusto& Soeiro, 2023). This approach offers several advantages, including reduced construction time, enhanced quality control, improved safety conditions, and minimized environmental impact (Bertram et al., 2019; Li et al., 2021). Research has shown that modular construction allows for simultaneous site development and factory-based fabrication, significantly shortening project timelines and decreasing delays caused by weather conditions (Lu & Liska, 2020; Kamali & Hewage, 2016). Additionally, the controlled environment of factories improves construction accuracy, resulting in fewer defects and greater consistency in building components (Abubakar & Aina, 2020). Beyond efficiency, modular buildings are increasingly designed with flexible layouts and high aesthetic standards, challenging the outdated perception that modular architecture lacks visual appeal (Zhang, Wang, & Zhang, 2022; Ahmed & Goyal, 2021). This shift reflects a growing recognition of modular construction as a competitive and sustainable alternative to traditional building methods (Tighnavard & Ramadan, 2024).

2.2 Adoption in Emerging Markets

Modular construction has gained considerable traction in developed countries such as the United States, the United Kingdom, and China. However, its adoption in emerging markets, including Nigeria, remains relatively low (Adedamola et al, 2024). Factors such as high startup costs, a lack of skilled labor, poor infrastructure, and weak regulatory frameworks hinder its spread in countries like Nigeria (Enshassi, Walbridge, West,& Haas, 2019; Akinsanmi Akindeinde, Akinola, Ojo, & Okechukwu,2024). The barriers to adoption are multifaceted, encompassing economic, technical, and cultural dimensions. According to studies by Enshassi et al. (2019), the high initial costs associated with establishing modular construction facilities and importing specialized materials and equipment are significant deterrents. Although

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modular housing presents potential solutions to the housing deficit in Lagos, challenges such as inconsistent power supply, dependency on imported materials, and the absence of localized design templates limit its feasibility (Adedamola et al, 2024). Limited awareness and understanding of the benefits of modular construction also contribute to its slow uptake among industry stakeholders in emerging markets. Additionally, inadequate supply chains pose another substantial challenge. Modular construction relies on a robust network of material suppliers and manufacturers, which is often underdeveloped in emerging economies like Nigeria (Akinsanmi Akindeinde et al., 2024). Clients and contractors frequently prefer traditional construction methods due to their familiarity, lower perceived risks, and concerns regarding the durability and acceptance of modular designs (Bello,Khan,Idris& Awwal, 2023; Ibrahim & Ayeni, 2022). Nonetheless, studies in countries like India and Kenya demonstrate that with government incentives and public-private partnerships, modular technologies can gain significant traction even in developing contexts (Ahmed et al, 2021; Nganga,Mburu, & Otiende,2022).

2.3 Architects' Role in Construction Innovation

Architects play a crucial role in driving innovation in the built environment, particularly through the adoption of new construction techniques (Kamar et al 2021; Murtagh et al, 2017; Olatunji et al, 2023). Their design choices, material selections, and interactions with clients greatly influence the construction methods used for a project (Murtagh et al, 2017; Olatunji et al., 2023). The successful integration of modular construction into the overall design and construction process relies heavily on architects' perceptions, education, and exposure to modular projects. These factors impact their willingness to recommend and adopt this method (Bello et al., 2023). In Nigeria, however, few architectural firms offer comprehensive training on modular design principles (Akinola, Akinsanmi, Ojo&Okechukwu 2023). Often, architects serve as intermediaries between clients and construction teams, promoting efficient and sustainable construction practices (Murtagh et al., 2017). Additionally, the incorporation of modular construction into architectural education is limited, which diminishes early exposure for students and interns. To empower architects as leaders in modular innovation, it is essential to expand curricula related to modular construction and foster collaboration with manufacturers (Gabriel et al., 2023; Kamar et al, 2021).

2.4 Challenges in Lagos' Urban Context

Lagos, with its rapid urbanization and growing population, presents a unique yet challenging environment for the adoption of modular construction (Akinsanmi Akindeinde et al., 2024). The city faces a critical housing shortage, inefficient infrastructure, and increasing pressure on land and public services (Oluwaseun et al, 2024; Afolabi et al., 2019). While modular systems could offer a scalable solution, several barriers hinder their effective adoption such as transport and logistics pose significant challenges, as modular construction necessitates the movement of large prefabricated components through congested and deteriorating road networks, which raises costs and risks damage to materials (Adeyemi, 2023; Picard et al., 2022). Logistical inefficiencies often lead to increased costs and project delays, undermining the cost-saving advantages of modular construction (Picard et al., 2022). Additionally, the high cost of importing modular components and the lack of local production facilities make this construction method financially inaccessible for many developers (Ali et al., 2024; Enshassi et al., 2019). Furthermore, stringent building codes and regulatory complexities discourage stakeholders from pursuing modular construction. The regulatory frameworks in Lagos often do not accommodate innovative construction methods, resulting in delays in project approvals and additional bureaucratic hurdles (Gabriel et al., 2023).

Despite these challenges, modular construction has tremendous potential within Lagos' dynamic urban landscape. It can help address the city's housing shortages, provide sustainable solutions for urban development, and create economic opportunities through the establishment of local modular manufacturing industries. Overcoming the barriers to adoption requires a collaborative effort from architects, policymakers, and other stakeholders to raise awareness, streamline regulations, and develop local expertise in modular construction.

III. METHODOLOGY

This study employed a purposive sampling technique to select 50 architects practicing in Lagos. Purposive sampling was chosen because it allows for the deliberate selection of participants who possess specific knowledge, experience, or expertise related to the research

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topic, in this case, modular construction. Architects were targeted as key stakeholders due to their critical role in the design and implementation of innovative construction technologies.

The sample size of 50 architects was determined using a formula suitable for estimating an adequate number of participants in studies with a finite population. Since the exact population of practicing architects in Lagos is known through professional bodies such as the Nigerian Institute of Architects (NIA), the sample size formula for a finite population was applied:

Where:

- n = required sample size
- N = population size (total number of architects practicing in Lagos, approximated at 500 based on recent NIA data)
- e = margin of error (set at 10%, or 0.1, to allow for manageable variability given the exploratory nature of the study)

Substituting these values into the formula:

$$n = \frac{500}{1 + 500(0.1^2)}$$

$$n = \frac{500}{1 + 500(0.01)}$$

$$n = \frac{500}{1 + 5} = \frac{500}{6} = 83.33$$

The formula yielded a minimum sample size of approximately 83 participants. However, due to logistical constraints and the qualitative nature of the study, a reduced sample size of 50 was chosen. This smaller sample size balances feasibility with the need to gather diverse insights, as the goal of qualitative research is not statistical generalization but rather an in-depth understanding of the issue.

Data were collected through two methods:

1. Structured Questionnaires: These were used to gather quantitative data on architects' awareness, perceptions, and challenges related to modular construction.
2. Semi-Structured Interviews: These provided qualitative insights into participants' personal experiences, professional expertise, and recommendations for overcoming barriers to modular construction adoption.

Data Analysis

The quantitative data collected from the structured questionnaires were analyzed using SPSS statistics, such as frequencies, percentages, and mean scores, to summarize and identify trends in architects' responses. This approach enabled the identification of key themes related to their awareness and perceptions of modular construction.

The qualitative data from the interviews were subjected to thematic analysis. This involved coding and categorizing participants' responses to identify recurring patterns, themes, and nuanced perspectives. Finally, the findings from both data sources were triangulated to ensure validity and reliability, enhancing the credibility and robustness of the study's conclusions.

This mixed-methods approach allowed for a comprehensive understanding of the research problem, ensuring that both numerical trends and contextual insights were captured to address the study's objectives.

IV. FINDINGS AND DISCUSSION

Demographic Profile of Respondents

The respondents comprise a knowledgeable group of professionals, with 60% male and 40% female participants, indicating a persistent gender gap, although female representation is increasing. Most architects have over five years of experience and work in mid- to large-sized firms, equipping them to evaluate innovative construction methods. While many have theoretical knowledge of modular construction, few possess practical experience, suggesting their insights are somewhat limited in the Lagos context.

Table 1: Awareness and Familiarity with Modular Construction

Awareness Level	Percentage (%)
High	42
Moderate	40
Low	18

The table shows that 82% of architects reported a moderate to high awareness of modular construction; however, practical experience is limited, as most have not participated in actual modular projects. This indicates a significant gap between theoretical knowledge and real-world application, suggesting that modular construction in Lagos is still in its early stages of adoption. Respondents mainly acquired their knowledge through academic training, industry conferences, and professional publications. Although the architectural community acknowledges the potential of modular construction, the lack of pilot projects and limited market penetration continue to

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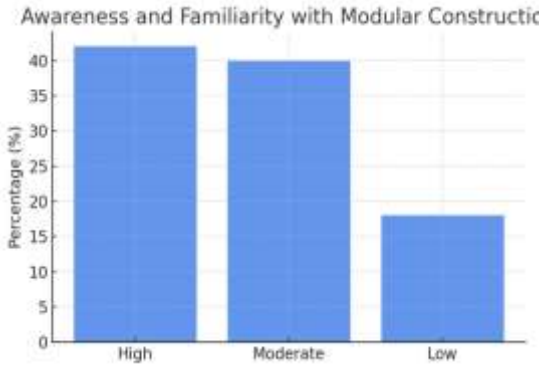
hinder its adoption. This highlights the need for practical demonstration efforts and professional training programs to bridge the gap between awareness and implementation..

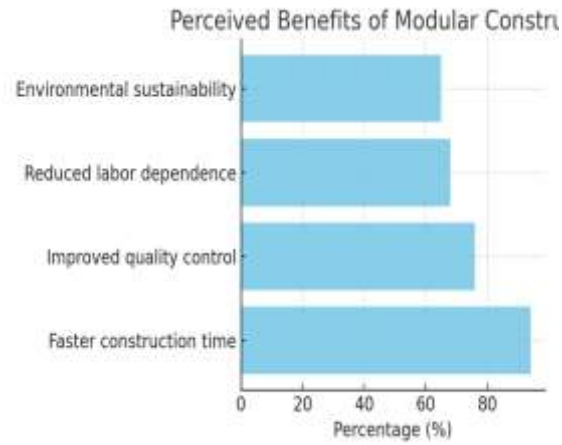


The chart above show the distribution of awareness levels among architects:

Table 2: Perceived Benefits of Modular Construction

Benefit	Percentage (%)
Faster construction time	94
Improved quality control	76
Reduced labor dependence	68
Environmental sustainability	65

The table shows that 94% of architects in Lagos view accelerated construction timelines as the top advantage. Following this, 76% highlighted improved quality control, which reflects the precision from off-site fabrication. Additionally, 68% noted reduced labor dependence, addressing skilled labor shortages in the city. Environmental sustainability was recognized by 65% of participants, emphasizing benefits like decreased on-site waste and better energy efficiency. Overall, these findings highlight the significant value of modular construction in responding to the challenges of Lagos' urban landscape.



The chart above show the distribution of awareness levels among architects

Table 3: Barriers to Modular Construction Adoption

Barrier	Percentage (%)
High initial cost	88
Logistics issues	72
Material availability	65
Regulatory issues	59
Cultural resistance	56

The table reveals significant challenges for architects in Lagos. The most pressing issue, identified by 88% of respondents, is the high initial costs of establishing prefabrication systems and importing materials. Logistical constraints, noted by 72%, include poor road networks and traffic congestion that hinder transportation of modular units. A lack of locally sourced materials, mentioned by 65%, and regulatory challenges, cited by 59% due to unclear building codes and lengthy approval processes, further complicate matters. Additionally, 56% of architects report cultural resistance, reflecting scepticism from clients and practitioners toward prefabricated methods. These findings suggest that overcoming these economic, infrastructural, regulatory, and cultural challenges is crucial for successfully integrating modular construction into Lagos' built environment.

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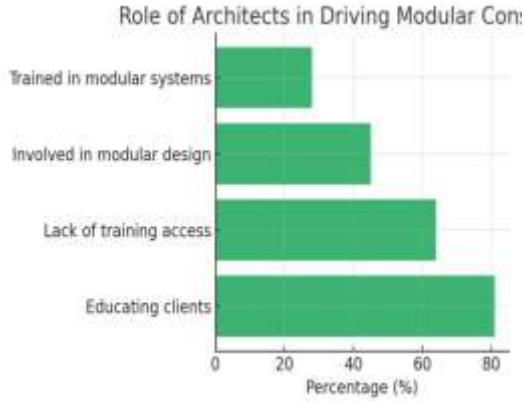

Table 4: Role of Architects in Driving Modular Construction

Architect Role	Percentage (%)
Educating clients	81
Lack of training access	64
Involved in modular design	45
Trained in modular systems	28

The table highlights their pivotal influence in shaping the future of the built environment in Lagos. A notable 81% of respondents agreed that architects play a critical role in educating clients about the feasibility, benefits, and design flexibility of modular construction, reinforcing their position as trusted advisors and drivers of innovation. However, 64% identified a lack of adequate training as a major constraint, indicating that many architects feel ill-equipped to propose or implement modular solutions. Only 45% reported active involvement in modular design projects, pointing to limited hands-on experience within the profession, while just 28% had received formal training in modular systems, revealing a clear gap in professional development. These findings suggest that although architects are strategically positioned to advance modular construction, their effectiveness is currently constrained by insufficient exposure, training, and institutional support.

V. CONCLUSION

This study explored the perceptions and challenges that architects face when adopting modular construction in Lagos. While many architects demonstrate a strong theoretical understanding of modular systems, their practical experience is limited. The key benefits of modular construction—such as faster building times, improved quality control, and environmental sustainability—are widely recognized. However, several challenges persist, including high costs, insufficient training, weak regulations, and cultural resistance, which continue to impede widespread adoption. The findings indicate that although architects are well-positioned to lead innovation in modular construction, their impact is constrained by institutional and infrastructural gaps.

VI. RECOMMENDATIONS

To promote the adoption of modular construction in Lagos, it is crucial to enhance architects' skills through specific professional training and reforms in architectural school curricula. Principles of modular design should be integrated into academic programs, while ongoing professional development workshops can improve practical skills and familiarity with prefabricated systems. Regulatory bodies need to update building codes and simplify approval processes to support modular practices. Additionally, government incentives can encourage local manufacturing of modular components, thereby reducing costs and dependence on imports. Architects and stakeholders should spearhead public awareness campaigns that highlight the design flexibility, speed, and sustainability of modular systems, addressing cultural resistance and client scepticism. By implementing these integrated efforts, we can empower architects as innovators and promote a

more efficient and resilient built environment in Lagos.

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