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Research Article

Evaluation of Building Professionals Perspectives on the Adoption of Container Architecture for Public Buildings in Nigeria

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Abstract

The adoption of container architecture for public buildings in Nigeria presents an innovative approach to addressing infrastructure needs, offering potential benefits such as cost-efficiency, modularity, and environmental sustainability; however, its implementation remains limited despite its documented advantages. This paper explores the perspectives of building professionals on the adoption of container-based construction for public projects in Nigeria to understand the factors hindering adoption and to recommend practical solutions. Employing a qualitative research approach, purposive and snowball sampling techniques were used to identify professionals with direct experience in container architecture. Data was collected through semi-structured interviews with six industry experts, and thematic analysis was applied to extract key insights. Findings reveal critical factors influencing adoption, including climatic factors, cost concerns, technical know-how, and general perception. The study also highlights the need for success stories, improved technical knowledge through experimentation, and increased public awareness to facilitate wider acceptance. The research contributes to the discourse on alternative building technologies by offering practical recommendations for integrating container architecture into Nigeria's public infrastructure sector.

Keywords: Container Architecture, Public Buildings, Building Professionals, Adoption, Sustainability

1. Introduction

As the quest continues for innovative and sustainable solutions to address the challenges of urban development around the world, container architecture has emerged as a viable alternative to conventional building methods Container architecture involves the use of repurposed shipping containers originally designed for the transportation of goods, as structural components in the construction of buildings due to their inherent durability, modularity, and portability. This has led to global attention on this innovative method over the past two decades due to its affordability, sustainability, and adaptability with applications ranging from residential housing and office spaces to retail outlets and public infrastructure. This architectural approach not only promotes sustainability through the reuse of materials but also allows for faster construction timelines and greater adaptability to diverse site conditions.

In Nigeria, container architecture is gradually carving a niche in the built environment, with increasing recognition of its potential to address pressing issues such as housing shortages, rapid urbanization, and limited access to affordable building materials. According to Abiodun the adoption of container architecture in Nigeria has gained traction over the past decade due to Nigeria's current state as a high import country [1]. Given this high influx of shipping containers and low export, a lot of these containers remain unused in ports across the country. While container buildings are more commonly observed in the private sector—particularly for residential and commercial purposes—their application in public infrastructure remains limited. According to Obia, container architecture has seen various adoption purposes range from site offices to residences and commercial spaces [2]. Projects such as the MadHouse Creative Hub at the University of Lagos and a few container-based offices in urban centres highlight the emerging interest in this innovative construction method. However, despite these promising examples, container architecture has yet to achieve widespread adoption for public buildings in Nigeria, such as schools, healthcare facilities, and administrative offices. Despite its potential benefits, container architecture has not yet been widely accepted for large-scale public infrastructure. The limited adoption of container architecture for public infrastructure in Nigeria raises important questions about its viability, acceptance, and scalability. Public buildings often require specific design considerations to accommodate large populations, ensure durability, and adhere to stringent safety and accessibility standards. These challenges are further compounded by the need to balance innovation with economic and environmental sustainability in the context of Nigeria's unique urban development landscape.

Given the slow growth of container architecture over the years in Nigeria, the perspectives of professionals in the built industry who have ventured into this area is critical to understanding and addressing the challenges that limit the potential of container architecture for public buildings in Nigeria. Architects, engineers, urban planners, and policymakers play pivotal roles in shaping the adoption of new construction technologies. Their insights into the feasibility, benefits, and limitations of container architecture can provide valuable guidance for its effective implementation on a larger scale, further expandingits benefits and sustainability. A study by found that the perceptions and critical assessments of designers played an important role in the performance of post-conflict housing schemes in Nigeria [3. Similarly, the works of all capture opinions of building professionals on the use of shipping containers and some enablers and hinderers of its application in the country [1,4,5]. Going by the above, it is important to further explore these perspectives in order to can help identify the key factors affecting adoption specifically in public buildings.

1.1. Aim and Objectives

This paper aims to explore the perspectives of built industry professionals on the adoption of container architecture for public buildings, to propose approaches for future applications of container architecture on a larger scale for sustainable urban development.

- To identify the factors affecting the adoption of container architecture for public buildings in Nigeria.
- To recommend solutions to facilitate the increased adoption and implementation of container architecture in public buildings.
- To explore the perspectives of built industry professionals on the prospects of container architecture for public infrastructure.

1.2. Literature Review

Container architecture, the practice of repurposing shipping containers for building construction, according to begin between the 1960s and 1980s when the first patents to convert shipping containers into habitable structures were first obtained by Insbrandtsen Company Inc and Phillip Clark in 1965 and 1989 respectively [6]. Since then, the building construction method has gained significant attention globally. According to the global shift of attention towards this architectural approach originated as an innovative response to the growing availability of decommissioned shipping containers and as an experimental solution to housing shortages, and has evolved into a mainstream approach for various applications, including offices, schools, healthcare facilities, and commercial spaces [2,7]. Shipping container architecture is recognized for its sustainability, adaptability to various building types, including residential, commercial, and public structures with several studies highlighting the benefits of container-based construction, such as resource efficiency, reduced construction time, modularity environmental sustainability and cost efficiency to mention a few [8-19].

In the Nigerian context, container architecture has been explored primarily for temporary structures, commercial spaces, and low-income housing [20]. According to due to increasing awareness of its benefits, there is a growing trend among designers beginning to explore the approach with companies like Tempo Housing Nigeria and Tin spaces are leading the charge in implementing the use of shipping containers for commercial and residential projects [21]. However, despite its growing popularity, the adoption of container architecture for public buildings in Nigeria remains relatively low. Existing research in the Nigerian context has identified the potential of container architecture to solve the housing deficit problem within the country and major cities like Lagos [1,5]. The works of highlight issues surrounding user perception, acceptability and challenges and enablers of the construction method in the Nigerian context. The works of assessed the viability of shipping container architecture as an alternative to conventional construction techniques as a means for catering to student housing [19,22].

These works are primarily underscored by themes such as user perception, acceptability and the significance of professional opinions in the adoption of alternative building technologies, however, a gap in methodology has been observed which this paper seeks to fill. Highlighted the opinion of the built industry professionals' attitudes toward container architecture using quantitative methods and primarily examining the use of the method for residential purposes [5]. A similar study examining container architecture as an alternative housing option was carried out by using a survey targeted at clients of a construction firm to understand their awareness and expectations from container housing [1]. Studied the use of containers as housing strategy for low-income earners in Nigeria [4]. The work of highlighted the opinion of the built industry professionals' attitudes toward container architecture using quantitative methods and primarily examining the use of the method for residential purposes [23]. Studied the potential of shipping containers as alternative material to traditional sandcrete hollow blocks and utilized surveys to harvest the opinions of Lagos residents on the potential for residential projects [19]. The work also made use of secondary data from an interview with a single professional in the construction industry to understand the advantages of the approach. Examined acceptability of shipping container housing amongst the residents of the Niger-Delta region of the country [24]. Studied issues surrounding users' perception through purposive sampling of respondents within specific middle-class demographics [21]. Explored the viability of container architecture as a solution to student housing surveying students of universities in the country [22].

While these works all highlight relevant issues such as perceived benefits and limitations, technical and structural considerations, regulatory and policy barriers, all the studies relied on quantitative methods and survey-based assessments often neglecting in-depth qualitative insights from professionals who have proven experience in the niche practice of container architecture. Additionally, the studies

also did not venture into the use of containers for public or large-scale projects which is an avenue to expanding the sustainability benefits of container architecture to the urban development of Nigeria. This study seeks to fill these identified gaps by taking a qualitative approach to understanding the opinions of professionals with proven experience in container architecture about its adoption for large scale/public projects.

2. Methodology

This study adopted a qualitative research approach to explore the perspectives of building industry professionals on the adoption of container architecture for public buildings in Nigeria. The qualitative approach is appropriate for this study as it allows for an in-depth exploration of expert opinions, experiences, and contextual factors influencing the adoption of shipping container architecture, that quantitative methods may overlook [25]. The qualitative approach is grounded in interpretivist philosophy, which emphasizes the subjective nature of human experience and the importance of context in understanding social phenomena [26].

A purposive sampling technique was employed to select building industry professionals who have direct experience in the design and construction of shipping container buildings. This strategy ensures that only individuals with relevant expertise contribute to the study, thereby enhancing the reliability of the findings. Additionally, the snowball sampling technique was utilized to recruit participants through professional networks and referrals, allowing access to a niche group of experts with specialized knowledge on container architecture [27]. A total of eight (8) respondents were to be interviewed in this study. This number is justified within the context of qualitative research, where the focus is on depth rather than breadth emphasizing the principle of data saturation. According to, data saturation, where no new themes emerge, can be achieved with as few as six to twelve participants in homogeneous expert groups [28]. Similarly, highlight that small but well-targeted samples are appropriate for qualitative studies focusing on professional expertise, as the depth of information obtained from experienced practitioners often outweighs the need for a large sample size [29]. Previous studies have indicated that qualitative research can achieve saturation with as few as five to ten participants, depending on the complexity of the topic and the diversity of perspectives within the sample. Given that this study targets a specialized group of professionals, eight respondents are deemed sufficient to generate rich, meaningful insights while maintaining feasibility [27]. Data was collected through semi-structured interviews, which provide flexibility in exploring key themes while allowing respondents to elaborate on their experiences and perspectives. This method is widely recognized for its effectiveness in qualitative research, as it enables a deeper understanding of complex issues and accommodates unanticipated insights [30,31,27].

Ethical approval was obtained prior to conducting the study. Participation was entirely voluntary, with respondents informed of the study's purpose and their right to withdraw at any stage. The names and personal identifiers of all participants were withheld to ensure anonymity and confidentiality. Interviews were recorded only after obtaining verbal consent from each participant. All audio recordings and transcripts were securely stored and accessed solely by the researchers for analysis purposes, maintaining strict data protection protocols. The data collected was analyzed using an inductive thematic analysis, an analysis method in which initial codes are inductively derived from the data, and themes are refined through iteration and constant comparative analysis [32]. This approach involved coding and categorizing responses to identify recurring themes and patterns relevant to the adoption of container architecture for public buildings.

3. Results and Discussions

A sample size of 8 interviewees for this study was determined and justified by existing literature. A total of 12 interview requests were submitted to companies specializing in container architecture, as well as known practitioners known to have worked on container architecture. Of the 12 requests, a total of 6 interviews were granted and conducted (75% of the sample size). The interviews play a crucial role in identifying the factors that hinder the application of container architecture to public buildings as well as determining solutions to these challenges. The interviews were carefully crafted to draw out detailed insights specifically from professionals in the built industry who have relevant experience in the use of shipping containers for the construction of habitable buildings. Below is a summary of the background information of the professionals interviewed.

S/N	PROFESSIONAL TITLE	YEARS OF EXPERIENCE	SCOPE OF CONTAINER PROJECTS
1	Structural engineer	18	3 Banking outlets
2	Architect	30	Office building, Creativity lab, Commercial offices
3	Architect	10	Office and Clinic
4	Structural engineer	10	Restaurant and short let
5	Architect	11	Outdoor bar
6	Civil Engineer	6	Banking outlets, large-scale urban market

Table 1: Table Showing Summary of Respondent Characteristics

The interview recordings were transcribed and analyzed to derive themes under the objectives outlined for the study.

1. Factors affecting the adoption of container architecture for public buildings in Nigeria.

a) Climatic Concerns

The most recurring theme under the challenges hindering the adoption of container architecture for public buildings in Lagos and Nigeria at large was concerns about climate, specifically mitigation of heat, a pattern that is noticeable through out literature. Four of the five interviewees brought up the need for thermal control and insulation as a major hinderance to the application of container architecture. Another common subtheme mentioned in three of the five interviews was water tightness. The second interviewee stated that due to the welding a joining of the containers, the structure is exposed to various weak spots that can lead to capillary action at various joints leading to leakages in the structure. This statement was also further corroborated by other interviewees to also be caused by piping and other mechanical issues

Interviewee	Direct quote
Interviewee 1	"Mostly we use containerized structures as a a makeshift building and it is not convenient for people to stay in because it is metal and metal attracts heat"
Interviewee 2	"containers are things that when you think about the sustainable aspect and you think about how hot things are in these parts and how you now have to insulate them" "Because when you stack containers, you have to make sure that the enclosure that is formed needs to be completely watertight. And a lot of people that have tried to dabble into container architecture that don't know about this always find out in the end, the hard way."
Interviewee 5	"typically, in our region, what we are bothered about is heat loss from the building, while in other regions, what they try to achieve is heat gain in their buildings.... So if you have a container building, or a container structure, you need to do a lot of insulation, walls, floors, and perhaps ceiling, to be able to make that container habitable"

Table 2: Table Showing Direct Quotes on Climatic Concerns

b) Cost Concerns

According to three of the interviewees, given the extensive need for insulation and other thermal control measures, the overall cost of construction can easily rack up to equal the cost of traditional construction also coupled with the need for some of the insulation materials being imported. Another reason for the cost concern is the further deteriorating economic condition of the country leading to shipping containers becoming more and more expensive.

Interviewee	Direct quote
Interviewee 1	"Okay, the most reason why people don't widely use a containerized structure is because of this factor. That it's a bit expensive"
Interviewee 2	"And you see what it is as well, is that cost, using containers is not necessarily a cheaper option. Yes, you have the containers that are formed and you already have the spaces from the containers. But when you do a cost analysis of using a traditional methodology of construction and using container, I wouldn't say that it's cheaper"
Interviewee 5	"As at the time I did my publication, that was in 20... I can't remember when, containers were more affordable, but now, the cost of getting a normal 40-feet container, I don't know how much it is, but I know it's quite outrageous.... because after you purchase the container, you have to basically transport it to your site, and then you now have to fabricate it, do your openings. And you know, for the way containers are, it comes in, it's designed... so cost is another issue"

Table 3: Table Showing Quotes on Cost Concerns

c) Construction Technicality

Construction technicality or technical know-how is a hinderance that is perceived by four of the five interviewees. As mentioned by the fifth interviewee, while the smaller scale projects leave room for experimentation with more manageable consequences, scaling up to the level of public buildings would require more precise and construction methods that are guaranteed to the work for the application. The second interviewee mentioned that this is important for the sake of reducing the perceived risk by the clients.

Interviewee	Direct quote
Interviewee 3	"Technicality, you know, it's specialized work kind of. In shipping containers, you can't just get a random person to come and work on it. It's specialist work. Those are specialist works and they are new. You have to imbibe some new technology, which so many of the artisans are not comfortable or used to those styles. You know, of course, already used to the conventional ways of working. So that's the first challenge, the technicality of it."
Interviewee 4	"Not many of these professionals really have so much experiences, you know, when it comes to container structures, you know. So, the number of professionals or technicians in that area are quite limited, you know. So, that could be a bit of a challenge."
Interviewee 5	"Okay, first of all, the technical know-how, because, you know, in our region, or rather in our country, the way we practice architecture, we are used to sand crates, mud, and burnt bricks, right? So anytime you have to bring a technology that is different from the usual, it becomes a bit of a problem, because the technical skill is not there."

Table 4: Table Showing Direct Quotes on Technical Concerns

d) General Acceptability

Acceptability is another common theme that came up during the interviews and across literature. As it pertains specifically to public buildings, the most noted perception is that most of the public sees container buildings as temporary structures, therefore the idea of applying container architecture for public buildings or more permanent structures is one that has not been explored enough or accepted by the general public. The second interviewee took this further stating that even the regulators also consider the structures as temporary structures.

Interviewee	Direct quote
Interviewee 1	"The thing is, there are no regulations because people see it as a temporary structure.
Interviewee 2	"But you don't really get a lot of people who want to use containers, you know, clients. So, you know, so a lot of projects haven't come along for us"
Interviewee 5	"And then thirdly, general acceptability of the container housing is an issue. Because there's this idea out there that container housing is cheap, and it's for poor people. Because you see how it's being used in our country."
Interview 6	'I think the educational part of it. So people are not aware of it and also the biases of, "oh, I cannot... you want me to stay in a shipping container", you know?

Table 5: Table Showing Direct Quotes on General Acceptability of Container Architecture

e) Logistics and Accessibility

Logistics and accessibility to the shipping containers is another concern shared by some of the interviewees. The first subtheme was ensuring that the containers are obtained legally and in sound quality as highlighted by the second, third and fifth interviewee. Another concern was that of transporting the containers to site and storing them while they wait to be installed. The second interviewee recounted a personal experience where a container was stolen from a work site. The theme of accessibility also extends to the procurement of other construction materials such as insulation and the heavy-duty equipment required for the construction of such structures.

Interviewee	Direct quote
Interviewee 1	"Another, some of the challenges are transportation, moving, transportation to the site and sitting it at the right place."
Interviewee 3	"Then secondly, for now, around here, the materials used are a bit scarce sometimes. Even the containers are scarce and getting expensive now. The containers are scarce and getting expensive"
Interviewee 5	And then, fourthly, which is also a key issue, accessibility, availability of the container. The containers are there, but to access them is a problem. If you look at statistics, for a long time, we know we import more than we export so we have a lot of containers coming into the country. And most times, these containers are reused to export, so we have a lot of them, but access them is a problem

Table 6: Table Showing Direct Quotes on Logistics and Accessibility

f) Size Constraints

Surprisingly, only two of the interviewees expressed great concern about the space constraints imposed by the standardized size of the shipping containers, although it was glossed over by every interviewee at some point in the interviews. Interviewee five expressed concerns over the habitability of such small sized modules while interviewee four expressed concerns about structural implications that may rise due to cutting and joining the containers.

Interviewee	Direct quote
Interviewee 4	"Because you can actually join the containers to suit. However, cutting the containers, especially the cladded parts, tend to reduce the load-bearing capacity from a structural point of view.... so, if for any reason you still want to stick to the containers, you would have to stiffen the structural framework of the containers. You also have to look into the headroom. You know, the headroom for a typical container is about 2.59. So, for most public buildings, that's not very suitable."

Table 7: Table Showing Direct Quotes on Size Constraints

2. Solutions to facilitate the increased adoption of container architecture in public buildings.

a) Climate-Sensitive Design

Seeing as climatic factors were considered by the interviewees as the biggest hinderance to the further adoption of container architecture for public buildings, it is not surprising to see that climate sensitive design is also the leading solution. This theme covers other subthemes such as the use of native materials as insulation as mentioned by the second interviewee, as well as use of passive design strategies to mitigate the adverse effects of the environment on the structure as mentioned by the first interviewee

Interviewee	Direct quote
Interviewee 1	"Another one is, look into, I think I mentioned that before. So, I mentioned that before. So, a sustainable design, a proper design. the climate and weather conditions and things like that. Weather conditions. Yeah."

Table 8: Table Showing Direct Quotes About Climate Sensitive Design

b) Increased Exposure and Experimentation

Another common theme found in every interview was the need for further experimentation to find more solutions suitable to our context. Two of the interviewees also mention the need for "success stories" of projects like this in shifting the public perception and existing narrative about container architecture in Nigeria.

Interviewee	Direct quote
Interviewee 2	"Well, like I said it's all about the exposure and experience that one has.... anything is possible... if we have the same entrepreneurial spirit in Nigeria, we might want to take it on."
Interviewee 3	"Maybe once people start using it, maybe some others will. For one, maybe once I get to a convenient point that I know that I can do that, I will probably do a container structure. Maybe a two-bedroom, three-bedroom. If you don't see examples, you won't think it's workable actually. Yeah."
Interviewee 5	"So for people to accept this and for it to be widely adopted, we need success stories. We need success stories. I mean, there are some containers, for your case, there are some container estates in Lagos I'm aware of., so the question now is, how many of these things can we have around to be able to convince people that this is good, that this can be adopted?"

Table 9: Table Showing Direct Quotes About Increased Exposure and Experimentation

c) Composite Construction

Interview three mentioned combining container architecture with other traditional methods of construction in a bid to complement the weaknesses of on with the strengths of the other. A specific reference made was the use of typical sand Crete block construction for the wet areas of the building, such as toilets

Interviewee	Direct quote
Interviewee 3	"So, that one is another aspect. So, some of the areas you don't want to use containers, you can actually clad it with some other material. And, it looks like the normal block work."

Table 10: Table Showing Direct Quote on Composite Construction

d) Concealing Containers

Interviewee three also suggested that finding ways to creatively conceal the containers and making them appear like conventional buildings might go a long way in making them more appealing, a statement that interviewee two doesn't necessarily agree with.

Interviewee	Direct quote
Interviewee 3	"So, that one is another aspect. So, some of the areas you don't want to use containers, you can actually clad it with some other material. And, it looks like the normal block work. If you're not told, you won't know. Yeah, yeah. You can make it look conventional. It serves the purpose.
Interviewee 2	"I don't like having it on the exterior of my containers. I like my containers to stay as containers. I don't like to hide them. They need to reveal what they are, you know."

Table 11: Table Showing Direct Quotes on Concealing Containers

e) Increased Prefabrication

Interviewee 5 suggested prefabrication as a solution to the storage and logistic challenges identified. While prefabrication is already an established advantage of container architecture, interviewee five suggested that in the context of public buildings, as much of the building as possible can be fabricated to ensure seamless and quick construction.

Interviewee	Direct quote
Interviewee 5	"So, I mean, if it actually was a real problem, you know. You do most of your prefabrications, you know, off-site."

Table 12: Table Showing Direct Quotes on Increased Prefabrication

3. Prospects of container architecture for public infrastructure.

When asked about their opinion on the future container architecture in Nigeria, all of the respondents showed optimism about its improved applications for projects with one of the interviewees expressly stating that he has personal plans to embark on a container-based project for his own use. All of the respondents emphasized the place of further experimentation and open-mindedness amongst designers and engineers, stating that the solutions to the problems being faced currently can only be solved with persistent trials. With regards to public adoption and acceptance, three of the interviewees emphasized the importance of "success stories" in shaping the way people think about container architecture as well as the possibilities of the construction method.

4. Conclusions & Recommendations

At its onset, this study sought to harvest the opinions of practicing professionals in the niche of container architecture in Nigeria about the adoption of this construction approach to public buildings. The study took a qualitative approach to dive into patterns, experiences, and opinions of these professionals to highlight factors that have hindered the application of container architecture to public/large-scale buildings as well as recommend solutions that can aid its adoption for such projects. Themes identified under challenges included Climatic factors, cost concerns, construction technicality, general acceptability, logistics and transportability, and size constraints.

To improve the application of container architecture and expand its sustainability benefits to public buildings, recommendations were tailored specifically for professionals in the built environment. Some of these recommendations included:

- Open-mindedness to the potential and possibilities of container architecture beyond temporary structures.
- Broadcasting of success stories of container projects to further sensitize the general public on its potential.
- Construction methods such as concealing the containers, composite construction and reliance on prefabrication were also highlighted as having the possibility to limit the factors that prevent the adoption of containers for public buildings.

In conclusion, the study presents the insights of professionals with relevant experience in container architecture to other professionals who may be skeptical about taking the leap, as well as emphasizing the need to research indigenous and experimental solutions to problems unique to the Nigerian context. Future research should focus on pilot container-based public infrastructure projects and comprehensive studies on user perception to provide empirical evidence that can further inform policy, public acceptance, and large-scale adoption in Nigeria

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