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Preamble

One of the most reputed mediums of exchanging the outcomes of research activities is the academic journal, and it is germane, as scholarship is about the creation and sharing of knowledge.

The reasons for the creation of the Construction and Human Settlements Management Journal (CHSMJ) include:

i. providing a unique record of scholarly activity in Construction and Human Settlements Management Journal while presenting an African perspective to the academic community;

ii. scholarly recognition it will bring to the Nelson Mandela University;

iii. creation and sharing of new ideas and knowledge which will contribute to the economic and cultural development of the built environment in South Africa, Africa and beyond;

iv. it will also support the goals of Nelson Mandela University by giving national and international recognition, further demonstrating the ability of the university to compete with other research agencies in the production of knowledge while also forming the basis of new collaborations between local, regional, or international researchers, research departments, and institutions.

v. the publication will help close the "knowledge gap" between the developed nations and the often-overlooked ideas, innovations, and discoveries from the African continent.

vi. the enrichment of the research areas of construction and human settlements management, and

vii. the Journal will, through the sharing of local knowledge and perspectives, make local research more visible throughout Africa and to researchers, students, and scholars globally.

Topics

The Construction and Human Settlements Management Journal covers the following topics, although it is not limited to these:

Construction project management; Project management; Design and construction management processes; Housing and infrastructure development; Stakeholder management; Project planning and project impact assessments; Design and implementation of labour-intensive projects; Procurement management; Management of construction companies; Industry development; Knowledge management in construction; Empowerment of women; Innovation; Human settlement development and management; Real estate development and management; Industry 4.0; Housing; Spatial planning; Project financing; Performance management in construction and projects; Human factors in construction and projects; Health, safety and well-being in construction and projects; Scholarship of Construction and Human Settlements; Current and emerging infrastructure issues in developing countries.

Access

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Editorial

Dear colleagues in the research community. We are delighted to present Volume 1 Issue 2 of the Construction and Human Settlements Management Journal.

In this Issue, Louis Nwachi unpacks the social, economic, political and physical elements that impact urban planning and argues that both formal and informal planning approaches have essential roles in sustainable urban development planning.

Edike *et al. i*n their paper on defects in in-situ and prefabricated housing units confirm that there are defects common to both types of building structures and suggest that a generic approach could therefore be devised and adopted to resolve the maintenance needs of both types of housing units.

Hassan *et al.* examined contractors' health and safety practices. They found that the practices employed in medium-risk projects did not observe prescribed health and safety protocols. They recommend that more attention should be paid to implementation of health and safety measures so as to improve health and safety risk management across project types and construction cycles.

Ebiego-Oselebe *et al.* argue that project success is a wicked problem with causes and solutions that defy common wisdom. They posit that current views of project success are potentially flawed by being skewed to take account of some stakeholders' perceptions over others. They suggest that the views of underrepresented stakeholders need to be brought to bear on an inclusive definition and understanding of project success.

The final paper in this issue by Yussuf and Diugwu investigated the effects of inadequate geo-technical design on project success. They established that inadequate geo-technical investigation and design impact project success adversely and results in cost and schedule overruns and inappropriate designs with expensive consequences.

The papers are available for download or onsite access at https://sbe.mandela.ac.za/Construction-and-Human-Settlements-Management-Jour

With warmest regards,

Winston Shakantu and Ayo Adeniran

Editors

The integration of formal and informal urban planning systems: A case study of Abuja, Nigeria.

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Abstract

Urban planning systems are complex systems of social, economic, political and physical elements in which all the elements impact and interact with each other. The urban planning system of cities varies by country and depends entirely on each country's formal and informal structures. This paper explores the formal and informal urban planning approaches in Abuja, Nigeria and how they interact with the urban planning system to achieve sustainable urban development. The purpose of this study is to investigate the effectiveness of these approaches. It was observed that places vary in their outlook depending on the primary considerations that underpin their development, which determined the effectiveness of each approach. Therefore, a city government needs to build an urban planning system that is relatable and responsive to evolving local needs. It also shows that for cities in developing countries to achieve an effective urban planning system, their urban planning approach needs to reflect local conditions and consider the public's cultural, social, economic, environmental, and institutional needs. Finally, it shows that both the formal and informal planning approach has an essential role in meeting these conditions.

Keywords: Cities, Urban, Planning, Formal, Informal.

1. Introduction

Urban planning systems vary in their origins, institutional arrangement, policy tools and personnel (Cullingworth, 1994); thus, different countries with different origins and governance have different urban planning systems. Urban planning systems should ensure that every socio-economic population group's economic, social, environmental, institutional, and cultural needs are considered (Okpala 2009). City governments need to build urban planning systems that are flexible and responsive to shifting local needs, improving living situations in local communities through sustainable urban development benefits (Awuah *et al*., 2014). The rapid rate of urbanisation in Abuja has reshaped the city's political, economic, spatial and environmental landscape (Lamond *et al.,* 2015). As one of Africa's most urbanised and diverse cities (Demographia, 2015), it is confronted with the development challenges to provide appropriate places, spaces, and economic and social opportunities for all residents (Lamond *et al.,* 2015). The urban planning system in Abuja has

evolved over the years since the 19th century from an informal planning approach where traditional rulers are responsible for governance to a formal planning approach governed by three tiers of government at different levels.

This paper aims to explore the different urban planning approaches in Abuja, Nigeria and how they interact with the urban planning system to achieve sustainable urban development.

2. Literature review - Abuja Urban Planning System

Formal urban planning in Nigeria began in the late nineteenth century with British colonial urban development activities (Home, 1983). The urban planning system was based on two local administration structures, subordinate to the colonial government. First was a local administration structure based on the indirect rule system, which relied on the Native Authorities and Native Treasuries through the traditional chiefs responsible for the native communities. The other was a structure of townships and municipal administrators, supervised by colonial administrators responsible for colonial urban areas, European residential areas, and non-European reservations (Home, 1983). The native areas maintained their indigenous planning system, while the colonial urban areas planning system was based on British urban development standards and provided the requisite infrastructure (Mabogunje, 1990).

The approach to urban planning in Nigeria evolved when the Town and Country Planning Ordinance No. 4 of 1946 sought to promote Great Britain and her colonies (Ogu, 1999). In 1978, the Land Use Decree (LUD) was passed, and became the basic framework for land administration in Nigeria (Butler, 2009; Aluko, 2011; Adeniyi, 2013). The Urban and Regional Planning Decree 1992, which allocated urban planning and development control to the country's three-tier governmental structure, was established (Federal Republic of Nigeria 1992). The National Urban Development Policy was also formulated in 1992 (reviewed in 2004 and 2012) to promote a dynamic system of urban settlements which fosters sustainable economic growth, promotes efficient urban and regional planning and development, and ensures an improved standard of living and well-being of citizens (Lamond *et al.,* 2015). Falade (2012) argues that the combined effect of the Land Use Degree and the Urban and Regional Planning Decree is to make the federal government responsible for planning at the national level, while the state and local governments are responsible at the state and local levels as shown in Figure 1 (Aribigbola, 2007; Ikejiofor, 2009; and Falade, 2012).

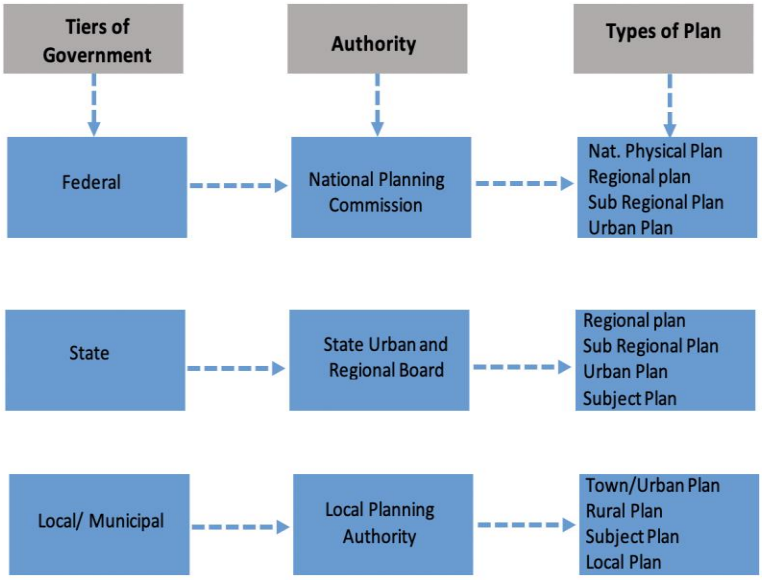

Figure 1: Diagram showing the Nigerian urban planning system (Source: Falade, 2012)

2.1 Governance in Abuja Urban Planning System

Governance in Nigeria involves diverse actors who share the responsibility to govern and exercise power through various instruments through both formal and informal structures. The formal structures consist of the three tiers of government, and the informal structures include the traditional and local heads, as shown in Figure 2 (Adeniyi, 2013).

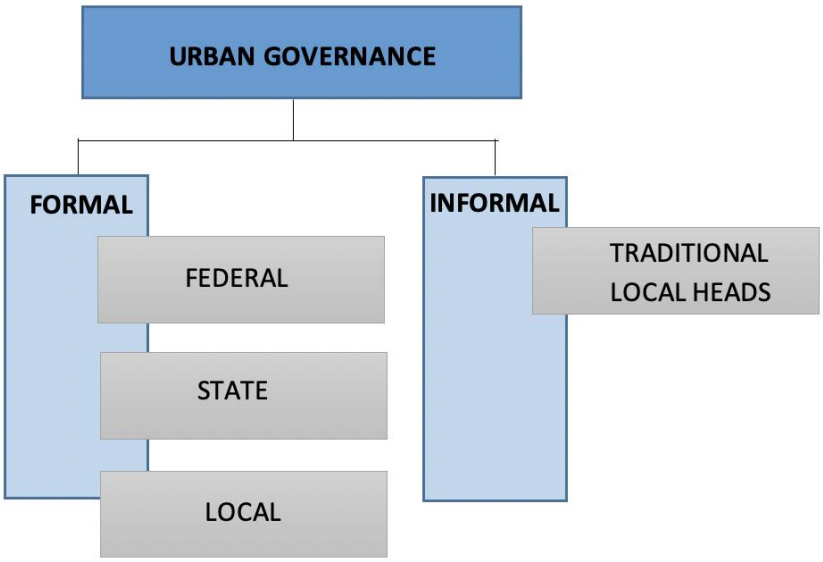

Figure 2: The different governance structures in Nigeria (Adapted from Adeniyi, 2013).

In Abuja, Nigeria, the outputs of governance within urban planning systems are a product of many interacting forces resulting from FCT city administrators and the citizens (Adeniyi, 2013). Adama (2012) suggests that the significant problem of governance in Abuja is the lack of citizen participation, social governance, and transparency which must be addressed before good governance can be achieved. In contrast, Lamond *et al.* (2015) contradict Adama's assertion by noting that Nigeria's current urban development and governance initiatives have sought to promote integrated approaches to urban planning with relevant urban sector stakeholders. The primary policy that affects urban governance in the Abuja urban planning system is the National Urban Development Policy. This policy states the goals, objectives, and strategies for sustainable urban planning and development. It also recognises the role of multiple tiers of government in promoting effective urban development and sustainable human settlements, as well as providing for the autonomy of the three tiers of government in discharging their roles under the policy provisions (Lamond *et al.,* 2015).

The Role of Formal Institutions

The federal government is positioned at the top of the urban governance structure in Nigeria with the role of setting the development trajectory for the country, taking account of developmental challenges, and identifying enabling policies to be pursued and realised through state and local government initiatives (Lamond *et al.,* 2015). Nigeria has thirty-six states and a Federal Capital Territory (FCT, Abuja), with 774 local government areas (Otegbulu, 2013). The Second Schedule of the 1999 Constitution highlights that most powers accorded to the states is exercised concurrently with the federal government (Lamond *et al.,* 2015). The National Urban Development Policy stipulates that all local and city governments shall be encouraged to act within the FCT Urban Development Policy context and establish a city Planning Authority (FCDA) to prepare and adopt requisite plans. The National Housing Policy (2012) directs that the roles of the local and city governments include: providing residential site and service layouts; maintenance of urban infrastructure and environmental sanitation; delivering urban planning needs (in partnership with government agencies and private sector companies) (Lamond *et al.,* 2015).

The Role of Informal Institutions

From the pre-colonial era, through the colonial era and on to the post-colonial eras, the traditional institutions in Nigeria have gone through many political changes (Myers, 2011). The political status and influence of local and traditional institutions and leaders have decreased since the early 1960s after Nigeria gained independence. This has had far-reaching consequences for governance and administration in the country (Otiti, 2015). These local and traditional institutions are local and indigenous structures headed by a community leader who controls the local community's norms and

activities. Their positions are sanctioned by their respective peoples' traditions, history, and culture, who hold them in high esteem and reverence (Otiti, 2015). Ikejiofor (2009) highlights that the importance of these informal institutions is to preserve the customs and traditions of the people and manage conflicts arising between community members by the instrumentality of the laws and customs of the people. Traditional institutions are the custodians of their people's norms, cultures and practices. They symbolise indigenous peoples' rights, privileges, laws, customs, and traditions, including paramount rulers and councils (Boege, 2006). Boege notes that some informal institutions are charged with legislative, executive and judicial functions. They make laws, execute them and interpret and apply the fundamental laws, customs and traditions of the people for the smooth running of their communities (Boege, 2006).

It is important to note that what is suitable in one community may not be in another since Abuja, Nigeria, is a multi-ethnic and multi-cultural society (Myers, 2011). In addition, Boege (2006) argues that traditional approaches vary considerably from society to society, from region to region, from community to community and that, therefore, traditional leaders need to develop a system that suits their community.

The Planning Process in Abuja Urban Planning System

Cities vary in their outlook depending on the primary considerations that underpinned their development (Ogu, 1999). Abuja's urban planning process is determined by the political, socio-economic and cultural considerations in Nigeria's urban planning system (Arimah and Adeagbo, 2000). Abuja is a planned city and mainly uses a formal urban planning process structured and controlled by the relevant urban planning authorities (Abubakar, 2014). However, a few informal urban planning processes can be seen around some areas within the FCT, especially in rural and squatter settlements where particular socio-economic conditions or cultural norms pertain. It is believed that, with an integrated approach, the potential of both the formal and informal urban development and management models could be harnessed, and their unsuitable aspects discarded (Lamond *et al.,* 2015). Formal urban developments in Abuja are developed through formal land administration, urban planning and governance processes. The Federal Capital Development Authority (FCDA) are the main body stipulated by law responsible for carrying out the planning processes in Abuja. The urban planning process consists of five sub-stages, which do not necessarily run sequentially. As shown in Figure 3, these stages identify the plan's objectives, design, development and implementation, monitoring and inspection and, finally, management of the plan. Falade (2012) observes that Abuja's typical urban planning approaches and governance have suffered significant constraints due to lack of continuity, but it remains a

formidable way of achieving urban development.

Informal urban planning processes can also be seen around a few areas within the FCT. In contrast with the formal urban planning process, the informal urban planning process is usually located in rural areas and squatter settlements (Lamond *et al.,* 2015). For some community or rural projects, the urban planning process starts with the local head or leader identifying a particular project to be executed in consultation with the native clans. Then, they designate a person or group of persons responsible for planning and monitoring the plan from start to finish (Ikejiofor, 2009). The practices adopted to deliver the development sometimes involve the assistance of private developers or public officials, either legally or illegally. In some cases, the landowners engage their surveyors and planners who survey and plan their lands for allocation or sale (Ikejiofor, 2009).

In formal urban planning processes, most plans are developed with infrastructure and services. Informal urban planning processes lead to developments that are perceived to be unplanned and lack the necessary infrastructure and services (Rakodi, 2006). This lack of official recognition leads to a lack of development control, frequently resulting in the development of sub-standard infrastructure and the breach of planning regulations (Rakodi, 2006). Informal planning and its processes in Abuja are often criticised as a nuisance (Abubakar, 2014). However, the UN-Habitat Report (2014) suggests that these developments constitute the more significant proportion of all urban planning in Abuja and provide the main housing and service accommodation source. Some informal planning projects and developments in Abuja are well laid-out, are covered by some form of the urban planning scheme and have connections to basic infrastructure and services. This is achieved when the community, in conjunction with public officials, plan the project. It is estimated that between 50 per cent and 60 per cent of rural and squatter settlement developments in Abuja are supplied through this system, and it serves as the central avenue for the urban poor to access land for development (Abubakar, 2014).

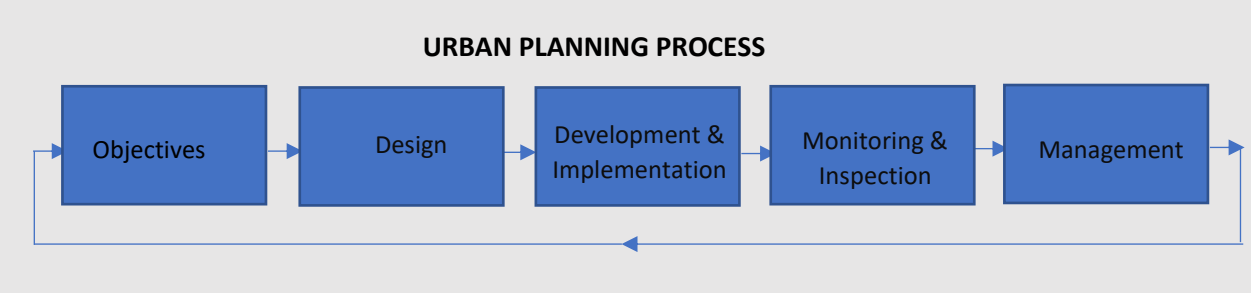

Figure 3: The plan-making process in Abuja (Adapted from FCDA, 2018)

The approach towards urban planning in Abuja from the early 2000s has been dependent on public-private-partnership (PPP) initiatives (Ukoje and Kanu 2014). PPP initiatives in the plan-making process allow the community power structure to be determined by the local inhabitants, businesses and groups (Odemigwe, 2014). Here

informal institutions and local inhabitants are involved as stakeholders in the participatory process through which they are informed about the proposed plan and involved in the consultation process (FCDA, 2018). In addition, local businesses and indigenous groups collaborate with the government to develop urban plans for the community. Amber (2010) argues that this participation process is essential for urban development, but more needs to involve the public in the decision-making process.

Abubakar (2014) highlights that the city's urban development strategies and approaches are no longer defined for a specific population or land area due to this new participation initiative. Instead, the local planners and the public plan urban development in Abuja to provide a range of housing alternatives within the framework of service and transportation systems and specified residential densities (Abubakar, 2014). In addition, activities and facilities that promote social inclusion in each neighbourhood, such as schools, hospitals, kindergartens, shopping centres, parks etc., are included in the urban plans (Abubakar, 2014). This urban planning concept is in-line with the envisaged city structure, based on creating hierarchies of development that serve as the main framework for organizing social and economic activities (International Planning Associates, 1979).

3. METHODS

This study employed a mixed-method approach, driven by the pragmatic ontological position adopted by the researcher. It used both qualitative and quantitative methods to collect and analyse data. It draws from all the reasons identified by Creswell *et al.* (2011) to create an appropriate synergy for the research.

3.1 Sampling Strategy

The probability sampling technique was used on the quantitative data in this study because the researcher had little or no control over who was presented for selection. Information about the urban planning system in Abuja municipal, FCT, Nigeria, was obtained during the first data collection phase, as shown in Figure 4. A simple random sampling of 100 participants was drawn from the local urban planning authority in charge of the Abuja municipal (Abuja Municipal Area Council) and the state urban planning authority in charge of the Abuja Federal Capital Territory (Federal Capital Development Authority) from a total staff complement of approximately 400 officials. The authorities were considered in order to present an overview of the urban and regional planning system in FCT, Abuja, Nigeria.

Non-probability sampling was used in obtaining qualitative data for this research. Here the controlled selection of participants was not a critical factor because it was purposeful to capture

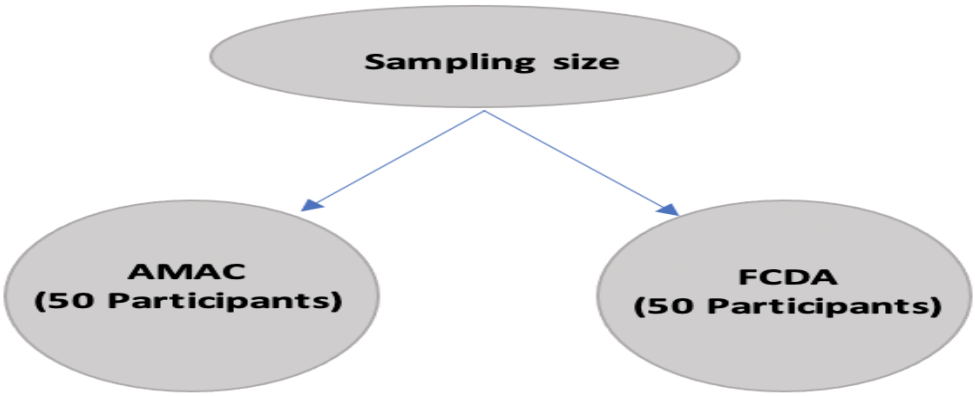

Figure 4: Author's adaptation of the probability sampling size for the research.

the qualitative elements of the research.

The participants were selected based on their knowledge of the urban planning system and their ability to supply information relevant to the research objectives. Semi-structured face-to-face interviews were used to capture the data. A purposive non-probability sampling technique was used to select 33 participants from different sectors in the urban planning system, ranging across politicians, administrators, professionals, academia, developers, and civil society. This approach helped ensure a general representation of the overall stakeholders involved in the urban planning process. Four Politicians/legislators and ten local administrators from the urban planning authorities in charge of the Abuja metropolitan area and environs were selected. In addition, nineteen stakeholders involved in the urban

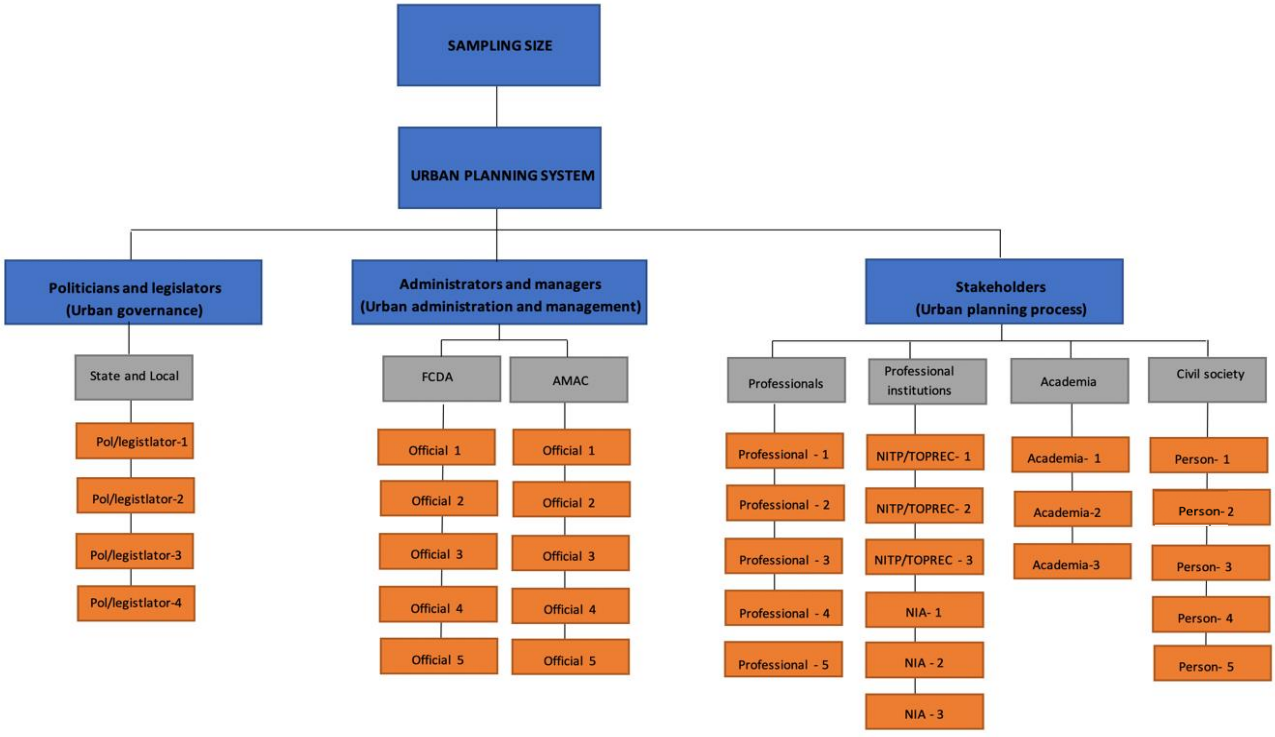

Figure 5: Non-probability sampling size for the research adopted by the Author

planning process were selected. These were drawn from a range, including professionals from different sectors, developers, academics and civil society (see Figure 5).

The sampling framework included the creation of strata or groups of relevant and related respondents. It was intended that a reasonable number of respondents with a good knowledge of the research area would be chosen from each stratum. The smaller number of respondents in the civil society group reflected the limited number of private individuals or civil society groups who were knowledgeable of the research area and the Abuja urban planning process. Denscombe (2007) argues that this sampling method is primarily used when a limited number of people or institutions have expertise in the area.

4. Results

Effectiveness of the Abuja plan-making process

The plan-making process in the study area can either be carried out formally or informally. Which approach is taken is dependent on the political, socio-economic and cultural consideration of the particular area of the city to be planned (Arimah and Adeagbo, 2000). This section of the research only presents the effectiveness of the Abuja formal urban planning process since most of the city's urban planning uses a formal approach (Abubakar, 2014). It also presents the quantitative data used to support the findings.

Quantitative Data Presentation for the Effectiveness of Abuja Plan-Making Process

The purpose of this section is to use the quantitative data to capture the effectiveness of the Abuja plan-making process as it relates to goal and problem identification; Plan-making; Design and development; Implementation; and Management. The questionnaire responses were evaluated based on an ordinal scale (Likert scale 1-5) to measure the effectiveness of the Abuja plan-making process.

The goal and problem identification stage in the urban planning process involves the identification of the goals of the proposed policy, plan or project (FCDA, 2018). The quantitative findings show that most respondents suggest that this stage in the urban planning process is moderately effective (33.3%). However, it was also seen that 17.8% of the respondents highlight that it is highly effective, while about (28%) feel that it is slightly or not an adequate stage.

The plan-making stage involves policy, plan or project creation in-line with the objectives set in the first stage of the plan-making process (FCDA, 2018). The survey data show that under 50% of the respondents believe that the plan-making stage is moderately or highly effective. However, a significant number of respondents (23.3%) consider it only slightly or ineffective.

Plan design and development in the urban planning process are carried out in the second and third stages. This stage entails realising an idea

into a plan, project or policy (FCDA, 2015). The analysis shows that most respondents (56.7%) see it as a highly effective or moderately effective stage. This indicates that the design and development stage has the highest level of effectiveness when compared to other stages in the urban planning process. On the other hand, only 13.3% considered this stage slightly or ineffective.

The implementation and enforcement stage recorded the lowest level of effectiveness when compared to other stages in the Abuja plan-making process. This stage involves the implementation of plans and policies developed in the plan-making and design stage (FCDA, 2015). As shown in Figure 6, 51.2% of the respondents believe that the implementation and enforcement stage in the plan-making process is less than moderately effective. Only 14% of the respondents consider this stage to be highly effective.

The management stage is usually the final stage in the plan-making process of most urban planning systems. It entails setting out strategies to maintain and manage processes and resources at all stages (FCDA, 2018). From the survey data, 9% of the respondents feel that it is not an effective stage, while 20% suggest it is a highly effective stage as indicated by most respondents.

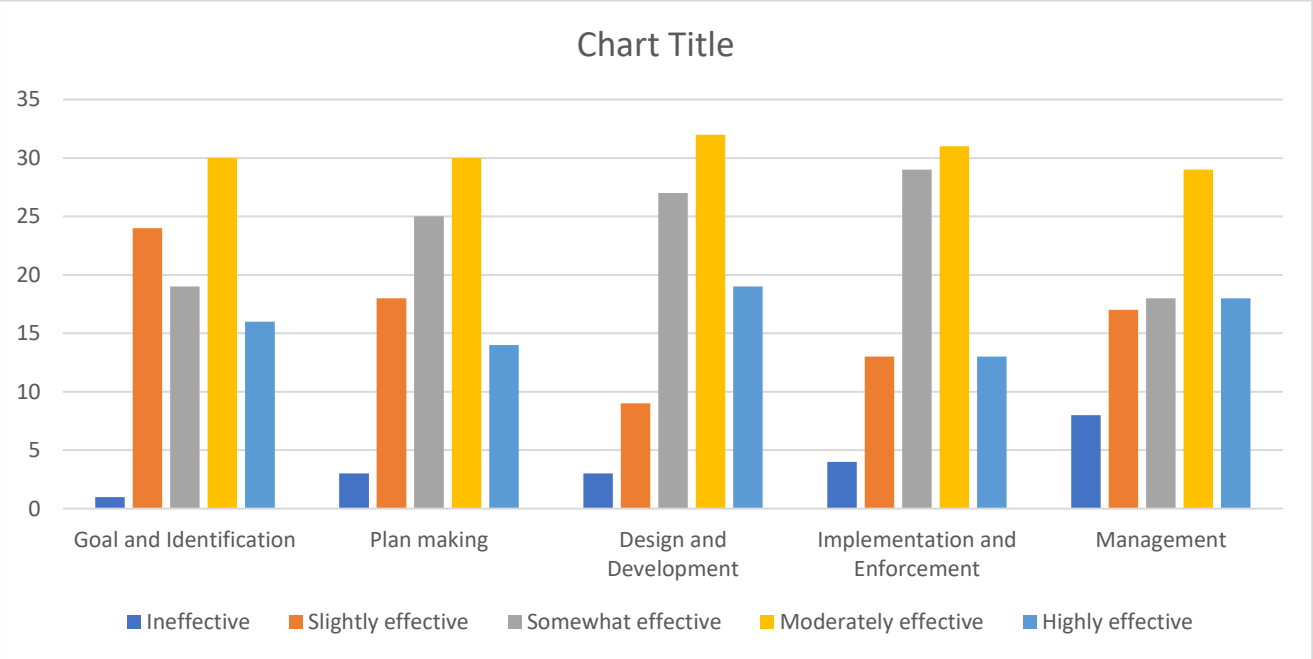

Figure 6: The level of effectiveness of Abuja Urban Planning Process

Opinions of stakeholders on the effectiveness of the Abuja plan-making process

This section considers the stakeholders' views on the effectiveness of the Abuja urban planning process. From the semi-structured interviews, most legislators and urban administrators indicate that the urban planning process is effective by highlighting that it involves an

inclusive process. They note that the urban planning process involves the public, the traditional leaders, and the local indigenes of Abuja who are directly affected by the proposed plan through stakeholders' consultations and meetings. They argue that the government encourages an inclusive process that involves the public and the developers as part of the urban planning process.

They also highlight that public contributions in the urban planning process are essential in making the plan more effective and efficient. In addition, their involvement makes the plan more acceptable. Through an inclusive process, different stakeholders and professionals are allowed to make contributions, which increases the likelihood of producing an effective and acceptable plan.

Despite the majority of legislators and urban administrators highlighting that the urban planning process of Abuja is effective, a few of the urban administrators suggest that the plan-making process is ineffective and weak. They observe that this ineffectiveness in the urban planning process is a result of the influence of the colonial urban planning system on Abuja's system, which does not fit the lifestyle and culture of the inhabitants of Abuja. Furthermore, they consider that the ineffectiveness of the Abuja urban planning process is because of the political and sentimental nature of governance in the city. They argue that the political process is usually biased and influenced by personal or inter-group gain. This is to say that the actions and policies of politicians and urban administrators in the city are usually driven by their interest or cultural and ethnic group's interest rather than in the overall interest of the city.

The majority of the academics, professionals and members of civil society contradicted the opinion of the majority of the urban administrators. They saw the urban planning process as being ineffective. They say the urban planning process is ineffective because most of the plans in the study area are 'imported' and do not address specific urban planning challenges in the city. The respondents note that these imported plans do not fit the way of life of the inhabitants of the city. They also suggest that the city's urban planning system is alien to the people and not in harmony with the local and indigenous pattern of the urban dwellers. This implies that most urban dwellers in the city are not engaged with the existing urban planning system because it does not fit their lifestyle.

One urban planning professional described the urban planning process as 'frozen music', which does not encourage local and cultural inclusion. The respondent notes that the urban planning process is an avenue to promote social planning where the dwellers and the local public, along with the relevant professionals, are involved in plan-making. However, he emphasised that this has not been the case in the study area. The respondent also concurred with the academics, professionals and members of civil society that the existing plan-making process in Abuja discourages interaction and

neighbourliness because of the foreign style of planning currently embedded in the urban planning system. As a result of this, the public does not fit into the majority of the plans developed by the government.

Most of the academics, professionals, and members of civil society highlight that most of the civil society process in Abuja is obsolete and does not align with best practices around the world. They believe that the Abuja urban planning process employs a top-down approach, where those in authority and a few urban planning professionals are responsible for making the plans. They also note that the level of implementation of most plans in the study area has been poor due to the public's lack of involvement in the urban planning process. They reveal that it is essential that the government provide an equitable platform for the public to be fully involved in the plan-making process from the 'plan initiation' to the 'plan implementation'.

The academics, professionals and members of civil society also state that the urban planning process has stagnated and deviated from its original purpose. They highlight that this stagnation in urban development is due to the rapid increase in population in the city, which has risen to more than twice its estimated rate. Furthermore, they observe that the city's urban fabric has not evolved accordingly despite the increase in population, putting existing infrastructure under stress.

Some of the respondents from the semi-structured interviews note that plan implementation is a significant challenge in the Abuja urban planning process. They see plan implementation in Abuja as a fundamental process. They stress that plan implementation supersedes all other plan-making processes. No matter how good a plan is, it becomes irrelevant when not implemented. However, they argue that it has been a weak and poor process. They suggest that the political and governance system in the city discourages plan implementation as a result of continuous changes in government ministers and administrators in most urban planning authorities. They also note that, for Abuja urban planning system to be effective, it is essential for the city to be governed by someone knowledgeable on the built environment, rather than someone from an unrelated profession.

The respondents also noted the effects of political instability and the lack of continuity in governance as a factor that affects effective urban planning in the city. They highlight that changing from one policy to another discourages effective planning. They also argue that these changes can hinder achieving the plan's primary objectives. However, the government must embrace continuity and ensure that new or incoming governments understand and promote existing plans and policies.

Comparative data analysis on the effectiveness of Abuja Urban Planning Process

Generally, the quantitative findings show that the urban planning process of the Abuja urban planning system is moderately effective across the

different stages. However, the qualitative data varied across different stakeholder groups in the urban planning system. The quantitative findings seem to support the opinion of the majority of the politicians and administrators, who feel that the urban planning process is quite effective. However, the quantitative data contradicts the majority of academics, professionals and civil society representatives, who suggest that the urban planning process is weak and ineffective.

It was also noted from the quantitative data that the implementation stage of the urban planning process has the lowest number of respondents who feel it is highly or moderately effective. This was highlighted by most of the respondents from the semi-structured interviews who were agreed that the major challenge with the Abuja urban planning process is the ineffectiveness of the implementation stage. This suggests that, despite the different opinions of the respondents from both the questionnaire administration and semi-structured interviews on the effectiveness of the Abuja urban planning process, there is a consensus that the implementation stage is the least effective aspect.

5. DISCUSSION

Formal Urban Planning Systems in Developing Countries

The literature shows that the theories and practices of urban planning in most urban planning systems worldwide have changed over the years from a spatial and development-oriented approach to an institutional, policy-driven and communicative one. (Ozgur, 2012). This new concept is based on participation, collaboration, learning and consensus-building. However, it was observed from the literature that most formal urban planning systems in developing countries are still reliant on Euro-centric colonial-type master planning systems (AAPS, 2010). The literature shows that this style of planning has not been effective in meeting the needs of people in these countries (Kamete, 2013). It encourages socio-economic exclusion and fails to come to terms with the livelihood realities of the majority of the public by zoning and segregating places according to socio-economic group and class (Jiroko, 2008; Kameta, 2013)

The broader changes in spatial planning systems, based on participation, have not been fully adopted in the study area. It is also clear from the interviews carried out for this research that those involved in, and affected by urban planning in Abuja, believe that Nigeria's maintenance of the colonial pattern left by the British government has affected the way Abuja was planned. The findings confirm that the Abuja urban planning system remains a top-down approach that does not emanate from the people. This has resulted in social segregation and a lack of citizens' involvement in urban planning. Furthermore, the findings show that most of the policies and plans in the study area tend to reinforce the existing social gap. Due to this, the most vulnerable and the socially excluded who barely have

the means to live often become victims of ineffective urban planning. Respondent XXVII neatly encapsulates this finding:

> *"I will say that we haven't reached a very good planning process in Abuja because of the nature and the type of planning system that has been existing. Nigeria has maintained the colonial pattern left by the British government. The issue of participation in Abuja is still very very low, in that planning is removed from the people due to the planning system that has been operated. … And that is why you get destabilisation of communities into socio-economic groups. (Respondent XXVII)"*

The essential items of policy and legislation affecting the study area are the National Urban Development Policy (NUDP) (1992), revised in 2012, and the Land Use Act of 1978. The NUDP outlines the goals, objectives and strategies for sustainable urban planning and development. It also specifies the role of the various tiers of government in promoting effective urban development and sustainable human settlements, and it provides for the autonomy of the tiers of government in discharging their roles under the policy provisions. This policy appears to support and embrace the new concept of urban planning, where urban planning policies are based on participation, collaboration, learning and consensus-building.

However, this inclusive policy approach is not supported by the Land Use Act policy of 1978, which plays a significant role in most urban planning in Abuja. The Land Use Act policy is still reliant on the old colonial concept of planning where the rights of occupancy of all land and development are controlled by the government, which is responsible for final decision making in land-use policies. Most interview respondents from the study area suggest that these policies should be modified to reflect an inclusive urban planning approach that takes cognisance of the people's way of life and the different socio-ethnic and cultural groups in the society.

Informal Urban Planning Systems in Developing Countries

The literature shows that colonial urban planning approaches have destroyed developing countries' informal and traditional planning approaches by employing land-use zoning divisions that segregate formal urban areas from informal settlements (Ogbazi, 2013; Oyesiku, 2004). The research provides an insight into this in the study area and reveals that the informal urban planning system practice consists of local and traditional institutions headed by a community leader that controls the norms and practices in such a community. The literature holds that traditional institutions symbolise indigenous peoples' rights, privileges, laws, customs and traditions, which may be charged with legislative, executive and judicial

functions (Boege, 2006; Ikejiofor, 2009). In addition, they help preserve the customs and traditions of the people and often manage conflicts arising among community members (Boege, 2006; Ikejiofor, 2009).

The research shows that the informal urban planning systems in developing countries are guided by a traditional approach, starting with the traditional leaders identifying a particular plan or project to be executed in consultation with the native clans. These systems engage with the people and usually designate a group of persons within the locality who will be responsible for planning and managing a plan or project. Furthermore, these plans or projects are usually community-led so that the public will see and accept the plan as their own. Surprisingly, this inclusive approach seems to be in harmony with best practices in urban planning systems around the world, where public engagement and consultation are essential in developing sustainable solutions that meet the needs of the public, as illustrated in the literature (Healey, 2006; UN-Habitat. 2014; Cilliers, 2014; Hopkins, 2001).

However, the literature indicates that most traditional planning practices in developing countries are non-existent in urban centres (Otiti, 2015). Instead, these urban centres are driven and guided by the new formal institutional governance approach rather than by the old informal, traditional practices. This is evident in Abuja's case study area, where local and traditional heads' political status and influence have decreased significantly in recent years (Otiti, 2015).

This was corroborated by most of the respondents in the study. They generally agreed that urban planning institutions and urban planners in the study area had disregarded the informal sector, and in so doing, have disregarded the traditional institutions and way of life of the urban dwellers. 'Pseudo-urbanisation' is the new norm in the city where the public struggles to meet the new challenges of the formal urban planning system. Here, they tend to modify their traditional way of life to accommodate the new urban lifestyle, resulting in the destabilisation of the traditional fabric of the society.

The findings show that informal urban planning practices still exist in a few areas within the study area, especially around the city's fringes and in rural and squatter settlements. This is due to the socio-economic situation (low standard of living) or cultural norms (beliefs and way of life) that still apply in such areas. These areas are often criticised as a nuisance and are perceived to be unplanned because they lack infrastructure and essential services. However, the findings show that informal urban planning practices constitute a more significant proportion of all urban developments in the city. Critically, they are the primary source of social inclusion outcomes (such as housing in the city). This was evident in the study area, where informal settlements play an essential role in providing more than 50% of urban development in the city. They also serve as the principal avenue for the urban poor to access land for housing and development in Abuja.

Implications of Combining the Formal and Informal Urban Planning Approach

The literature indicates that for urban planning systems to be effective, the plan-making process should be of efficient scope, related consequences of actions, and use formal and informal institutions to deliberate and make choices (Hopkins, 2001). In addition, the plan-making approach must reflect local conditions, and the formal and informal way of life, in sustaining the livelihoods of local people in developing countries (UN, 2013a; Okpala, 2009). Okpala (2009) suggests that for a society to achieve effective plan-making processes, the urban planning systems need to reflect a new awareness that holistically integrates all of its components to meet environmental, social, economic and governance needs.

The findings show that the plan-making approach in Abuja combines the formal and informal urban planning approaches. It includes a diversity of actors, which involves the formal structure consisting of three tiers of government and the informal structures consisting of the traditional and local heads. They share the responsibility to govern and exercise power through various instruments. However, combining these two approaches has been challenging due to the reliance on the formal (Euro-centric and colonial) plan-making approach. This diminished the relevance of the informal plan-making approach and, ultimately, led to the development of the NUDP (2012), which aimed to modernise the old system and make it more relevant to the country's socio-economic and cultural needs. The policy's main goal was to promote a dynamic system of urban settlements that fosters sustainable economic growth, promotes efficient urban and regional planning and development, and ensures an improved standard of living and well-being for the public.

Interestingly, the NUDP has the potential for both the formal and informal plan-making approaches to be harnessed and their unsuitable aspects discarded to become mutually beneficial to developing a sustainable plan-making approach. This is because this policy initiative promotes an integrated approach to plan-making, emphasising participation and inclusion of all the different socio-economic and cultural groups in society.

The research highlights the need for developing countries to promote traditional practices where they exist or can be re-developed. It also suggests that effective public participation of different socio-economic and cultural groups encourages an integrated approach that embraces both the formal and informal plan-making structures.

6. Conclusion

The literature indicates that most urban planning systems worldwide have shifted from a spatial and development-oriented approach to a policy-driven and communicative approach based on participation, collaboration, learning and consensus-building. However, it was seen from the research that this

shift had not been reflected in most cities in developing countries because colonial-type master planning systems still guide them. These systems encourage socio-economic exclusion by segregating places according to socio-economic and socio-cultural groups and class. The research shows that for cities in developing countries to achieve effective urban planning practices, the urban planning framework needs to reflect local conditions and consider the public's cultural, social, economic, environmental, and institutional needs.

The research also shows that the informal urban planning systems and institutions still influence formal urban planning decisions in these cities. Despite informal urban planning practices being criticised as nuisances and perceived to be unplanned, they still provide the highest social inclusion outcomes in these cities. The research suggests that for urban planning systems in cities in developing countries to be successful and effective, the urban planning process should be sufficient to use formal and informal institutions to deliberate and make choices. Therefore, it is essential to promote an integrated approach to urban planning that embraces both the formal and informal systems and structures.

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Defects in prefabricated and in-situ constructed buildings

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Abstract

The problem of housing maintenance has been an inherent issue in Nigeria, with structures getting defective to the point of uncomfortable living and even building collapse. With Nigeria being relatively behind on maintenance practices, the need to acquire and improve knowledge on housing maintenance cannot be overemphasised. This study investigated defects and maintenance challenges associated with prefabricated and in-situ constructed buildings to remedy Nigeria's housing stock. The study was conducted in Ministerial Quarters, Abuja, and the data collection instrument was a structured questionnaire administered to the study area residents on a one-on-one basis. The survey resulted in 64 valid responses. Descriptive statistics and Mann Whitney U Test Rank were used to analyse the data. The study found that both in-situ constructed and prefabricated buildings have some common defects, but the severity varies. Common defects found in both buildings include cracks, fading, and peeling wall paints. The variation in the ranking of defects was demonstrated in all 20 defects presented in the study. However, the variations did not amount to significant differences in the overall occurrence of the defects in both building types. The study recommends that the selection of a generic approach could be adopted in the maintenance of in-situ constructed buildings and prefabricated buildings. Also, a comprehensive approach should be adopted to maintain residential buildings by having an outlined maintenance itinerary for various buildings.

Keywords: *Building defects; Building failure; Housing problems; Nigeria; Occupants*

1. Introduction

The issue of building maintenance is a longstanding and complex problem for the Nigerian populace and the government. Some residential buildings in Nigeria are fraught with maintenance issues, resulting in varying degrees of deterioration and eventual failure, including buildings collapse. Despite advanced technological developments, buildings still suffer from defects caused by workforce errors, inadequate design and deterioration, which promotes maintenance during the life cycle of the buildings (Cardellicchio 2021, Gurmu *et al.*, 2020, Lawal *et al.,* 2017).

BS EN 13306 describes maintenance as the combination of all administrative, technical and management measures taken during an item's life cycle to keep it in or return it to a state where it can perform the required functions. Maintenance has also been defined as work done to maintain, restore, or improve a facility, that is, every aspect of the item, including the services, and the surroundings, to current appropriate quality and to keep the utility and value of the building (Cruzan 2020, Olanrewaju 2010). Zulkarnain *et al.* (2011) remarked that the principal aim of building maintenance is to sustain a building in the functional state as far as possible to serve the predetermined purpose cogently.

For buildings to attain the designed service lifespan, buildings require serious attention and care from all the stakeholders involved (Hopkin *et al.* 2017, Hopkin *et al.,* 2016). This can be done thoroughly at the early stage of the design and construction of the building. Therefore, the most crucial consideration for building and maintaining the services is to ensure that the building can fulfil the intended purpose over a long period while sustaining a high level of reliability and functionality. Other objectives of carrying out building maintenance include reduction in the rate of deterioration, sustaining the aesthetics and appearance, keeping the components in an acceptable condition, maintaining the facility and also the worth of a building, restoring the property and the services to their original state, hence satisfying the requirements of safety and health (Gahlot, 2006 in Olanrewaju & Abdul-Aziz, 2015).

Maintenance requires proper defect diagnosis, remedial procedures, an excellent technical understanding of material utilisation, resource management, and the design and implementation of integrated plans and policies. Although much can be done during the design and construction stages to avoid frequent maintenance work, producing maintenance-free buildings is highly desirable but unlikely (Zulkarnain *et al.,* 2011, Faremi *et al.,* 2013). However, the exact parameters necessary for consideration at the construction stage to ensure a substantial maintenance-free period for buildings are not known, and in some cases, the list is not logical when known. Some of the factors bringing up errors and defects at the construction stage include construction materials, inspections, construction machinery, and management-related factors (Tayeh *et al.*, 2020).

There are two main types of buildings regarding the location of

component fabrication: in–situ constructed or traditional buildings and off-site or prefabricated buildings. Prefabricated buildings are buildings whose components or significant elements are fabricated off-site and transported to the site for assembly (James *et al.,* 2004). On the other hand, in-situ buildings or traditional buildings are homes whose components are assembled at the designed or specified position on site. Economic world powers have created a strong building market by using the prefabrication construction method to overcome housing deficit problems. For instance, since 2013, nearly 4 billion square meters of building structures are being constructed in China each year, and the government has projected additional 33 billion square meters by the year 2040 (UNE and IEA 2017, Chang *et al.*, 2018).

The prefabricated and traditional construction methods have positively impacted the Nigerian Housing Stock. The advantages of these construction methods include the speed of erection, timely project completion, provision of employment to the youth, low cost of the construction project, and satisfactory project delivery. However, the satisfaction derived from the buildings will not be sustainable if the end-users are daunted by frequent maintenance of the houses. Hence, delivering unsustainable buildings with continuous maintenance requires concerted research effort to find a lasting solution, especially in construction methods. This study, therefore, reviews the influence of construction methods on defects in buildings with a specific focus on prefabricated buildings and in-situ constructed buildings. To achieve the aim of the study, the types of defects and deterioration that occurs in both prefabricated and in-situ constructed buildings were assessed, and the effects of in-situ construction and prefabricated construction methods on the maintenance of buildings were also established. The study hypothesises that there is no significant difference in building defects in prefabricated buildings and in-situ constructed buildings.

2. Literature review

Building Defects

Defects are flaws in a building work that can affect the building's durability, functionality, or strength (Harris, 2006). These are errors in a construction project that can be recognized and corrected to satisfy all expected values and functions of the building. Defects can arise due to construction flaws or design errors that reduce the value of the building and present unsatisfactory conditions. A building defect can also occur due to many other factors, such as utilising inferior materials, poor workmanship, and lack of a proper maintenance strategy.

Chew and DeSilva (2003) investigated high-rise residential building maintenance issues in Singapore and discovered that leakage was the most severe issue. The study reported that leakages account for 46.59 per cent of building defects, comprising 36.20 per

Table 1: Common defects in buildings

Defects	Ilozor (2008)	Hatfield (1989)	Olanrewaju (2012)	Hopkin & Cooks (2003)	Olanrewaju & Abdul-Aziz (2015)
Fading of wall paint		✓		✓	✓
Cracking of walls	✓	✓	✓	✓	✓
Sink leakage			✓		
Bad soap holders			✓		
Peeling Wall Paint				✓	✓
Damage to plasterwork	✓	✓		✓	✓
Floor tile failure			✓	✓	✓
Faulty door locks			✓	✓	
Faulty fan			✓		
Damaged roof structure	✓		✓	✓	✓
Faulty hot water dispenser			✓		
Faulty shower			✓		
Faulty fire alarm			✓		
Faulty heat extractor			✓		
Faulty smoke detectors			✓		
Faulty air conditioner			✓		
Faulty lighting			✓		
Pipe leakages			✓		✓
Broken Doors			✓		✓
Damaged window			✓	✓	✓
Faulty fire extinguisher			✓		✓
Electrical faults	✓		✓		
Timber rot	✓			✓	
Rising damp	✓			✓	✓
Stump fault	✓				✓
Damaged roof			✓	✓	✓
Cracked staircase			✓	✓	✓

cent of ceiling leakage and service pipe leakage with corrosion 10.39 per cent of all (nine) problems identified. Condensation, spalling, bowing, dampness, delamination, staining, stone decay, and efflorescence are among the array of building defects explained in Hinks and Cooks (2003). Other building defects asserted in previous studies are shown in Table 1.

3. Method

A questionnaire survey was conducted between January and March 2020 in Ministerial Quarters, Abuja. One approach to obtain a standard and consistent collection of data from a given demographic is to conduct a survey (Robson, 1993). The opinions and views of occupants were sought on the defects occurring in the buildings where they live. The questionnaire was self-administered to the residents of Ministerial Quarters before the COVID - 19 pandemic total lockdown in Nigeria. Residents of Ministerial Quarters, including visitors who have stayed more than six months, were the target survey respondents randomly selected from the prefabricated and in-situ constructed building residents in the study area. The questionnaire was designed in such a way that the respondents could complete the survey in a short time

The survey questionnaire was based on 27 building defects identified in the literature. A "pilot" survey was conducted with 10 well-experienced specialists in both prefabricated and traditional building construction and maintenance to ensure that the questionnaire items are adequate and that the survey instrument is precise. Before administering the questionnaire, some of the feedback and suggestions from the pilot survey were considered and implemented on the survey instrument. The survey respondents were asked to score their level of agreement with the incidence of each of the identified building defects on a 5-point Likert scale where "1" represented "never", "2" represented "rarely", "3" denoted "occasionally", "4" signified "often" and "5" denoted "always" on the statements. Respondents were also invited to suggest and rate any other unspecified building defect on the survey form based on personal discretion and experience, but ultimately no new defect was proposed in the responses.

A total of 96 questionnaires were administered to the residents on a one on one basis for the occupant's kind responses. Seventy-one (71) questionnaires were returned, although not all of the questions were answered in some cases. In addition, seven (7) respondents did not specify the type of houses they were living in. Thus 64 valid returned questionnaires were used for the analysis. Hence, the analysis excluded responses to the seven incomplete questionnaires.

The summary of the details concerning the administration of the questionnaire survey is shown in Table 2. The valid response rate is approximately 67 per cent, which is considered adequate for a social science study (Fincham, 2008). Respondents who did not complete the survey most likely did not live in the quarters for more than six

months. There is no specific response rate that can be used to represent the population because there is currently no database indicating the number of residents in the Ministerial Quarters. Sarantakos (1988) stated that the response rate that is considered representative of a given population is dependent on several factors. There are over 200 housing units in Ministerial Quarters, and not more than one questionnaire was administered to randomly selected buildings.

The data were analyzed using Statistical Package for Social Sciences (SPSS) version 21.0. Frequency tables and mean scores, for example, are descriptive statistics tools employed in the study. Mann-Whitney U test rank inferential statistics gave good insight into the research problem, and the mean score establishes the relative ranks of distinct building defects. Subsequently, the mean was used to cross-compare the relative significance of the defects between the "prefabricated" and the "in-situ" constructed buildings. The internal consistency or reliability of the responses under the proposed Likert scale of measurement of the defects was then verified using Cronbach's alpha reliability test (Ho, 2006; Santos, 1999).

Based on the residency of respondents, the responses were categorised into two major groups for analysis: the "prefabricated building residents" and "in-situ constructed building residents". The agreement of various respondents on the ranks of defects based on mean values within a particular group was measured using Kendall's concordance analysis and Mann-Whitney U tests (Chan *et al.,* 2010). Kendall's concordance analysis was used to determine the level of agreement between in-situ constructed buildings and prefabricated buildings respondent groups on the ranks of building defects. Kendall's concordance correlation coefficient value is between -1 and 1, with 1 indicating a perfect positive linear correlation and negative values indicating a perfect negative linear correlation, implying that a low ranking correlates with a high ranking on the other.

The Mann–Whitney U test is a non-parametric test used to see if any two respondent groups have statistically significant variations or divergences in the median values of the same component under consideration (Chan *et al.,* 2010). The Z-value and p-value are used to analyse Mann–Whitney U test results. The null hypothesis that there are no significant differences in the median values of the same factor between respondents of "prefabricated buildings" and those of "in-situ constructed buildings" can be rejected if the calculated p-value is less than the probability significance level of 0.05.

4. Results and Discussion

Tables were used to present the data gathered during this research project. First, the total scores, mean frequencies, and percentages were generated by feeding the survey results into SPSS version 21. Next, Table 2 shows the results of the survey response.

Table 2: Results of Survey Response

Questionnaires	No. of Questionnaires	Percentage (%)
Total Distributed	96	100
Total Unreturned	25	26.01
Total Returned	71	73.96
Invalid Questionnaires	7	7.29
Total Valid Questionnaires	64	66.67

Table 2 shows that 96 questionnaires were distributed to the respondents, and 71 questionnaires were returned, while 25 questionnaires were not returned, indicating approximately 74% response rate.

The high response rate recorded in this study is attributed to the self-administration of the questionnaire and waiting on the respondent to fill the questionnaire and answer any question that may arise in filling the questionnaire. However, the table also indicates that out of the 71 returned questionnaires, only 64 were valid, the reason being that the respondents understood the questions on the research subject, and 7 of the returned questionnaires were invalid because the building the respondents reside was not indicated, and some indicated both.

Respondents' background information

The analysis of the demographic section of the questionnaire (in Table 3) revealed that 62.5 per cent of the respondents lived in in-situ constructed buildings, while 37.5 per cent lived in prefabricated buildings. Approximately 72% of the respondents have lived in the buildings for more than one year. This suggests that the respondents could provide reliable information and genuine opinions to the research questions. More than 41% of the respondents had lived over five years in the Ministerial Quarters, while 28.1% of the respondents had lived less than one year. Hence, the survey respondents' opinions would be reliable and representative of the survey

Table 3: Background information of respondents

Respondents		Frequency	Percentage	Respondents		Frequency	Percenta
Gender	male	36	56.30	**Type of house**	In-situ	40	62.50
	female	28	43.70		Prefabricated	24	37.50
	Total	64	100.00		Total	64	100
Age range	< 18 yrs.	0	0	**Residency period**	< 1 year	18	28.10
	18 to 30 yrs.	35	54.70		1 - 5 yrs.	18	28.10
	31 to 45 yrs.	26	40.60		6 - 10 yrs.	7	10.90
	≥ 46 yrs.	3	4.70		11 - 15 yrs.	21	32.80
	Total	64	100.00		Total	64	100.00

population, and the opinions could reflect the building defects in the respective buildings.

Defects in in-situ constructed and prefabricated buildings

Results of analysis derived from the questionnaire survey are discussed with reference to previously published literature wherever appropriate. Table 4 shows the result of the reliability test of the survey instrument on the building defects administered to the respondents. The Cronbach's alpha coefficient for 20 rated defects in both in-situ constructed and the prefabricated buildings was 0.814, which is significantly higher than the 0.80 requirement for the reliability of the survey instrument (Ho, 2006). The result indicates that in terms of the relationships among the 20 defects and the 5-point Likert scale employed for measurement, there is satisfactory reliability (internal consistency) of the building defects in both the in-situ constructed buildings and prefabricated buildings. At the 5% significance level, the measurement instrument is trustworthy and internally consistent among the responses.

Table 4: Cronbach's Alpha test result

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Number of Items
0.814	0.814	20

respondent group was calculated, and each defect was ranked within a particular group, as shown in Table 5.

The mean values for the defects as rated by all respondents ranged from 2.17 to 3.67. However, for those scored by the respondents living in in-situ constructed buildings, the mean value ranged from 2.08 to 3.65, while the defects rated by the respondents living in prefabricated buildings the mean value is from 1.88 to 3.96. The results showed that the variation of the mean values for "prefabricated building occupants" (2.08) is greater than "in-situ constructed building occupants" (1.57) when considering all the 20 defects collectively. This indicates that the respondents living in prefabricated buildings share more extensive opinions on the defects. However, all respondents agreed with all the 20 defects occurrence in the buildings as all the mean values were above one (1) and skewed toward the "often occurrence" category. Hence, the respondents were agreeable to the occurrence of the defects elicited in general but with different levels of agreement.

Table 5 shows that the responses of the residents of in-situ constructed buildings identified "faulty shower" as the most common building defect with a mean score of 3.65. Faulty shower could arise due to bad handling by the building occupants, rusting of the shower components, improper

The defects occurring in each building type - in-situ constructed and prefabricated buildings were examined using mean scores and a ranking system. First, the mean score of each defect for each building residence

components repairs etc. Following a descending order, other common defects in the in-situ constructed buildings are wall paint peeling, cracking of walls, and fading of wall paint with a mean score of 3.63, 3.60 and 3.30, respectively ranked second, third and fourth. Generally, peeling of paint could result from moisture, dirty surface, poor surface preparation, too many layers, expired paint etc.

The results in Table 5 indicate that the responses of the occupants who live in prefabricated buildings revealed that the common building defects in prefabricated buildings include fading of wall paint, cracking of walls, sink leakages and peeling of wall paints which are ranked first, second, third and fourth respectively with 3.96, 3.79, 3.54, and 3.42 mean scores. Fading of wall paint could result from various factors, including excessive exposure of walls to sunlight, poor quality paints, when the paint has not been properly prepared, and chalking of the paint film layer. Cracks in prefabricated buildings could occur due to stresses in the building components exceeding the designed strength. Externally imposed forces, such as dead, live, wind, or seismic load, can also induce stress in building components.

All the respondents ranked "cracking of walls" as the most occurring defect, which directly resonated with the need for planned building maintenance because the problem of building neglect poses potential threats to building occupants and the public (Buildings Department, 2012; Housing *et al.,* 2006). The finding corroborates Lawal *et al.* (2017) that active and hairline cracks, spalling of concrete and excessive deflection, water damage or stains, paint peeling on façade faces of walls are the critical defects in some university buildings. The shortage of adequate building maintenance could lead to fatal consequences, including Severe Acute Respiratory Syndrome (SARS) outbreaks and catastrophic building-related accidents (Yau, 2010). Therefore, building occupants and homeowners and government should ensure regular building inspection and proper maintenance practices for the in-situ and prefabricated buildings to eliminate the occurrence of tragic casualties and the potential collapse of any component of building structure or its structural parts, such as concrete slab, beam and column spalling.

Similarly, the respondents ranked "peeling of wall paint" as the second most occurring defect, consistent with Cardellicchio (2021) and Olanrewaju and Abdul-Aziz (2015) who identified paint failure as a significant failure of cosmetic nature in buildings. Apart from moisture, dirty surface, poor surface preparation, too many layers, expired paint, peeling of paint could occur as a result of ageing and deterioration due to poor maintenance. Chang (2004) noted that the general awareness of homeowners on the need to maintain buildings is low and often passive "wait-and-see" attitude is exhibited until major damage occurs. To address challenges of building ageing and deterioration, Chang *et al.* (2014) suggested a command-and-control mechanism through

Table 5: Defects in in-situ constructed and prefabricated buildings

Defects	Prefabricated buildings			in-situ constructed buildings			All respondents		
	Sum	Mean	Rank	Sum	Mean	Rank	Sum	Mean	Rank
Faulty shower	73	2.63	12	146	3.65	1	209	3.27	4
Peeling Wall Paint	82	3.42	4	145	3.63	2	227	3.55	2
Cracking of walls	91	3.79	2	144	3.60	3	235	3.67	1
Fading of wall paint	95	3.96	1	132	3.30	4	227	3.55	2
Faulty hot water dispenser	66	2.75	11	131	3.28	5	197	3.08	6
Floor tile failure	77	3.21	7	125	3.13	6	202	3.16	5
Faulty lighting	54	2.25	17	122	3.05	7	176	2.75	10
Faulty air conditioner	55	2.29	16	122	3.05	7	177	2.77	8
Faulty fire alarm	59	2.46	13	118	2.95	10	177	2.77	8
Faulty heat extractor	56	2.33	14	119	2.98	9	175	2.73	11
Damaged window	52	2.17	19	110	2.75	12	162	2.53	16
Faulty fire extinguisher	45	1.88	20	111	2.78	11	156	2.44	19
Broken Doors	53	2.21	18	106	2.65	13	159	2.48	17
Sink leakage	85	3.54	3	102	2.55	14	187	2.92	7
Faulty fan	73	3.03	8	98	2.45	15	171	2.67	12
Damaged roof structure	71	2.96	10	92	2.30	16	163	2.55	14
Faulty smoke detectors	55	2.29	15	84	2.10	18	139	2.17	20
Cracked walls	79	3.29	6	84	2.10	18	163	2.55	14
Faulty door locks	73	3.03	8	86	2.15	17	159	2.48	17
Bad soap holders	82	3.42	4	83	2.08	20	165	2.58	13

the implementation of a mandatory building inspection scheme (MBIS). Effective maintenance is essential because a well-maintained building can contribute to sustainable development by providing a comfortable living environment, extending existing premises' service life, and reducing embodied energy used (Tan *et al.,* 2012).

Comparison of survey results between in-situ and prefabricated building occupants

After the determination of the internal consistency of the respondent groups' rankings, the next step in the analysis was to assess if there was any significant agreement or disagreement on the rankings between the survey groups, as indicated by *Kendall's tau b* concordance analysis correlation coefficient, which was calculated using the SPSS software package. The correlation coefficient of the rankings between the "In-situ constructed building occupants" and "Prefabricated building occupants" on the defects that occur in the respective buildings was 0.043 with a significance level of 0.795, as indicated in Table 6. Hence, the null hypothesis is accepted. This implies that there is sufficient information to infer that there is no significant association between the "in-situ constructed building occupants" and

Table 6: Relationship between defects in in-situ constructed and prefabricated buildings

Test			In-situ constructed buildings	Prefabricated buildings
Kendall's tau_b	In-situ constructed buildings	Correlation Coefficient	1.000	0.043
		Sig. (2-tailed)	-	0.795
		N	20	20
	Prefabricated buildings	Correlation Coefficient	0.043	1.000
		Sig. (2-tailed)	0.795	-
		N	20	20

Table 6: Mann-Whitney U Test Rank

	Type of Residence	N	Mean Rank	Sum of Ranks
Rank for two	In-situ	20	20.48	409.50
	Prefabricated	20	20.53	410.50
	Total	40		

Table 8: Mann-Whitney U Test Statistics[a]

	Type of Residence	Rank for two
Rank for two	Mann-Whitney U	199.5
	Wilcoxon W	409.50
	Z	-0.014
	Asymp. Sig. (2-tailed)	0.998
	Exact Sig. [2*(1-tailed sig.)]	0.989[b]

a. Grouping variable: Residency type b. Not corrected for ties

the "Prefabricated building occupants" on the defects in the respective buildings.

In particular, the 20 defects accessed by the respondents have different ranks in both in-situ constructed buildings and prefabricated buildings, as shown in Table 4. This observation is contrary to Chan and Hung (2015) who found a significant correlation between the benefits of the Mandatory Building Inspection Scheme between private and public groups. Several

items had the same rank in the two groups in the study. In the current study, Table 4 revealed that some defects shared very close ranks in in-situ constructed and prefabricated buildings. For instance, "Cracking of walls" was ranked second by occupants of prefabricated buildings and third by occupants of in-situ constructed buildings. Similarly, peeling of wall paint, fading of wall paint and seven other defects were ranked closely with the ranking variance of within four places. This suggests that the respondents in both cases may hold similar views on the occurrence of these defects. Furthermore, the relative ranking among the majority of the defects is an indication that the respondents in both cases may hold similar views on the occurrence of these defects contrary to *Kendall's tau b* test result. Thus, a much more advanced non-parametric inferential statistical test is required to establish a significant difference in the building defects that arise in prefabricated buildings compared to in-situ constructed buildings.

In addition, the Mann–Whitney U test was used to determine if there were any significant variations in the median values of the responses between the prefabricated and in-situ constructed building occupants on the 20 defects. A wide variation in the median values is established if the estimated p-value is smaller than the prescribed significance level of 0.05. As indicated in Table 8, the obtained Mann–Whitney U statistic is 199.5. However, when corrected for tied rankings and converted to a z-score (critical ratio test), this value is not significant at the 0.998 level. This means that the two medians' probability of the same is very high. Thus, it can be concluded that there is no significant difference between the median of the prefabricated building occupants and the in-situ constructed building occupants on the 20 defects. Thus, the null hypothesis is accepted that there is no significant difference in the building defects that arise in prefabricated buildings and the in-situ constructed buildings.

5. Conclusion

This paper aimed to review the current state of defects in buildings and investigate the major defects occurring in traditionally constructed buildings and prefabricated buildings in Abuja, Nigeria, as experienced by the occupants. A total of 20 defects identified from the literature were compiled and administered via an empirical questionnaire survey to occupants of in-situ constructed or prefabricated buildings to rank based on experience. The study also aimed to compare the defects' ranking patterns and test for any significant agreements or disagreements on the defects among the survey respondents.

Generally, the occupants of both in-situ constructed buildings and prefabricated buildings agreed that cracking of walls, fading of wall paint and peeling of wall paint are the three most common defects occurring in both types of buildings. The in-situ constructed and prefabricated building occupants ranked the three defects as the top occurring defects. Moreover, in-situ constructed building occupants consider faulty showers and faulty hot water dispensers as another

set of pressing defects; the occupants of prefabricated buildings do not experience many of such defects. Both respondents' rankings of the two defects are at variance. The variation in the ranking of defects was also demonstrated in all other defects. However, such variations did not amount to significant differences in the overall occurrence of the 20 defects in the building types. The study concludes that defects in in-situ constructed buildings are not significantly different from those in prefabricated buildings. The study, therefore, recommends that the selection of a generic approach could be adopted in the maintenance of in-situ constructed buildings and prefabricated buildings. Also, a comprehensive approach should be adopted to maintain residential buildings by having an outlined maintenance itinerary for various buildings.

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Examining the implementation of health and safety measures among construction contractors in Nigeria

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Abstract

The implementation of health and safety measures in construction projects remains one of the critical parameters by which successful projects delivery can be determined. In order to maintain a healthy environment, the cost of health and safety is the expense incurred to comply with legal requirements with respect to accident prevention and improve health and safety conditions in all areas of the work performed. The lack of adequate provision for H&S during the forecasting of construction cost brings about a poor attitude of construction contractors towards implementing H&S measures on construction sites in Abuja, Nigeria. The study aimed to examine the implementation of H&S measures among construction contractors in Abuja. The study is a criteria-based study in which certain criteria were outlined for selecting construction sites. The study employed the use of Safety and Health Assessment in construction (SHASSIC) in examining the implementation of health and safety measures among construction contractors, and the results show that the total SHASSIC score of the five sites visited is 63.40% which is a 3-star ranking. It was concluded that, H&S measures are documented and managed. However, there are still a few medium-risk work activities that are neglected. The study recommends that effective awareness of H&S measures is useful to improve its implementation on construction sites and reduce construction site accidents.

Keywords: contractors, construction, health and safety, implementation, measures.

1. Introduction

The laws guiding construction health and safety require full action and implementation to protect workers at their workplace just as well as the general public whom the work may influence. The Malaysian Occupational Health and Safety Act (OSHAct) of 1994 obliges employers to provide great and satisfactory health and safety measures in their workplaces. According to Chang (2008), more than a hundred million individuals in different parts of the world partake in construction work as a profession. The Global Training Centre of the International Labour Organisation (ILO, 2011) stated that some of the six deadly accidents at work happen on a construction sites. Therefore, the significance of health and safety in the construction industry cannot be overemphasized. Providing a safe work environment has been reiterated by

various researchers; the breach of which has a negative and compounding effect on overall productivity and performance.

The application of health and safety measures on construction projects remains one of the essential criteria to which effective projects delivery can be determined (Ibrahim, 2015). This statement is supported as health and safety policy is seen as one of the important factors used in prequalifying contractors for the award of construction projects in the country (Windapo, 2013 and CDM, 2015).

The main contention of this research is that inadequate provision of H&S cost during construction forecasting brings about the poor attitude of construction contractors towards implementing H&S measures on construction sites in Abuja, Nigeria. This poor attitude leads to an increase in the rate of accidents, injuries, and fatalities; and victims are paid compensation. The resultant effect is an increase in the final cost of projects. The aim of the research is to examine the implementation of H&S measures among construction contractors in Abuja.

2. Literature review

Construction Health and Safety Measures

Rashid, Ahmad, Roomi and Iqbal (2016) reasoned that safety focuses upon minimizing accidents on the worksite and curtailing the possible adverse impact on the workers in each aspect. However, in light of different evaluations by many specialists, for example, Aniekwu (2007); Idoro (2011); Okoye and Okolie (2012); Idubor and Oisamoje (2013); Umeokafor *et al.* (2014) and Dodo (2014) on the management and regulation of safety in construction projects, the fact remains that compliance and adoption of H&S provisions remains one of the significant catalysts in advancing the construction production measures. Then again, failure in consenting to H&S measures would increase accidents and raise the production cost. In light of this, Famakin and Fawehinmi (2012) expressed that safety routines are standards to rate successful building construction activity, which is generally important to the client since they extensively affect productivity and viability among experts and workers in the construction business.

The irregularities perceived as a result of failure to comply with minimum requirements regarding H&S practices in construction may waste both the victim and industry's time and bring about loss of money. Although construction organisations may have taken life assurance for their employees, there are additional direct costs that can accrue from injury suffered, and there still exists some specific risks which cannot be insured, like loss of workers, and hours of lost production Aniekwu, 2007). Therefore, the non-compliance to safety implementation could cause some significant disruption to production and progress on construction projects.

A few measures have been taken into consideration by most construction organisations regarding improving their general safety performance. However, unlike developed countries, many developing countries

like Nigeria still lack universal laws and guidelines on H&S practices (Ikechukwu and Dorothy, 2013). The research posits that viable administration of safety practices is helped by different factors, such as socio-economic and humanitarian views. George *et al.* (2013) further point out that construction firms ought to create awareness, for every project, which includes a thorough review of the safety necessities, agreements and frameworks, disciplinary exercises, substance abuse scanning record and proactive administration strategies.

Boustras *et al.* (2015) carried out a general survey on supervision of H&S by small firms in Cyprus. The investigation centred on the factors determining safety performance in small scale firms in the work environment. It was a purposive report; hence, copies of a well-designed questionnaire were utilized to obtain the required information. The result of the study revealed that work safety settings in limited scope firms must be improved by the adoption of "guidance", "risk assessment,' and "safety policy design ".

Awwad *et al.* (2016) analyzed construction safety exercises and difficulties in a central Eastern agricultural nation. An experimental survey of construction specialists, insurance firms and governmental organizations was conducted. The outcomes of the research revealed the accessibility of construction work safety laws but also revealed the lack of the essential application, poor supervision, lack of safety awareness, weak support from the majority of stakeholders handling safety routines on construction sites. The survey thus recommended that construction firms should be properly informed, which may help alleviate the difficulty.

Kolawole (2014) evaluated safety procedures on building construction sites: using North Central, Minna as a case study. Although the outcome from the analysis revealed that site workers supported a "safety policy" which improves performance and lowers injuries on-site, the government as a body lacks a definite precautionary measure for construction activities. Furthermore, the study suggested training and re-training workers on the significance of safety practices as a priority for all; the study also recommended that the government should enact a "safety act" to regulate activity and reduce accidents occurring at the sites.

Idoro (2011) reviewed the impact of support on the functioning of Occupational Health and Safety (OHS) of construction firms in Nigeria. His paper assessed the degree of mechanization and its correlation with OHS performance in the industry. The study established that mechanization has a significant effect on OHS functioning and advocated for viable OHS management by contractors. The result showed that accident and injury occurrences increased with increased mechanization. The research concluded that failure to manage mechanization degenerates OHS functioning on project sites. The study recommended that construction managers should devise efficient H&S measures rather than extra safety garments.

In an analysis conducted by Agwu (2012) on Total Safety Management (TSM), a methodology was designed to develop organisational implementation in selected construction companies in Nigeria. Both random and stratified sampling procedures were utilized in questionnaire administration to six (6) selected construction firms. The study proposed that incorporation of absolute safety management as a feature of the hierarchical arrangement would prompt improved safety practices on building projects.

In a research project by Okoye *et al.* (2016) carried out on construction workers' H&S knowledge on sites in Anambra State, Nigeria, the Mean Score Index and Pearson's Product-moment Correlation Coefficient (r) were used to analyse the information from fifteen (15) randomly selected sampled construction sites. Low safety responsiveness and inconsistency among the sites' agents were found to be the factors which lowered scheme management. The analysis suggested that knowledge and consistency of application of H&S practices alone cannot accomplish the optimum and desired project performance. It would be necessary to also refine safety measures, including elements like adopting strict safety regulations and ensuring full enforcement, workers' involvement, and management commitment. Given the above, Akinwale and Olusanya (2016) examined the implications of occupational health and safety intelligence in Nigeria through a cross-sectional study. An in-depth research interview was conducted on managers and senior staff of selected organisations in Lagos State, Nigeria. The data collected were subjected to content analysis and demographic procedures.

The investigation found that workers and administrators suffer significantly from occurrence of industrial health threats, for example, loss of human resources, efficiency and employer stability. The study also found that though a high degree of understanding of the significance of occupational safety is required, there is, on the contrary, insufficient interest in capacity building on safety programmes in the union. Consequently, the research suggested an improvement in communication of safety and significant adjustment to insurances and safety knowledge sharing to improve individual and hierarchical advancement in Nigeria.

3. Research methodology

The study is utilised the survey research method and used quantitative measures in examining the implementation of H&S measures among construction contractors. The study is criteria – based, with the following criteria outlined:

i. The area of the study is the Federal Capital Territory, Abuja.
ii. The construction firms must have been in building/civil construction works for more than twenty (20) years.
iii. The quantity surveyors with knowledge of H&S on the construction site selected for this study must have been with the construction firm for at least fifteen (15) years.

iv. The selected construction projects should have been taken within the seventeen (17) years, between 2001-2018.
v. Work progress should be within 25% - 75% (workers are in full force, construction is at its peak, potential accidents are identified)

Only five (5) construction sites met the study criteria and were selected for the study. The sample frame of this research constituted quantity surveyors with knowledge of H&S and H&S officers in the construction industry. The snowballing sampling technique was employed for this study. According to Mohammed (2018), the snowball sampling technique is used in two ways: -

a. Identify potential targets in the population; often, one or two targets can be found initially.
b. Ask those targets to recruit other target (and ask those targets again to recruit another target) etc.

This study employed the use of questionnaires to elicit information from the respondents. The questionnaire was allotted into four (2) parts - the first included background information of the respondents. The second section elicited information on implementing H&S measures among construction contractors in Abuja, Nigeria. The instrument has 61 questions in the Document check section; construction site inspection 235 questions, and employer's/construction workers interview 218 questions.

The study employed the SHASSIC method of analysis. SHASSIC is an acronym for Safety and Health Assessment in Construction. This assessment method is used in carrying out H&S evaluation in construction (SHASSIC) as explained below.

Weighting Percentage

The weighting for H&S performance is allocated with respect to three (3) factors, as shown in Table 1.

Table 1 Distribution of weighting percentage for Component

FACTORS	WEIGHTING PERCENTAGE
Document check	40%
Workplace inspection	40%
Employee interview	20%
Total score	100%

Source: CIDB CIS 10:2008, Mohammed Y. D 2015

The weighting order is designed to make the quantitative result denoting the H&S functioning of different contractors. The basic formulas for factor weighting are as follows;

a. *Document Check*

$$\frac{Table\ number\ C\ scord}{(61 - number\ of\ NA)} \times 40\% = SHASSIC\ score\ for\ document\ checking - (A)$$

b. *Workplace Inspection*

$$\frac{Total\ number\ C\ scored}{(235 - number\ of\ NA)} \times 40\% = SHASSIC\ score\ for\ workplace\ inspection - (B)$$

c. *Employee's Interview*

$$\frac{Total\ number\ C\ scored}{(218 - number\ of\ NA} \times 20\% = SHASSIC\ score\ for\ employees\ interviewed - (C)$$

Where C denotes the absolute number of "Compliance", NC represents the total number of "Noncompliance", and NA represents the total number of items "Not Valid".

Star ranking

The overall SHASSIC target in Document Check (A) plus (+) overall SHASSIC target in Workplace Inspection (B) plus (+) overall SHASSIC grade in Employees Interview (C). The component will justify the ranking star(s), which ranges from 1 to 5 stars, as shown in Table 2.

4. Results and discussion

Examining the implementation of H&S Measures Among Construction Contractors in Nigeria.

The following were the analysis/result of assessments carried out in each of the five construction sites used for the analysis.

Document Check.

Using the SHASSIC, site 1 scored 30.16% out of 40% allocated to the document checking, implying that most documents needed for check are properly managed at the site office. Site 2 scored 25.96%, implying that documents needed for check are fairly managed at the site office. For Site 3, 3 out of the 61 questions were not applicable. The score was 29.96% which implies that documents needed for check are fairly managed at the site office. On site-4, three out of the 61 questions were not applicable; the SHASSIC score for site 4 was 29.96%. This means that documents needed for check are fairly managed at the site office. On site 5, eight out of the 61 questions were not applicable. The SHASSIC score was 17.36%, implying that documents needed for check are poorly managed at the site office.

Table 2 Stars ranking

SHASSIC (rank %)	Star(s) Awarded	Classification
85 to 100	*****	H&S Measures are managed and documented.
70 to 84	****	H&S Measures are maintained and recorded, although risks activities remain neglected.
55 to 69	***	H&S Measures are maintained and recognized. but few standard risks behaviors are neglected.
40 to 54	**	H&S Measures are partly managed and not properly documented.
39 and less	*	H&S Measures are inadequately managed and not properly documented.

Source: CIDB CIS 10:2008, Mohammed Y.D 2015

Table 3 General review of the five (5) sites

SITES	CONTRACT SUM	WORK PROGRESS	LOCATION
1	100 Million	75%	Abuja
2	150 Million	55%	Abuja
3	270 Million	60%	Abuja
4	225 Million	45%	Abuja
5	163 Million	68%	Abuja

Source: Researcher's Analysis (2020).

Table 4 Scores of the Five Sites.

SITES	COMPONENTS/ WEIGHTAGE (%)						SCORE
	Document check 40%		Workplace inspection 40%		Employees interview 20%		DC + WI+ EI
	Total number 'c' score X 40 (61-number of 'NA')		Total number 'c' score X 40 (235-number of 'NA')		Total number 'c' score X 20 (218-number of 'NA')		
1	42X40		230 X 40		203 X 20		87.91%
	61-0	=30.16%	235-0	=39.15%	218-0	=18.60%	
2	37 X 40		173 X 40		157 X 20		70.15%
	61-4	=25.96%	235-0	=29.79%	218-0	=14.40%	
3	24 X 40		175 X 40		130 X 20		58.26%
	61-3	=16.55%	235-0	=29.78%	218-0	=11.93%	
4	24 X 40		175 X 40		130 X 20		58.26%
	61-3	=16.55%	235-0	=29.78%	218-0	=11.93%	
5	23 X 40		105 X 40		80 X 20		42.96%
	61-8	=17.36%	235-5	=18.26%	218-0	= 7.34%	
TOTAL	106.58%		146.78%		64.20%		

Source: Researcher's Analysis (2020).

Workplace Inspection.

With respect to Workplace inspection for site one, the contractor scored 39.15%, which implies that the site is properly managed with regard to the issue of its safety. For site two workplace inspection, the contractor scored 29.79%. This implies that the site is well managed with regard to the issue of its safety. For Site 3 workplace inspection, the contractor scored 29.79%, which means that the site is well managed regarding the issue of its safety. On site four, the contractor scored 29.79%; this implies that the site is well managed with regard to the issue of its safety. Finally, for site 5, 5 out of them were not applicable; the contractor scored 18.26%, which implies that the site is poorly managed regarding its safety.

Table 5 Analysis of the Five Sites.

106.58 X 40	146.78 X 40	64.20 X 20.
200	200	100
=21.20%	=29.36%	=12.84%.

THERE FORE TOTAL SHASSIC = 63.40% (55 – 69). 3 – STAR IN RANKING.

Sources: Researcher's Assessment.

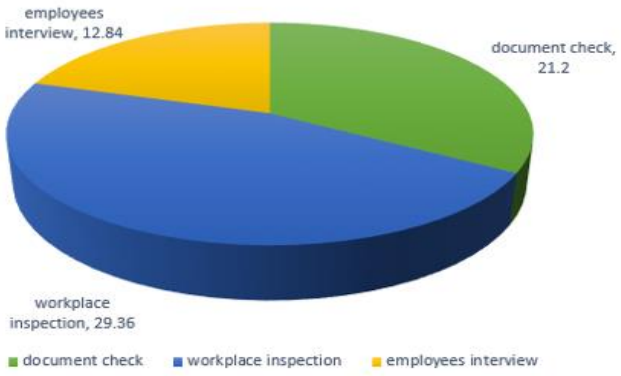

Figure 1 SHASSIC Result of the five (5) sites.

Employee's Interview.

This section is divided into three subsections, i.e. management personnel interview, health and safety personnel or committee members interview and construction workers interview.

For Site 1, the score was 18.60%, which implies that H&S measures on the site are well understood, well communicated and well managed among the employees. Site 2 had a score of 14.40%; this implies that H&S measures are understood, well communicated and well managed among the employees. For site three, employees' interview, the score was 11.93%; which implies that H&S measures are fairly understood, fairly communicated, and managed. Site 4 had a score of 11.93%; which implies that H&S measures are fairly understood, fairly communicated, and managed among the employees. Site 5 had a score of 7.34%; this implies that H&S measures are poorly understood, poorly communicated and poorly managed among the employees.

The total SHASSIC score of the five sites is 63.40%, which is three stars in ranking, implying that H&S Measures are maintained and recorded, but work risks activities are ignored. Figure 1 shows the contributions of the three basic components to the total SHASSIC, as shown in Table 5.

5. Conclusion and recommendations

The importance of H&S in construction cannot be overemphasized. Providing a safe work environment has been reiterated by various researchers. The breach of H&S provisions has a negative and compounding effect on an organisation's overall productivity and performance. H&S implementation on construction projects remains an important aspect for determining successful project delivery. From the findings of the five (5) selected construction sites, the conclusion reached is that the contractors pay little attention to implementation of H&S measures.

Based on the results and conclusions reached, the following recommendations are made:

Effective awareness of H&S measures is a requirement for improved implementation on construction sites; and, Construction site accidents can be minimized when the implementation of H&S measures is given adequate attention; H&S measures should be included as part of project performance criteria and should also be one of the criteria for awarding construction projects to suitable contractors.

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Construction Project Success as a Wicked Problem: The role of the local community in Ebonyi, Nigeria

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Abstract

Construction projects are viewed as either a success or a failure, and this usually pertains to their performance against time, cost, and quality criteria. However, the numerous broad definitions proposed in the literature for success and failure have served to convolute the concepts. Add that most previous studies have only considered project success and failure from the perspectives of the same stakeholder groups, notably the client, consultants, and contractors. Project success can arguably be described as a wicked problem, a complex social problem where causes and solutions are ever-changing and difficult to identify. A gap exists in current literature around understanding project success and failure from underrepresented stakeholders such as the local community. This research aims to explore this gap in the literature and understand project success from the perspectives of previously underrepresented stakeholders. As project success is a wicked problem due to the multiple perceptions, a constructivist ontological position is adopted. A total of twenty-two semi-structured interviews were conducted with multiple stakeholders across three major construction projects in Ebonyi, Nigeria. A thematic analysis of the results revealed that the perceptions of community stakeholder groups are often neglected when ascertaining the success or failure of a construction project; what the community view as project success and the failure do not align with the views of the client, consultants, and contractors. This research contributes to a currently underexplored area in the literature by highlighting the project success perceptions of an often neglected but equally important stakeholder group. The findings also help better understand the wicked problem of defining project success and illustrate how construction industry practitioners can increase the successful delivery of projects.

Keywords: *Project success, Wicked Problem. Construction Industry, Community engagement.*

1. Introduction and background of the study

The construction industry can be described as the design, development, construction, refurbishment, repair, and demolition of the built environment and has been described as vital for the economic development and national growth of a country (Ahady *et al*., 2017). However, the industry has historically suffered from a negative reputation due to its high accident frequency rate, extraction of natural resources, and general wasteful nature (Barthorpe,

2010). It has also been described as an industry that lags behind others when addressing its negative impacts and image, so arguably, it has more reason than most to improve its practices (Glass *et al.,* 2012). Such calls for the industry to enhance and improve its practices come from a range of stakeholders whom all call for construction companies to take responsibility beyond their immediate economic contribution and impact the wider environment and society (Watts *et al.,* 2019a). In response to this, the industry has made improvements over recent decades, focusing on making construction projects more successful. Notably, this has included additional performance indicators revolving around Corporate Social Responsibility (CSR), social value, productivity and client satisfaction. As a result, the construction industry's performance is often benchmarked against a myriad of factors, with its overall success judged by many stakeholders. However, the weight of each stakeholder's view is not always treated equally.

In Nigeria, the construction industry accounts for approximately 3% of the country's GDP (Fadun and Saka, 2018). Despite its relatively small economic contribution, the industry has been identified as one of the dominant stimulants in its economic development (Afolabi *et al.,* 2018), with a 3.2% annual growth forecast over the next five years (International Trade Administration, 2021). It is reported that the Federal Government is behind around 65% of projects, with the State Government responsible for around 23% of projects (Afolabi *et al*., 2018). The Nigerian construction industry is therefore arguably driven by the public sector. As the public sector is primarily responsible for spending public funds for the benefit of all society, such funds are spent under greater scrutiny from a greater number of stakeholders who all have perceptions of the success or failure of construction projects. The construction industry also operates almost wholly in the public eye and is under more scrutiny than most as any repercussions from potential negative impacts of project failure could be felt more widely throughout society. The construction industry also underpins many other industries (i.e., banking, finance, hospitality, and retail all depend on the buildings the construction industry produces to operate and the infrastructure it develops to transport people and goods). Therefore, it can be argued that the importance of project success cannot be overestimated, nor can the negative impacts associated with project failure be ignored as the potential ramifications and knock-on impacts to other industries can be significant. Therefore, all stakeholder perceptions must be ascertained and fully understood when a project has succeeded or failed. Arguably, it is only by fully understanding project success and failure that successes can be repeated and failures avoided. However, whilst there is a wealth of research on project success and failure, the research problem is that the existing literature largely derives from the perspectives of a few select stakeholders, notably

clients, consultants and the construction team. There is a paucity of project success and failure research exploring and understanding the views of wider stakeholders such as the community's local to construction projects. Local communities are arguably one of the most important stakeholder groups for construction projects as they are the stakeholder group who have to live with the construction project whilst it is being built and then in its shadow whilst it is in operation. Therefore, current views of project success are potentially flawed by being skewed to take account of some stakeholder perceptions over others. This could ultimately result in projects being viewed as successful to a minority of stakeholders groups but unsuccessful to a majority.

This paper explores this gap and contributes to the existing literature by understanding project success and failure from the community's local to construction projects, as these are previously underrepresented stakeholder perspectives. The research objectives are to understand the factors affecting project success and failure; identify key stakeholders from construction projects in Ebonyi, Nigeria; ascertain, analyse, and compare the perspectives of these stakeholders with regards to project success and failure. First, this paper explores the wider contemporary literature on project success and failure. Next, the concept of wicked problems is introduced, and project success is positioned as a wicked problem due to its interlinking variables and large-scale social challenges in gaining widely agreeable success definitions across multiple stakeholder groups. The research methodology behind this paper is then discussed, with the ontological and epistemological positions stated and research methods introduced. Sixteen semi-structured interviews were undertaken with four different stakeholder groups from two different recently completed construction projects in Ebonyi, Nigeria. Analysed thematic analysis of results is then undertaken before the findings are presented and discussed in the context of the wider literature. Finally, the paper is concluded, and the contributions to both literature and construction industry practice are outlined.

2. Literature Review

Project Success

Project success and failure have been widely studied in the literature, and whilst broad definitions have stood the test of time (Csehati and Szabo, 2014), none apply to all types of the project nor widely accepted across all stakeholders groups (Al-Tmeemy *et al*., 2010). Therefore, project success has been nebulous and often difficult to define. However, historically, the iron triangle of time, cost, and quality historically has been seen as project success's yardstick. Reflective of many studies, Ghadamsi (2016) considers project success from the point of view of the client, design team and contractor. It is argued that clients view project success against the finished quality of the project and whether it was completed within its budget and on the

planned schedule. The design team considers the project success through client satisfaction, architectural merit, achieving the client's budget and schedule with little or no construction problems. Finally, Ghadamsi (2016) argues that contractors consider project success by completing the project within the timeframe planned and to the agreed quality, profit-making, and ensuring client satisfaction is achieved. Whilst Ghadamsi (2016) reveals numerous measures of project success, and it could be argued that almost all measures revealed can be categorised into the iron triangle of time, cost, and quality, albeit client satisfaction is also widely considered. If these three main criteria are the only criterion of any importance, however, it is reported that only around 29 per cent of projects are ultimately successful (Taylor 2000). Chan *et al.* (2002) focussed on a project being completed in the time frame set and to a high level of quality, and although did not discuss cost directly, did have a successful project criterion as the level of satisfaction a client feels with a project, which could arguably be linked to the amount of money the client has spent on it.

There have also been attempts to broaden the understanding of project success. Taking a more structured approach, Frimpong *et al.* (2003) espoused that project success could only be achieved when the goals and objectives stated in the project plan were achieved. Bradley (2008) included the dimension of organisational impact whilst noting that project success is based on the complexity, size and scope of the project and the client experience. Chan and Chan (2004) recommended a time-driven approach to project success, with four distinct periods: accomplishing planned goals, producing benefits for end-users, adding value to the organization and improving the infrastructure. Finally, Al-Tmeemy *et al.* (2010) introduced a more organisationally focussed lens on the concept of project success by stating that for a project to be considered successful, its outcomes must align with both the short-term and long-term goals of the organisation.

However, it could be argued that such findings are limited; like many other studies on project success, success is only considered from the point of view of a limited number of stakeholders, namely the client, design team and contractor. Therefore, calls have been made in the literature for any definition of project success to consider the view of wider stakeholders (see Bradley, 2008 and Damoah *et al*., 2015). Notably, Cheung *et al.* (2003) argue that factors such as teamwork, relationship, and cooperation between project stakeholders should be considered to become successful. Judgev and Muller (2005) emphasise the need for project success to be assessed from the different views of multiple stakeholders. Ghani *et al.* (2013) also consider project success in terms of meeting stakeholder expectations. Finally, Zuofa and Ochieng (2014) propose a definition of project success that includes the measurement of

stakeholder satisfaction and the project's completion within a specified time and cost. However, these calls do not go far enough in considering the view of wider and underrepresented stakeholders, nor do they ascertain such views and compare them to other stakeholder views to ascertain if perceptions of project success align across different stakeholder groups. Notwithstanding the lack of diverse stakeholder representation in crafting understandings of project success, where project success has been discussed, it has been argued that it is not a stand-alone concept; project failure should also form part of the discussion. Indeed, much of the literature focuses on project failure, inferring that a successful project is, therefore, one that has not failed.

Project Failure

If a project is considered successful when it achieves its set targets, then arguably, it fails when it does not achieve one or more of these targets. Some studies have calculated that approximately 20-30 per cent of projects are classed as complete failures, with between 30-60 per cent classed as failures for not meeting one or more of the iron triangle criteria (Standish 2013). However, it is rarely as simple as such a subjective concept has room for manoeuvre along a continuum of success and failure perspectives, and in order to navigate clear and broad parameters by which to judge a project, the elements considered a failure would need to be identified.

Many define project failure as when a project does not achieve its time, cost and quality targets (Adebisi *et al.,* 2018). Some believe the iron triangle approach is relevant but needs to be broadened to projects that do not satisfy end users' needs and aspirations and those that do not benefit society (Ika, 2012). Others argue that the iron triangle is applicable but only at the project delivery stage (Abednego and Ogunlana, 2006). It has also been argued that the failure of projects can be classified into two categories; partial failure and complete failure (Kezner, 2014). Partial failure can be defined as an unfinished project terminated in the early stages of the project life cycle but impacted knowledge through lessons learnt that will be used to execute future projects. Projects considered complete failures are terminated without lessons learnt (Kezner, 2014).

The literature on why projects fail has also been considered, with Kaliba *et al*. (2009) arguing it is due to scope change and Ochieg and Price (2010) suggesting project failure is due to poor communication. It has also been argued that geographical and cultural clashes could contribute to projects failing (Ahsan and Gunawan, 2010). This is in addition to any unique project attributes, the density of the project network, and the urgency of the project outcomes that all can influence the potential likelihood of project failure (Thai and Swierczek, 2010). Pourrastam and Ismail

(2011) believe project failure is down to inadequate planning and lack of resources, whilst Fabian and Amir (2011) argue that it is due to projects not having access to the required capital and socio-cultural difference that may arise. Ikediashi *et al*. (2014) indicated that poor risk management, budget overrun, schedule delay, poor estimation practices, cash flow difficulties, disagreements in designs, inadequate project structure, lack of effective change management, and lack of top-level management teamwork management are the main causes of project failure. Alao and Jagboro (2017) found mismanagement of funds, inadequate budgetary allocation, inadequate finance, inflation, and bankruptcy of contractors as the main causes of project failure.

Research by Adnan *et al.* (2014) found that in the construction industry, poor decision making, scope creep, poor leadership skills, material changes, delay in payments and cash flow difficulties by contractors were the main causes of project failure and within Africa nations. On the other hand, Ika and Saint-Macary (2014) argue that project failure's main causes are corruption and poor policy planning and implementation. However, much like project success, it has been posited that project failure can be a somewhat subjective concept and down to the perceptions of individuals (Flvbjerg *et al*., 2003), with the factors influencing project failure nebulous and differing from company to company and from country to country (Ghapanchi *et al.,* 2012). It has, however, been highlighted that it is vital to be aware that failed projects might be biased, subject to who is defining project failure (Ika, 2009). Therefore, it is of the utmost importance that all studies that consider project success and failure are subject to critical analysis to understand the stakeholder groups, opinions, and perceptions utilised in each study's conclusions.

Consequently, project success and failure are nebulous and complex concepts for which there are no widely agreed definitions amongst the stakeholders that are most often surveyed for their opinions. What understandings exist are often based upon the perceptions of the same stakeholder groups. Therefore, it is more difficult to identify solutions as to how project success can be achieved in the eyes of underrepresented stakeholder groups such as local communities. Defining project success is ultimately a wicked problem.

Project Success and Failure as a Wicked Problem

A wicked problem is where a complex social issue exists for which it is difficult to identify definitive causes and solutions, and the interconnecting elements of the problem can be difficult to link together (Reinecke and Ansari, 2016). Defining and agreeing on project success and failure can be classified as wicked problems as they have become divisive and complex topics due to the individual project demands and the multitude of diverse

stakeholder groups they span. The ongoing and evolving nature of project success and how what one stakeholder group considers success may not match the perceptions of the other all contribute to the nature of the wicked problem. A failure of the construction industry to understand the project success perceptions of some stakeholder groups such as local communities has further reinforced the nature of the wicked problem. It has resulted in construction projects potentially being viewed as failures by communities yet as a success by the construction team. This is potentially disastrous as the construction team may never be aware of this contradiction as the community's views are never captured and understood. Therefore, any mistakes in the delivery of the project could be repeated time and again, further amplifying the negative ramifications of any project failures.

Therefore, as a wicked problem, it can be difficult to identify those responsible for perpetuating the inability to agree on project success and failure widely and for definitive solutions to be provided (Waddock, 2008). It can also be difficult to identify the causes of wicked problems (Ferraro *et al.,* 2015). For example, defining and achieving project success can be linked to many criteria. As construction projects often have diverse direct and indirect stakeholders, several of which are underrepresented in the literature, the idea of a holistic and widely accepted project success understanding is complex and difficult to achieve. This is further fuelled by the different perceptions different stakeholders often hold, leading to clashes over proposed solutions (Reinecke and Ansari, 2016). For example, the works of literature illustrate project success from a client's perspective as focused around time, cost and quality, yet these criteria may not be shown the same level of importance by local community groups. Indeed, in the parallel construction management literature pertaining to CSR, it has been shown that diverse stakeholders often hold contradictory views, but that these views change and evolve, further convoluting any solution to reaching a wide consensus (Watts *et al*., 2019b). Such challenges presented by project success as a wicked problem result in a formidable challenge for construction organisations to fully understand what constituents a successful or failed project in the opinions of all stakeholders. These challenges motivate the research aim of understanding project success from the perspectives of the local community, as a previously underrepresented stakeholder, and comparing these to the perceptions of clients and the construction teams of the same projects. Undertaking such research will reveal new insights on project success and failure and help understand how construction projects can be delivered more successfully for a broader range of stakeholders.

3. Research methodology

If the nature of reality can be plotted on a continuum, at one extreme, there would be the ontological position of objectivism and at the other

constructivism. Objectivism derives from a natural science approach that argues that social experience exists independent of the agreements reached between social actors (Clark *et al.,* 2021). However, understanding project success is a wicked problem because the concept changes and is influenced by the diverse social actors (stakeholder groups) involved. Therefore, this paper adopts a constructivism approach and argues that understandings are socially constructed and agreed upon by the social actors involved and subject to agreement, negotiation, and evolution (Clark *et al.,* 2021). Furthermore, constructivism dictates an interpretivism epistemological stance, as this is where the subjective meanings of social actions are best suited to understanding the phenomena in question (Cresswell, 2013). This approach underpins the research methods adopted in this study to appreciate project success, perceptions, and interpretations fully; interpretivism aligns with the collection of qualitative data. This offers rich and detailed insights into the motivations, decisions, and beliefs of social actors. Initially, however, a structured literature review was conducted so that research areas could be determined, existing studies could be classified, and points of departure within current research could be found.

The first step was to identify the sources of potential literature material by identifying appropriate academic search engines; Web of Science, Google Scholar and Scopus. A framework for conducting a literature review was developed in line with recommendations by Creswell (2013). This included:

a. The identification of themes and keywords important to the topic
b. The use of these keywords on the search databases identified
c. The collating of all appropriate papers into a map of the literature
d. These literature maps were then analysed, compared and collated to reveal trends and patterns emerging in the literature, revealing the wider context of appropriate papers and the research methods employed.

For the first two steps, the words of key importance used to search the database were ‘project success’ and 'project failure’. It was decided to limit the terms of the literature search to any publications from 2015 onwards to ensure the most up to date literature was being assessed and also to draw a boundary around the research parameters of this study to ensure the literature analysis could be conducted in a timely and comprehensive manner. A literature map was then created (third step) on which all identified research papers were recorded. This map consisted of numbering each paper, identifying the authors and year of publication, recording the paper title, a summary of the findings, the country the research was based, the research methods employed, and the stakeholders utilised. Finally, analysis of literature findings (fourth step) revealed patterns and trends in the wider project success and failure

literature. The results of this literature review are discussed in the findings as they inform the structure and focus of the semi-structured interviews conducted. Semi-structured interviews were the selected research tool to achieve the qualitative data required as they are essentially conversations between two people structured around a central theme. They have the ability for the discussion to go into areas of interest not originally envisaged but allow the research to bring back on track any conversations that veer too far from the central theme (Bryne, 2012). The research plan, including all planned research methods, questions, and analysis techniques were then submitted for ethical approval to the University ethics panel. The proposal was double-blind peer-reviewed and then accepted by the panel. This then allowed the research to commence.

Three recently completed Nigerian construction projects in Ebonyi state were identified as suitable projects to review as they were all public-funded. All of them are relatively large scale, with completely different construction and consultant teams, and within the same state, yet far enough away from each other geographically to impact a different local community. In total, twenty-two semi-structured interviews were conducted across all projects. Twenty-two was deemed optimum to gain a robust understanding of the project success and failure interpretations for all projects as the interviews covered four main stakeholder groups, including representatives from the community local to each project, a previously underrepresented stakeholder group. Research by Guest *et al.* (2006, 2020) also confirmed that in most research projects adopting a <5% new information threshold, six or seven interviews will have captured the majority of themes (Guest *et al.,* 2020), with full saturation typically occurring after eleven or twelve interviews (Guest *et al.,* 2006, 2020). The breakdown of the interviewees can be seen in table 1.0.

For all projects, the perceptions of underrepresented stakeholders were key, but other stakeholders' perceptions were also important, despite such perceptions already appearing more frequently in the existing literature. This was to ensure the different stakeholder perceptions gained could be compared and contrasted around the same

Table 1: The breakdown of interviews conducted

	Type of Respondents			
	Project 1	**Project 2**	**Project 3**	**Total**
	Client (1)	Client (1)	Client (1)	**3**
	Community (2)	Community (3)	Community (4)	**9**
	Consultant (1)	Consultant (1)	Consultant (1)	**3**
	Contractor (3)	Contractor (2)	Contractor (2)	**7**
Total	**7**	**7**	**8**	**22**

project, allowing the identification of any distinct similarities and differences. An online search was conducted of both projects, and any key stakeholders were identified and then subject to their online search for relevant contact details. Initial emails were then sent to the companies identified requesting the contact details of the individuals involved with each project who would be available to be interviewed. This process of purposive sampling was completed in order to identify and reach the recipients who would fulfil the criteria of belonging to one of the identified project stakeholder groups as they would best satisfy the purpose of the research. An element of snowball sampling was also undertaken as for all projects, the contact details of the appropriate consultants were not available online, so these were gained through the contractors interviewed.

The interviews asked the same set of core questions to all stakeholders with a few small differences for each stakeholder group. Questions such as 'what do a successful project look like to you?'; and 'how did the project impact your local community?'. All interviews were recorded and transcribed, and then NVivo10 software was used as part of thematic analysis. Thematic analysis reviews and compares qualitative data to identify prevalent themes across the different data sources (in this instance, the different stakeholder interviews). The process involves identifying and allocating codes and then sections of text grouped using these codes to help identify, compare and contrast key elements of information to generate themes of persistent data ultimately. As Clark *et al*. (2021) discussed, the six-step approach to conducting a thematic analysis was followed in this research. This consisted of:

a. A familiarisation of the data
b. The generation of initial codes
c. The searching for themes
d. Reviewing the themes
e. Defining and naming of the themes
f. Completion of the analysis

5 Findings and Discussion

After duplicates were removed, the literature map revealed that 140 research papers met the criteria for the study. 69 (49%) solely focused on project success, 55 (39%) on project failure and 16 (12%) on both project success and failure. In addition, 121 of these papers conducted primary research in either one or more countries, with 19 papers not specifying a country or themselves being a literature review. A further breakdown of the 121 papers across the six continents can be seen in table 2.0

Table 2.0: A breakdown of countries used in project success sand project failure papers

Continent	Number of papers published
Africa	45
Asia	37
Australia	3
Europe	21
North America	10
South America	5

Further analysis of the 45 papers published based on an African context (table 2.0) revealed 36 were based in Nigeria. Table 3.0 shows the stakeholders each of the 36 Nigerian papers focused upon.

The analysis revealed that some stakeholders are not included in any recent Nigerian research papers on project success and failure, for example, the community and businesses local to the project itself. This lack of stakeholder inclusion is even more extreme for those studies adopting interviews as a research method as further analysis of the literature reveals that such a method is only used to ascertain the views of contractors and the wider construction team. Analysis of the literature also reveals that questionnaires are the predominant research method selected by studies investigating project success and failure. While this research method has associated benefits, questionnaires often fail to address the depth and nuance required to understand subjective concepts such as project success and failure and would fail to understand these as a wicked problem. Such findings from the literature support the position of this paper that to understand project success as a wicked problem in a Nigerian context from a new perspective, interviews are required, specifically including previously underrepresented stakeholders such as the community local to any completed project.

The results of the semi-structured interviews revealed interesting differences between the views of the local community and the rest of the stakeholders interviewed (clients, consultants, and contractors) when it comes to their perceptions of project success and failure. Perhaps surprisingly, there were very few overlapping areas when defining project success. Instead, clients, consultants, and contractors all believed the success of a project is determined around its performance against time, cost, and quality, and therefore a failure to achieve these criteria ultimately results in project failure. As one contractor stated:

"*if you have a programme in place, it is very important to the client that you achieve it; that can determine whether [the project] is successful or a failure.*"

However, each contractor did show a slightly different interpretation of what they considered project success to be, as another contractor argued:

"*To us, it was a successful project because we have delivered what the client wants."*

Table 3: A breakdown of the number of papers published focusing on a Nigerian context by stakeholders

Stakeholders	Number of papers published focusing on Nigeria
Client	5
Contractor	7
Contractor and Consultant	3
End User	3
Wider Construction Team	18

These illustrate the client's potential power in determining project success criteria and reinforce key themes from the literature that project success means different things to different stakeholders (Ghadamsi, 2016). It further perpetuates project success, and failure as a wicked problem as the issue is complex, with an associated difficulty to identify causes, solutions, and the interconnecting elements (Reinecke and Ansari, 2016

However, the results of this research also build upon previous literature whilst answering earlier calls for a more diverse stakeholder appreciation (see Ghani *et al*., 2013; Zuofa and Ochieng, 2014). An analysis of the interview data reveals that local community stakeholders view project success differently entirely. The local community stakeholders are more focused on a lack of ownership of the recent projects. One key success factor for the local community was how invested they felt in the new project. The results revealed that the higher involvement levels in the planning, design, and building of the project local community members have, the more invested the community feels. This also leads to a lower conflict and a greater perception of project success. As one local community interviewee responded:

"...any project that occurred without community conflict might be considered a successful project".

A further divide between the local community as a stakeholder and the clients, consultants, and contractors as stakeholder groups was also apparent in their interpretation of the three projects wider social value and impact. Clients, consultants, and contractors were all on one side of the divide, stating that a new project's very nature benefited the local society. This was due to the influx of site operatives during the construction phase, increasing the wealth of the area and the new asset itself once the works were completed and operational – all factors they felt resulted in the projects being considered successful and beneficial to the communities impacted. However, the local community disagreed with this as a beneficial social impact or project success factor. Indeed, in direct contradiction to the views of all other stakeholders interviewed, one local community interviewee stated they felt the community were treated as if they should be:

"...thankful and pleased to have their rights violated...by people who believe they have the authority to decide what the community needs."

Further, the local community viewed projects as a failure during the operation phase if local areas suffered an influx of strangers, even temporarily. The reasons for this were given as negative influence on the youth, personal property infringement, and any loss of livelihood from disruptions to the status quo of the local areas. Again, this directly contradicts the perceptions of contractors, clients, and consultants and further serves as an ingredient to project success's growing wicked problem.

Interestingly the clients, consultants, and contractors never reached out to the local community representatives before, during, or after construction. However, all believed with different levels of self-

assurance that the projects they were involved in would benefit the local community. However, as these stakeholders had all openly agreed that project success is of paramount importance and is judged against a combination of time, cost, and quality, they believed any successes for local communities aligned with their project success criteria. The local community realised this as one interviewee stated that even when meetings between the client, construction team and the community are organised, cancellation is high, and attendance is low as:

"...at the end of the day, the government take it upon themselves to do things the way they always do things, that is the Nigerian factor here."

With one local community stakeholder even saying:

"Our people have gone to court; the government used their power to influence the decision of the court."

The client, consultant, and contractor focus on criteria concerning time, cost, and quality as project success was not echoed by the local communities. None of the local community stakeholders interviewed highlighted any of these three factors when discussing and describing successful projects, nor did they discuss such factors when describing failed projects. Ultimately, local communities reported a lack of a voice and recognition as an important stakeholder in the construction process as the reason projects are deemed as failures in their eyes; as one local community interviewee stated, project success could be achieved if those in charge:

"...took the views and the perspectives of the community into consideration, what they need, how they need it and how it would best serve everyone."

Whilst another community member called for better integration of:

"…community members into the planning and design stage of the project, and then the construction…."

This is an interesting revelation as it appears far from a lasting legacy or even positive social benefits; what the local community want for each project, and what would make each project a success in their eyes, is to have their voices heard. Moreover, this factor was recognised by other stakeholder groups, as one consultant revealed:

"I think most of the government's projects, when they are sited politically without consideration of the communities, whether the projects are correctly sited or not…."

This would arguably further convolute project success as a wicked problem, as one of the root causes of the wicked problem is the number of disparate and diverse stakeholder groups. Indeed, this was confirmed in the data analysis as clients, consultants, and contractors all held overlapping roles in project responsibility, and all had their agendas as to the cost, time, and quality criteria, often in direct competition with one another. For example, one client reported that achieving the lowest cost overall for the finished construction project would be a mark of success. However, the contractor of that project believed the project would have been more successful for their organisation if they had made more profit – so an increase in the project

success for the contractor would inevitably decrease the project success for the client. With such conflicting perceptions of project success, the wicked problem it has become is unlikely to be resolved, especially with the inclusion of different perceptions of success from previously underrepresented stakeholder groups such as the local community.

Nevertheless, one contributing factor to project success being a wicked problem is the lack of clarity over the requirements of each stakeholder group, the findings of this research serve to inform this by providing such clarity. Clients, consultants and contractors can no longer project their definitions of project success upon the local community and expect them to stay in place, especially when such projections are void of reality. Local communities demand to have their voices heard and simply allowing this to happen is the first step to empowering the local community and supporting them to view projects as successful. This paper has illustrated how it can achieve wider project success for all stakeholders in the construction industry. It has contributed to the existing literature in firstly utilising interviews to understand and compare project success from multiple stakeholders as this has revealed an insightful and detailed understanding of how the local community views project success. However, it has also contributed by showing that paradoxically, listening to wider stakeholder views would better inform the construction, client and consultant of wider project success criteria and further perpetuate the problems experienced as a result of project success being a wicked problem.

6 Conclusion

Extensive research has been conducted on what constitutes project success and failure. With a broad understanding, a project that achieves its time, cost, and quality criteria is successful, and one which does not is not successful. Such research, however, has predominantly focused upon clients, consultants, and contractors as the stakeholders whose perceptions are gained. As a result, the perceptions of the local community are often ignored. This, combined with the evolving nature of project success and the already disparate nuances in defining and agreeing on the topic, makes it a wicked problem. Through an extensive and structured literature review and interviews with clients, consultants, contractors, this paper sought to understand disparate stakeholder views pertaining to the success or failure perceptions of two recently completed Nigerian construction projects. Analysis of the data revealed that differences existed between the perceptions of project success amongst the client, consultant and contractor, further fuelling the wicked problem of project success. However, there was broad consensus amongst these three stakeholders, but they were on one side of a divide with the local community on the other. The former projected their own beliefs of what project success looked like for the local community and argued these would be realised with the construction of the building itself. However, by not including the local community in their project discussions, the clients, consultants, and contractors were unaware that all the local community required was acknowledgement

and to have a degree of ownership of their own views and an arena to have their voices heard. To the community, it is not if a project achieves its time, cost, or quality criteria that make it successful, but that their voices are heard in its design, development, and construction.

This paper contributes to the existing literature in two main ways. Firstly, there is a paucity of research around local communities when it comes to defining and understanding project success and failure, and this research serves to provide them with a platform. Secondly, for the construction industry itself, allowing the voices of all stakeholders to be heard would enhance the chances of a wider range of stakeholders growing a project as successful. Meaningful community engagement should be viewed with the same importance as time, cost, and quality. Recommendations for future research are to build on the findings of this study by including local communities in more project success studies and expanding beyond the context of the Nigerian construction industry to see if the findings are generalisable beyond the context of this study.

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Geotechnical Investigations and Implications on the Execution of Building Projects in Nigeria.

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Abstract

This study examined the difference in awareness levels among clients, contractors, and consultants about geotechnical investigation practices in construction projects. It also identified the causes of inadequate geotechnical investigation in building projects and determined its performance impact. A structured questionnaire was administered to 384 randomly selected construction industry professionals in Kwara, Kogi, Niger States, and the Federal Capital Territory (FCT), Abuja, all in the North-central geopolitical zone of Nigeria. A response rate of 62.20% (239 valid responses) was achieved, and the data were analyzed using a combination of descriptive analysis, rank order, and inferential statistics using Microsoft Excel and Statistical Package for the Social Sciences (SPSS). The findings reveal the existence of a heterogeneous practice of geotechnical investigation for building projects among the contracting firms, consulting firms, and client organizations in Nigeria, and the regression model could predict that relationship among geotechnical investigation and identified variables. $Adequate\ Geotechnical\ Investigation = -0.250 + 0.089 * Client\ Awareness - 0.038 * Financial\ Constraint" + 0.387 * Sampling\ Technique + 0.582 * Equipment"$ *Additionally, the impact of the inadequate geotechnical investigation on cost, schedule, and performance of building projects amount to overruns and poor performance.*

Keywords: *Building Projects, Construction Industry, Cost Overrun, Project Performance, Schedule Overrun*

1. Background

The success of most civil engineering projects largely depends on the adequacy of geotechnical investigation of surface and subsurface soil conditions. A poor appreciation and application of geotechnical engineering have been a major concern, being blamed for many engineering and structural failures. These engineering failures relate to the ground conditions and foundations, slopes and infrastructure for road, rail and utilities, and often to extreme and expensive consequences (David *et al*., 2017). Inadequate or insufficient geotechnical investigations leads to inappropriate designs, environmental damage to the site, delays in

construction schedules, costly construction modifications, and other related issues (Temple and Stukhart, 1987; Zumrawi, 2014; Žlender and Jelušič, 2016; Neupane, 2016). The stability and durability of civil engineering structures (for instance, buildings, highways, dams, bridges, etc.) are dependent on the stability of soil used for foundation or as construction materials (Laskar and Pal, 2012).

It is inferable from earlier studies on geotechnical investigations (Nwankwoala and Amadi, 2013; Avwenagha *et al*., 2014; Nazir, 2014) that engineers, project managers, and other built environment practitioners use the information acquired from geotechnical investigation to design and effectively manage these projects in order to satisfy the project constraints of time, cost, and quality. The results from the geotechnical investigation are used to determine the strength of the soil and groundwater levels and to propose any geometry of the supporting structures (Nazir, 2014). Although a geotechnical investigation is usually carried out in phases, many scholars highlight the phases involved as preliminary investigation or desk study, detailed investigation, and investigation during construction (Baecher and Christian, 2003; Zumrawi, 2014; Albatal *et al*., 2013; Myburgh, 2018). The initial phase involves carrying out a desk study or acquiring geological information about the region. Myburgh (2018) notes that the desk study involves a detailed review of existing records. After the initial phase, a detailed investigation is carried out to obtain data through in-depth exploration, sampling, measurement, physical examination, laboratory tests, and analyses of both surface and subsurface soils. Although this phase may be regarded as the costliest, it is the most cost-effective phase of the investigation process by reducing the potential for unforeseen ground risks. The investigation during the construction phase mainly aims to enhance previous findings of the preceding phases of the investigation (Myburgh, 2018). This investigation is carried out during earthwork or construction of the foundation; therefore, geotechnical investigations must be conducted and supervised by qualified and experienced professionals to guard against the observation (Charles, 2005).

It has been shown that a link exists between geotechnical analysis and cost overrun in infrastructure projects (Amadi and Higham 2016; Hintze 1994; Temple and Stukhart, 1987). In addition, case histories presented by Kelly *et al*. (2020) demonstrated that the quality and depth of site investigation directly impact actual performance versus predicted performance and hence on the cost and time performance of the project. Attributed risks within the ground amount to high cost and time overruns on construction projects. Sadly, a comprehensive site investigation to address such risks is often ignored as an unnecessary cost (Hytiris *et al*., 2014). Contrarily, Moh (2004) and Nazir (2014) attributed geotechnical failures to inadequacy of standard

specifications concerning the scope and quality of site investigation.

The consequences of insufficient information from geotechnical conditions adversely affect both the financial and technical performance of construction projects, resulting in additional costs of construction, operation, or maintenance (Clayton, 2001) and, in worst cases, loss of lives and properties, building collapse, or complete demolition and reconstruction. In addition, inadequate site investigation can lead to overdesign and/or under design. This could have been avoided if a proper site investigation had been conducted. According to Hytiris *et al*. (2014), the cost performance analysis for some selected building projects showed that 44% of cost increases are attributable to inadequate site investigation. This is similar to the outcome presented in Albatal *et al*. (2013), which shows that inadequate geotechnical and site investigation lead to cost overrun by about 64.2%.

The incidence of building collapse has been a reoccurring issue for a considerable period in Nigeria (Ayedun *et al*., 2011, Hamma-Adama and Kouider, 2017). Building collapses are manifestations of failures that are not identified and addressed (Okagbue *et al*., 2018). A failure can be considered as occurring in a component when that component can no longer be relied upon to fulfil its principal functions (Ayininuola and Olalusi, 2004). According to So *et al.* (2008), structural failures may occur at three phases of a building's lifespan: construction, operation, and rebuilding. Hence, failures at any stage may result in potentially fatal accidents for construction workers or end-users, as the case may be. Lawal *et al*. (2017) also argued that buildings give initial symptoms of distresses in the form of defects before they eventually fail. Defects in buildings thus constitute undesirable challenges and threats to users. Olanitori (2011) opined that defects emanate from design errors, manufacturing flaws, defective materials, improper use or installation of materials, lack of adherence to the design, or any mix of the aforementioned causes. Lawal *et al*. (2017) identified active cracks on beams, columns, slabs and walls, improperly sloped roof gutters as building defects. According to their study, the probable causes of these defects were workmanship errors and defective materials.

Islam *et al*. (2021) presented that building professionals frequently experience defects and failures in different structural components, which are essential to a buildings' performance within its service period. Their study revealed that the most severe defects in buildings were footing/column settlement, tilting, cracks (in columns, beams, walls, and slabs), efflorescence, and seepage in walls and slabs. The study also identified improper sub-soil investigation, imperfect structural design, poor quality of materials used, poor workmanship, and excessive live load due to change in service types after construction as the common causes of these defects.

Ayedun *et al*. (2011) empirically ascertained the causes of building failure and collapse from the stakeholders' perspectives. These include poor workmanship by contractors, use of incompetent contractors, faulty construction methodology, non-compliance with standards by contractors, inadequate supervision, structural defects, defective design/structure, and dilapidating structures as the major causes of building collapse in Lagos State. Similarly, through a systematic review of literature, Okagbue *et al*. (2018) harmonized the causes of failures and collapses of buildings in Nigeria. The findings revealed the most common causes as inferior construction materials, geophysical or natural causes, structural defects, inefficient management of construction processes, construction defects, corruption or sharp practices, as well as non-compliance with legal requirements. Hamma-Adama and Kouider (2017) identified substandard reinforcement, structural steel and cement used for foundations, erection of columns, beams and slabs as the main causes of building collapse in Northern Nigeria. Additionally, Fagbenle and Oluwunmi (2010) identified hasty construction, low-quality workmanship, poor supervision, inexperience (use of incompetent hands), ignorance, evasion/ non-compliance with building regulations and non-enforcement of building quality as the major causes of building failures in Northern Nigeria.

Akinradewo *et al*. (2019) concluded from their study that poor financial control on-site, previous contractor experience, contract management, and wrong estimation method were major factors that cause cost overrun in building construction projects. Cost overrun is the difference between the planned or estimated cost and the actual construction cost on completion (Niazi and Painting, 2016). Enshassi and Ayyash (2014), in their study, categorized the factors causing cost overrun in building projects as client-related, project team-related, contractor-related, economic-related, political-related or manpower-related. Similarly, Chulkov *et al*. (2019) grouped the underlying factors into project, contract, client, contractor consultant, workforce and external categories.

The significance of geotechnical investigation cannot be overemphasized as findings would curb project failure drastically. As such, risks would be minimized, and the potential for a safe and economical design would be maximized. A higher likelihood of project completion within time and cost is also realizable (Watts and Davis, n.d.). It is also imperative that project team members, including young and inexperienced practitioners, be accustomed to minimum geotechnical investigation requirements for basic knowledge applicable to any kind of project.

Given the preceding, this paper seeks to examine the difference in awareness level among clients, contractors, and consultants about geotechnical investigation practices in

building construction, to identify the causes of inadequate geotechnical investigation on construction projects, and to assess the impact of the inadequate geotechnical investigation on construction project performance.

2. Materials and Method

The study adopted a mixed-method approach, combining both qualitative and quantitative methods. Wisdom and Creswell (2013) note that a mixed-method approach is an emergent methodology of research that systematically integrates both the qualitative and quantitative data within a single programme of study. It enhances an understanding of the contradictions inherent in quantitative and qualitative results and ensures that findings are rooted in participants' experiences (Wisdom and Creswell, 2013). The survey questionnaire was utilized as a data-gathering tool to ascertain respondents' perceptions on some geotechnical investigation related issues. The survey was conducted with a sample size of 384 using the formula for sample size determination proposed by Cochran (1977) (equation 1).

$$n_0 = \frac{Z^2 pq}{e^2} \qquad \text{eqn 1}$$

Where:

e = desired level of precision = 0.05

p = proportion of the population with desired attribute = 0.5

q = 1 – p = 0.5

Z = 1.96 at 95% Confidence level

Questionnaires were administered to Civil Engineers, Geotechnical Engineers, Engineering Geologists, Project Managers, Builders, Architects, Quantity Surveyors, and Surveying & Geo-informatics professionals from client organizations, contracting firms, and consulting firms in North-Central Nigeria (Kwara, Kogi, and Niger States and the Federal Capital Territory (FCT) Abuja). As suggested in earlier works on sampling techniques (Drott, 1969; Emerson, 2015), the participants were randomly selected. The choice of the study areas was influenced by a combination of convenience, proximity, geological nature of the areas, as well as the prevailing socio-economic situation. A combination of descriptive analysis, rank order and inferential statistics were used to present the data. Microsoft Excel and Statistical Package for the Social Sciences (SPSS) were used to analyse the data.

In order to achieve the objectives of this study, five hypotheses were proposed as follows:

$H_0$1: The distribution of geotechnical investigation practice in building construction is not statistically different across categories of organization type

$H_0$2: The distribution of 'designated groups or personnel responsible for geotechnical investigation' is not statistically different across categories of organization type.

$H_0$3: The distribution of 'adherence to the results acquired from a geotechnical investigation in the design and

construction of building projects is not statistically different across categories of organization type.

$H_0$4: The distribution of 'sampling technique' is not statistically different across categories of organization type.

$H_0$5: The distribution of 'method of soil observation' is not statistically different across categories of organization type.

The hypotheses would be tested using the Kruskal-Wallis H Test. This is a non-parametric test for determining whether samples originate from the same distribution (Daniel, 1990, Kruskal and Wallis, 1952). The Kruskal-Wallis test's null hypothesis, while assuming that the groups' mean ranks are equal, does not assume that the underlying data are normally distributed (Xia, 2020). Existing works on statistical analysis (Gauthier and Hawley, 2015, Riffenburgh and Gillen, 2006, Hoffman, 2019) suggest that Kruskal-Wallis test statistic determined using an equation similar to equation 2.

$$H=\frac{12}{N(N+1)}\sum_{i=1}^{K}\frac{R_i^2}{n_i}-3(N+1) \quad \text{eqn 2}$$

Where N is the total number, ni is the number in the i-th group, and Ri is the total sum of ranks in the i-th group.

The Kruskal-Wallis H Test would be used to examine differences in awareness levels of the clients, contractors, and consultants about geotechnical investigation practices in building construction. The decision rule is to reject the null hypothesis and accept the alternative hypothesis if the significance value is less than the chosen alpha value (α =.05).

A regression analysis was equally carried out to derive a mathematical model of the relationship between the identified dependent and independent variables (Chatterjee and Simonoff, 2012). The equation model of the study is presented below:

$$Y=\beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\beta_6X_6+\varepsilon \quad \text{eqn. 3}$$

Where:

"Y=Adequate Geotechnical Investigation"

"β" _"0" "=Constant" ; "β" _"1" 〖"- β" 〗_"6" "=Regression coefficients" ; "X" _"1" "=Client awareness" ;

"X" _"2" "=Financial Constraint" ; "X" _"3" "=Result presentation" ; "X" _"4" "=Supervision" ;

"X" _"5" "=Sampling Techniques" ; "X" _"6" "=Equipment" ; "ε=Stochastic disturbance error term"

3. Analysis of Results and Findings

3.1 Distribution of Respondents

A 62.2% response rate (239 valid responses) was achieved, which is adjudged sufficient to produce a valid and generalizable outcome. Furthermore, the result of the data analysis revealed a good mix in terms of professional affiliation, qualification, experience, and location. Therefore, the outcome is representative and could be generalized to a larger population. The distribution of the respondents according to academic qualification is National Diploma (12 respondents or 15%), Bachelor's

degree (130 respondents or 54.4%), Master's degree (76 respondents or 31.8%), and PhD (21 respondents or 8.8%) as shown in Table 1. The distribution according to the professional qualification of respondents showed that 23% (55) of the respondents were Civil engineers, 14.6% (35) were Project managers, and 13.8% (33) were Geotechnical engineers. Other representative professionals include Architecture (12.6%), Surveying and Geo-informatics (12.6%), Quantity Surveyor (11.3%), Engineering Geologist (7.9%), and Builder (4.2%), as shown in Table 2.

Table 1: Highest qualification of respondents

Qualification	Frequency	Percent
ND	12	5
Bachelor's Degree	130	54.4
Master's Degree	76	31.8
PhD	21	8.8
Total	239	100

Table 2: Profession of respondents

Profession	Frequency	Percent
Civil Engineer	55	23
Geotechnical Engineer	33	13.8
Engineering Geologist	19	7.9
Project Manager	35	14.6
Builder	10	4.2
Architect	30	12.6
Quantity Surveyor	27	11.3
Surveying and Geo-informatics	30	12.6
Total	239	100

The result equally revealed that 30.5% (55) of the respondents were in the FCT, 26.8% (64) in Kwara State, 24.3% (58) in Niger State, and 18.4% (44) in Kogi State. About forty-four per cent (107) of the respondents work in contracting firms, while 29.3% (70) were from client organizations, and 25.9% (62) in consulting firms. For the frequency distribution for years of practice experience in building construction, results showed that about 46.4% (111) had at least ten years of practice experience in building construction while the other 53.6% (128) had years of experience ranging between 1-10 years.

3.2 Uniformity in Geotechnical Investigation Practices by Organizations

The summary of the Kruskal-Wallis H Test to examine to determine if a difference in awareness level among clients, contractors, and consultants about geotechnical investigation practices in building construction exists is presented in Table 3. There was no sufficient evidence to support the proposed hypotheses based on the results. Therefore, null hypotheses $H_0$1, $H_0$2, and $H_0$3 were rejected as they had values of .256 and .263, respectively. Therefore, because they are greater than the chosen alpha value (α = .05), we accept the proposed null hypotheses $H_0$4 and $H_0$5.

3.3 Causes of inadequate geotechnical investigation

Causes of the inadequate geotechnical investigation were ranked and presented in Table 4. According to respondents' assessments, the result shows that 'Client Awareness', 'Equipment', 'Sampling technique', and 'Financial Constraints' are the major causes of inadequate geotechnical investigation in building projects. The result also reveals that 'Lack of geotechnical expertise' and 'Lack of

Table 3: Kruskal-Wallis H Test Summary for Hypotheses 1 to 5

S/No	Description Hypothesis	Sig.	Decision
1	$H_0$1 - The distribution of 'geotechnical investigation practice in building construction is not statistically different across categories of organization type.	.000	Reject the null hypothesis.
2	$H_0$2 - The distribution of 'designated group or personnel responsible for geotechnical investigation' is not statistically different across categories of organization type.	.000	Reject the null hypothesis.
3	$H_0$3 - The distribution of 'adherence to the results acquired from a geotechnical investigation in the design and construction of building projects' is not statistically different across categories of organization type.	.000	Reject the null hypothesis.
4	$H_0$4 - The distribution of 'Sampling technique' is not statistically different across categories of organization type.	.256	Retain the null hypothesis.
5	$H_0$5 - The distribution of 'Method of Soil Observation' is not statistically different across categories of organization type.	.263	Retain the null hypothesis.

significant values less than the alpha value of.05. The alternate hypotheses accordingly were retained. However, the Kruskal-Wallis H Test summary for sampling technique and methods of soil observation summary shows significant

Table 4: Causes of inadequate geotechnical investigation in building projects

	(1)	(2)	(3)	(4)	(5)	Mean	Std. Dev.	Rank	*p*-value	R
Client Awareness	0	6	14	55	164	4.59	.710	1	.000	.494
Equipment	0	0	33	53	153	4.50	.727	2	.000	.902
Sampling technique	20	0	13	42	164	4.38	1.164	3	.000	.894
Financial constraint	0	36	38	25	140	4.13	1.156	4	.004	-.185
Supervision	20	2	26	102	89	4.00	1.128	5	.017	.115
Result presentation	20	0	46	117	56	3.79	1.068	6	.000	.295
Time constraint	0	10	88	94	47	3.74	.818	7	.003	.822
Lack of geotechnical expertise	20	30	58	92	39	3.46	1.222	8	.005	.874
Lack of integration	33	10	48	109	39	3.42	1.153	9	.000	.956

integration' ranked lowest with mean values 3.46 and 3.42 respectively.

3.4 Implications of inadequate geotechnical investigation on building projects

The study sought to establish the perception of critical building project stakeholders about the implications of inadequate geotechnical investigation on cost, schedule, and performance of building projects. Concerning cost, the results revealed that inadequate geotechnical investigation has a significant impact on the cost of building projects (Figure 1).

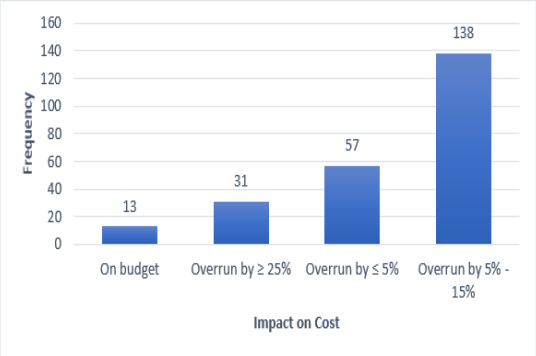

Figure 1: Implication on Cost

Although about 5% of the respondents believed that the project would remain within the budget even with geotechnical related changes, a larger proportion of the respondents believed that it would lead to cost overrun. About 58% of the respondents estimated that the cost overrun could be between 5% and 15%. Although another 24% of the respondents agreed that it could lead to a cost overrun, they believed the cost overrun is usually more than 5%, while 13% agreed that cost overrun is usually over 25% of the project cost.

It is equally noticeable from the study results that geotechnical related changes adversely affect the schedule of building projects (Figure 2).

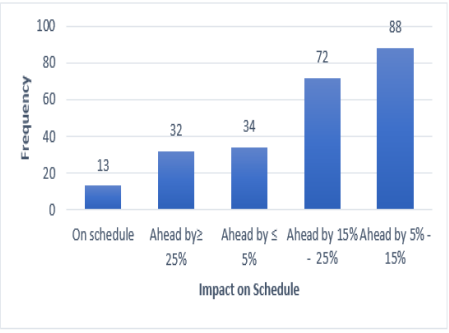

Figure 2: Impact on Schedule

About sixty-seven per cent of the respondents agreed that geotechnical related changes caused schedule overrun ranging between 5% and 25%. Additionally, thirteen per cent of the respondents felt that schedule overrun due to geotechnical related changes could be greater than 25%, while fourteen per cent of the respondents agreed that schedule overrun is usually less than 5%.

3.5 Implications on Performance of Building Projects

Table 5 presents the respondents' views about the implications of inadequate geotechnical investigation on the performance of building projects. The variable, 'Settlement', ranked first with a mean score of 4.49, while 'reduction in bearing capacity due to ground failures' ranked second with a mean score of 4.50, and 'cracks on structural elements (beam, slab, column)' ranked third with mean score 4.48. Furthermore, 'kinematic forces acting on deep foundations due to shear deformation of soils and overturning moments imposed on the foundation from the superstructures' ranked fourth with mean scores 4.46; 'collapsed foundations and tilting of buildings' ranked sixth with a mean score of 4.41, while 'cracks on walls' with a mean score of 4.19 was the least ranked. These indicate the extent to which inadequate geotechnical investigation adversely impacts building projects. Hence, the severity could be as high as settlement of the structure, reduction in bearing capacity, or collapsed foundations. More so, these defects could lead to the loss of lives and properties.

Multiple regression analysis was conducted to study the relationship between adequate geotechnical investigations and the identified predictors. An initial analysis showed

Table 5: Impact of geotechnical investigation related defects on building project performance

	(1)	(2)	(3)	(4)	(5)	**Mean**	**Std. Dev.**	**Rank**	***p*-value**	**R**
Settlement	0	20	13	13	193	4.59	.926	1	.000	.659
Reduction in bearing capacity due to ground failures	0	0	33	53	153	4.50	.727	2	.000	.708
Cracks on structural elements (beam, slab, column)	0	0	33	59	147	4.48	.727	3	.000	.403
Kinematic forces acting on deep foundations due to shear deformation of soils	0	20	13	42	164	4.46	.929	4	.000	.735
Overturning moments imposed on the foundation from the superstructures	0	20	13	43	163	4.46	.929	4	.000	.767
Collapsed foundations	0	20	13	54	152	4.41	.926	6	.000	.741
Tilting of buildings	0	20	13	56	150	4.41	.925	6	.000	.839
Collapsing soils/liquefaction	20	0	13	42	164	4.38	1.164	8	.000	.599
Cracks on wall	0	36	36	13	154	4.19	1.169	9	.000	-.079

high multicollinearity among the independent variables. Hence, the final regression analysis excluded three independent variables (time constraint, lack of geotechnical expertise). Table 6 summarises the descriptive statistics and analysis of results and shows a multiple correlation coefficient (R) value of 0.947) of the six independent variables with the dependent variable as presented. The adjusted R-Square value of .894 indicates that 89.4% of the variance in the dependent variable is explainable by the six independent variables.

Table 6: Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.947a	.897	.894	.301	1.749

[b]. Dependent Variable: Y

In order to examine the desirability of the regression model, independent variables with p-values greater than .05 were removed from the model.

The model of the relationship between the dependent variable (adequate geotechnical investigation) and the independent variables is represented by:

$$Y=-.250+.089X_1-.038X_2+.387X_5+.582X_6$$ eqn. 4

Where Y = Adequate Geotechnical Investigation,

X1 = Client Awareness, X2 = Financial Constraint, X5 = Sampling technique,

X6 = Equipment

4. Discussion

The findings from the study revealed a disparity in the perception level of the three groups (clients, contractors, and consultants) about the practice,

Table 7: Coefficients[a]

	Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
	B	Std. Error	Beta	T	Sig.	Tolerance	VIF
(Constant)	-.250	.181		-1.379	.169		
Client awareness	.089	.033	.068	2.695	.008	.697	1.436
Financial constraint	-.038	.017	-.048	-2.222	.027	.959	1.043
Error in result presentation	.013	.036	.015	.358	.721	.263	3.801
Supervision	.011	.033	.013	.329	.743	.281	3.558
Sampling	.387	.031	.487	12.430	.000	.289	3.456
Equipment	.582	.052	.457	11.094	.000	.262	3.818

a. Dependent Variable: Y

designation of responsibility, and adherence to results of a geotechnical investigation in building projects. However, there is no statistical evidence of a significant difference in sampling technique and (soil) sample observation methods in building projects among the groups. The study also identified the causes of inadequate geotechnical investigation in building projects. The findings further revealed that identified variables are statistically significant, with *p*-values ranging from 0.00 to 0.017 and correlation coefficient 'r' ranging from -0.185 to 0.956. This result implies that most clients, especially residential buildings, have very low awareness of the importance of conducting a geotechnical investigation.

Furthermore, the emergence of 'equipment' as a major cause of inadequate geotechnical investigation in building projects implies that the lack of necessary equipment and machinery significantly affects the adequacy of the geotechnical investigation. Furthermore, the results indicate a possible lack of technical know-how or understanding of geotechnical investigation sampling techniques adopted in building projects, given its high mean score. It is also evident that there is usually no budget for geotechnical investigation or insignificant allocated cost. Overall, the trend of the presented result revealed that little or no attention is given to geotechnical investigation in building projects, especially in residential projects.

The variable 'client awareness' with a statistically significant value of .008 (*p*-value < .05) and an unstandardized coefficient .089 indicates that every unit change in client awareness would cause a 0.089 improvement in geotechnical investigation. Similarly, a statistically significant value of .027 (*p*-value < .05) and coefficient value of -.038 for financial constraint implies that a unit increase in budget provision for geotechnical investigation would cause an inadequacy to the geotechnical investigation. The sampling technique used also has a statistically significant value of .000 and a coefficient value of .387, which implies that the variable improves geotechnical investigation by .387. At the same time, a unit increase in equipment would cause an increment of .582 in the adequacy of the geotechnical investigation. On the contrary, result presentation and supervision are not statistically significant with a *p*-value > .05. This implies that these independent variables have no significant impact on the dependent variable. The outcome of this is in line with the conclusion drawn in earlier studies that insufficient geotechnical investigation is one of the first sources of projects' delays, disputes, claims, and projects' cost overruns and that the intended savings, due to conducting inadequate site investigations, lead to cost overrun by 64.2% of the project cost (Albatal *et al*., 2013; Albatal, 2013; Neupane 2016; Žlender & Jelušič 2016).

5. Conclusion and Recommendation

The study concludes that there is a heterogeneous practice of geotechnical investigation in building projects among

the contracting firms, consulting firms, and client organizations in Nigeria. The major causes of inadequate geotechnical investigation in buildings are client awareness, equipment, sampling technique, and financial constraint. The study also developed a regression model to show the relationship between these causes and adequate geotechnical investigation. Additionally, based on findings, the study concludes that the inadequate geotechnical investigation impact cost, schedule, and performance of building projects adversely through overruns and poor performance.

Based on the findings and conclusion of this study, the following is recommended;

- Government policies to enforce the detailed and standard practice of geotechnical investigation in building projects
- Clear presentation of investigation results for easy interpretation
- Adequate sampling technique
- Provision of adequate budget to explore subsurface conditions.
- Retention of suitably qualified and experienced design consultants to investigate, evaluate potential risks, prepare drawings, specifications and a geotechnical baseline report consistent with the risks.
- Allocation of sufficient time and financial resources to prepare a detailed geotechnical investigation consistent with other design documents.

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