TAMPERE UNIVERSITY
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# SHIPPING CONTAINER AS AN ALTERNATIVE HOUSING SOLUTION

Case Study Lagos, Nigeria.

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**ABSTRACT**

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The ever-growing population of Lagos state, Nigeria has brought a challenge in housing which has resulted in a housing deficit of 5 million people in Lagos and 17 million on a national scale. An alternative solution of using habitable shipping container homes to support the construction capacity of conventional construction method that lacks the capacity to the deliver the annual required number of houses, is readily available but not common to many Lagos residents as they are familiar with temporary shipping container structures such as kiosk, site offices and emergency shelters.

This study was set out to understand the perspective, concerns and requirements in using shipping containers as an alternative solution in providing affordable and decent housing from a societal point of view of low and middle-income earners majorly affected by prominent housing deficit within Lagos and also the viability of the alternative solution for tropical region like Lagos in terms of cost, quality, and affordability when compared to conventional building methods.

The result shows that the choice of Lagos resident in accepting shipping container homes as alternative is not dependent on their educational background, age, or income, rather it is more societal status issue where people will accept what is commonly used by the society at large. Recommendations where made on how best to deliver this shipping container alternative home to Lagos residents and how Lagos state government can also support in the implementation.

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Key words: shipping container homes, low and middle-income earners, housing deficit,

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## 1.1 INTRODUCTION

## 1.2 Background

Adequate housing is a significant need for human survival, and a fundamental right according to article 25 of the United Nations human right declaration of 1948. (United Nations, 2014). However, several international conventions on adequate housing as a right as been signed and ratified by Nigeria, but Section 16 sub section 2(d) of the 1999 Constitution of Nigeria provides that the State shall direct its policy towards ensuring that suitable and adequate shelter is accessible for all citizens, which is not stated as a right , rather as an objective of the state, making it non-justiciable in accordance to section 6 sub section 6(c) of the 1999 constitution of Nigeria. (Chegwe, 2014). This simply connotes that actualization of socio-economic right of Chapter 2 of the Nigerian constitution by the Nigerian government cannot be judicially obligated. (Diala, 2012)

The demand for affordable and adequate housing has been on the increases over the past few years in Nigeria. In a recent housing summit held in Abuja, it was made known that as at 1991 the housing deficit was estimated at 7 million and 17 million in 2017 which has been a major source of concern for the Nigerian government in finding drastic solution in solving the problem. (Okafor, 2017).

Lagos state being the commercial nerve centre and also the smallest state in Nigeria shares an estimated 5 million housing deficit which makes up 31% national estimate. This huge amount in housing deficit as brought about many informal dwellings and settlements within the city and as a result increase the number of slums from 42 in 1985 to over 100 as at January 2010. (Olugbenga & Ogundiran , 2013). The people affected the most by the housing deficit are majorly the lower-middle and low-income earners of the society who have no access to adequate housing as result of the inability to afford the financial cost of adequate housing on the market due to the high poverty rate within the city. (Oshodi, 2010)

There are several reasons for the increasing housing deficit in Lagos. Rapid urbanization alongside the regular rise in population, with an estimate of 86 people moving into Lagos per hour (Lagos State Government, 2017), has stupendously increase the population from an estimated 11.2 million in 2011 to an estimate of over 21 million in 2016, accounting

for 12% of the national estimate of 180 million in 2016 (World population review, 2017). However, several affordable adequate housing programs has been made in the past by the state government and in collaboration with the private sector in combating the housing deficit challenges but all has been unable to relieve this situation as a result of low construction capacity of 2 dwelling per thousand people against the required 8-10 dwellings per 1,000 people recommended by the United nations.

It is evident that using the conventional method of building construction (brick, sandcrete blocks and mortar) will not drastically decrease the housing deficit facing Lagos and Nigeria at large due to time, cost and delivery capacity of both public (government) and private sector. However, the use of shipping container-based building technology is not new in around the world as well as Nigeria. This solution is readily available but not immensely in use irrespective of the terrible state of housing in Lagos. Several researches as shown that it is possible to employ this solution in temperate region like Lagos when properly constructed. The most common studies as regards Nigeria involves the sustainability of shipping container housing (Olotu & Adebayo, 2013) from several professional's front of view and the potential of shipping container building looking at the comfortability and structural integrity (Mazadu & Danraka, 2015). These studied did not consider the social perspective, in terms of how the several potential residents of the container based housing sees it.

### 1.3 Problem Statement

According to Akinmoladun and Oluwoye (2007), several factors influence the provision of adequate housing in Lagos metropolis but the following are of paramount effect:

1. The limited land and acquisition obstacle
2. The lack of adequate physical planning /development control
3. High cost of building material
4. The lack of proper co-ordination of public agencies and law
5. Poor infrastructure
6. High population growth and population density.
7. Housing finance constraints

Thus, the outline above shows that the housing delivery in Lagos is a political, financial and socioeconomic issue. For these reasons, it can be inferred that there is no one size fits it all solution in addressing all straightaway (Akinmoladun & Oluwoye , 2007).
However, the approach of solving the housing problem in Lagos over the years has focused on conventional means (brick, sandcrete blocks and mortar), it may be appropriate to focus on how alternatives such as shipping container-based building technology which is already available locally in Nigeria can help depreciate the housing deficit drastically if not solve the problem.

### 1.4 Objective of the Study

The primary objective of this study is to research whether shipping container-based housing will be viable for the Lagos government to embark upon in collaboration with the private sector by taking advantage of the faster construction time as compared to conventional construction methods employed presently. In achieving this goal, the objectives are divided as follows:

1. Understand the current situation of housing in Lagos as well as the challenges still confronting housing delivery
2. Comparison of shipping container solution with conventional methods in terms of cost, time, affordability and quality
3. Evaluate factors affecting container housing in Lagos
4. Ascertain the social acceptability of this container solution by means of public participation.

## 1.5 Aim and scope of the study

This research will be looking into the principal challenges in low-cost housing delivery in Lagos and how the Lagos society will be open to a possible alternative of utilizing shipping containers in providing affordable housing in a similar fashion in the developed countries.

The aim of the study is to firstly, understand the perspective, concerns and requirement in using shipping containers as an alternative solution in providing affordable and decent housing for lower-middle and low-income earners who are majorly affected by the housing deficit within Lagos and Nigeria at large.

Secondly, the aim is to research Lagosian willingness and objections to accepting residential shipping container housing with government subsidy and possibly propose possible solutions to already available companies that sells this technology. The study was conducted with an online questionnaire sent to a sample of resident in Lagos and analysing their replies in questions concerning shipping containers as alternative housing solutions.

# 2 LITERATURE REVIEW

## 2.1 The Contest of Low-Cost Housing in Lagos

The concept of government as provider of social amenities is a function that is on global display, as governments all over the world are either directly or indirectly involved in the provision of basic amenities such as roads, running water, and electricity among others. As this research is mainly concerned with issues related to housing, it is also important to reiterate that the provision of housing also falls under the purview of government, directly or indirectly, as they are either in charge of enacting laws and act, the regulation and control of housing matters, or the development and administration of housing matters (Arimah, 1997).

The situation is no different when examining housing provision in Nigeria, as the involvement of government in housing dates to the period of colonial rule in the country, and it has continued to be under the purview of the government even after independence. It is therefore pertinent to review the history of the involvement of government and their role in the development and administration of housing in Nigeria. As examined by Adekoyejo (2001), this can be best illustrated in three different periods/timeframe: the colonial period; the post-independence period and the era of civilian rule and administration in Nigeria between 1979-1983 (Akinyode & Tareef, 2014).

### 2.1.1 The Colonial Period

The recorded history of formal involvement and intervention of the Nigerian government in housing matters dated back to the colonial administration, as the activities of government during this period was largely based on the construction and provision of official quarters to expatriates and to selected indigenous public service workers, mainly in areas reserved for government workers and also designated as Government Reserved Area (G.R.A). Basically, this is the division of reserved areas from the traditional areas particularly those in the regional areas that were later made state capitals. The interest of the colonial government in public housing program was spurred by the outbreak of the Bubonic Plague in Lagos between 1925 and 1928, and this necessitated the establishment of the Lagos Executive Development Board (LEDB) in 1928. The board was primarily

charged with the responsibility of eradicating slums throughout Lagos and to replace them with the construction of housing units. The strike embarked on by the workers in 1945 also contributed and expedited to the participation of government in the housing program. In addition, there was also the creation of a residential region in the Surulere outskirts of Lagos (Akinyode & Tareef, 2014).

According to Agunbiade (2001), It is important to note that these programs and other similar ones were autocratically done without the contribution of the civil society and other relevant stakeholders (Akinyode & Tareef, 2014). As there was no meticulous management of the created housing units, it consequently led to the failure of the housing programs. Within the context of the program, government did not make provision for the sale or rent of the houses to the general public. In the same vein, little was done to supervise the growth of these settlements situated outside government's quarters.

As established by Adekoyejo (2001), during the colonial rule and prior to independence, the different regional governments created housing corporations to provide housing units for the public; and this formed the basis for the modern housing estates in Nigeria. In addition, it also marked the commencement of groundwork for the national housing development plans. The created housing units were setup in form of staff housing layout. Also, bodies like the Lagos Executive Development Board (LEDB) and the Nigerian Building Society (NBS) were placed in charge of providing housing for the public. During this period, the increasing wave of urbanization and overcrowding contributed to unsanitary conditions, which necessitated the first urban development scheme in the country. In 1945 the grounded Lagos Executive Development Board (LEDB), endeavour to solve the worsening situation of housing in Lagos Metropolis as workers housing and re-housing estates were created in Apapa, Ilupeju, Surulere, Ikoyi and Isolo. However, these housing projects only served the need of the middle and high-income categories due to a lack of adequate finance, technical know-how and a deficient of relevant technology needed in the building and construction sector. As the western and eastern regions of Nigeria attained self-governance in 1956, with the northern region following suit in 1959, the regional governments established various housing corporations in an effort to provide more housing options for the public (Akinyode & Tareef, 2014).

### 2.1.2 Post-Independence Period

As stated by Adekoyejo (2001), after attaining independence in 1960, the Nigerian civil war broke out in 1967 and lasted until 1970. After the war, the previously existing regions were dissolved and states were created by the Gowon-government. The creation of states however aggravated the predicament of housing deficiency and it necessitated government's intervention and involvement in post-independence Nigeria. This period also coincided with the implementation of the national development policy. Basically, the establishment of the National Council of Housing in 1971 was regarded as a practical push by the federal government at confronting the housing problem in the country. The government planned to construct and provide about 59,000 housing units throughout the country; with 15,000 of those to be situated in Lagos and 4,000 units in the other eleven state capitals. This initiative was to stretch across the first and second national development projects of 1962 and 1970/74. The federal and state governments however decided to diminish their direct involvement in the construction of housing units for workers; rather they expanded credit facilities to building societies and housing corporations. This period also witnessed a phenomenal growth and expansion in the building industry due to the government's indirect participation in fostering the delivery of houses through its provision of land and other building materials such as iron-rods, roofing sheets, cements among others. Despite the liberation to import these building materials, the effort to provide housing to the medium and low-income citizens was however not widely felt (Akinyode & Tareef, 2014).

According to Arayela (1996), an adjustment to the strategy was adopted and effected in 1975 through the Third National Development Plan between 1975 and 1980. Through this strategy, the government initiated a comprehensive and enterprising intervention in the housing sector by getting involved in a 'direct' and 'active' participation in the provision of housing, as compared to its former policy of shifting its responsibility to the private sector. During this period, the government renamed the Nigerian Building Society, as it became the Federal Mortgage Bank of Nigeria in 1976 with government providing a grant of ₦150 million. Furthermore, Adekoyejo (2001) explicated that, during this plan period, an estimated sum of ₦1.83 billion was also utilized as capital investment in the housing sector between the federal and state governments. Also, a noteworthy effect of these investments by the governments was the 98% increase in the domestic production of cement and burnt bricks. It enabled the national housing program in the third national

development to meet its goals of rendering about 60,000 residential housing units in five years. In the year 1977, the program was re-examined upwards with the anticipated housing stock expected to go up to 8,000 units to be constructed in each of the existing 19 states capitals, with the exception of Festac Town and Ipaja in Lagos, and Kaduna, which were allocated 46,000 and 4,000 additional units respectively. Basically, a total of about ₦2.6 billion was allocated for this project. By the end of the third plan period however, The Federal Housing Authority was only able to complete 9,464 housing units in Lagos and 17,486 units in the rest of the country at an outrageous cost of about ₦430 million (Akinyode & Tareef, 2014). In evaluating the figure, less than 15% (about 13.3%) of the initial target was attained by January 1980. Also, the medium and low-income earners were mostly excluded from this scheme. Furthermore, in examining the reasons for the failure of the scheme, Adekoyejo (2001) proffered the following reasons:

1. The problem of site acquisition;
2. The exorbitant contractual procedures and inflation in labour cost;
3. Budget reduction and the improper phasing of infrastructure and housing construction;
4. A slow rate of construction as a result of inadequate capacity on the path of the construction industry;
5. Inadequate building and construction technology and a lack of material choice.

As a result of the failings of the housing project outlined during the third and fourth national development plans, the devastating outcome was an increased shortfall of urban houses and also a deterioration of rural houses. This therefore necessitates an elaborate national housing program established on the concept of affordability and massive participation of the citizens, and this project was embarked upon in 1980 during the 2nd Republic of civilian rule in Nigeria. The low-income earners and households whose annual income wasn't more than ₦5000 were the main target group for this project, as they were to be provided with one-bedroom core houses, while medium-income earners whose annual income wasn't more than ₦8000 were to be provided with two-bedroom core houses. (Akinyode & Tareef, 2014)

### 2.1.3 Civilian Administration Period

According to Adekoyejo (2001), the civilian administration of the 1980s used the provision of housing as a major political tool in canvasing for votes and also used by the government at the centre as one of its core political agendas. Unfortunately, though, the housing plans of the government were based on the faulty blueprint that characterized and led to the failings of the previous housing plans. The utopian objective of the project was the provision of about 400,000 housing units throughout the federation. The plan was to construct 160,000 of the projected units during the first phase of the program, with 8,000 housing units in each of the state's nationwide and also in the federal capital territory. This time however, the housing project was divided into one-bedroom and three-bedroom units specifically for low and middle-income earners respectively.

Upon completion of the houses, they were to be sold on an owner-occupier basis at a cost of ₦6000 and ₦15000 for the one-bedroom and three-bedroom housing units respectively. These prices represented a subsidized figure provided by the government. However, at the end of the fourth national development plan, there was a failing and shortage in the target of the units expected to be provided as only 32, 227 units were provided out of the 400,000 targeted units. The failure of the scheme could be credited to the faulty conceptualization and the hasty nature of execution of the plan, an inappropriate building and construction technology as highlighted in the past failed scheme, and also wastage of materials from material choice, the choice of sites and an inadequate financial system.

Between 1983 and 1988, it became obvious that the performance of the government towards increasing the housing stock was profoundly low when compared to the efforts and policies of past housing schemes. This can be attributed to the inconsistent role and attitude successive governments had towards housing policies and programs, as most of the governments failed to execute or implement their housing policies before leaving office. However, in 1989, the federal adopted new strategies that included the restructuring of the Federal Mortgage Bank of Nigeria, as it was now meant to serve as the nation's apex finance institution for housing. Savings were to be generated through the National Housing Fund (NHF), whereby the government would ensure a steady flow of funds to the Federal Mortgage Bank to facilitate lending to other primary mortgage institutions. There were however initial indications that showed an imminent lack of success of this initiative, with situations such as the inaccessibility to this loan by majority of the low and

middle-income earners; a slow rate of savings within a short timeframe due to the escalation in the prices of building materials and workforce; and also, the long process of acquiring the loan from the fund and mortgage institutions among others.

The ineffectiveness of these housing policies therefore led to the provision and establishment of the 2002 third national housing policy, with the government's main intention geared at making housing adequate for its citizens. To achieve this goal, the government was in collaboration with the private sector. The main features of this policy are to ensure that the majority of Nigerians become homeowners through the facilitation of mortgage. It also aimed to make houses available at affordable prices to both low and middle-income households. The policy also established the Federal Ministry of Housing and Urban Development, with the purpose of promoting, monitoring, supervising and regulating the private sector-driven housing delivery project.

It is however worth mentioning that mere examining and assessing the high housing demand and its limited supply, the housing needs of Nigerians is yet to be fully achieved. Different governments at various period in time have adopted various methods to tackle the problem, such as the provision of loans through mortgage institutions, sponsoring the owner-occupier housing schemes, low-cost housing projects, rent edicts (rent control) among others, however these efforts haven't yielded expected positive results neither have they reduced the problem of homelessness among Nigerians, especially among the low-income earning households.

In a nutshell, the urban and semi-urban environments have both witnessed a reoccurring situation where the housing demand is significantly more than its supply and this has led to a prevalence of shanties and slums in towns and cities. There is the need for an urgent attention to curtail the situation as the housing problem in Nigeria is on the rise. Basically, Nigeria needs to provide her citizens with decent and affordable houses, regardless of their social or economic class. Housing is an essential need to compliment other social assets if humans are to live a productive life (Akinyode & Tareef, 2014).

Also, the Federal Government took on the national sites and services scheme in 1986 as strategies to be used in housing delivery by expanding the supply of serviced plots of land at affordable cost (Onu & Onu, 2012). This initiative was introduced in order to create an

easy and viable access to land, which had always been one of hindrances to home ownership. The goals of the project were to provide serviced land for the development of houses and other commercial activities in a well-structured and planned environment. Achieving this goal would eliminate the hurdle to the supply of housing and also provide solutions to the private and public sector, as well as individuals, in the housing delivery network. Despite having this projection, only 20,000 plots of land have been allocated so far in 20 states of the federation since the start of the project in 1986 (Ajanlekoko, 2001), (Onu & Onu, 2012). The acquisition of land through transfer for an agreed price is rarely smooth, as it is often times costly and most times involve fraudulent practices whereby the same land could be sold to two or more people (Agbola, 1988). The promulgation of the 1978 land use decree was implemented to solve the problem of land grabbing and other fraudulent activities that had long characterized the acquisition of land in Nigeria, especially in Lagos. The decree basically vested the entire land within a state into the hands of the state governor to hold in trust for the people of the state. Prospective homeowners would therefore need to apply for the use of the land from the government at an affordable price. Despite the implementation of this decree, land grabbing and fraudulent activities that have long dodged the ownership of land and houses in Nigeria are still prevalent (Arimah, 1997), this has been another contributing factor to the inadequacy and unaffordability of houses in most of the urban areas in the country (Akinyode & Tareef, 2014).

## 2.2 Lagos State Development and Property Cooperation (LSDPC)

As noted above, the housing provision in Lagos State as involved both the federal and state arms of government in the past, but in recent time The Lago State Development and Property Corporation (LSPDC) is a state managed public cooperation, created in 1972 and formerly known as Lagos Executive Development Board (LEDB) is charged with providing affordable and decent housing in central and the surrounding environ of Lagos. However, the private developers and individual contribute majorly to housing developments in Lagos but this study will be focusing on the public developers.

LSDPC have used various housing delivery strategies to improve housing needs, these housing delivery methods have faced some challenges and have enjoyed some rate of success. This study explores the housing delivery method deployed by LSDPC and the challenges of this housing delivery method.

The housing delivery strategies deployed by LSDPC includes;

1. Site and service scheme**:** this method is one which is being adopted by various governments in most developed countries in providing housing on and before demand. In site and service scheme, the agencies (LSDPC in this case) supports the provision of infrastructural serviced plots for individuals who are then encouraged to develop their own type of buildings. In this strategy, access roads, drainage, water, sewage, electricity and variety of other individual as well as community services to mention a few are what the allotted land plots are equipped with.

2. Hybrid: this involves direct government construction for the low-income earners with housing challenges, the middle and the upper-middle class. As such Lagos State Development and Property Cooperation (LSDPC) will acquire land and develop and sell houses for profit in high end areas and the profit will be used by government to fund social housing for the vulnerable members of the society. This housing delivery method was adopted for the construction of the newly built Elegushi Housing Estate, located within the metropolis of Lekki-Ajah, Eti-Osa Local Government Area.

3. Joint Venture: this strategy is one which involves collaboration between government agency (which is LSDPC in this case) putting resources with private developers to construct and provide affordable, hygienic and good houses which are sold to the public. The profit which is generated from the project is distributed among the parties; this strategy is also very commonly used by other government agencies.

4. Turnkey: government agency such as the LSDPC combine resources with some private developers to provide good housing project which are sold to interested parties and the profit realized from them is used by the government to fund social housing for vulnerable members of the society. This is usually a form of Corporate social responsibility for the private organization involved.

5. Private Public Partnership: this strategy is like the joint venture strategy as it consists of the combination of resources (such as financial, human, technical and in-

tangibles) of government agency (LSDPC) with private developers for the construction and provision of housing for the public. It has also been defined as a combine effort among public, private and third sector organization based on mutual understanding, a division of labour and a comparative advantage in the sharing of responsibilities, risk and benefits.

6. Design and sell: this is the most common housing delivery adopted in most the developed countries in the world. This strategy is one in which the government agency provides the design of various types of houses with the presence of the necessary social facilities and amenities such as water, electricity, sewage, drainage etc which are designed in a line with the Building Regulation law which they sell to interested developers such as Individuals and Cooperate bodies (Obada, 2016).

As published by Lagos State Ministry of Information, Culture and Sport in Lagos Dairy 1997, within 1980 -1997 LSDPC was able to provide 21,630 housing unit which comprises of 12,072 low income houses, 1,798 medium income houses and 760 upper income houses. In addition, figures 1 shows that within 1999 to 2005 the Lagos state government provided 5240 housing units while 2100 are either proposed, uncompleted or under construction (Akinmoladun & Oluwoye , 2007).

TABLE 1. Total number of housing units completed by Lagos state government between 1999-2005(Akinmoladun & Oluwoye, 2007, modified).

| **Housing type/ year** | **Economic** | **Medium** | **Upper medium** | **High** | **Total** |
|---|---|---|---|---|---|
| Jubilee housing | | | | | |
| 1999 | 120 | - | - | - | 120 |
| 2000 | 1507 | - | - | - | 1507 |
| 2001 | - | 912 | 96 | | 1008 |
| Alliance housing | | | | | |
| 2002 | 454 | - | - | - | 454 |
| 2003 | - | - | - | - | - |
| 2004 | 138 | 270 | 1560 | - | 1968 |
| 2005 | | 68 | 52 | 64 | 184 |
| Total | 2219 | 1250 | 1708 | 64 | 5241 |

Efforts have been made by the board to revive old housing unit to conform with modern standards as well as the construction of the new housing unit for Lagos residents, yet the housing situation as not significantly changed for better and it is still far from being solved.

It is important to find out if the houses developed are affordable to the low and medium income earners and how easy it is to acquire these houses. According to the United Nations, the challenges of affordability of housing in all African countries is as a result of very low income and expensive cost of housing. In addition, housing affordability can be measured in such a way where house hold is capable of financially servicing housing without compromising on basic non-housing needs for human survival (United Nations, 2012).

### 2.2.1 Affordability of Lagos state government houses.

As stated previously, affordability of a house is said to be the fulfilment of housing purchase requirement without any form of prohibition or threat in meeting and enjoying other basic living cost and rights. However, there are two major factors that determines affordability which includes capital variable and occupational variable. Figure 1 elucidates the two variables and other components involved in determining affordability.

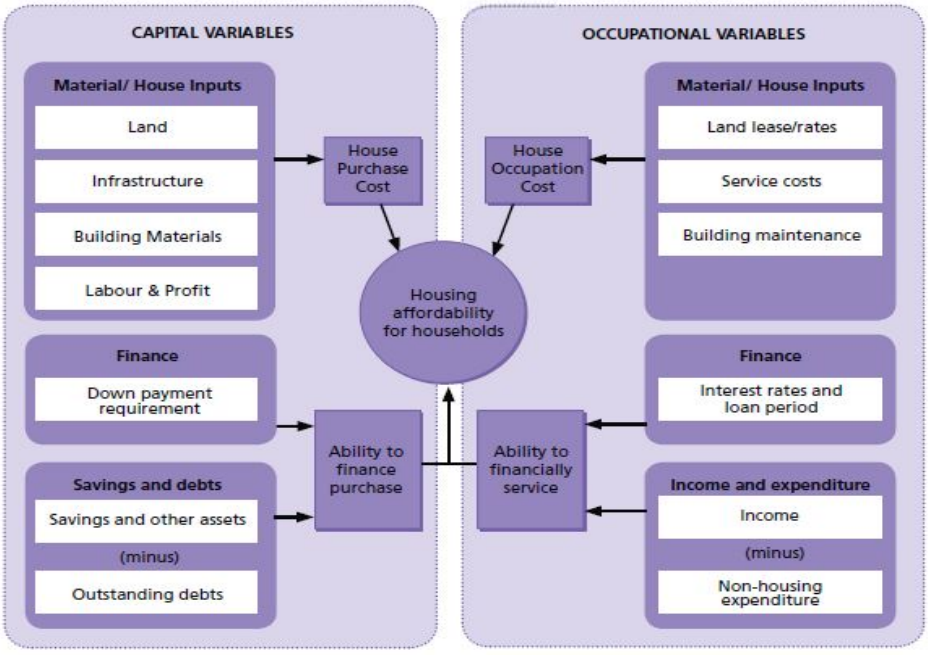


FIGURE 1. Basic components of housing affordability (United Nations 2012)

For any household to want to own a house, the key factors that will influence the purchase will be the purchase cost which is usually determined by location, land, Infrastructure, materials used in building and sellers profit, and also financial power to make the purchase which is the down payment and the amount left in household savings. Therefore, an affordable house is one which all housing related expenses of a household such as mortgage repayment, rent, taxes, insurance and service payments cost less than 30 percent of their income (United Nations, 2012).

With the above-mentioned components that determines affordability of housing. A look into the most recent housing schemes embarked upon by the Lagos state government in order to investigate how affordable are the houses for low and medium income earners.

### 2.2.2 Lagos state home ownership mortgage scheme

As result the federal national housing policy of 2011 which made provisions for state government to devise its own housing policy. This brought about the establishment Lagos Home Ownership Scheme (Lagos H.O.M.S.) in 2012 with an intent to mitigate the housing deficit in Lagos. The approach of the Lagos state government is by fully funding mass housing construction and also making fund available for lasting mortgage facilities to prospective home owners which as major challenge for many Lagos resident over the years. The scheme was majorly targeted at civil servants and people in paid employment whose income brackets falls within low and medium income earners respectively (Alufohai, 2013). The eligibility and conditions for the mortgage scheme is as follows:

1. Applicant must reside in Lagos and under 60 years of age
2. Applicant must have verifiable means of income and credit worthy
3. A down payment of 30% of the intended house to purchased must be paid by applicant
4. 6% interest rate will be paid on mortgage by beneficiaries
5. Purchased houses and apartments must be occupied by beneficiary with no possibility of transferring or renting out until all obligations has be fulfilled.
6. Applicant must be first time home buyer
7. Applicant must have been in current employment for at least six months.

According to the then governor of Lagos state in person of Mr. Babatunde Fashola, he stated that the house types were carefully designed to suit different income brackets and also the houses are affordable because the interest will be a maximum of 9.5% irrespective of the nation's economy, there is already a 25% discount on the houses taking into account land and construction cost and finally, beneficiaries can pay over a 10 years period (Adegboye, 2014). The price of the constructed houses is dependent on location and size of the apartment. A 60.22 $m^2$ one-bedroom apartment in Epe cost between ₦4.3 million (€13545) to ₦6.4 million (€20160) while a 60.22 $m^2$ one-bedroom apartment in Surulere is ₦8.25 million (€25988). The table 2 below shows various completed houses price and locations.

TABLE 2. Price, location and type of Lagos HOMS (Nigeria Finder 2016, modified).

| **Property type** | **Location** | **Size ($m^2$)** | **Price (₦)** |
|---|---|---|---|
| Room/parlour | Michael Otedola estate Odorangunshi Epe | 60.22 | 4.34m |
| 1-bedroom type 1 | Odonosa/Odoayandelu | 60.22 | 4.10m |
| | Oba Adeboruwa estate Igbogbo Ikorodu | 60.22 | 6.47m |
| | Michael Otedola estate Odorangunshi Epe | 60.22 | 6.40m |
| 1-bedroom type 2 | Igbogbo phase 2 | 60.22 | 7.50m |
| | Igando gardens | 60.22 | 7.54m |
| | Magodo | 60.22 | 7.57m |
| | Omole scheme | 60.22 | 7.71m |
| | Sangotedo | 47 | 7.85m |
| 1-bedroom type 3 | Chief Anthony Enahoro scheme 1, Shogunro | 60.22 | 8.35m |
| | Chief Anthony Enahoro scheme 2, Shogunro | 60.22 | 8.61m |
| | Shitta, Surulere | 60.22 | 8.25m |
| | Ilupeju | 60.22 | 9.08m |
| | Mushin | 60.22 | 8.28m |
| | Lekki scheme 1 | 60.22 | 9.91m |
| 2-bedroom type 1 | Odonosa/Odoayandelu | 75.79 | 6.22m |
| | Oba Adeboruwa estate Igbogbo Ikorodu | 75.79 | 7.91m |
| | Michael Otedola estate Odorangunshi Epe | 75.79 | 7.22m |
| 2-bedroom type 2 | Igbogbo phase 2B | 75.79 | 9.44m |
| | Igando gardens | 75.79 | 9.48m |

| | | | |
|---|---|---|---|
| | Magodo Shangisha | 75.79 | 9.52m |
| | Omole scheme | 75.79 | 9.71m |
| 2-bedroom type 3 | Chief Anthony Enahoro scheme 1, Shogunro | 75.79 | 10.51m |
| | Chief Anthony Enahoro scheme 2, Shogunro | 75.79 | 10.83m |
| | Shitta, Surulere | 75.79 | 10.38m |
| | Ilupeju | 75.79 | 11.42m |
| | Mushin | 75.79 | 10.42m |
| | Lekki scheme 1 | 75.79 | 12.47m |
| | Lekki scheme 2 | 75.79 | 10.54m |
| 2-bedroom type 4 | Sangotedo | 88 | 14.69m |
| 2-bedroom flat | Chois gardens, Abgowa | 75.79 | 9.75m |
| 3-bedrooms flat | Chois gardens, Abgowa | 123.9 | 14.5m |
| 3-bedroom terrace | Odonosa/Odoayandelu | 123.9 | 8.77m |
| 3-bedroom type 1 | Odonosa/Odoayandelu | 123.9 | 6.96m |
| 3-bedroom type 2 | Iloro scheme | 123.9 | 8.98m |
| | Honourable Sotonwa estate, Igbogbo | 123.9 | 9.96m |
| | Hon. Mustapha estate, Ojokoro | 123.9 | 11.02m |
| 3-bedroom type 3 | Igbogbo phase 2 | 123.9 | 15.43m |
| | Igando gardens | 123.9 | 15.50m |
| | Shitta, Surulere | 123.9 | 16.69m |
| | Magodo Shangisha | 123.9 | 15.57m |
| | Omole scheme | 123.9 | 15.87m |
| 3-bedroom type 4 | Chief Anthony Enahoro scheme 1, Shogunro | 123.9 | 17.17m |
| | Chief Anthony Enahoro scheme 2, Shogunro | 123.9 | 17.71m |
| | Mushin | 123.9 | 17.03m |
| | Lekki scheme 2 | 123.9 | 17.22m |
| | Sangotedo | 100 | 16.69m |
| 3-bedroom type 5 | Ilupeju | 123.9 | 18.67m |
| | Lekki scheme 2 | 123.9 | 20.39m |

However, most of the houses in table 2 above are too expensive and the Lagos state government did not consider low and lower-middle income earners who by large are the majority of Lagos residents in urgent need of housing. For federal government civil worker resident in Lagos whose salary is ₦18000 (€42) minimum wage, he or she can only dream

to own one of these houses when a level 14 civil service worker with 10 years of active service cannot afford to buy one of the apartments as result of imbalance in income and apartment prices if we consider it from the United Nations point of view of less than 30% of income should be spent on housing (Salau, 2017).

According to a study conducted by Renaissance capital (2011), the average income range of middle class Nigerians is between ₦75000 (€339) - ₦100000 (€479) with most living in rented apartments, 92% possess a post-secondary education and 76% work in the public sector (Renaissance Capital, 2011) .These figures conform with the salary structure of the Lagos state civil service as seen in table 3 but differs from that of the federal civil service and private sector salary structure. However, the middle class of Nigeria can be said to be divided into lower-middle income class and upper-middle income class where the former earns an estimated income of one million naira per annum and the latter four million naira per annum (Adeniyi, 2015)

TABLE 3. Harmonized public service salary structure (Lagos state government 2007, m.d)

| GRADE LEVEL | 1 N | 2 N | 3 N | 4 N | 5 N | 6 N | 7 N | 8 N | 9 N | 10 N | INCR. RATE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 62100 | 63528 | 64957 | 66385 | 67813 | 69242 | 70670 | 72098 | 73526 | 74955 | 1428 |
| 02 | 63164 | 65031 | 66899 | 68767 | 70634 | 72502 | 74369 | 76237 | 78105 | 79972 | 1868 |
| 03 | 64072 | 66368 | 68663 | 70958 | 73254 | 75549 | 77845 | 80140 | 82435 | 84731 | 2295 |
| 04 | 67276 | 70034 | 72792 | 75549 | 78307 | 81065 | 83822 | 86580 | 89338 | 92095 | 2758 |
| 05 | 76681 | 79885 | 83089 | 86293 | 89496 | 92700 | 95904 | 99108 | 102312 | 105516 | 3204 |
| 06 | 94238 | 98143 | 102049 | 105954 | 109860 | 113765 | 117670 | 121576 | 125481 | 129387 | 3905 |
| 07 | 126386 | 131200 | 136014 | 140828 | 145642 | 150456 | 155270 | 160083 | 164897 | 169711 | 4814 |
| 08 | 164434 | 170163 | 175893 | 181622 | 187351 | 193080 | 198810 | 204539 | 210268 | 215998 | 5729 |
| 09 | 193819 | 200641 | 207462 | 214284 | 221106 | 227928 | 234750 | 241571 | 248393 | 255215 | 6822 |
| 10 | 228180 | 235681 | 243182 | 250684 | 258185 | 265687 | 273188 | 280690 | 288191 | 295693 | 7501 |
| 12 | 263240 | 274875 | 286511 | 298147 | 309782 | 321418 | 333054 | 344690 | 356325 | 367961 | 11636 |
| 13 | 294307 | 306608 | 318910 | 331212 | 343513 | 355815 | 368116 | 380418 | 392719 | 405021 | 12302 |
| 14 | 325518 | 338761 | 352005 | 365248 | 378491 | 391735 | 404978 | 418222 | 431465 | 444708 | 13243 |
| 15 | 360537 | 378247 | 395957 | 413667 | 431377 | 449087 | 466797 | 484507 | 502217 |  | 17710 |
| 16 | 398771 | 420055 | 441339 | 462623 | 483907 | 505192 | 526476 | 547760 | 569044 |  | 21284 |
| 17 | 444611 | 468765 | 492920 | 517075 | 541229 | 565384 | 589538 | 613693 | 637848 |  | 24155 |

A quick analysis of mine as seen in table 3 in testing the affordability of the Lagos state government houses, the salary to be considered will be that of the low-income earners in level 1 step1 whose salary is below ₦75000 (€175) and lower-middle income employees within the above-mentioned range which is level 7 step1 in the Lagos state civil service

as seen in table 3 below. Three different cases will be looked into for purchasing the cheapest one bedroom, two bedrooms and three-bedrooms apartment of the Lagos state home ownership scheme, with the assumption that individual purchasing the apartment will save his or her entire salary monthly to raise the 30% down payment first. It's ascertained (table 4) that many low-income earners in the Lagos state civil service cannot afford even the cheapest apartment regardless of choosing to pay mortgage for 10 years or 20 years while the middle-income earner can only afford a one-bedroom apartment with mortgage repayment time of 10 years.

TABLE 4. Basic analysis of Lagos home ownership scheme (Balogun 2018)

| | | | |
|---|---|---|---|
| Low income earner monthly salary ₦62000 (€144) | | | |
| Lower-middle income earner monthly salary ₦123000 (€286) | | | |
| Apartment type | 1-bedroom apartment | 2-bedroom apartment | 3-bedroom apartment |
| Purchase cost of apartment (₦) | 4100000 | 6220000 | 6960000 |
| 30% down payment cost (₦) | 1230000 | 1866000 | 2088000 |
| Months to save down payment if full salary is committed to saving (low income earner) | 20 | 30 | 34 |
| Months to save down payment if full salary is committed to saving (lower-middle income earner) | 10 | 15 | 17 |
| 6% interest rate mortgage finance (₦) | 2870000 | 4354000 | 4872000 |
| Monthly repayment of mortgage for 10 years (₦) | 31862.88 | 48338.33 | 54089.19 |
| Percentage of income spent on mortgage repayment per month by low income earner | 51% | 78% | 87% |
| Percentage of income spent on mortgage repayment per month by lower-middle income earner | 25% | 38% | 42.80% |

### 2.2.3 Lagos state rent to own scheme.

The Lagos state Rent to own housing scheme is another housing policy launched in December 2016 by the present Lagos state governor Akinwunmi Ambode. The scheme is an amendment to the policies of the previous government of Babatunde Fashola in term of the percentage paid for down payment. According to Mr. Gbolahan Lawal the State's commissioner for housing (2016), in spite of the mortgage scheme provided by the Lagos state government which attracted lots of people in wanting to own one of the housing unit, the short fall is that majority are unable to afford the 30% equity contributions required by the mortgage scheme (Vanguuard, 2016). The rent to own scheme has lowered the percentage on the down payments in other enable low and middle-income earners have access to affordable housing along with the following eligibility criteria:

1. Applicant must be primarily resident in Lagos state and will be required to submit a copy of their Lagos state resident registration card (LASRRA).
2. Applicant must be a first-time buyer.
3. Applicant must be 21 years old and above
4. Only tax compliant resident with proof of tax payment will be eligible.
5. Applicant must be able to make 5% commitment fee and the balance is spread monthly at a fixed rent over a period of 10 years.
6. Applicant must pass the affordability test and not more than 33% of the monthly income as repayment (Lagos Sate Ministry of Housing, 2017).

Furthermore, the prices of the housing unit were slashed due to an economic down turn in the nation, an example is the 2-bedroom apartment which was sold for ₦7.2 million (€22680) is now sold for ₦3.5 million (€11025) while the 1-bedroom apartment is now sold for ₦2.3 million (€7245) (Olowoopeju, 2016). Table 4 shows the available housing unit on sale now in the Rent to own scheme.

TABLE 5. Homes on sale at the rent to own scheme (Lagos H.O.M 2018, modified).

| **Name and location** | **Unit type** | **Unit price (₦)** |
|---|---|---|
| Michael Otedola estate Odoragunshi Epe | Room & parlour | 1.5m |

| | | |
|---|---|---|
| | 1-bedroom | 2.0m |
| | 2-bedroom | 3.5m |
| Chois gardens, Agbowa | 2-bedroom | 3.5m |
| | 3-bedroom | 5.0m |
| Oba Adeboruwa estate Igbogbo Ikorodu | 1-bedroom | 3.0m |
| | 2-bedroom | 4.8m |
| Alhaji Adedotun Mustapha scheme, Ojokoro | 3-bedroom | 9.0m |
| Honorable Olaitan Mustapha scheme, Ojokoro | 3-bedroom | 9.0m |

The above reduction in price and down payment has been commended by many Lagos residents and so far, 500 beneficiaries have been allotted homes under the ongoing scheme. However, for low income earners resident in Lagos who earns below minimum wage of Lagos state civil service worker such as petty traders and federal government workers earning ₦18000 (€42) minimum wage, still find the prices of the housing unit too high (Adio, 2017). How affordable the cheapest apartments could be for a Lagos civil service worker could be found in my analysis in table 5 below. A low-income Lagos civil service worker will also find this apartment not affordable if considered from the United states point, of spending less than 30% of one's income on housing, while the lower-middle income earner will conveniently purchase one of the units.

TABLE 6. Basic analysis of Lagos Rent to own scheme (Balogun 2018)

| | | | |
|---|---|---|---|
| Low income earner monthly salary ₦62000 (€144) | | | |
| Lower-middle income earner monthly salary ₦123000 (€286) | | | |
| Apartment type | 1-bedroom apartment | 2-bedroom apartment | 3-bedroom apartment |
| Purchase cost of apartment (₦) | 2000000 | 3500000 | 5000000 |
| 5% down payment cost (₦) | 100000 | 175000 | 250000 |
| Months to save down payment if full salary is committed to saving (low income earner) | 1.6 | 2.8 | 4.0 |

| | | | |
|---|---|---|---|
| Months to save down payment if full salary is committed to saving (lower-middle income earner) | 0.8 | 1.4 | 2.0 |
| 6% interest rate mortgage finance (₦) | 1900000 | 3325000 | 4750000 |
| Monthly repayment of mortgage for 10 years (₦) | 21093.90 | 36914.32 | 52734.74 |
| Percentage of income spent on mortgage re-payment per month by low income earner | 34% | 59% | 85% |
| Percentage of income spent on mortgage re-payment per month by lower-middle income earner | 17% | 29% | 41.73% |

Thus, the demand for low-cost and affordable housing will continue to rise as the current government housing unit does not meet the realities of the enormous number of Lagos resident in the low-income bracket. If a further reduction in the prices of the Lagos state government housing unit is not possible as a result of construction cost, then a possible alternative with lower construction cost should be embraced in solving the housing the housing deficit in Lagos and to prevent further scarcity of housing as a result of high prices of housing from the informal sector.

# 3 SHIPPING CONTAINER AS ALTERNATIVE TECHNOLOGY

The intended and sole purpose of the invention of the shipping container was to allow for easy loading, transportation and unloading of goods around the globe so as to reduce transportation and labour cost. In recent times, Architects around the world have been able to develop innovative ways to use and incorporate this global trade shipping containers into building construction due to its structural integrity, cheap cost and availability which in turn brought about a new type of Architecture referred to as Container Architecture (Schwarzer, 2017). This form of architecture is considered by environmentalist to be sustainable because of the amount of energy saved in upcycling the abandoned shipping containers.

Upcycling according to Gunter Pauli can be simplified as repurposing goods and things in their manufactured or use purpose end of life with the smallest of modification into valuable product. Upcycling when compared to traditional recycling does not require as much energy, making it more environmentally friendly and also an economical way of waste treatment. (Pauli, 2010).

This chapter will be looking into the origin of the modern-day shipping container and its possibilities for housing design, affordability and how it has been incorporated into modern architecture.

## 3.1 Brief History of Standardized Intermodal Freight Container

Prior to the invention of the standardize shipping container that is globally used today, several forms of containers have been used to transport goods on boats, horse and carriages as well as rail systems as far back as the 1792 in England. (World Shipping Council, 2018). Trade between countries and continents via the sea has been around for thousands of years and also a great employer of labour, but the greatest challenge has been that of moving the goods on and off the ships and also to their required destinations easily within a short period of time, because of this, many manufacturing companies situate their factories and warehouses close to the seaport to access raw material and also deliver finished product faster. However, the closeness to the seaport does not really translate to effective and fast delivery because a typical freight to be loaded onto a truck to seaport will be loaded piece by piece which may be of homogeneous or mixed goods in paper

board carton, wooden crates and casks. This good will require different men to unload and load them from the truck to the ship because of how heavy they could be and, number of goods is counted and recorded during this process of unlading and loading making the entire process physically exhausting, difficult, labour intensive and overall expensive.

The invention of modern day standardized intermodal shipping container for rail, road and sea is credited to the Malcom McLean alongside his engineer Keith Tantlinger. Although in early 1950's the United States Army towards the end of the second world war designed the first globally accepted standardized container also known as the "transporter" of 2.6m x 1.91m x2.08m in dimension as means to prevent theft and impairment which was used to officer's goods. During the Korean war, the container's use significantly transformed from the transportation of officer's good to the transportation of engineering supplies due to an upgrade on its structural durability which was referred to as CONEX (container express). The CONEX containers went on to eliminate dockside-unloading congestion as well as shipping time of supplies from 55 to 27 days. Mclean who owns a renowned trucking business which he sold after his acquisition of the Pan-Atlantic Steamship Corporation due to regulations by the Inter State Commerce Commission (ICC), which does not allow for a trucking company to also own a shipping company simultaneously.

Mclean's obsession to cutting cost and saving time brought about his quest for quick and efficient way to transport goods. His idea for the modern day standardized intermodal shipping container evolved from his first plan of carrying loaded trailers on ship and driving them off the ship to several destinations. This idea was found to be inefficient because, it was realized that the wheels below each trailer would waste valuable space on board the ship. He (Mclean) then came up with another idea which requires the subtraction of the wheels and frames of a trailer filled with twenty ton of freight such that it is detached from its steel chassis and lifted onboard the ship. This idea allowed for the possibility of stacking the trailer body, maximum use of ship space and also possible 94 percent reduction in shipping of goods when costed. By late 1955 after Mclean's Pan-Atlantic company acquired two World War II tanker (T-2) sold for cheap by the US government. A little modification was made to the purchased tanker to help hold the container alongside each other, and Mclean's Pan-Atlantic company named the tankers Ideal X. Mclean along with his engineer decided to make the containers for Ideal X 33 feet long as result of the available deck space. The container for the Ideal X was design such that six pieces of steel

with small holes at the bottom and about a foot long was attached to sides of the container which allows for insertion of rod to keep it locked in place. On April 26,1956, the Ideal X made her first voyage from Newark to Houston loading 58 containers in less than eight hours (Levinson, 2006)

The successful trip of Ideal X proved cargo handling can be done safely with containers on ships. It is an historical chapter in the development of the maritime cargo industry and this method of cargo handling as found a globally acceptability with a huge impact on world trade and commerce. Figure5 below shows the various kinds of modern standard container available globally.


FIGURE 2. Common global Container sizes: the 10ft (3m in length), 20ft (6m in length), 40ft (12m in length) with same height of 8.6ft (2.6m) for all. (Tivacom.com 2018, modified)

However, over the years there has been several types shipping container circulating around the globe and this various type are manufactured based on the purpose it is going to serve as well as the design and characteristics. According to DIN ISO 6346 of January 1996, there are significant differences between the following types:

1. General purpose container
2. Bulk container
3. Named cargo container
4. Thermal container
5. Open-top container
6. Platform container
7. Tank container
8. Air/surface container

For the purpose of this study a major focus will be place on the general-purpose container which in some cases is also referred to as standard container, dry cargo container or box container as seen in figure 5 above (GDV, 2018)

### 3.2 Shipping Container Applications

It is globally common to use shipping container modules as temporary structures in spaces with other developmental plans. A common example would be temporary site office found in construction sites and also temporary shelter used in cases of disaster. In addition, the global use of shipping containers in the transportation sector has made them readily available to access if the need arises impromptu. Picture 1 below shows the possibilities attainable with shipping containers. other several solutions that can evolve from shipping container modules includes the following and this is dependent on the need, maybe:

1. Offices building
2. Residential building
3. Commercial building
4. Event and exhibition building

The first shipping container building documentation officially recognised was designed by Phillip Clark in 1987 when he filed for a patent in the United States of America titled “Method for converting one or more steel shipping containers into habitable building” which was granted after two years in 1989. Although, this is highly debateable because the idea as previously been presented by Nicholas Lacey a British Architect in his university thesis in the 1970’s. In addition, there are other two cases where the idea of using shipping container as building was also exhibited. The first was in 1985 on the production set of the movie “Space Rage” where shipping containers where used in making several buildings and the second is back in the 1962 where Christoper Betjemann was named as the inventor in a patent titled “Combination shipping container and showcase” filed by Insbrandtsen Company Inc. Thus, the idea is no longer new as many Architects over the decades have been able to come up several designs that are not temporary structures but permanent habitable homes that are compliant to legislations because the shipping container buildings significantly are economical, environmentally friendly, durable, fast to

construct and also generates less construction waste (Woods, www.containerhome-plans.org, 2015).

PICTURE 1. Grillagh Water House by Patrick Bradley Architects (Aidan Monaghan 2015).

Although, many still consider avoiding building with shipping containers due to many concerns such as: the need for special equipment for cutting through the steel to create openings, the need for insulation in extreme (hot or cold) temperatures which further reduce the already limited functional space, and for used shipping containers the danger of contaminated and toxic material transported with the container is of great consideration (Smith, 2015)

### 3.3 Shipping container structural integrity

The structural integrity of a shipping container is of utmost importance when it is being considered for dwelling purposes. This could be compromised by factors such as rust as a result of weathering and structural modification of the shipping container to suit the proposed dwelling design. This section will be looking into the two factors detrimental to the structural integrity of the shipping container and possible ways to prevent and treat them.

### 3.3.1 Shipping container rust

There is mistaken impression by many people that shipping containers are rust proof because they are manufactured from COR-TEN steel (**Cor**rosion resistance and **ten**sile strength) which is an alloy of steel with copper, chromium and nickel composition, and also known as weathering steel. In fact, Cor-ten steel were not made to be rust proof rather made to slow down the process of corrosion by the formation of a protective dark brown oxide film which prevents deeper penetration of rust when the metal is exposed to corrosive weather conditions. In order to actually have strong bond of protective anti-rust layer, there as to be balance between its exposure to wet and dry condition because COR-TEN steel invariably exposed to wet and salty conditions will get rust faster than that with alternating wet and dry conditions. Therefore, environments with salt laden air, high rainfall, humidity, or persistent fog is not best suitable for using COR-TEN steel (Western metal roofing, 2018).

Evidently, the above-mentioned properties of COR-TEN steel applies to every general-purpose shipping container made from COR-TEN steel for transporting goods or one used in constructions such as residential, commercial or institutional buildings. Structural and non-structural rust will be the result of exposing such shipping container to harsh weather conditions. Structural rust will compromise the structural integrity of shipping container and probably make the shipping container unusable for construction purposes while non-structural rust gives minimal concern as it effect reduces sales value. However, there are several ways to prevent the shipping container from extensive rust when applied partly or completely in building construction which includes the following:

1. Pre-construction rust prevention: this involves the careful observation of the site condition, weather patterns and direction to determine the face of the shipping container that will be exposed to constant harsh weather conditions that will bring about rusting. An example is shipping container placed directly on the ground, ground moisture in constant contact with bottom surface might probably result in rust which could be prevented by raising the shipping container above ground. Another example is that of a site where the weather strikes the body of the container constantly, vegetations could be planted to around the shipping container or preferably a cladding could be done to protect the COR-TEN steel.

2. Maintenance rust prevention: this involves proper inspection before purchase and regular inspection after purchase. The inspection includes the removal of stagnant and trapped waters from any part of the shipping container. An example of trapped waters is the container rain, it occurs as a result of condensation of the water vapour inside container coming in contact with the cooling steel surfaces container condensing it from vapour to liquid which usually situated at the ceiling of the container and then runs down the walls shipping container. Trapped waters can be removed by simply draining it off regularly and the case container rain formation, proper ventilation of the container to allow water vapour escape or the application of desiccants to absorb the moisture in the container will prevent the formation of rust.

Shipping container rust can be treated in several ways depending the extent of the rust. The application of zinc paint coat with 90% dry zinc powder will is one way to decelerate the rust process on the container. In non-severe rust situations grinding, chipping and sand blasting are methods applicable in removing the rust which exposes the metal for sealing with primer and topcoat paint. (Carthcart, 2017)

### 3.3.2 Shipping container structural modification

Shipping containers are rigid box and as a structural component in building construction they require some modification to either create larger space envelop or to create openings for access and ventilation. In the process carrying out these modifications the structural strength of the shipping container might be lost which makes the balance of load during modification a crucial detail during construction. Also, modification may also drive up the cost of construction as special tool and expertise are required in cutting the shipping container steel, as such minimal modification will be of greater value in cost reduction.

As noted previously, shipping container is made out of weathering steel and it comprises of four corner posts with castings, two bottom side and two top side rails, two bottom cross members, a front top end rail and a door header which are the major load bearing elements while the side walls, end wall, and roof bears the least load which is dependent on the material used for that particular component (GDV, 2018) .

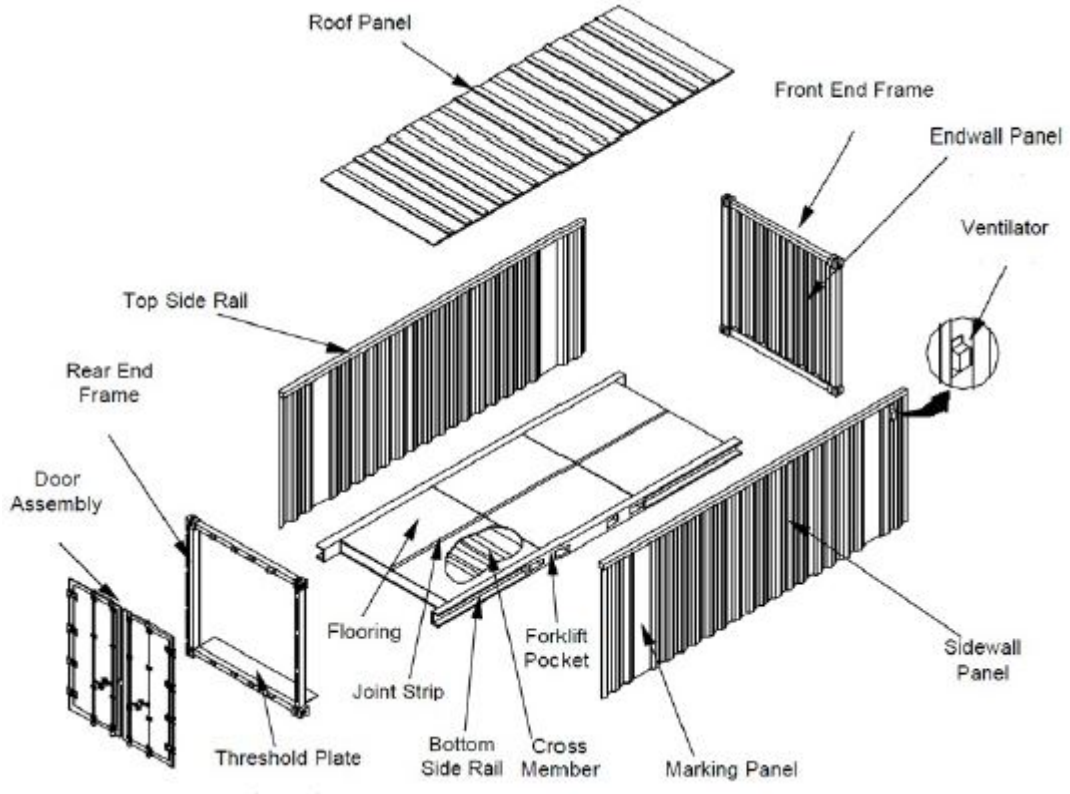


FIGURE 3. Exploded axonometric view of a typical 20-foot shipping container. (residentialshippingcontainerprimer.com 2017, modified)

According to Giriunas, Sezen, and Dupaix (2012) a shipping container with no form of modification in its corner post under an evenly distributed load will bear load up to 212 kip (212000 pounds) but at the event of any form of modification such as the removal of the side walls, the container maintains its structural integrity by being able to still bear load up to 212 kip (212000 pounds) while the removal of door assemblies and end-wall panels result in the shipping container loosing structural integrity because it can only bear loads up to 168 kip (168000 pound) (Mammadov, 2015)

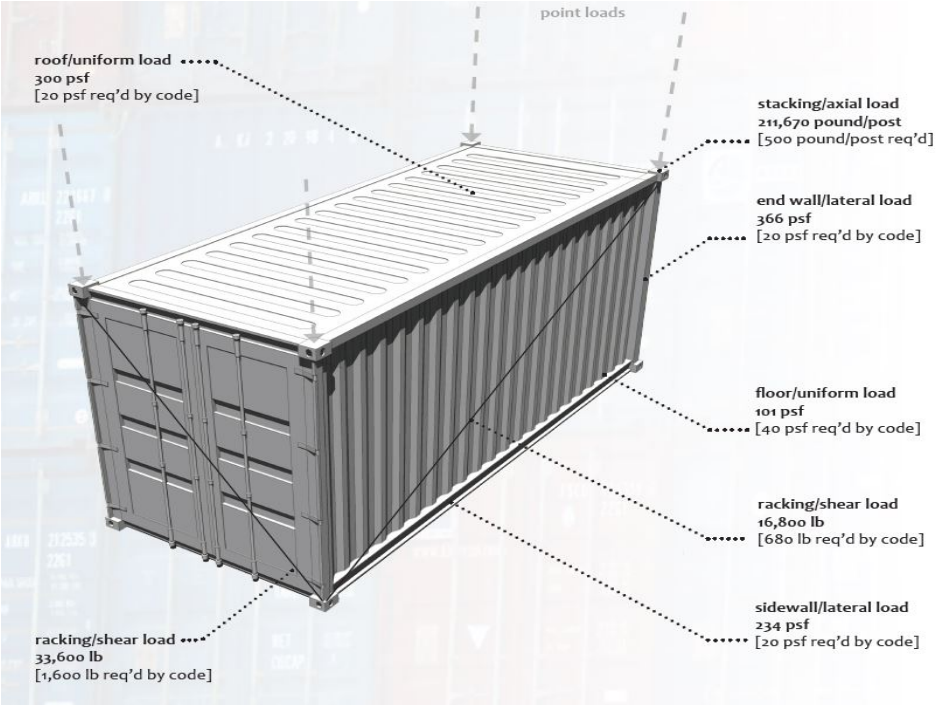


FIGURE 4. Non-modified shipping container load forces. (William J Penland 2008.modified)

In order to retain the original structural integrity of a shipping container when modification such as opening for access and ventilation is carried out during building construction, construction drawings should be as detailed as possible with clear dimension and location of openings and also framing and vertical strengthening element should be applied around the openings to create lateral stability and evenly distributed load across the shipping container (Penland, 2008).

### 3.4 Modular Building using Shipping Containers

For the purpose of clarity, it is important to define what a modular construction is. According to Modular building institute (MDI) (2018), "modular construction is a process in which building is constructed off-site, under controlled plant conditions, using the same materials and designing to the same codes and standards as conventional built facilities – but in about half the time". It could also be defined as building that are entirely or partly completed, but delivered on site for erection by placing or stacking it (BC Housing, 2014). There are two types of modular construction namely:

1. Permanently modular construction: Also known as PMC, from the name it is evident that this type of building is constructed to be non-movable while utilizing

offsite manufacturing methods in fabricating parts or the entire building. This construction method can be incorporated into site-built project as it is highly effective in monitoring quality and also reduce waste.

2. Relocatable modular buildings: in a similar way they are prefabricated from the factories and this type of buildings are designed majorly for temporary spaces with the possibilities of reusing and repurposing them in a different site by transportation which saves construction time as illustrated in figure6 below (Modular Building Institute, 2018).

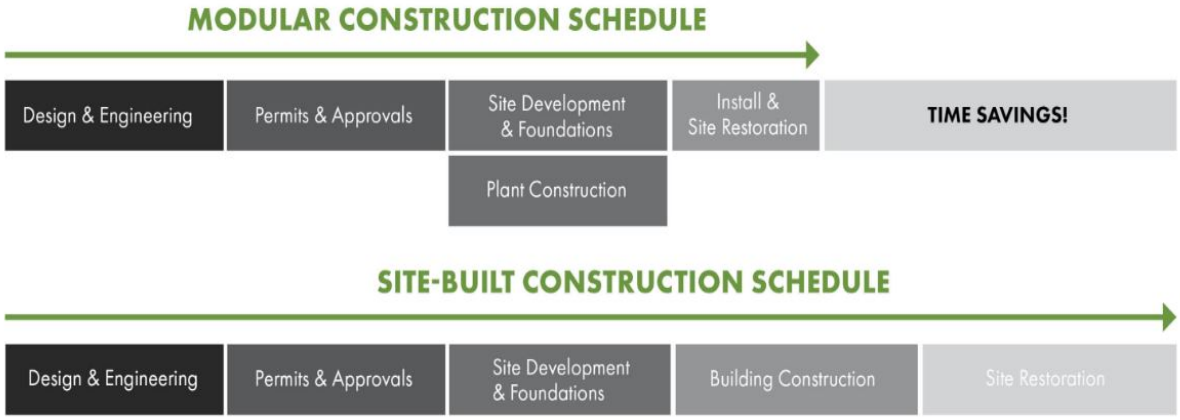


FIGURE 4. Timeline comparison of Modular and Site-built construction. (modular.org 2018)

The above definition of modular construction indicates that shipping containers can be used separately, entirely or combine with conventional construction to attain a permanent habitable building since each container unit is a module that can be stacked vertically and horizontally (figure 7), as the shipping container structural durability is adequate to bear the load exerted upon it. At maximum load the stacking possibility for a general-purpose shipping container is to stack six containers while other purposely built containers with higher strength could be stacked nine to twelve high (GDV, 2018).


FIGURE 5. Stacking possibilities of shipping containers (Gregory La Vardera 2007. modified)

# 4 LOW-COST HOUSING USING SHIPPING CONTAINER IN LAGOS

This chapter will be looking into how better of a solution is shipping container housing for low and middle-income earners in Lagos in terms of availability, cost and quality.

## 4.1 Container availability in Lagos

There are no data available to state the precise number of recyclable shipping containers or rather waste shipping containers in Lagos and Nigeria at large. However, the fact that Lagos is the commercial centre of Nigeria where importation and exportation of goods takes place on a daily is a one way in which shipping container traffic could be estimated.

Nigeria is the 53rd largest importer in the world with products ranging from refined petroleum, cars, wheat, telephones, medicaments, building material, etc. amounting to a total of $39.5B as at 2015 as compared to $49.2B in 2010. However, $47.8B worth of goods such as rough wood, cocoa, beans, and petroleum gas was exported in 2015 making Nigeria the 49th largest exporter which indicates an 11.9% decrease in exportation (figure) when compared to that of 2010, with crude petroleum accounting for 77.2% of the total export (Atlas Media, 2018). Lagos port data from Apapa and Tincan ports corroborates the above decline in importation as shown below in Table 6.

TABLE 7. Container traffic from Lagos ports (Nigerian ports authority 2017)

| **Year** | 2012 | 2103 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|
| **Imported** | 69,2016 | 79,945 | 94,923 | 73,604 | 62,493 |
| **Exported** | 70,780 | 78,793 | 97,263 | 75,685 | 66,216 |

The overall reduction in importation in Nigeria does not directly transform to the unavailability of shipping containers that could be repurpose. The availability of shipping container for repurposing is dependent on how many is decommissioned annually due to legislation of use that requires shipping companies to renew their fleet after use for 25 years (Kolawole, 2014), which is not always the case because in many shipping company's containers get decommissioned after 10 years when they are used to a great extent with obvious dents or rust (Woods, 2015).

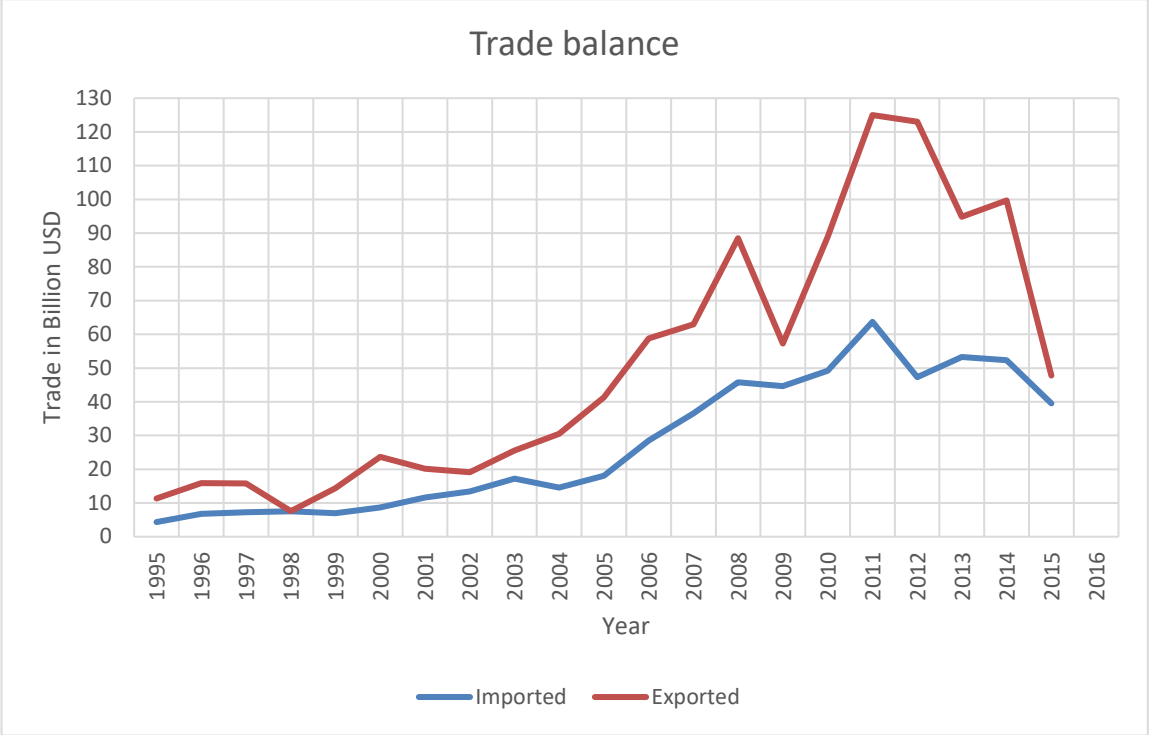


FIGURE 6. Trade balance data of Nigeria. The data generated from OEC (The observation of economic complexity) and represented using the above chat. (atlas.media.mit.edu n.d, modified).

The common types of general purpose shipping containers available in Lagos are the (20ft (6m in length) and 40ft (12m in length). These containers are available in various conditions which ultimately determine the price they are sold. The 20ft (6m in length) container cost within ₦270000 (€628) - ₦400000 (€930) while the 40ft (12m in length) is sold around ₦380000 (€884) - ₦600000 (€1395) in Lagos as found on online stores (jiji.ng and olx.com.ng).

## 4.2 Comparison of container housing unit to conventional housing

Every housing construction is carried out in stages which includes, site clearing and preparation, foundation, erection of walls, roofing and finishes. However, shipping container housing construction tends to omit some of the stages as seen above (figure 6) which bringing about a reduction in cost as well as time saving. These cost and time savings evolves from the foundation, wall, wall finishes and roofing during construction, as it recognised that a used shipping container considered for construction purpose is a box with already erected wall, floor and roof that requires little modification in creating habitable homes in a tropical region like Lagos.

This technology of building with shipping container in location such as Lagos, Nigeria is already available and provides solution to the major concerns of many which is the hot temperature within the space since it is made of steel with high heat conductivity. According to Woods (2015), using shipping container in hot climatic region requires keeping the indoor environment cool and can simply be done with proper insulation supported by shades, space cross ventilation, and reflective material on roofs and walls of container. (containerhomeplans, 2015). Table 7 below shows a general comparison of conventional building methods with shipping container building methods also known as cargotechture.

TABLE 8. General comparison of conventional and cargotechture method of construction (Tempo housing 2012, modified).

| **Criteria** | **Cargotechture** | **Conventional** |
|---|---|---|
| Low cost | Many used containers are available at a cost that is low compared to a finished structure built by other labour intensive means such as brick and mortar | Conventional building method are very expensive in Nigeria, mainly due to the high cost of cement |
| Construction time | Once the plan is designed, the containers are prepared and fitted out at the workshop. Construction time on-site can be as little as 7 days. Tempohousing built 1000 units in 6 months. | Construction time using conventional methods are very long, which adds to accruing interest on loans. |
| Structural strength | Shipping containers offers a huge structural strength for fraction of the cost of traditional timber, steel and concrete construction, because all the strength is contained in the structural elements themselves, the foundation design is simpler and less expensive. | Structural strength of conventional builds is often supported by additional steel rods and more expensive foundation. |
| Modular | All shipping containers provide modular elements that can be combined into larger structures. This simplifies design, planning, and transport. As they are already designed to interlock for case of mobility during transportation. | It's possible to go higher with conventional design methods, but this increases cost of construction due to need for additional structural strength. |
| Transport | Pre-fabricated module can also be easily transported by ship, truck, or rail, because they already conform to shipping sizes. | Transportation of the different materials needed contributes to making construction cost higher. |

| | | |
|---|---|---|
| Availability | Used shipping containers are available across the globe. | Cement, the primary product for building is readily available, but at a high cost in Nigeria and the highest in Africa. |
| Temperature | Steel conducts heat very well; so, the container will normally have to be better insulated than most brick, block or wood structures. | Buildings are usually well insulated. |
| Labour | The welding and cutting of steel is considered to be specialized labour and can increase construction cost, though available now are experienced craftsmen in fabricating container steel. | This method is very labour intensive thereby increasing construction cost. |
| Limitations to design flexibility | Shipping containers have rigid shape, making it difficult for more complicated designs. | Shaping bricks and mortar is a lot easier so design flexibility is endless. |

In other to analyse both conventional and shipping container construction method the overall building cost of a 3-bedroom bungalow apartment, basic construction material and finishes will be taken into consideration without land cost and approval cost.

### 4.2.1 Cost comparison

The construction cost of a 3-bedroom shipping container home varies depending on materials selected for the finishes. Tempo housing a shipping container home construction company provides a 3-bedroom bungalow apartment at a cost between ₦5000000 (€15822) - ₦6500000 (€20570) using three 40ft shipping container at ₦50000 (€158) - ₦75000 (€237) per square meter with basic finishes such as PVC walls, flex tiles on floors and PVC ceiling (Michael, 2016). This apartment is said to be 25% less expensive when compared to conventionally constructed one (Dele, 2018).

Using the average cost of ₦62000 (€196) per square meter of a container building to estimate the cost of cheapest 3-bedroom apartment sold by Lagos state government which is 123.9m² and sold at ₦6960000 (€22025). Constructing such apartment with shipping container will be estimated to cost ₦7743750 (€24505) when calculated by simply multiplying the cost ₦62000 per square meter of a container building by 123.9m². In addition, an estimated cost of constructing a 3-bedroom apartment conventionally using basic fin-

ishes and material is estimated at ₦5294685 (€16755) (Castleshub, 2017), which is relatively the same as constructing with shipping container. This cost of shipping container buildings already exceeds the affordability bracket of low and medium-income earners.

According to Architect Emmanuel Obioha (2017) building a bungalow with shipping container which will be of same comfortability as a conventional building is majorly fast in constructing but not less expensive as claimed by many. Furthermore, for a shipping container to be less expensive several compromises will have to be made which will eventually increase the cost of maintenance such as the use of air conditioning unit which will increase cost in terms of energy consumption (Obioha, 2017)

### 4.2.2 Quality comparison

The quality of any building starts with compliance with local building regulations. However, there are currently no established regulations for the construction of a shipping container home in Lagos which simply indicates that a proposed shipping container building might have to comply to conventional building regulations in terms of, fire resistance, acoustics, foundation, roofing, aesthetics, thermal comfort etc. (Obioha, 2017).

As a resident of Lagos, the quality of a shipping container home is most likely the thermal comfortability, life span and aesthetics. As stated above the thermal comfortability can be solved with proper insulation that gives effective result based on the R value (heat resistance value) of the material used which simply means that the higher the R value the better insulation that is attained. Spray foams and insulation panels with R value of 7.5 are relatively expensive, blanket insulation made with rocky wool or fibre glass could be applied when cost reduction is of high priority because it is way cheaper than foam spray and panel insulation (containerhomeplans, 2015), while the conventional building methods in Lagos requires little or no extra insulation.

According to Ademuson (2017), shipping container homes are starter homes, in other words they are homes one can purchases or construct before acquiring a house built conventionally. Furthermore, the quality of the shipping container homes in terms of life span is 20-25 years if properly built and could be executed in less than 3 months (Ademuson, 2017). Conventional buildings are known to have a longer life span of about one hundred

years which is a dependent on the maintenance as well as absence of any form of natural disaster (Woods, 2015).

# 5 METHODOLOGY

The study was conducted by carrying out an online survey using Google forms. The use of online survey was considered as best option as it was impossible to meet with each and every selected person physically based on company's time schedule and policy.

The link to the questionnaires was made available to Mr. paul Ojo a representative of Blueray construction LTD who then distributed it via email to 200 persons all resident in different parts of Lagos, which includes clients that have ongoing projects with the company, potential clients of the company interested in building a house in the near future and persons living in residential facilities managed by the company. The response time was two months from the first day of July 2017 which was then closed after a month and half as responses was no longer coming in and a total of 50 responses were recorded.

It is self-evident that the major part of the over 21 million residents are not conversant with shipping container residential projects because they are not common around the Lagos environments. Rather, they are mostly familiar with shipping container road side temporary kiosk, shops and site offices. Due to these reasons, the questionnaire was divided into two sections which comprises of an introduction showing the possibilities that could and have been done in constructing housing using shipping containers while the other section involves background questions relating to respondent's current income, housing situation, expectations etc. Questionnaire used to carry out the survey can be found as attached in Appendix 1

## 6 RESULT

However, the survey was targeted to get one hundred people to participate but as mentioned earlier only fifty people responded and also left comment which were of great importance to how best to provide, design and implement shipping container housing projects to meet their needs.

The respondents are resident in 15 Local government areas out of 20 LGA in Lagos metropolitan.

From the result, the highest respondents are from Surulere LGA, Lagos Mainland LGA, Ikorodu LGA with 12%(6) respondents each followed by Ojo LGA and Oshodi-Isolo LGA with 10%(5) respondents each, followed by Agege LGA with 8%(4) respondents, followed by Ikeja LGA, Ifako-Ijaye LGA,and Alimosho LGA with 6%(3) respondents each. Badagry LGA, Eto-Osa LGA and Mushin LGA had 4%(2) respondents each while Ajeromi-ifelodun LGA, Amuwo-Odofin LGA and Lagos Island had 2%(1) respondents each. Figure 7 shows the bar chat of the residence of the respondents that filled the questionnaire.

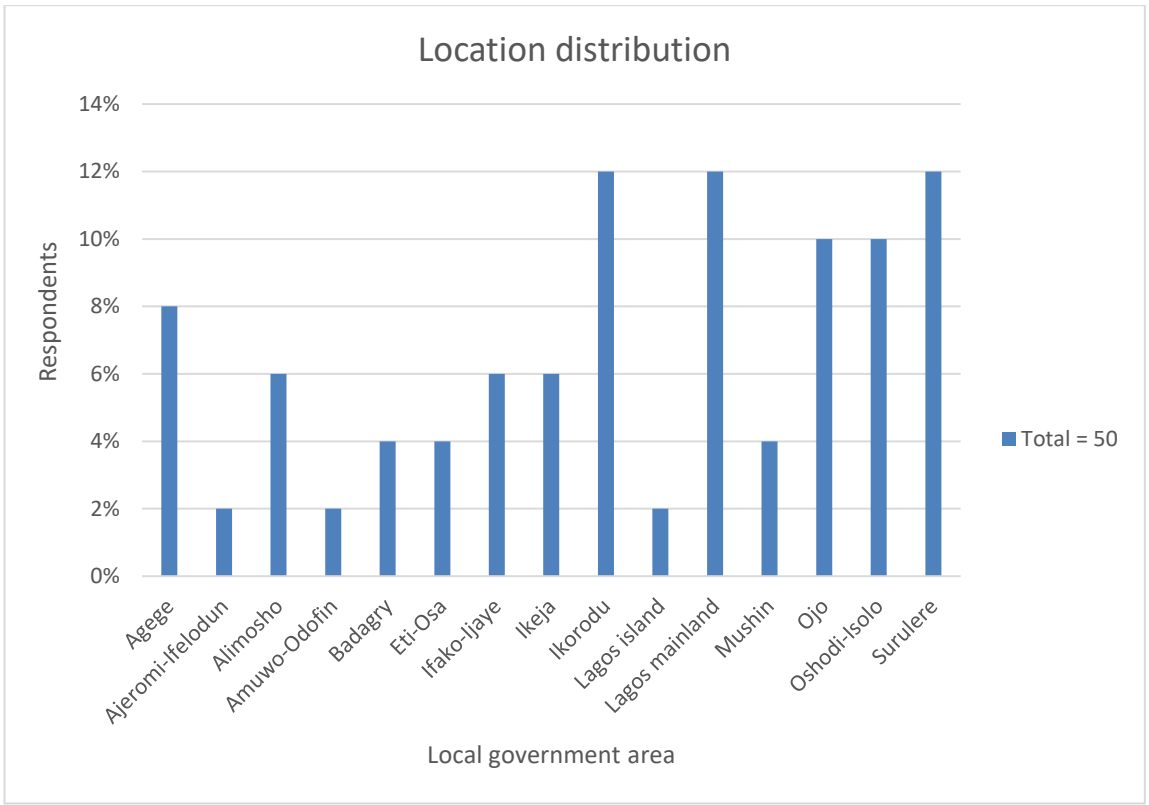


FIGURE 7. Residential location of respondents in Lagos

**GENDER**

72%(36) of the respondents were male and 28%(14) respondents were female as shown in the chart below.

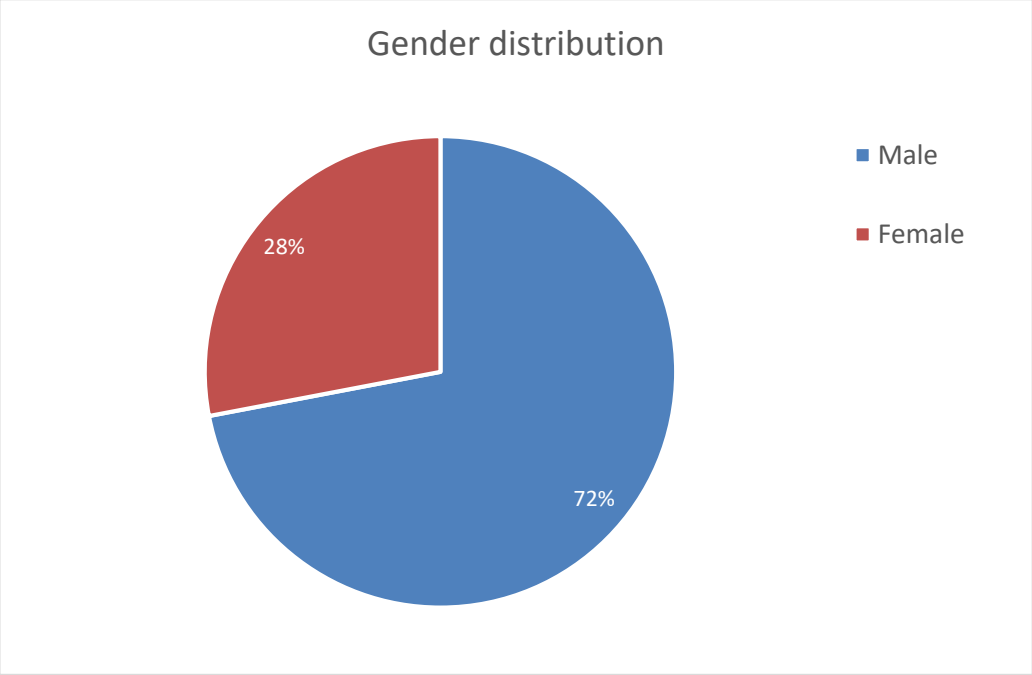


FIGURE 8. Gender distribution of respondent to questionnaire

**Age Distribution of the respondents**

From the result, most of the respondent fall within the age of 30 to 39 which is responsible for 52%(26). The second largest group of the respondents is between 21-29 which is responsible for 36%(18) followed by age group 40 to 49 with 10%(5) respondents and the least is between 50 to 59 with 2%(1) respondents.

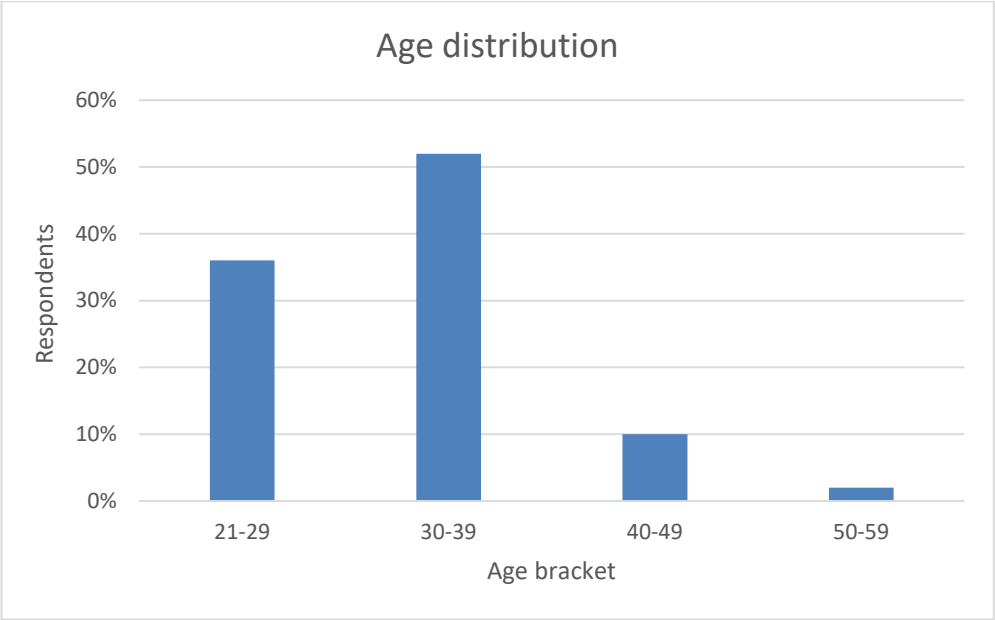


FIGURE 9. Age distribution of respondents

**Employment Status**

The employment status of the respondent is an important parameter in the acceptance of using Shipping container for building. 78%(39) of the respondents are gainfully employed, 16%(8) are entrepreneur while 6%(4) are unemployed.

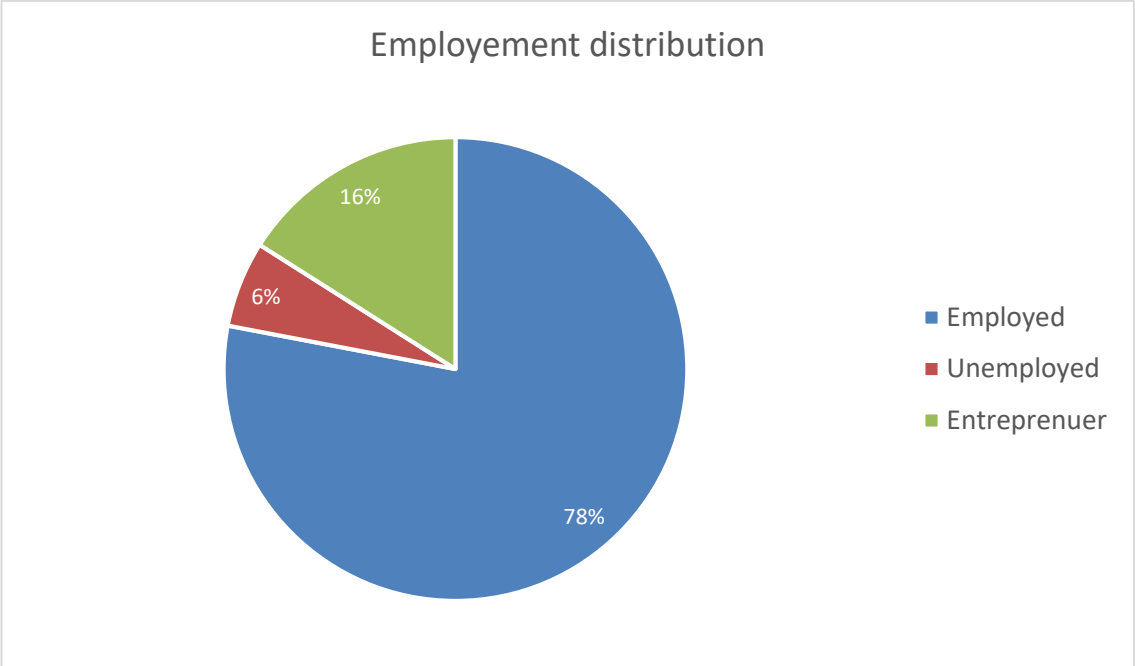


FIGURE 10. Employment status of respondents

**Level of Education**

Most of respondents are well educated. 44%(22) respondents have Bachelor degree, 34%(17) respondents have Master degree, 16%(8) respondents have Higher National Diploma, 4%(2) respondents have Ordinary National Diploma and 2%(1) respondent has post graduate diploma as the highest level of education attained. Level of education will have an influence in the choice of people in using shipping container as affordable housing because being educated will make them to be enlightened and be open minded.

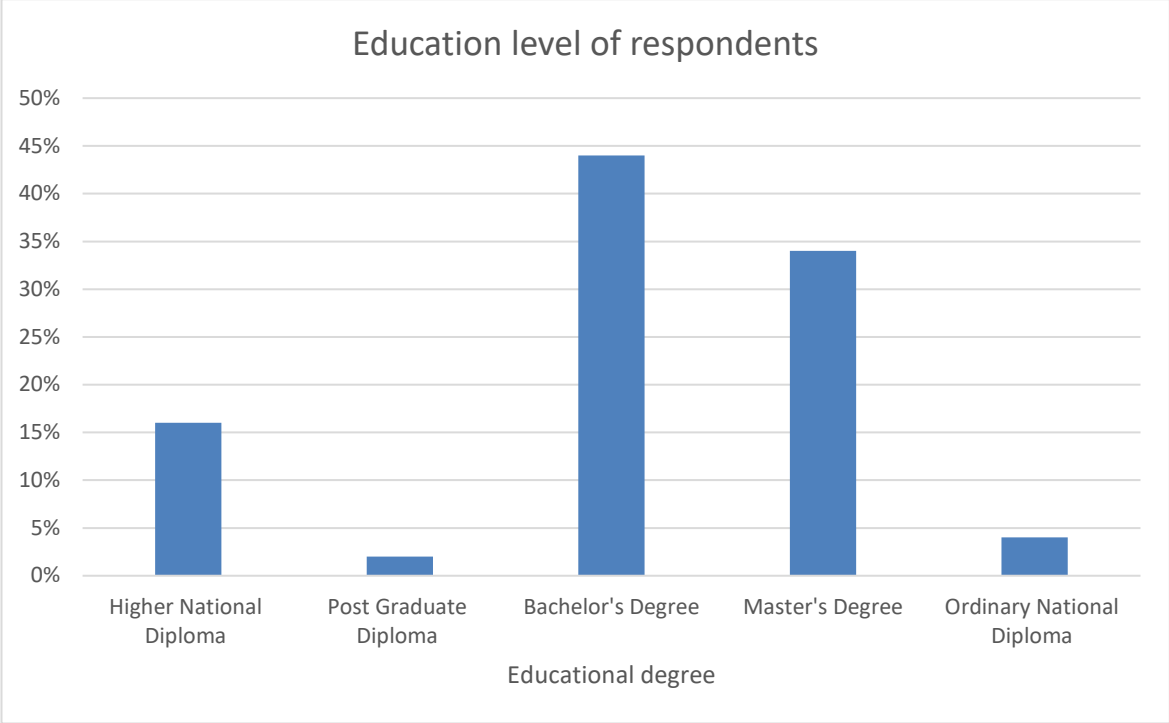


FIGURE 11. Educational background of respondents

**Monthly income**

According to the bar chart below, 24%(12) respondents earn above ₦200000, 22(11) respondents earn between ₦161000 to ₦200000, 10%(5) respondents earn between ₦121000 to ₦160000, 16%(8) respondents earn between ₦81000 to ₦120000, 20%(10) respondents earn between ₦41000 to ₦80000 while 8%(4) respondents earn ₦40000 and below. Income of the respondents is also considered an important factor which will also have influence on the choice of people in choosing affordable housing.

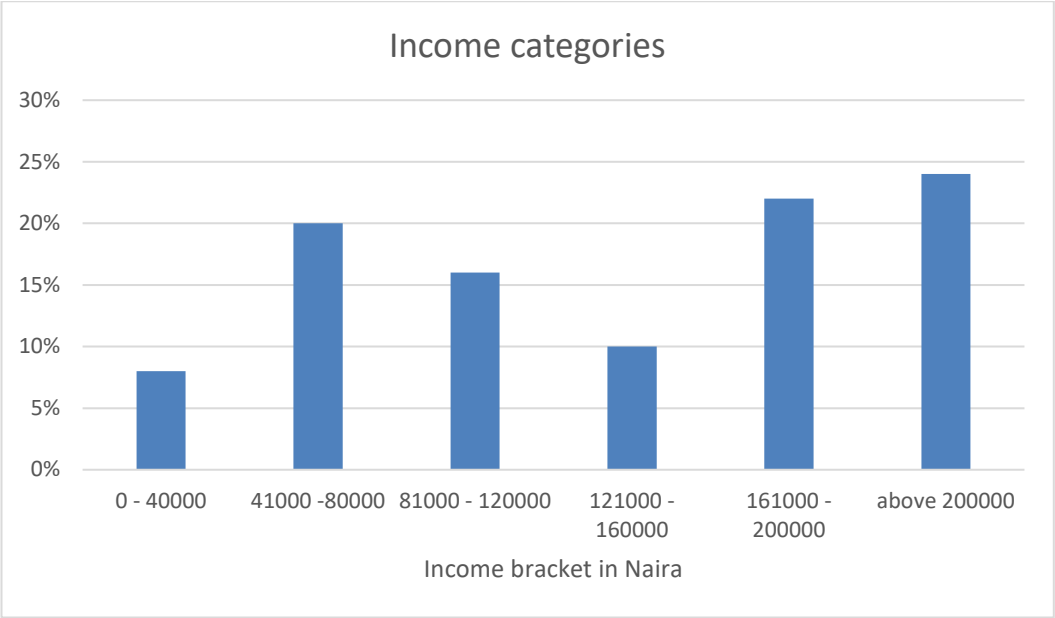


FIGURE 12. Income distribution of respondents

**Housing Situation**

This result shows the current housing situation of the respondents. Most of the respondents were living in the rented apartment which responsible for 60%(30) respondents followed by people living with other people who themselves were not paying either rents or mortgage with 22%(11) respondents. This category of respondents is either living with other people and support in rents or mortgage payments is 2%(1) while respondents that own their homes is 16%(8)

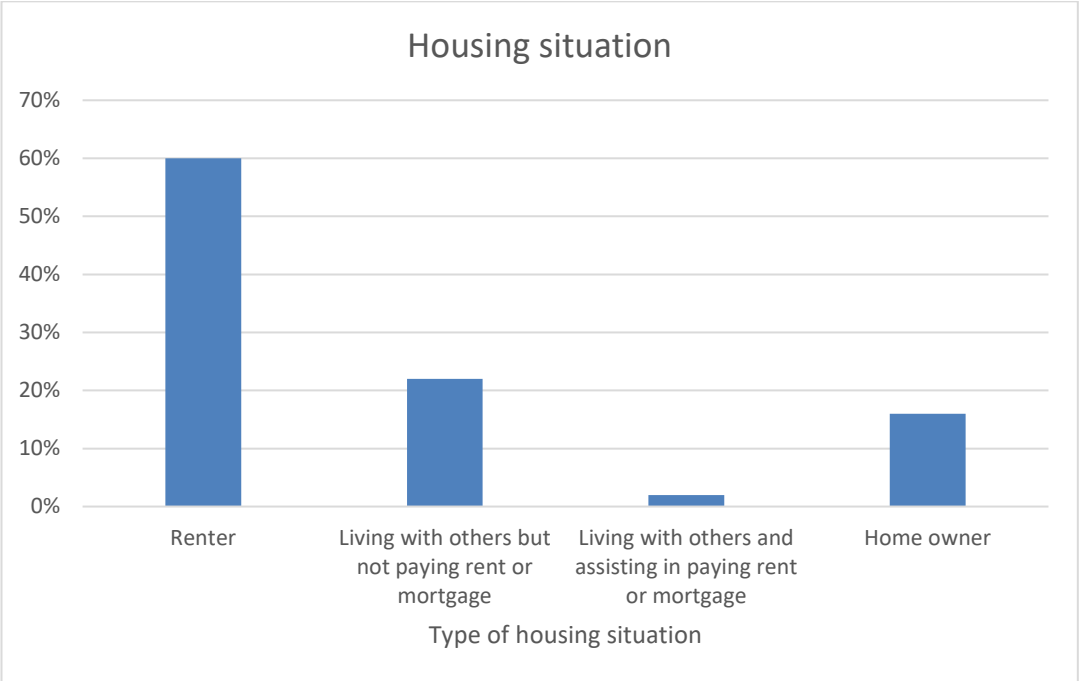


FIGURE 13. Current housing situation of respondents

**Factors to be considered for choice of Housing**

This result shows the factors the respondents consider as priority when renting, purchasing or constructing a house. 84%(42) respondents are of the opinion of considering the location of the apartment, 66%(33) respondents will consider the affordability and the structural makeup of the housing. 54%(27) people will consider the quality of the building and the same number of respondent will also consider the neighbourhood in which the housing is situated and 54%(26) the habitability of the housing. 46%(23) will consider the closeness to services while 42%(21) will consider the size of the housing and 40%(20) will consider the beauty and aesthetic of the housing.

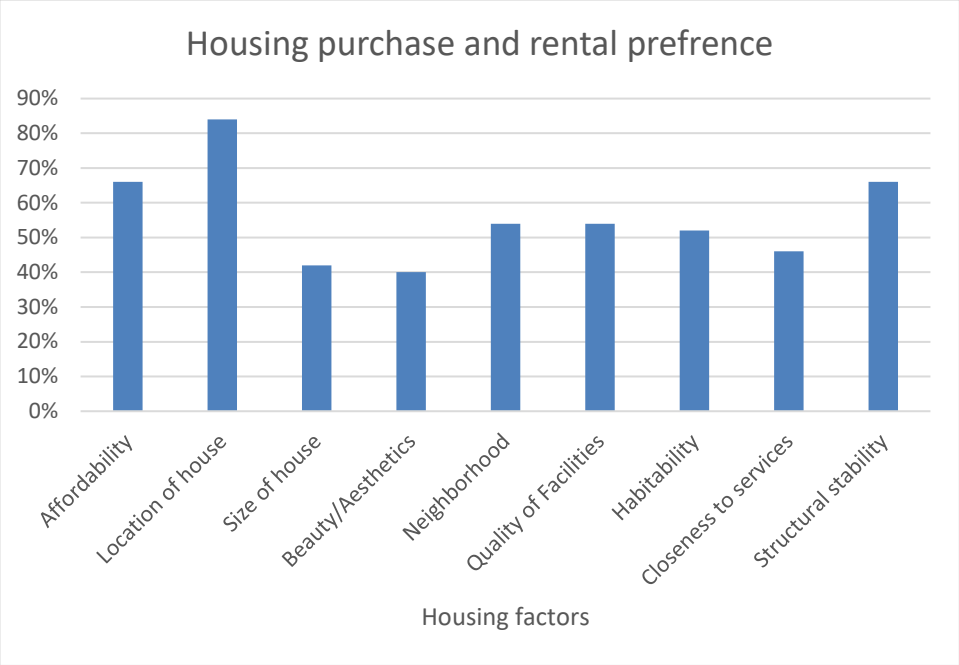


FIGURE 14. Purchase and renting factors considered important by respondents

**Acceptability**

When the question was asked if the respondent who shipping container fulfilled their choice of housing, if they will rent or buy such housing, 16%(8) will not rent or buy such housing even though it fulfil their housing while 84%(42) of the respondent will rent or buy such housing. When asked further those that will not rent or buy housing made of shipping container their reason for such decision, some of the reason given are as follow: - not befitting their social status, security issue and risk of burglary, fire accident, health reason, lack of information about the safety of such housing.

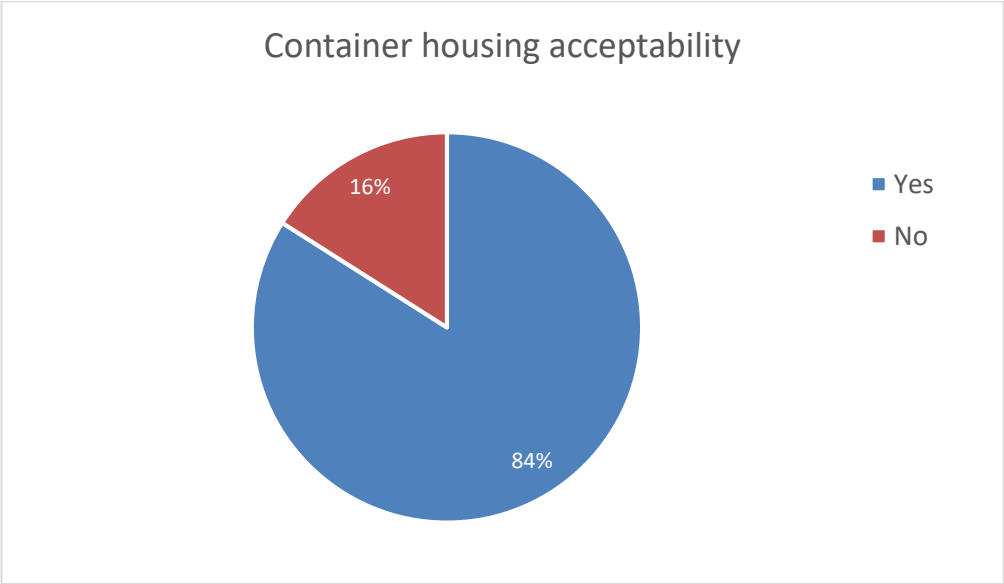


FIGURE 15. Response on container homes fulfilling personal purchase or renting requirements

Furthermore, the question of subsidy and incentives were asked like, if the government decides to subsidize or put incentives on the shipping container housing if the respondent will love to acquire it or not. 88%(44) of the respondents will acquire at least one while 12%(6) will not. Some of the respondents who will not acquire one gave similar reason as the previous question such as security, durability, construction quality and no good information on shipping container and people acceptability and housing orientation, heat transfer issue since Nigeria is a temperate region.

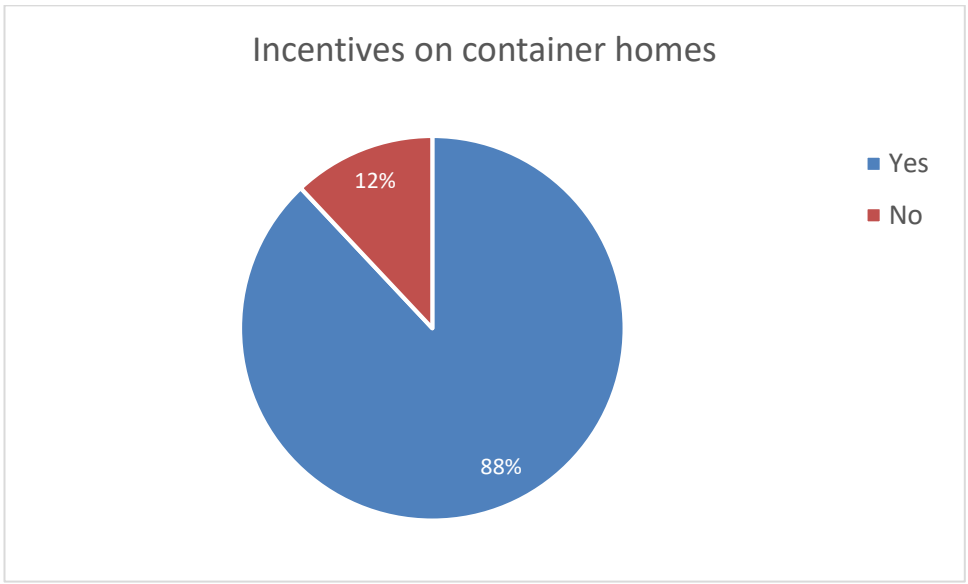


FIGURE 16. Response to subsidy and incentives by government on container homes.

However, among those people that will want to acquire such housing if incentive and subsidy is introduced gave reasons why they will acquire one. Such reasons are as follows:

- less time consuming in constructing.
- cost effectiveness and affordability.
- if well designed and beautiful, it is considered strong and durable.
- good for office settings.

When people were asked to make a general comment recommendation or give other opinion apart from what was covered in the questionnaire, the responses are as follows.

- I need to know how proper heat transmission and sound attenuation is worked upon considering containers are metals. Note Knowing Lagos is a highly populated and hot region when it comes to sun light radiations.
- How big can the apartment be, and is it relocatable?
- In my opinion, shipping container houses are not for human habitation.
- You should've included a range for the cost of building with containers and that of masonry building construction to exaggerate the difference and pros
- Please expand your survey to evaluate the suitability of these houses in Lagos; looking at skill of the work force in Lagos to build and maintain the house including potential safety and security concerns. A colleague of mine moved into a home built with synthetic materials in Lekki and after an electrician visited to fix a flaw, the house burst into flames. I recommend robust risk assessment of this solution.
- Is this available in Nigeria?
- I think we need more awareness and education on this subject matter in Nigeria. The mindset of people when it comes to container structures is that it's for the poor or those with very low income trying to cut cost. For people to begin to accept and embrace the idea of owning or renting container houses, this mindset has to be changed through sensitization.
- Details and cost implication of shipping container need to be included for the audience for easy comprehension or a brief introduction about what shipping container implies?

- This will be a great innovation to happen in any part of Nigeria

A cross tabulation analysis of the data done using IBM SPSS Statistics with the following condition where:

$H_0$ = Null hypothesis = No significant relationship between variables

$H_1$ = Alternative = There is a relationship between variables

Also, Chi-Square test P value is considered as:

P value = 5% = 0.05

$P \leq 0.05$ = Reject $H_0$

$P > 0.05$ = Retain / accept $H_0$.

The result in the table 10 below shows the P value for Chi-Square Test when Age, Income and Educational level of respondents were cross tabulated with Q9, Q10, Q11, where Q9, Q10, and Q11 represent questions number 9,10 and 11.

Where:

Q9 = If a shipping container house fulfils all your choice in question 8 above will rent or buy such an apartment/house? (container home purchase)

Q10 = If the government puts incentives/subsidy on container houses renting and buying would you acquire one? (incentives on container homes)

Q11 = Do you think shipping container houses suits your income type and societal status? respectively in the questionnaire? (Social status)

All of the P values are greater than 0.05 which signifies that the Null hypothesis $H_0$ will be accepted and there is no relationship between the variables

TABLE 10. P values of the Chi-Square test from crosstab analysis of age, income, and education level (Balogun 2018).

| **Variables** | **Q9 (P value)** (container home purchase) | **Q10 (P value)** (incentives on container homes) | **Q11 (P value)** (Social status) |
|---|---|---|---|
| Age | 0.730 | 0.713 | 0.229 |

| | | | |
|---|---|---|---|
| Education Level | 0.761 | 0.505 | 0.648 |
| Income | 0.517 | 0.365 | 0.860 |

It is important to state that the P values is considered as the Likelihood ratio because there are more than two categories in the variables used for the analysis and details of this could be found in Appendix 2

Similarly, the result in the table 11 below shows the P-value for Chi-Square Test whenQ10(incentives on container homes) and Q11(Social status) of respondents were cross tabulated with Q9, where Q9, Q10, and Q11 is the same as mentioned above. All of the P values are less than 0.05 which signifies that the Null hypothesis $H_0$ will be rejected which reveals that there is form relationship between the variables.

TABLE 11. P values of the Chi-Square test of crosstab analysis Q10 and Q11 (Balogun 2018)

| **Variables** | **Q9 (P value)** |
|---|---|
| **Q10** (incentives on container homes) | 0.000002 |
| **Q11** (Social status) | 0.000079 |

# 7 DISCUSSION

The results show that majority of the respondent live in rented apartments, are highly educated and are willing to accept shipping container housing as many of them falls between the low and lower-middle income earners and corroborates with the background information respectively. However, as seen from the statics analysis in table 10, with P values greater than 0.005 this simply signifies that income, educational level and age of the respondent is independent of their choice of living in a shipping container home. Hence, in providing shipping container homes for Lagos residents a first-hand hand experience of living in the space will be an appropriate approach as established in the literature that many Lagos residents are not familiar with such homes even when it already in use.

While some of the respondent consider that shipping container is not appropriate for human habitation, which is as a result of their perspective of shipping container homes in terms of comfortability in tropical region like Lagos the as well as their social status. Table 11 shows a P value of the Chi-Square Test of Q10 to be less than 0.005 which means that the response of the respondents to their willingness to live in a shipping container home is dependent on their social status. It could be said that a person who is a low or a lower-middle income earner might consider a shipping container home temporarily as container home is not what the majority of the society is living in. Therefore, extensive enlightenment and practical experience will be recommended to make them comprehend that shipping container homes are as good as any home when properly constructed, made affordable and also environmentally friendly. This could be attained public campaigns and regional erection of a pilot shipping container project in every local government area in Lagos for people to experience it fore-hand.

This study as shown that there are a number houses available in Lagos which are most luxury houses and are not affordable for the majority of the population usually low and lower-middle income earners that just need basic adequate housing. The analytical result in table 11 shows the P value of the Chi-Square test of Q11 to be less than 0.005 which simply implies that there is significant dependency between government putting incentives or subsidy on shipping container homes and the choice of respondents to live in a shipping container home. This can be seen as affordability, because any form of subsidy will translate to reduction in price of shipping container home which is also one of the

three most important preference of choosing a house by the respondents after structural stability and location as seen in figure 14. As established chapter in 4 shipping container homes are readily available but not affordable when compared to the expectations of Lagos residents in terms of income which is contrary to belief of many. For this reason, additional studies are required in preparing a suitable subsidized program for shipping container housing development for private land owners and developers willing to provide shipping containers homes and also on how to significantly reduce the price of shipping container houses using local materials compared to current prices in and around Lagos such that low and lower-middle income earners will be able to purchase it using less than 30% of their salary. In addition, it will be of great advantage to combine shipping container housing with conventional housing methods in providing adequate amount of housing in Lagos knowing that the current conventional construction methods lack the capacity to deliver the needed numbers of housing annually as the population of Lagos is nowhere near reduction.

# 8 CONCLUSION

Contrary to many beliefs that shipping container houses are cheaper than conventional building, this study as shown that in Lagos the price of shipping container is almost the same and somewhat higher than that of conventional building if similar standards are put in place. Therefore, it can be concluded that the provision of shipping container housing as alternative is viable as it is fast to construct but yet difficult as a suitable alternative to compete and possibly replace conventional buildings, since social status possesses a significant effect in the decision-making process of Lagos residents in choosing a shipping container home. Thus, shipping container houses should not be considered for Lagos residents until it is made cheaper and trendy.

## 9 References

Adegboye, K. (2014, May 13). *building-low-cost-houses-fashola*. Retrieved 02 26, 2018, from www.vanguardngr.com: https://www.vanguardngr.com/2014/05/building-low-cost-houses-fashola/

Ademuson, K. (2017, March 16). Could shipping container be the future of real estate in nigeria? Ventures Africa audio Visuals. Retrieved from https://www.youtube.com/watch?v=UxPWsmgf-Z4

Adeniyi, M. A. (2015, October 11). *understanding nigerias high poverty rate*. Retrieved May 10, 2018, from http://www.nairaland.com: http://www.nairaland.com/2658056/understanding-nigerias-high-poverty-rate

Adio, S. (2017, November 30). *Lagos residents commend rent to own mortgage scheme* . Retrieved from www.sunnewsonline.com: http://sunnewsonline.com/lagos-residents-commend-rent-to-own-mortgage-scheme/

Agbola, T. (1988, November 19). *https://docslide.net/documents/the-housing-construction-process-in-nigeria-implications-for-urban-growth.html.* Retrieved from docslide.net: https://docslide.net/download/link/the-housing-construction-process-in-nigeria-implications-for-urban-growth

Ajanlekoko, J. S. (2001). Sustainable Housing Development in Nigeria - The Financial and Infrastructural Implication. *International Conference on Spatial Information for Sustainable Development* (pp. 1-14). Nairobi: fig.net. Retrieved October 2017, from https://www.fig.net/resources/proceedings/2001/nairobi/ajanlekoko-CMWS1-1.pdf

Akinmoladun, O. I., & Oluwoye , J. O. (2007). An Assessment of Why the Problem of Housing Shortages Persis In Developing Countries: A Case Study of Lagos Metropolis, Nigeria. *Pakistan Journal of Social Sciences, 4*(4), 591. Retrieved October 2017, from http://medwelljournals.com/abstract/?doi=pjssci.2007.589.598

Akinyode, B. F., & Tareef, K. H. (2014). Bridging the Gap between Housing Demand and Housing Supply in Nigerian Urban Centres: A Review of Government Intervention So Far. *British Journal of Arts and Social Sciences, 18*(11), 94-107. Retrieved September 2017, from http://www.bjournal.co.uk/volume/paper/BJASS_18_2/BJASS_18_02_03.pdf

Alufohai, A. J. (2013, May 6). Retrieved 2 20, 2018, from www.fig.net: http://www.fig.net/organisation/tf/property/ww2013_position_paper.pdf

Arimah, B. C. (1997). The Determinant of Housing Tenure Choice In Ibadan, Nigeria. *Urban Studies*, 105-124. doi:10.1080/0042098976294

Atlas Media. (2018). *english profile country Nigeria*. Retrieved February 28, 2018, from https://atlas.media.mit.edu: https://atlas.media.mit.edu/en/profile/country/nga/

BC Housing. (2014). *Modular prefabricated housing literature scan.* Retrieved 2 4, 2018, from bchousing.org: https://www.bchousing.org/research-centre/library/housing-affordability/modular-prefabricated-housing-literature-scan

Carthcart, B. (2017, October 16). Retrieved March 24, 2018, from www.confoot.fi: http://confoot.fi/en/avoid-shipping-container-rust/

Castleshub. (2017, August 27). Retrieved March 20, 2018, from castleshub.blogspot.fi: http://castleshub.blogspot.fi/2017/08/cost-of-building-3-bedroom-bungalow-in.html

Chegwe, E. (2014). *The right to housing in the context of nigerian law and human rights practice*. Retrieved march 2017

containerhomeplans. (2015, March 23). Retrieved March 23, 2018, from www.containerhomeplans.org: https://www.containerhomeplans.org/2015/03/5-methods-to-insulate-your-shipping-container-home/

Dele. (2018, April 5). Lagos housing crisis. (N. Kacungira, Interviewer) DIO THN. Retrieved from https://www.youtube.com/watch?v=xTEIyQN8jJE

Diala, A. (2012). Realising the Right to Adequate Housing in Nigeria. *Madonna University Law Journal,, 1*(2), 155-173. Retrieved September 2017, from http://www.academia.edu/2123571/Realising_the_Right_to_Adequate_Housing_in_Nigeria

GDV. (2018). *container-explanation of terminoligies*. (G. d. Versicherungswirtschaft, Producer) Retrieved 2 5, 2018, from containerhandbuch.de: http://www.containerhandbuch.de/chb_e/stra/index.html

Kolawole, Y. (2014, September 29). *container housing offers cheaper faster option mass housing tempohousing nigeria*. Retrieved October 26, 2017, from www.vanguardngr.com: https://www.vanguardngr.com/2014/09/container-housing-offers-cheaper-faster-option-mass-housing-tempohousing-nigeria/

Lagos Sate Ministry of Housing. (2017). Retrieved March 11, 2018, from www.lagosstate.gov.ng: https://lagosstate.gov.ng/wp-content/uploads/2017/07/BOOKLET-HOUSING.pdf

Lagos State Government. (2017, May 11). *Bridging housinf deficit in Lagos*. Retrieved October 2017, from Lagos state government website: https://lagosstate.gov.ng/blog/2017/05/11/bridging-housing-deficit-in-lagos/

Levinson, M. (2006). *The Box: How Shipping Container Made the World Smaller and the World Economy Bigger*. New Jersy: Princeton Press.

Mammadov, T. (2015, August). Retrieved August 20, 2017, from ir.library.illinoisstate.edu: https://ir.library.illinoisstate.edu/cgi/viewcontent.cgi?article=1432&context=etd

Mazadu, Z. B., & Danraka, M. M. (2015). Potentials of Shipping Container Buildings and the Implication to Nigeria Housing Challenges. *Unilorin Confrence Proceedings. 3*, pp. 1-9. Ilorin,Kwara State: cambridgenigeriapub.com. Retrieved September 7, 2017, from http://www.cambridgenigeriapub.com/wp-content/uploads/2016/03/POTENTIALS-OF-SHIPPING-CONTAINER-BUILDINGS-AND-THE-IMPLICATION-TO-NIGERIA-HOUSING-CHALLENGES.pdf?x75991

Michael. (2016, September 13). Retrieved March 10, 2018, from www.livinspaces.net: https://www.livinspaces.net/special-features/tempohousing-can-build-a-house-with-2-million-naira-using-shipping-containers/

Modular Building Institute. (2018). *Why modular*. Retrieved 2 4, 2018, from modular.org: http://www.modular.org/htmlPage.aspx?name=why_modular

Obada, A. (2016, August 13). Retrieved from www.scribd.com: https://www.scribd.com/document/321102999/An-Evaluation-of-Housing-Delivery-Strategies-in-Lagos-state

Obioha, E. (2017, June 5). Building with shipping container .

Okafor, C. (2017, september 27). *osinbajo: Nigerias housing deficit too high, unacceptable* . Retrieved October 10, 2017, from Thisdaylive Newspaper website : https://www.thisdaylive.com/index.php/2017/09/27/osinbajo-nigerias-housing-deficit-too-high-unacceptable/

Olotu, E., & Adebayo, A. k. (2013, April 18). *https://www.scribd.com/document/136650342/42-BUILDING-WITH-SHIPPING-CONTAINERS-A-SUSTAINABLE-APPROACH-TO-SOLVING-HOUSING-SHORTAGE-IN-LAGOS-METROPOLIS-pdf.* Retrieved September 2017, from www.scribd.com: https://www.scribd.com/document/136650342/42-BUILDING-WITH-SHIPPING-CONTAINERS-A-SUSTAINABLE-

APPROACH-TO-SOLVING-HOUSING-SHORTAGE-IN-LAGOS-METROPOLIS-pdf

Olowoopeju, M. (2016, December 23). *Recession: Ambode slashes prices lagos mortgage houses*. Retrieved March 11, 2018, from www.vanguardngr.com: https://www.vanguardngr.com/2016/11/recession-ambode-slashes-prices-lagos-mortgage-houses/

Olugbenga, E., & Ogundiran , A. (2013). Challenges of Housing delivery In Metropolitan Lagos. *Research on Humanities and Social Scienes, 3*(20), 3. Retrieved october 2017, from www.iiste.org: http://iiste.org/Journals/index.php/RHSS/article/view/9518

Onu, V., & Onu. (2012, December ). Urban ResidentailL Housing and Low-Income Earners: A Study of Markurdi Metropolis, Benue State, Nigeria. *European Scientific Journal, 18*(28), 231-246. Retrieved from http://www.eujournal.org/index.php/esj/article/download/648/710

Oshodi, l. (2010, 11 24). Retrieved from https://oshlookman.wordpress.com/2010/11/24/housing-situation-in-lagos-nigeria/

Pauli, G. (2010). *http://www.theblueeconomy.org/cases-1-to-100.html*. Retrieved from http://www.theblueeconomy.org/uploads/7/1/4/9/71490689/case_83_upcycling_versus_recycling.pdf

Penland, W. J. (2008, November). Retrieved July 19, 2017, from www.scribd.com: https://www.scribd.com/document/343909645/236016761-Container-Architecture-pdf

Renaissance Capital. (2011, September 26). Retrieved February 28, 2018, from www.fastestbillion.com: http://www.fastestbillion.com/res/Research/Survey_Nigerian_middle_class-260911.pdf

Salau, G. (2017, March 5). *Lagos stillgrappling with affordable housing for low-income-earners*. Retrieved March 5, 2018, from www.guardian.ng: https://guardian.ng/sunday-magazine/lagos-still-grappling-with-affordable-housing-for-low-income-earners/

Schwarzer, M. (2017, 08 19). *The Emergence of Container Urbanism*. Retrieved from Place journal website: https://placesjournal.org/article/the-emergence-of-container-urbanism/

Shanu. (2016, August 30). Retrieved 2017

Smith, H. (2015, September 2). Retrieved March 18, 2018, from grist.org: https://grist.org/cities/dear-architects-stop-trying-to-make-shipping-container-buildings-happen/

United Nations. (2012). Affodable Land and Housing in Africa. *3*. Nairobi, Kenya: UN-Habitat. Retrieved 7 17, 2017, from https://unhabitat.org/books/affordable-land-and-housing-in-africa/

United Nations. (2014, 5 1). *The right to adequate housing fact sheet no-21rev-1* . Retrieved November 3, 2017, from Un-habitat website: https://unhabitat.org/the-right-to-adequate-housing-fact-sheet-no-21rev-1/

Vanguuard. (2016, December 1). *Lagos launch rent housing scheme december 8*. (Adekunle, Editor) Retrieved March 11, 2018, from www.vanguardngr.com: https://www.vanguardngr.com/2016/12/lagos-launch-rent-housing-scheme-december-8/

Western metal roofing. (2018). Retrieved from www.corten.com: http://www.corten.com/frequently-asked-questions.html

Woods, T. (2015, April 9). Retrieved February 20, 2018, from www.containerhomeplans.org: https://www.containerhomeplans.org/2015/04/who-built-the-first-shipping-container-home/

Woods, T. (2015, January 20). Retrieved from https://www.containerhomeplans.org/2015/01/how-long-will-my-shipping-container-home-last-for/

World population review. (2017, 10 20). *Lagos population*. Retrieved 10 2017, from World population review website: http://worldpopulationreview.com/world-cities/lagos-population/

World Shipping Council. (2018). *History of Containerization*. Retrieved 1 18, 2018, from worldshipping.org website: http://www.worldshipping.org/about-the-industry/history-of-containerization

‘

**APPENDICES**

Appendix 1. Thesis Questionnaire.

## Thesis Questionnaire

INTRODUCTION

Thank you for agreeing to be part of this survey which intend to measure and understand why and how Lagos resident will accept alternative building construction for low cost housing using shipping containers, which can help solve the housing deficits in Lagos.

This survey should only take about 4-5 minutes to complete.Your response and opinion to this survey is part of a Bachelor's thesis of the department of Energy and Environmental Engineering, Tampere University of Applied sciences, Tampere Finland.

Kindly fill this quick survey in the next section and your response would be treated anonymously and confidentially .
Thank you for your cooperation.

Below are some shipping container houses built in different parts of the world showing the possibilities that can be attained using this alternative building construction technology.

* Required

### Grillagh water house Northern Ireland

### Graceville home Australia

1 /6

**Ventures Park Nigeria**


**Sarah house United States**

## Alternative Low-cost Housing with Shipping container

QUESTIONNAIRE ON THE OPINION OF LAGOS RESIDENT REGARDING LIVING IN A SHIPPING CONTAINER HOUSE.

1. **1) In what area of Lagos do you live** *

*Mark only one oval.*

- ◯ Agege
- ◯ Ajeromi-Ifelodun
- ◯ Alimosho
- ◯ Amuwo-Odofin
- ◯ Apapa
- ◯ Badagry
- ◯ Epe
- ◯ Eti-Osa
- ◯ Ibeju-Lekki
- ◯ Ifako-ijaye
- ◯ Ikeja
- ◯ Ikorodu
- ◯ Kosofe
- ◯ Lagos island
- ◯ Lagos mainland
- ◯ Mushin
- ◯ Ojo
- ◯ Oshodi-Isolo
- ◯ Somolu
- ◯ Surulere

2. **2) Gender** *

*Mark only one oval.*

- ◯ Male
- ◯ Female

3. **3) Which category below includes your age?**

*Mark only one oval.*

- ◯ 17 or younger
- ◯ 18-20
- ◯ 21-29
- ◯ 30-39
- ◯ 40-49
- ◯ 50-59
- ◯ 60 or above

4. **4) Which of the following best describe your employment status?** *
*Mark only one oval.*

- ◯ Employed
- ◯ Unemployed
- ◯ Entreprenuer
- ◯ Retired

5. **Others (please specify)**

_____

6. **5) What is the highest level of school you have completed or highest level of degree you have** *
*Mark only one oval.*

- ◯ First school living certificate
- ◯ Junior secondary school certificate (JSSC)
- ◯ Senior secondary school certificate (SSSC/GCE)
- ◯ Ordinary National Diploma (OND)
- ◯ Higher National Diploma (HND)
- ◯ Post Graduate Diploma (PGD)
- ◯ Bachelor's Degree
- ◯ Master's Degree
- ◯ Doctorate Degree

7. **6) Kindly signify your monthly income level** *
*Mark only one oval.*

- ◯ 0 to 40000 Naira
- ◯ 41000 to 80000 Naira
- ◯ 81000 to 120000 Naira
- ◯ 121000 to 160000 Naira
- ◯ 161000 to 200000 Naira
- ◯ 200000 Naira and above

8. **7) Which of the following best describe your current housing situation** *
*Mark only one oval.*

- ◯ Home owner
- ◯ Renter
- ◯ Living with others but not paying rent or mortgage
- ◯ Living with others and assisting in paying rent or mortgage

9. **Others (please specify)**

_____

10. **8) Which of the following factors would you consider when renting or buying an apartment /house or building your own house?** *
*Check all that apply.*

- [ ] Affordability
- [ ] Location of house
- [ ] Size of house
- [ ] Beauty/Aesthetics
- [ ] Neighborhood
- [ ] Quality of Facilities
- [ ] Habitability
- [ ] Closeness to services
- [ ] Structural stability

11. **Others (please specify)**

_____

12. **9) If a shipping container house fulfills all your choice in question 8 above will rent or buy such an apartment/house?** *
*Mark only one oval.*

- ◯ Yes
- ◯ No

13. **If your answer is 'No', please explain why?**

_____
_____
_____
_____
_____

14. **10) If the government puts incentives/subsidy on container houses renting and buying would you acquire one?** *
*Mark only one oval.*

- ◯ Yes
- ◯ No

15. **If your answer is 'No', please explain why?**

_____
_____
_____
_____
_____

16. **11) Do you think shipping container houses suits your income type and societal status** *
*Mark only one oval.*

- ◯ Yes
- ◯ No

17. **If your answer 'Yes' or 'No', please explain why?**

_____

_____

_____

_____

_____

18. **12) Considering question 9 & 10 , and you own a plot of land with intentions to build a house, would you build it using shipping container** *
*Mark only one oval.*

- ◯ Yes
- ◯ No

19. **If your answer 'Yes' or 'No', please explain why?**

_____

_____

_____

_____

_____

20. **13) Any other comments or questions? Please specify**

_____

_____

_____

_____

_____

Appendix 2. IBM SPSS Statistics result for Age, Education, and Income significance

```
CROSSTABS
  /TABLES=Age Education Income BY Q9 Q10 Q11
  /FORMAT=AVALUE TABLES
  /STATISTICS=CHISQ
  /CELLS=COUNT EXPECTED
  /COUNT ROUND CELL.
```

## Crosstabs

**Case Processing Summary**

| | Cases | | | | | |
|---|---|---|---|---|---|---|
| | Valid | | Missing | | Total | |
| | N | Percent | N | Percent | N | Percent |
| Age * Q9 | 50 | 100.0% | 0 | 0.0% | 50 | 100.0% |
| Age * Q10 | 50 | 100.0% | 0 | 0.0% | 50 | 100.0% |
| Age * Q11 | 50 | 100.0% | 0 | 0.0% | 50 | 100.0% |
| Education * Q9 | 50 | 100.0% | 0 | 0.0% | 50 | 100.0% |
| Education * Q10 | 50 | 100.0% | 0 | 0.0% | 50 | 100.0% |
| Education * Q11 | 50 | 100.0% | 0 | 0.0% | 50 | 100.0% |
| Income * Q9 | 50 | 100.0% | 0 | 0.0% | 50 | 100.0% |
| Income * Q10 | 50 | 100.0% | 0 | 0.0% | 50 | 100.0% |
| Income * Q11 | 50 | 100.0% | 0 | 0.0% | 50 | 100.0% |

## Age * Q9

**Crosstab**

| | | | Q9 | | |
|---|---|---|---|---|---|
| | | | No | Yes | Total |
| Age | 21-29 | Count | 4 | 14 | 18 |
| | | Expected Count | 2.9 | 15.1 | 18.0 |
| | 30-39 | Count | 3 | 23 | 26 |
| | | Expected Count | 4.2 | 21.8 | 26.0 |
| | 40-49 | Count | 1 | 4 | 5 |
| | | Expected Count | .8 | 4.2 | 5.0 |

| | | | | | |
|---|---|---|---|---|---|
| | 50-59 | Count | 0 | 1 | 1 |
| | | Expected Count | .2 | .8 | 1.0 |
| Total | | Count | 8 | 42 | 50 |
| | | Expected Count | 8.0 | 42.0 | 50.0 |

**Chi-Square Tests**

| | Value | df | Asymptotic Significance (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 1.154[a] | 3 | .764 |
| Likelihood Ratio | 1.297 | 3 | .730 |
| N of Valid Cases | 50 | | |

a. 6 cells (75.0%) have expected count less than 5. The minimum expected count is .16.

## Age * Q10

**Crosstab**

| | | | Q10 | | |
|---|---|---|---|---|---|
| | | | No | Yes | Total |
| Age | 21-29 | Count | 3 | 15 | 18 |
| | | Expected Count | 2.2 | 15.8 | 18.0 |
| | 30-39 | Count | 2 | 24 | 26 |
| | | Expected Count | 3.1 | 22.9 | 26.0 |
| | 40-49 | Count | 1 | 4 | 5 |
| | | Expected Count | .6 | 4.4 | 5.0 |
| | 50-59 | Count | 0 | 1 | 1 |
| | | Expected Count | .1 | .9 | 1.0 |
| Total | | Count | 6 | 44 | 50 |
| | | Expected Count | 6.0 | 44.0 | 50.0 |

**Chi-Square Tests**

| | Value | df | Asymptotic Significance (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 1.267[a] | 3 | .737 |
| Likelihood Ratio | 1.366 | 3 | .713 |
| N of Valid Cases | 50 | | |

a. 6 cells (75.0%) have expected count less than 5. The minimum expected count is .12.

## Age * Q11

**Crosstab**

| | | | Q11 | | |
|---|---|---|---|---|---|
| | | | No | Yes | Total |
| Age | 21-29 | Count | 6 | 12 | 18 |
| | | Expected Count | 4.0 | 14.0 | 18.0 |
| | 30-39 | Count | 5 | 21 | 26 |
| | | Expected Count | 5.7 | 20.3 | 26.0 |
| | 40-49 | Count | 0 | 5 | 5 |
| | | Expected Count | 1.1 | 3.9 | 5.0 |
| | 50-59 | Count | 0 | 1 | 1 |
| | | Expected Count | .2 | .8 | 1.0 |
| Total | | Count | 11 | 39 | 50 |
| | | Expected Count | 11.0 | 39.0 | 50.0 |

**Chi-Square Tests**

| | Value | df | Asymptotic Significance (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 3.156[a] | 3 | .368 |
| Likelihood Ratio | 4.320 | 3 | .229 |
| N of Valid Cases | 50 | | |

a. 5 cells (62.5%) have expected count less than 5. The minimum expected count is .22.

## Education * Q9

**Crosstab**

| | | | Q9 | | |
|---|---|---|---|---|---|
| | | | No | Yes | Total |
| Education | Bachelor's Degree | Count | 3 | 19 | 22 |
| | | Expected Count | 3.5 | 18.5 | 22.0 |
| | Higher National Diploma | Count | 1 | 7 | 8 |
| | | Expected Count | 1.3 | 6.7 | 8.0 |
| | Master's Degree | Count | 4 | 13 | 17 |
| | | Expected Count | 2.7 | 14.3 | 17.0 |
| | Ordinary National Diploma | Count | 0 | 2 | 2 |
| | | Expected Count | .3 | 1.7 | 2.0 |
| | Post Graduate Diploma | Count | 0 | 1 | 1 |
| | | Expected Count | .2 | .8 | 1.0 |
| Total | | Count | 8 | 42 | 50 |
| | | Expected Count | 8.0 | 42.0 | 50.0 |

**Chi-Square Tests**

| | Value | df | Asymptotic Significance (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 1.453[a] | 4 | .835 |
| Likelihood Ratio | 1.863 | 4 | .761 |
| N of Valid Cases | 50 | | |

a. 7 cells (70.0%) have expected count less than 5. The minimum expected count is .16.

## Education * Q10

**Crosstab**

| | | | Q10 | | |
|---|---|---|---|---|---|
| | | | No | Yes | Total |
| Education | Bachelor's Degree | Count | 3 | 19 | 22 |
| | | Expected Count | 2.6 | 19.4 | 22.0 |
| | Higher National Diploma | Count | 0 | 8 | 8 |
| | | Expected Count | 1.0 | 7.0 | 8.0 |
| | Master's Degree | Count | 3 | 14 | 17 |
| | | Expected Count | 2.0 | 15.0 | 17.0 |
| | Ordinary National Diploma | Count | 0 | 2 | 2 |
| | | Expected Count | .2 | 1.8 | 2.0 |
| | Post Graduate Diploma | Count | 0 | 1 | 1 |
| | | Expected Count | .1 | .9 | 1.0 |
| Total | | Count | 6 | 44 | 50 |
| | | Expected Count | 6.0 | 44.0 | 50.0 |

**Chi-Square Tests**

| | Value | df | Asymptotic Significance (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 2.069[a] | 4 | .723 |
| Likelihood Ratio | 3.323 | 4 | .505 |
| N of Valid Cases | 50 | | |

a. 7 cells (70.0%) have expected count less than 5. The minimum expected count is .12.

## Education * Q11

**Crosstab**

| | | | Q11 | | |
|---|---|---|---|---|---|
| | | | No | Yes | Total |
| Education | Bachelor's Degree | Count | 5 | 17 | 22 |
| | | Expected Count | 4.8 | 17.2 | 22.0 |
| | Higher National Diploma | Count | 1 | 7 | 8 |
| | | Expected Count | 1.8 | 6.2 | 8.0 |
| | Master's Degree | Count | 5 | 12 | 17 |
| | | Expected Count | 3.7 | 13.3 | 17.0 |
| | Ordinary National Diploma | Count | 0 | 2 | 2 |
| | | Expected Count | .4 | 1.6 | 2.0 |
| | Post Graduate Diploma | Count | 0 | 1 | 1 |
| | | Expected Count | .2 | .8 | 1.0 |
| Total | | Count | 11 | 39 | 50 |
| | | Expected Count | 11.0 | 39.0 | 50.0 |

**Chi-Square Tests**

| | Value | df | Asymptotic Significance (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 1.818[a] | 4 | .769 |
| Likelihood Ratio | 2.483 | 4 | .648 |
| N of Valid Cases | 50 | | |

a. 7 cells (70.0%) have expected count less than 5. The minimum expected count is .22.

## Income * Q9

**Crosstab**

| | | | Q9 | | |
|---|---|---|---|---|---|
| | | | No | Yes | Total |
| Income | 0 to 40000 Naira | Count | 0 | 4 | 4 |
| | | Expected Count | .6 | 3.4 | 4.0 |

| | | | | | |
|---|---|---|---|---|---|
| | 121000 to 160000 Naira | Count | 0 | 5 | 5 |
| | | Expected Count | .8 | 4.2 | 5.0 |
| | 161000 to 200000 Naira | Count | 3 | 8 | 11 |
| | | Expected Count | 1.8 | 9.2 | 11.0 |
| | 200000 Naira and above | Count | 2 | 10 | 12 |
| | | Expected Count | 1.9 | 10.1 | 12.0 |
| | 41000 to 80000 Naira | Count | 2 | 8 | 10 |
| | | Expected Count | 1.6 | 8.4 | 10.0 |
| | 81000 to 120000 Naira | Count | 1 | 7 | 8 |
| | | Expected Count | 1.3 | 6.7 | 8.0 |
| Total | | Count | 8 | 42 | 50 |
| | | Expected Count | 8.0 | 42.0 | 50.0 |

**Chi-Square Tests**

| | Value | df | Asymptotic Significance (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 2.950[a] | 5 | .708 |
| Likelihood Ratio | 4.226 | 5 | .517 |
| N of Valid Cases | 50 | | |

a. 8 cells (66.7%) have expected count less than 5. The minimum expected count is .64.

## Income * Q10

**Crosstab**

| | | | Q10 | | |
|---|---|---|---|---|---|
| | | | No | Yes | Total |
| Income | 0 to 40000 Naira | Count | 0 | 4 | 4 |
| | | Expected Count | .5 | 3.5 | 4.0 |
| | 121000 to 160000 Naira | Count | 0 | 5 | 5 |
| | | Expected Count | .6 | 4.4 | 5.0 |
| | 161000 to 200000 Naira | Count | 2 | 9 | 11 |
| | | Expected Count | 1.3 | 9.7 | 11.0 |

| | | | | | |
|---|---|---|---|---|---|
| | 200000 Naira and above | Count | 2 | 10 | 12 |
| | | Expected Count | 1.4 | 10.6 | 12.0 |
| | 41000 to 80000 Naira | Count | 2 | 8 | 10 |
| | | Expected Count | 1.2 | 8.8 | 10.0 |
| | 81000 to 120000 Naira | Count | 0 | 8 | 8 |
| | | Expected Count | 1.0 | 7.0 | 8.0 |
| Total | | Count | 6 | 44 | 50 |
| | | Expected Count | 6.0 | 44.0 | 50.0 |

**Chi-Square Tests**

| | Value | df | Asymptotic Significance (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 3.570[a] | 5 | .613 |
| Likelihood Ratio | 5.440 | 5 | .365 |
| N of Valid Cases | 50 | | |

a. 8 cells (66.7%) have expected count less than 5. The minimum expected count is .48.

## Income * Q11

**Crosstab**

| | | | Q11 | | |
|---|---|---|---|---|---|
| | | | No | Yes | Total |
| Income | 0 to 40000 Naira | Count | 1 | 3 | 4 |
| | | Expected Count | .9 | 3.1 | 4.0 |
| | 121000 to 160000 Naira | Count | 1 | 4 | 5 |
| | | Expected Count | 1.1 | 3.9 | 5.0 |
| | 161000 to 200000 Naira | Count | 4 | 7 | 11 |
| | | Expected Count | 2.4 | 8.6 | 11.0 |
| | 200000 Naira and above | Count | 2 | 10 | 12 |
| | | Expected Count | 2.6 | 9.4 | 12.0 |
| | 41000 to 80000 Naira | Count | 2 | 8 | 10 |

| | | | | | |
|---|---|---|---|---|---|
| | | Expected Count | 2.2 | 7.8 | 10.0 |
| | 81000 to 120000 Naira | Count | 1 | 7 | 8 |
| | | Expected Count | 1.8 | 6.2 | 8.0 |
| Total | | Count | 11 | 39 | 50 |
| | | Expected Count | 11.0 | 39.0 | 50.0 |

**Chi-Square Tests**

| | Value | df | Asymptotic Significance (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 1.998[a] | 5 | .849 |
| Likelihood Ratio | 1.918 | 5 | .860 |
| N of Valid Cases | 50 | | |

a. 8 cells (66.7%) have expected count less than 5. The minimum expected count is .88.

Appendix 3. IBM SPSS Statistics result for container home incentives and social status significance

```
CROSSTABS
  /TABLES=Q10 Q11 BY Q9
  /FORMAT=AVALUE TABLES
  /STATISTICS=CHISQ
  /CELLS=COUNT EXPECTED
  /COUNT ROUND CELL.
```

## Crosstabs

**Case Processing Summary**

| | Cases | | | | | |
|---|---|---|---|---|---|---|
| | Valid | | Missing | | Total | |
| | N | Percent | N | Percent | N | Percent |
| Q10 * Q9 | 50 | 100.0% | 0 | 0.0% | 50 | 100.0% |
| Q11 * Q9 | 50 | 100.0% | 0 | 0.0% | 50 | 100.0% |

## Q10 * Q9

**Crosstab**

| | | | Q9 | | |
|---|---|---|---|---|---|
| | | | No | Yes | Total |
| Q10 | No | Count | 5 | 1 | 6 |
| | | Expected Count | 1.0 | 5.0 | 6.0 |
| | Yes | Count | 3 | 41 | 44 |
| | | Expected Count | 7.0 | 37.0 | 44.0 |
| Total | | Count | 8 | 42 | 50 |
| | | Expected Count | 8.0 | 42.0 | 50.0 |

**Chi-Square Tests**

| | Value | df | Asymptotic Sig-nificance (2-sided) | Exact Sig. (2-sided) | Exact Sig. (1-sided) |
|---|---|---|---|---|---|
| Pearson Chi-Square | 23.000[a] | 1 | .000002 | | |
| Continuity Correction[b] | 17.659 | 1 | .000026 | | |
| Likelihood Ratio | 16.656 | 1 | .000045 | | |
| Fisher's Exact Test | | | | .000 | .000 |
| N of Valid Cases | 50 | | | | |

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is .96.

b. Computed only for a 2x2 table

## Q11 * Q9

**Crosstab**

| | | | Q9 | | |
|---|---|---|---|---|---|
| | | | No | Yes | Total |
| Q11 | No | Count | 6 | 5 | 11 |
| | | Expected Count | 1.8 | 9.2 | 11.0 |
| | Yes | Count | 2 | 37 | 39 |
| | | Expected Count | 6.2 | 32.8 | 39.0 |
| Total | | Count | 8 | 42 | 50 |
| | | Expected Count | 8.0 | 42.0 | 50.0 |

**Chi-Square Tests**

| | Value | df | Asymptotic Sig-nificance (2-sided) | Exact Sig. (2-sided) | Exact Sig. (1-sided) |
|---|---|---|---|---|---|
| Pearson Chi-Square | 15.590[a] | 1 | .000079 | | |
| Continuity Correction[b] | 12.130 | 1 | .000496 | | |
| Likelihood Ratio | 13.031 | 1 | .000306 | | |
| Fisher's Exact Test | | | | .001 | .001 |
| N of Valid Cases | 50 | | | | |

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 1.76.

b. Computed only for a 2x2 table