

**APPLICATION OF TRANSIT ORIENTED DEVELOPMENT STRATEGIES IN  
MULTIMODAL PUBLIC TRANSPORT HUB IN ABUJA, NIGERIA**

**BY**

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## ABSTRACT

Transportation plays an important role in the economic systems of most developed countries of the world. The public transport system in Abuja, FCT which caters for about 1.4 million commuters is confronted with many complicated and heterogeneous problems such as dilapidated facilities and insufficient public transport operator service that produce intolerable delay and traffic congestion. This study therefore aimed at evaluating passenger satisfaction with the service quality attributes of public transport hubs in Abuja, Nigeria, in order to improve the patronage and efficiency of the system. The study was conducted using a “Mixed-Method” technique that involved qualitative and quantitative data collection methods. A survey was carried out and Five (5) samples of transport hubs were selected for this study which includes; Nyanya-Karu-Mararaba axis, Kubwa-Zuba-Suleja axis, Lugbe-Kuje-Gwagwalada axis, Dutse-Bwari axis, and the City Centre axis. A random selection of 400 public transport hub users was made to draw out the overall users’ perception with the use of public transport hubs in Abuja, using a self-administered questionnaire. The data collected was analysed using descriptive statistics and findings were presented in form of tables and charts, illustrating passengers’ perceptions on the quality attributes and services provided in Abuja transport facilities. Out of 14 variables analysed, 12 quality attributes services of public transport hubs in Abuja were highly unsatisfactorily recorded by the respondents. Only two (2) variables (Good security measures within and around terminal and Traffic management in and around the terminal) partially met the expectations of passengers. The study therefore showed that, passengers of public transport hubs were not satisfied with the quality attribute and services provided by Abuja transport facilities. The design of any transport facility should incorporate the application of Transit Oriented Development Strategies for better living and comfortable environment.

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## CHAPTER ONE

### 1.0 INTRODUCTION

#### 1.1 Background to the Study

Transport suggests the mobility of people and goods, and it is one of the key initiatives to foster economic development and support quality of life (Litman, 2007; OECD, 1996). Notwithstanding, a wide range of negative impact, ranging from social, economic and environmental, have been generated with the rapid growth of motorized transport (OECD, 2002; World Bank, 1996). In 2014, the transport sector accounted for around 23 percent of the global carbon emissions where 75 percent of the total was attributable to road transport (IEA, 2016). Transport was also the dominant cause of worldwide fatalities among young people aged 15-29 years in 2012 (WHO, 2015). These have raised fundamental questions about the unsustainability of transport given its rapid development (Banister, 2008; Loo *et al.*, 2010). According to Rodrigue (2017), the economic system of most developed countries of the world growth because of portable transportation system. Cherchenko (2018) revealed that, in recent years, the leading economic powers have chosen multimodal transport as a priority for the growth of transport facilities. Multimodal transport systems (MMTS) are developed to explore and coordinate the application of more than one transportation system in achieving a safe, speedy, pleasant and comfortable movement of passengers within the urban centres (Izuwah, 2018). Multimodal transport system (MMTS) is per definition a combination of at least two or more different modes of transport at a spot in order to facilitate movement.

Kimball *et al.* (2013) opined that, incorporating sustainable practices into future city planning is becoming popular, careful measures are required to comprehend the exhaustive effect of land use and choice of transport system. One of the promising

strategies is Transit-oriented Development (TOD), which synchronizes the compaction of land with enhanced or new public transport facilities (Kimball *et al.*, 2013). Shamskooski (2012) had explained that, the TOD strategy encourages dense and mixed-use development that includes both transit users' and pedestrian friendly members encompassing present and future commuter rail, light rail and bus transit corridors.

TOD as defined by Macricopa Association of Government (2014) is a pattern of dense mixed-use development within five to ten-minute walk of current or future transit stations. Still (2002) also defined TOD as a “mixed-used community that motivates people living near transit services to minimize their reliance on driving” and explained that, it is an agenda which exploits the potentials of current or future transportation, liveability elements, land use and economic system. Furthermore, this strategy serves as a change towards enhanced air quality, concentrated economic development, engaging to the trade and tourist zones and overall improved healthy and sustainable communities (Quarmby *et al.*, 2019).

Lockton (2011) opined that, negative perception by majority of the populace is generally affecting the use of public transport system, but a well-organized transport hub can significantly influence individual choice of travel. Urban planning and Architecture can mould human behaviour (Moore, 1976). In addition, Transportation Research Board (2000) agreed that transit-oriented development urban planning and Architecture could greatly influence human behaviour and physical development.



## **1.2 Statement of the Problem**

According to Oniyangi (2012), the Federal Capital Territory Abuja public transport hubs that serves approximately 1.4 million commuters is presently confronting many complicated and heterogeneous problems such as dilapidated facilities and insufficient public transport operator service, produces intolerable delay and traffic congestion.

It is clear that most cities of developing countries are experiencing many problems and challenges in their transport sector, such as congestion, pollution, lack of users' safety requirements, and lack of users' comfort, public patronage decline and poor accessibility for the users' (Pojani and Stead, 2015). Furthermore, there is a view of public transport as a means of transportation for only the poor, as users use this means because they have no option (Cervero, 2000; Penalosa, 2004).

Breuil and Enskat (2017) opined that, insufficient supply of public transport, economic development and non-motorised transport facilities in developing countries such as Nigeria is forcing people toward the application of personal mode of transportation thereby leading to city congestion, traffic gridlocks on roads and environmental pollution. These consequences of personal motorisation result to countless health problems and inconvenience to people and diverse life forms (Giduthuri, 2015). Moreover, Tsay and Herrmann (2013) further explained that, unfavourable effect of personal motorisation on the environment that result to catastrophic climatic effects can be resolve through a robust and suitable transportation system.

According to Pojani and Stead (2015), development of the public transport sector especially in developing countries like Nigeria has been impeded by many factors including; dilapidated infrastructure, long travel distance and other risks. This has created

a wrong perception to the majority of the population over the system of public transport (Cervero, 2000; Penalosa, 2004).

### **1.3 Aim and Objectives**

#### **1.3.1 Aim**

This study aims to incorporate Transit Oriented Development (TOD) strategies in multimodal transport hubs in Abuja, Nigeria, in order to improve the patronage and efficiency of the system.

#### **1.3.2 Objectives**

The following are the study objectives

- i) To examine the condition of existing transport hubs in Nigeria.
- ii) To identify passengers' perception of the existing public transport hubs.
- iii) To propose a design of Multimodal Transportation hub that integrates Transit Oriented Development (TOD) strategies.

### **1.4 Research Questions**

The following are the research questions:

- i. What is the condition of existing transport hubs in Abuja?
- ii. What is the passengers' perception of the existing public transport hubs in Abuja?
- iii. How can Transit-oriented Development (TOD) strategies be integrate to a Multimodal Transportation hub?

## **1.5 Scope of the Study**

The study area Abuja Federal Capital Territory is located in the centre of Nigeria and covers a land area of 1,728km<sup>2</sup> with a population of over 2,406,239. It is one of the ten most populous cities in Nigeria due to its fast-rising development (Dawan, 2000). This study is limited to contribution of TOD Strategies towards improving patronage of multimodal transport hubs in Abuja, Nigeria. This will facilitate a more detailed study and enhance the reliability of findings.

Data would be collected through the case study approach with the help of visual survey and questionnaire. The facilities to be provided in the proposed design would be based on studies of existing multimodal transport hubs within and outside Nigeria. This is essential in order to achieve the standard services provided in a transportation hub but there will be possible additions to improve existing services. The information will be based on studies carried out in foreign developments and therefore, adjustments will be required to suit the locality of the proposed project.

## **1.6 Research Justification**

Abuja has an excessive level of vehicle congestion and pollution because of the ever-increasing number of private car users. The use of old taxis and commercial cars/buses in the capital city further compounds the challenges. Yakubu (2006) opined that the Abuja Metropolitan Management Council (AMMC) considered the current transportation structure to be insufficient for the status of a capital city. The council consequently, considered to re-organize the sector as envisioned in the Abuja master plan, which includes introduction of high capacity types of transport services such as metro rail lines and BRT for intra and intercity movement. It is evident that multimodal public transport hub creates opportunities to connect these several types of transport systems and gives

the users different options to select during their journeys. This in turn facilitates a seamless, efficient and convenient transfer from different modes within same facility (Pas, 1998).

The application of TOD strategies in the designs of multimodal transport hubs (in an area with a large growing population at the risk of air and environmental pollution) reduces the need for private vehicles and in turn improves economic and environmental conditions (Dorsey and Mulder, 2013). Hence, the need for the proposed multimodal public transport hub that incorporate transit-oriented development strategies.

## CHAPTER TWO

### 2.0 LITERATURE REVIEW

#### 2.1 Urban Transport Development

According to Litman, (2009) urban and transport planners in most developing cities of the world including Nigeria were today confronting challenges on high level of automobile dependence. A study carried out by Ogra and Ndebele (2014) revealed that Private automobile dependency rises through fragmented spatial organisation and low-density developments. As a result, Timothy (2013), declared that TOD model is now playing a significant role in transport policy and aimed at reversing auto-oriented developments as a key planning pattern. Its origin can be dated back to '1933' as described in a Book 'The Next American Metropolis' published by the American Architect Peter Calthorpe which was conveyed by land use and transport conceptions in the Ebenezer Howard's garden city concept proposal of the late 19<sup>th</sup> century (Simon *et al.*, 2011).

#### 2.2 Concept of Transit Oriented Development

Over centuries, several researchers defined Transit Oriented Development TOD in different point of view but all dwell on the same subject matter. For example, Sung and Oh (2011) defined Transit Oriented Development as a strategy aimed to minimize the use of private vehicles and increase human powered transportation and mode of public transit usage through mixed use, high density, and environmentally friendly development within areas of distance travel from the transit centre and Brishna *et al.*, (2005) also defined TOD as a mixed used development close, and relate to mass transit requirements such as rail station, heavily used bus and Bus Rapid Transport (BRT) corridors.



Figure 2.1: TOD along commuter rail  
Source: Brishna *et al.* (2005)



Figure 2.2: An expanse view of TOD along commuter rail  
Source: Brishna *et al.* (2005)

TCRP (2002) opined that, normal TOD trends incorporate pedestrian and cycle-friendly environment, urban compactness, public and civic spaces close to stations and stations as community hubs. According to Carruthers and Ulfarsson (2008), exponents satisfied that TOD could make settlement areas more sustainable in terms of the “Three E’s”

Economics, Environment, and Equity. It can make urban settlement areas more economically efficient by providing more neighbourhood amenities, promoting access to a range of places and reducing spending on public services in higher density spaces. It can improve the environment by reinforcing compact metropolitan development and reducing greenhouse gas emissions (Pendall, 2008).

Based on the above submission, it is understood that the primary purpose of TOD is to encourage people to choose transit over individual auto use by living near the transit stations or stops. The community needs to have some or all smart growth features for people to choose living near transit stations/stops. In general, the Transit Oriented Development TOD is a basic strategy that gives a framework to implement and develop measures that are in line with a particular region and location.

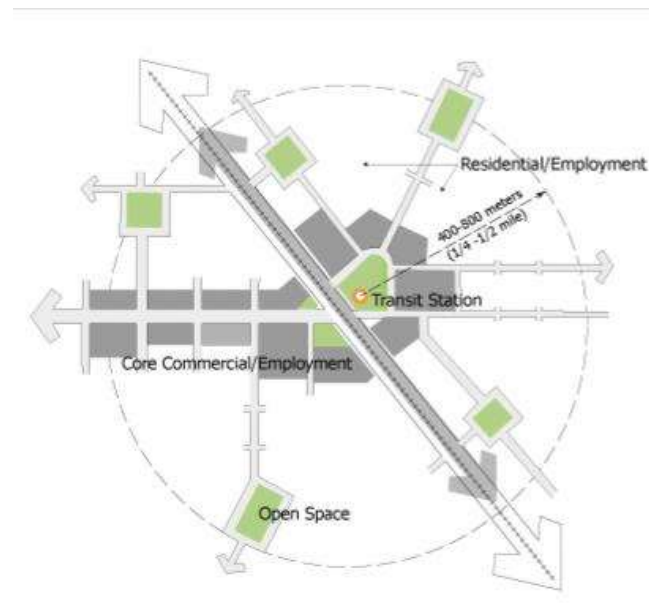


Figure 2.3: TOD basic concept 1  
Source: Pendall, (2008)

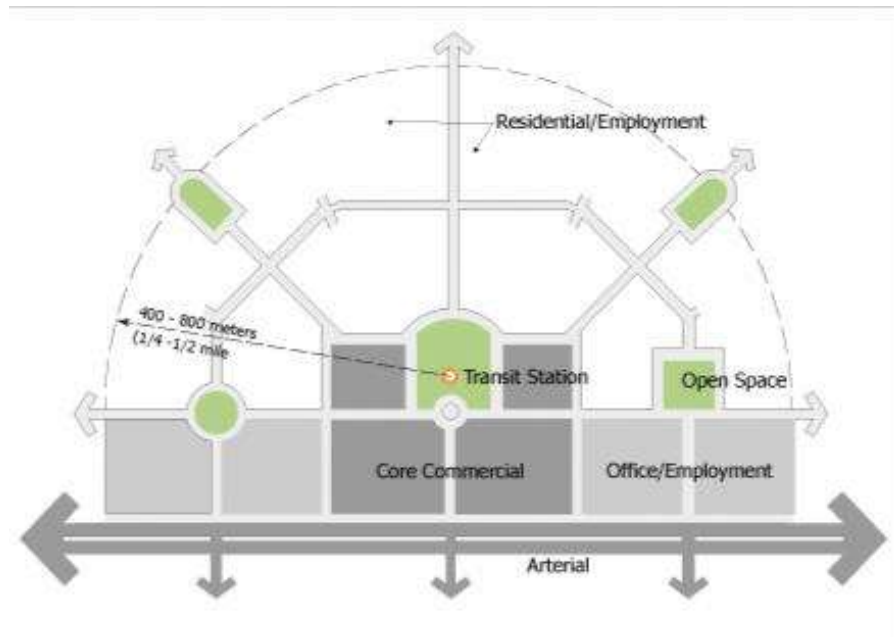


Figure 2.4: TOD basic concept 2  
Source: Pendall, (2008)

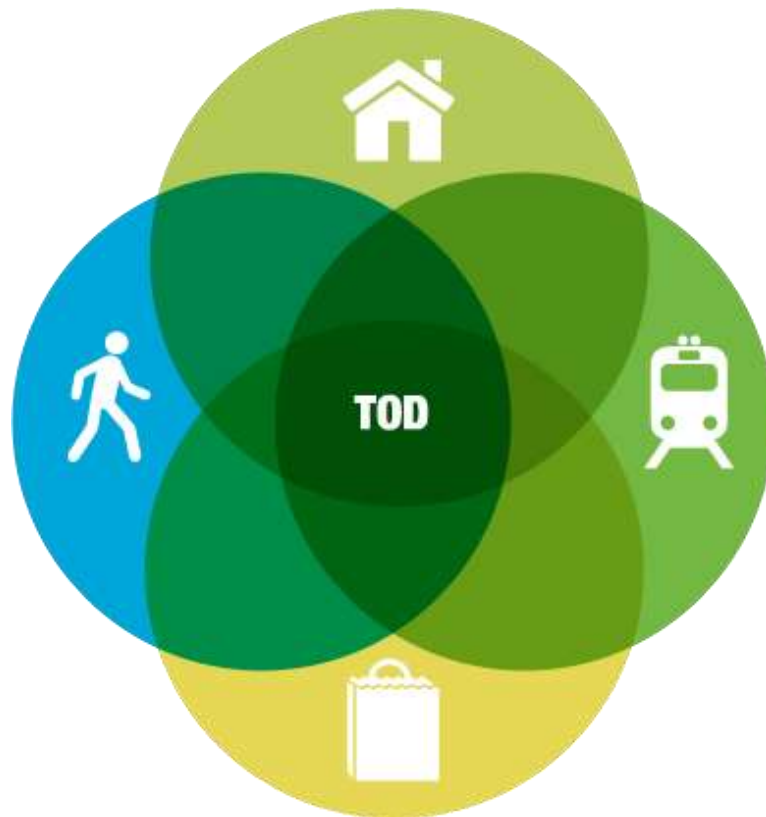


Figure 2.5: Summary of the TOD concept  
Source: Carruthers and Ulfarsson, (2008)



## 2.3 Types of Transit-Oriented Development

There exist two major categorisations of Transit Oriented Development (TOD). In 2008, the reconnecting America's centre for transit-oriented development and Federal Transit Administration (FTA) identified eight (8) basic centres which includes; Sub-urban Centre, Regional Centre, Transit Town Centre, Special Use/Employment District, Urban Neighbourhood, Mixed-used Corridor, Transit Neighbourhood and Urban Centre. The second categorisation by reconnecting America and Centre for transit-oriented development (2008) identified four (4) types of TODs; these are Core, Centre, Village and Destination.

### 2.3.1 Regional centre station design layout

As the name implies, regional centres were the main hubs for Socio-cultural and Commercial activities in any area. These are the district centres usually characterized by a high population and various housing, business, employment and entertainment ( Federal Transit Administration, 2008) and (<http://www.transitorienteddevelopment.org/> (Accessed 20 Aug 2019)).

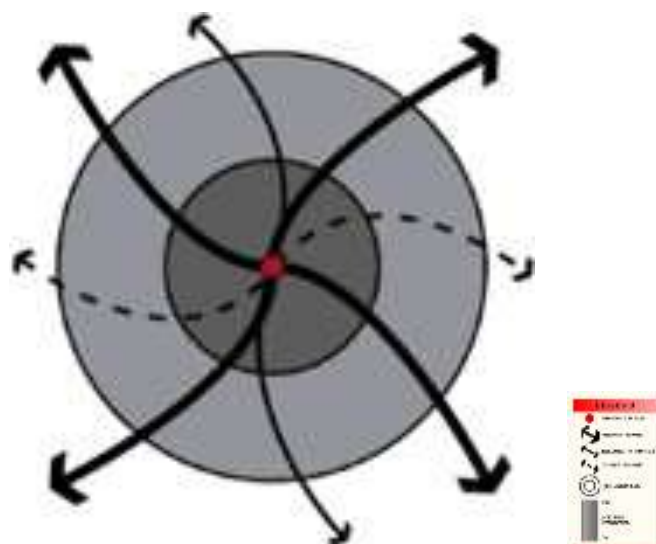


Figure 2.6: TOD Station Design Layout for Regional Centre  
Source: (<http://www.transitorienteddevelopment.org/> (Accessed 20 Aug 2019))

### 2.3.2 Urban centre station design layout

Urban Centres comprise of a combination of housing, business, employment and entertainment, normally at marginally with lower population density than in regional centres. Terminuses attraction people from nearby districts (Federal Transit Administration, 2008) and (<http://www.transitorienteddevelopment.org/> (Accessed 20 Aug 2019)).

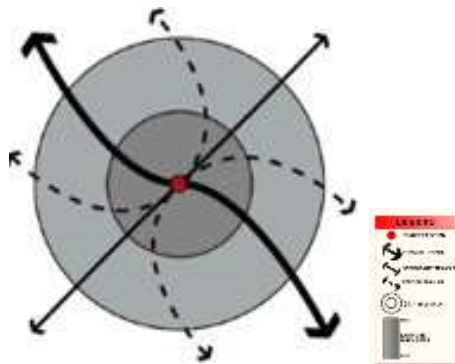


Figure 2.7: TOD Station Design Layout for Urban Centre  
Source: (<http://www.transitorienteddevelopment.org/> (Accessed 20 Aug 2019))

### 2.3.3 Sub-urban centre station design layout

Suburban centres comprise of housing, business, employment and entertainment, usually like that of the urban centres. However, it is slightly lower when compared with the regional centres. Suburban centres can function as beginnings and as final destinations for users (Federal Transit Administration, 2008) and (<http://www.transitorienteddevelopment.org/> (Accessed 20 Aug 2019)).

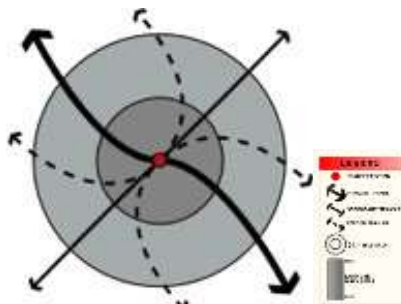


Figure 2.8: TOD Station Design Layout for Sub-Urban Centre  
Source: (<http://www.transitorienteddevelopment.org/> (Accessed 20 Aug 2019))

### 2.3.4 Transit town centre station design layout

Transit town centres serve more as local area of commercial/public activities. It is usually smaller than both urban and suburban centres. Furthermore, transit centres attract lower number of people from other regions (Federal Transit Administration, 2008) and (<http://www.transitorienteddevelopment.org/> (Accessed 20 Aug 2019)).

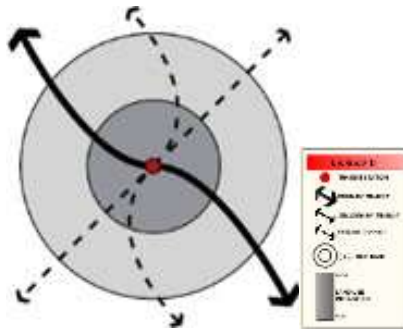


Figure 2.9: TOD Station Design Layout for Transit Town Centre  
Source: (<http://www.transitorienteddevelopment.org/> (Accessed 20 Aug 2019)).

### 2.3.5 Urban neighbourhood station design layout

Urban neighbourhoods are principally housing districts that have very good connection to urban centres and regional centres. Population is usually relatively dense and residence of the housing are usually combined with local business and small retail areas (Federal Transit Administration, 2008) and (<http://www.transitorienteddevelopment.org/> (Accessed 20 Aug 2019)).

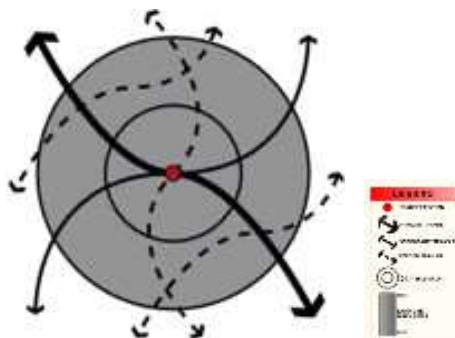


Figure 2.10: TOD Station Design Layout for Urban Neighbourhood  
Source: (<http://www.transitorienteddevelopment.org/> (Accessed 20 Aug 2019)).

### 2.3.6 Transit neighbourhood station design layout

Transit Neighbourhood were primarily residential areas often usually linked by Metro-rail facilities or high frequency vehicles routes. Population density are low to moderate and commercial activities are normally concentrated very close to the stations ( Federal Transit Administration, 2008) and (<http://www.transitorienteddevelopment.org/> (Accessed 20 Aug 2019)).

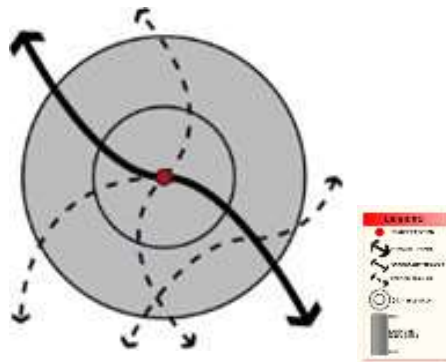


Figure 2.11: TOD Station Design Layout for Transit Neighbourhood  
Source: (<http://www.transitorienteddevelopment.org/> (Accessed 20 Aug 2019))

### 2.3.7 Employment /special use station design layout

Employment or Special use hubs are usually single use and characterized by some relatively low population employment areas. Furthermore, these types of hubs are normally located around very important institutions such as university campuses, entertainment centres, stadiums or sport arenas (Federal Transit Administration, 2008) and (<http://www.transitorienteddevelopment.org/> (Accessed 20 Aug 2019)).

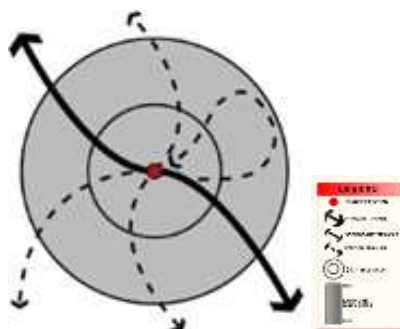


Figure 2.12: TOD Station Design Layout for Special Use/Employment  
Source: (<http://www.transitorienteddevelopment.org/> (Accessed 20 Aug 2019)).

### 2.3.8 Mixed-use corridor station design layout

Mixed-use corridors are transport centres that are usually found around mixed commercial and communal centres but have no specific distinct features. They are usually identified with a mix of relatively medium population density that are characterized by retail, services, employment, civic and socio-cultural uses (Federal Transit Administration, 2008) and (<http://www.transitorienteddevelopment.org/> (Accessed 20 Aug 2019)).

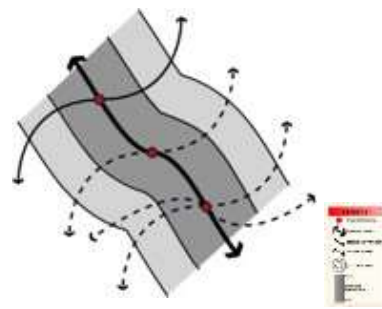


Figure 2.13: TOD Station Design Layout for Mixed-Use Corridor  
Source: (<http://www.transitorienteddevelopment.org/> (Accessed 20 Aug 2019)).

The second categorization are;

#### i. Core transit-oriented development type

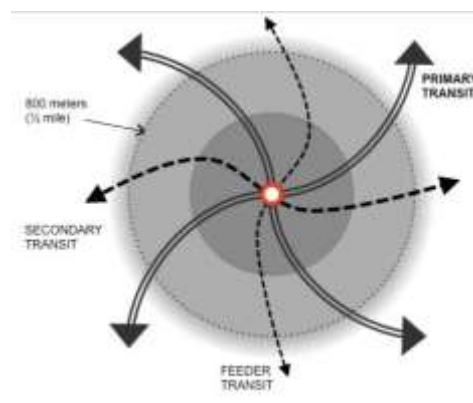


Figure 2.14: Core Transit Oriented Development Type  
Source: <http://www.transitorienteddevelopment.org/> (Accessed 20 Aug 2019).

The Reconnecting America and Centre for Transit Oriented Development categorized “CORE TOD’S” as a primary centre for cultural and economic activities within the

central business district or downtown. These areas were characterized by a high-density mix of commercial employment, residential and cultural/civic users. Core Tod's act as a dwellers hub for the region and served by adequate mix of transit including two or more modes of high capacity regional rail, high frequency and high bus services (<http://www.transitorienteddevelopment.org/> (Accessed 20 Aug 2019)). Transit oriented development core centres accommodate series of well-connected street grid for high mobility and transit access. 18-24 hours' activities were usually high at 400metres, a quarter mile radius within the transit station.

## ii. Centre transit-oriented development type

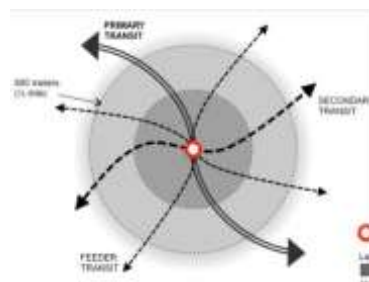


Figure 2.15: Centre transit-oriented development type 1  
Source: <http://www.transitorienteddevelopment.org/> (Accessed 20 Aug 2019).

The second after “CORE TOD’S” is “CENTRE TOD’S” which act as both origin and destination centres for dwellers, with a mix of transit options connecting to a regional transit network. Centre Tod's provides a regional destination or employment draw, but hence functions as district residential and employments district with a city. The centre contains at least two modes of 18-24 hours' transit services. CENTRE TODS' are often typically vibrant, mixed-used zones with a routes arrangement that made pedestrian, vehicle activity easier, and development of high density within a quarter mile radius of the transit section (<http://www.transitorienteddevelopment.org/> (Accessed 20 Aug 2019)).

iii. **Village transit-oriented development type**

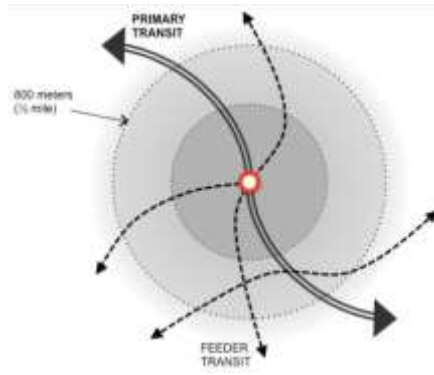


Figure 2.16: Centre transit-oriented development type 2  
Source: <http://www.transitorienteddevelopment.org/> (Accessed 20 Aug 2019).

The third after CENTRE TODS' is "VILLAGE TOD'S" which is a smaller local serving centre that functions as a region of economic and community activities. These centres attract small number of residents among the other part of the region with residents within 800meter, a half-mile region characterizing most of the user base. Village centres are often served with a mix of source and destination trips primarily commuter service to jobs in the area within a variety of transit modes. Densities were usually greater at 400-meter (Quarter mile) radius of station (<http://www.transitorienteddevelopment.org/> (Accessed 20 Aug 2019)).

iv. **Destination transit-oriented development type**

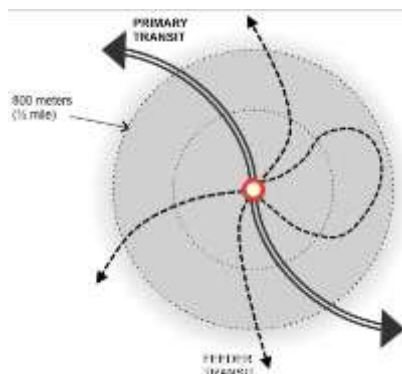


Figure 2.17: Centre transit-oriented development type 3  
Source: <http://www.transitorienteddevelopment.org/> (Accessed 20 Aug 2019).

The last on the list is "DESTINATION TOD'S" which serve as employment regions or special use, often encompassing a significant physical attraction with a high user base and often single use. Typical example of Destination TOD's was found In Hospitals, Retail Centres, Stadiums, Government Complexes, Large Employment Secretariats, Large Parks and Universities. Any development within Destination centres shall maximize pedestrian connection to the transit station. These stations are generally not the focus of economic activity, and densities were evenly distributed around stations (<http://www.transitorienteddevelopment.org/> (Accessed 20 Aug 2019). This is further explained In Table 2.1 and Figure 2.18.

**Table 2.1: Transit-oriented development types.**

	<b>Core</b>	<b>Centre</b>	<b>Village</b>	<b>Destination</b>
Station Area Characteristics	Primary centre of economic and cultural activity	Significant centre of economic and cultural activity	Local centre of economic and community activity	Single-use activity focus
Transit Mode	All modes	All modes	Community rail, local/regional bus hub, light rail	Light rail/street car, bus rapid transit, potentially heavy rail
Transit Peak Frequency	5 minutes	5-15 minutes	15-30 minutes	15-30 minutes
Land-use Mixed and Density	High-density mix of residential, commercial employment and civic/cultural use	Moderate-to- high-density mix of residential, commercial employment and civic/cultural use	Moderate-density mix of residential, commercial employment and civic/cultural use	Concentration of commercial, employment and civic/cultural/institutional uses.
Retail Characteristics	Regional serving destination retail; local serving retail	Regional serving destination retail; local and community serving retail	Community serving and destination retail; local serving retail	Regional and Community serving retail.
Housing Mix	High-rise and mid-rise buildings	Mid-rise, low-rise, some high-rise buildings	Mid-rise, low-rise, attached and single occupancy buildings	Limited residential



Source: <http://www.transitorienteddevelopment.org/> (Accessed 20 Aug 2019).

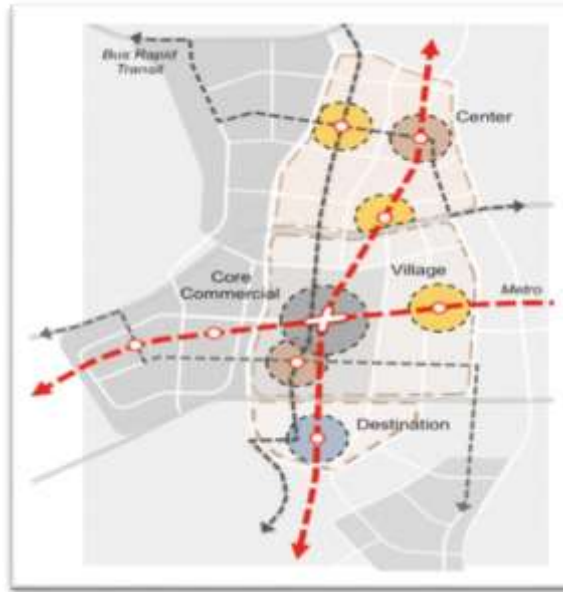


Figure 2.18: Transit oriented development station type.  
 Source: <http://www.transitorienteddevelopment.org/> (Accessed 20 Aug 2019).

Other transit station locations include commuter transfer areas surrounding the periphery of the urban core, which often serves as a stop along the transit corridor or terminus for the transit line. Whether in the urban core or at the village or suburban edge, opportunities will vary by TOD scale and pattern. Detailed planning and implementation strategies for various TODs and integrating additional transit area environments are further discuss in the Resources Section (Federal Transit Administration, 2008) and (<http://www.transitorienteddevelopment.org/> (Accessed 20 Aug 2019)).

Transit lines and TODs are located based on the type of service, transit capacity, density and mix of uses. Both public and private planned and coordinated transit development is necessary for an effective regional scale climate action plan, because a network of transit-oriented developments and destinations enables people to drive less, saving energy and reducing hazardous risks to the environment. Table 2.2, 2.3, 2.4, and 2.5 below gives a complete summary on the variations between TOD place type and TOD 202 guideline-station area planning.

**Table 2.2: Identifying TOD place type from TOD 202 guideline-station area planning**

<b>Regional Centre</b>	<b>Urban Centre</b>	<b>Suburban Centre</b>	<b>Transit Town Centre</b>
Primary centre of economic and cultural activity	Significant centre of economic and cultural activity with regional-scale destination	Significant centre of economic and cultural activity with regional-scale destination	Local centre of economic and community activity
All mode	All mode	All mode	Commuter rail, local/regional bus hub, light rail.
5 minutes	5-15 minutes	5-15 minutes	15-30 minutes
High-density mix of residential, commercial, employment and civic/cultural uses.	Moderate-to high-density mix of residential, commercial, employment, and civic/cultural uses.	Moderate-to high-density mix of residential, commercial, employment, and civic/cultural uses.	Moderate density mix of residential, commercial, employment, and civic/cultural uses.
Regional-serving destination-retail opportunity; need for local-serving retail	Regional-serving destination-retail opportunity; need for local-serving and community serving retail	Regional-serving destination-retail opportunity; need for local-serving and community serving retail	Community-serving and destination retail opportunity; need for local serving retail.
Integrating dense mix of housing and employment into built-out context	Integrating high density housing into existing mix of housing and employment to support local serving retail	Introducing housing into predominantly employment uses and improving connections/access to transit	Increasing densities while retaining scale and improving transit access.
Downtown San Francisco and Boston, Chicago's Loop, midtown Manhattan, downtown denver	Rosslyn-Ballston corridor outside wasington D.C; downtown Baltimore; Hoboken, New Jersey; Houston's Medical Centre	Lindberg city centre in Atlanta; Evanston, illinois, Addison circle outside Dallas; Stamford, Connecticut';	Rosslyn-Ballston corridor outside wasington D.C; downtown Baltimore; Hoboken, New Jersey; Houston's Medical Centre

Source: <http://www.transitorienteddevelopment.org/> (Accessed 20 Aug 2019).

**Table 2.3: Identifying a TOD place type from TOD 202 guideline-station area planning**

<b>Urban Neighborhood</b>	<b>Transit Neighborhood</b>	<b>Special Use/Employment District</b>	<b>Mixed-use Corridor</b>
Predominantly residential district with good access to regional and sub-regional centres	Predominantly residential district organized around transit station	Local focus of economic and community activity without distinct centre	Local focus of economic and community activity without distinct centre
Heavy rail, LRT/streetcar, BRT, commuter rail, local bus	LRT/streetcar, BRT, commuter rail, local bus	LRT/streetcar, BRT, potentially heavy rail	LRT/ streetcar, BRT, local bus
5-15 minutes	15-30 minutes	15-30 minutes	5-15 minutes
Moderate to high-density residential uses with supporting commercial and employment uses	Low to moderate-density residential uses with supporting commercial and employment uses	Concentration of commercial, employment and civic/cultural uses, potentially with some residential	Moderate-density mix of residential, commercial, employment, and civic/cultural uses
Primarily local-serving retail opportunity; need for some community-serving retail	Primarily local-serving retail opportunity	Potential for community and regional-serving retail but need to balance demands for access	Primarily local-serving retail opportunity; need for some community serving retail
Expanding local-serving retail opportunities and increasing high-density housing	Integrating moderate-density housing and supporting local-serving retail	Creating sustainable off-peak uses and accommodation peak travel demand	Expanding local-serving retail opportunities and high-density housing opportunities
Fruitvale in Oakland, Greenwich Village in New York City, the Pearl District in Portland, University City in Philadelphia	Ohlone –Chynoweth outside San Jose; Piano, Texas; Barrio Logan in San Diego; Capitol Hill in Washington D.C	South of Market in San Francisco, Camden Station in Baltimore, South Waterfront in Portland	International Boulevard in Oakland, Washington Street in Boston, University avenue in St. Paul, Minnesota

Source: <http://www.transitorienteddevelopment.org/> (Accessed 20 Aug 2019).

**Table 2.4. Development guidelines for TOD Place types from TOD 202 guideline-station area planning.**

<b>Regional Centre</b>	<b>Urban Centre</b>	<b>Suburban Centre</b>	<b>Transit Town Centre</b>
High-rise and mid-rise apartments and condons	Mid-rise, low-rise, some high-rise and townhomes	Mid-rise, low-rise, some high-rise and townhomes	Mid-rise, low-rise townhomes, small-lot single family
8,000-30,000	5,000-15,000	2,500-10,000	3,000-7,500
75-300 du/acre	50-150 du/acre	35-100 du/acre	20-75 du/acre
40,000-150,000	5,000-30,000	7,500-50,000	2,000-7,500
5.0 FAR	2.5 FAR	4.0 FAR	2.0 FAR
<p><b>Once the Planning</b> partners have identified an appropriate place type to guide planning in a particular station area, these guidelines can be used to think through the characteristics of the places they want to create. The following criteria should be disused:</p>	<p><b>Housing mix:</b> the range of housing types will vary depending on local conditions and the community vision. These types refer to new, not existing, housing.</p>	<p><b>Station area</b> total units target: The range will vary according to local conditions.</p>	

Source: <http://www.transitorienteddevelopment.org/> (Accessed 20 Aug 2019).

**Table 2.5: Development guidelines for TOD Place Types from TOD 202 guideline-station area planning.**

<b>Regional Centre</b>	<b>Urban Centre</b>	<b>Suburban Centre</b>	<b>Transit Town Centre</b>
Mid-rise, low-rise, townhomes	Low-rise, townhome, small-lot single family, and some mid-rise	Limited residential potential; mid-rise and high-rise if appropriate	Mid-rise, low-rise, townhomes, with small-lot single family off the corridor
2,500-10,000	1,500-4,000	2,000-5,000	2,000-5,000
40-100 du/acre	20-50 du/acre	50-150 du/acre	25-60 du/acre
NA	NA	7,500-50,000	750,1,500
1.0 FAR	1.0 FAR	2.5 FAR	2.0 FAR
<b>Net project density:</b> The range should include several housing types. Local market conditions will determine densities and design.	<b>Station area total jobs</b> target: The market for employment uses will determine the potential for jobs. The targets can help determine the amount of land devoted to each use.	<b>Minimum FAR:</b> The floor area ratios provide a baseline for the development of employment and help determine the appropriate mix of building types.	

Source: <http://www.transitorienteddevelopment.org/> (Accessed 20 Aug 2019).

## **2.4 Transit Oriented Development Strategies/Principles.**

According to Curtis *et al.* (2009), Transit-Oriented Development aims at reducing personal vehicle usage and intensify the public transit patronage. Transit patronage can be improved if movement of people between destinations will be made easier and in a convenient manner (Dunphy, 1995). This can be accomplished by providing increased densities, developing design of oriented pedestrian within walking distances and high-quality transit mixed land use. Transit Oriented Development creates a convenient and healthier environment that provide people with space for living, working, and shopping. TOD development should be based on providing options that support transit use, complement both local community and transit users', controlling secure circulation of cyclist, pedestrian, vehicle and parking (Wells and Renne, 2004).

Principles that ensure achievement of TOD goals are:

- i) Land Use
- ii) Layout
- iii) Pedestrian and Cyclist
- iv) Parking
- v) Street scope and environment

The principles above are design-based principles of transit-oriented development

### **2.4.1 Land use**

Transit Oriented Development (TOD) discourages non-transit supportive land-use that includes; "Wide swept walks and numerous vehicle crossings on sidewalks, create negative impacts for pedestrians such as isolation, low density residential development", that are mainly positioned to the Automobile rather than the cyclist, transit user and pedestrian. Heterogeneous land-use model that supports a sound area, community and

empower people to meet most of their daily needs, consequently minimizing the need to travel. These includes; Retail shops, Employments, Local services and amenities, Variety of district housing types and School around a close nearness of one another. Transit Oriented Development also ensures a transit supportive land-use “Libraries, Recreational and cultural facilities, Affordable housing, High school and post-secondary institution, Town-house, Hostels, Apartments, Medical clinics, Childcare, Fitness club”, all within 400 meters walking distance of a transit station (Herbert, *et al.*, 2012).

#### **2.4.2 Layout**

Sidewalks, Laneways, Streets, Pedestrian and Cycling connections should be done in a situation that will minimize distance to transit or any additional destination. Placed buildings (Commercial, Offices, Retail shop, Apartments) close to one another to provide ease of walking within buildings and public transit. These could be provided within individual building or several adjoining buildings. Increase pedestrian accessibility and guarantee pedestrian safety. For instance, create cycling and pedestrian ‘Shortcuts’ that can directly head to transit. Institute an adequate bicycle network within the station hub, station influence region and station neighbourhoods. TOD 202 guidebook helps determine preferred station area design layouts (Dittmar and Gloria, 2004).



### 2.4.2.1 Station layout comparison:

They include the conventional layout and the preferred layout.

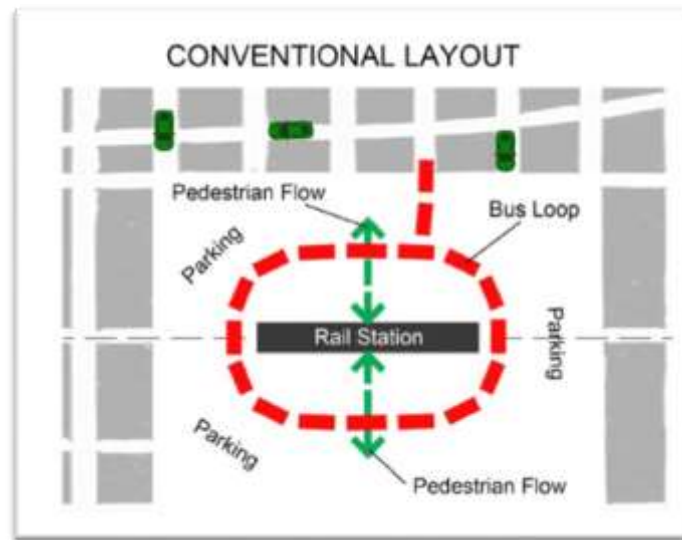


Figure 2.19. A TOD station area, conventional layout from transit-oriented development organization

Source: Herbert, *et al.*, (2012)



Figure 2.20. A TOD station area, preferred layout from transit-oriented development organization

Source: Herbert, *et al.*, (2012)

#### i) **Conventional station:**

A conventional layout isolates the station from the city centre. Such stations are only accessible via buses or cars. Features of such stations include:

No pedestrian friendly access.

No connection with city or urban centre.

No public space.

No cafes and retail space.

ii) **Preferred station:**

Seamlessly integrated into the city centre.

Station modeled after downtown rail stations.

Provides a pleasant, lively walking experience.

Easily accessible for pedestrians.

Prioritized safety.

Reduces vehicle traffic.

Develops commercial spaces and retail stores.

### **2.4.3 Pedestrian and cyclist**

Materials that includes, concrete for crosswalk or treatments such as ‘Painted patterns’ which ensures visual recognition of pedestrian routes for vehicles were needed for safe movement (Zhang *et al.*, 2014). This is to ensure safe, convenient, easily navigable, comfortable, continuous, barrier free pedestrian connection that channel plainly to transit station. In addition, (Himanen, 1988) revealed that, pedestrian connection should be preserved and operational at all instance while transit services are operating even beyond working hours. Provide weather protection by using a covered waiting area, electricity and heating, to achieve comfortable waiting and getting to and from transit terminals (Curtis *et al.*, 2009).

Provide and maximize bicycle facilities by giving bike lane a right of way for bicycle along with adequate and desirable provision of parking immediately after the building entrance, secured from the weather as well as visible from the building interior, and shouldn't restrict pedestrian movement (Ayed *et al.*, 2013).



Figure 2.21: Bicycle Parking  
Source: Curtis *et al.*, (2009).

#### 2.4.4 Parking

The idea behind Transit Oriented Development require a parking facility even with high transit utilization, as many people will come and go by automobile. Sufficient parking lots should be provided within the station area for both car and cyclist users', and should be located at the back of the building to maintain vehicular movement and pedestrian hindrance.



Figure 2.22: Vehicle Parking Along Transit Station  
Source: Curtis *et al.*, (2009)

#### 2.4.5 Street scape and environment (landscape)

In an attempt to minimize urban heat and conceive a comfortable microclimate, it is suitable to plants shade trees and shrubs, tree guards, bicycle racks, quality benches, street lighting, and garbage receptacles (McPherson, 1989). Provision of recycle containers, garbage and other same equipment for conducive environment.

Bolitzer and Netusil (2000) explained that, landscaping not only improves the liveability of TOD spaces, it can also greatly enhance the local feature of a city. As stated earlier, large shade trees can facilitate cooling, reduce flooding, suppress dust, filter air and improve biodiversity. Landscaping is more than vegetation and encompasses benches, rest areas, gazebos, barbecues, art (e.g. sculptures), courtyards and plazas, which greatly enhance the public realm, drawing people into civic spaces, improving sociability and safety, and improves the attractiveness of walking and cycling (Gomez, 2013). However, TODs that actually implement these ideas are rare, as many designers will attest.



Figure 2.23: Outdoor Facilities for TOD  
Source: Curtis *et al.*, (2009).



Figure 2.24: Street Landscape Features  
Source: Curtis *et al.* (2009).

## 2.5 Benefits of Transit Oriented Development

Transit Oriented Development had several benefits and advantages to the society, many of its benefits are realistic (Renne and Reid, 2009). TOD addresses issues related to climate change and enhances universal energy security. According to Sullivan and Cervero (2011), it enhances a compact, walkable neighbourhood that significantly decrease the need for using private cars and energy consumption. Avineesh and Alok (2018) opined that, driving could reduce by up to 85% with this type of living arrangement.

Litman (2018) identified some benefits of Transit Oriented Development:

- i. The ideal TOD is aesthetically appealing to many users despite the fact that human being has varying reasons and standards for sharing similar facility.
- ii. TOD helps increased user-friendliness, as it gives choices among automobile base land-uses. It conceives a category of land-use that improves transportation choice that is vital to lifestyles and business practices.

- iii. TOD facilitates public conversation among peoples that is difficult to obtain in car-dependent urban environments.
- iv. TOD enhances the adoption of public transport by advancing high-density areas in the surrounding zone that increases the portion of transit and walk journeys made by the residents or workers and reduces overcrowding in the area.
- v. TOD provides all the basic needs for shopping, work, public amenities, entertainment and work in the influence region with mixed land use growth that reduces the wish to travel.
- vi. TOD concept reduces carbon dioxide emission by adopting environmentally friendly travel choices.

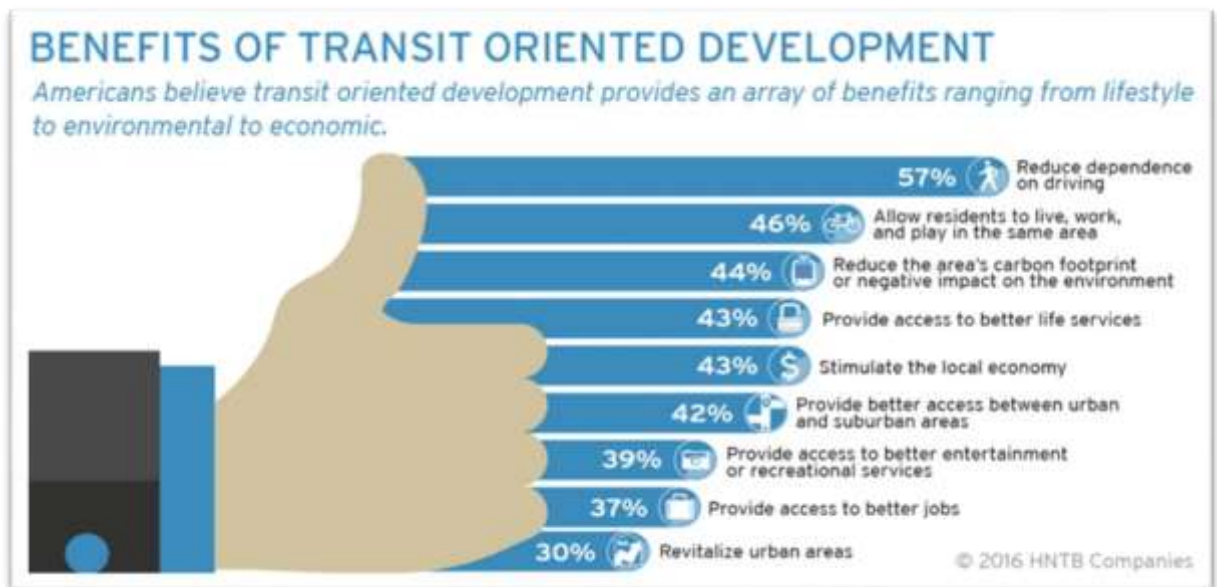


Figure 2.25: Benefits of transit-oriented development  
 Source: Renne and Reid, (2009)

The table below shows the possible environmental, socio-cultural and economic benefits of TOD (Dorsey and Mulder, 2013).

**Table 2.6: Economic, Social and environmental benefits of TOD**

S/n	Area/Sections	Benefits
1	Financial	Reduced household transportation spending, Housing affordability, Infrastructure saving, Increase developer returns and marketability, Increase transit ridership, Cost-effective transit.
2	Commercial/Social	Mobility, housing and community choices, Urban revitalization and infill, Enhance public safety and health.
3	Environmental	Regional air quality and congestion improvement, Open space preservation, Brownfield redevelopment, Improved water quality.

**Source:** Dorsey and Mulder (2013)

## 2.6 The Concept of Multimodal Public Transport

According to Litman (2018), travelling by automobile tends to be more restful than other modes of transportation and passengers make accounts for 70-90% of trips. Hence, driving is the commonest mode of transportation even though automobile is pricey to possess, regarding fixed cost such as “Insurance, Schedule maintenance, Depreciation, Registration fee, and Residential parking expenses”, they relatively frugal to drive but commonly costing much per mile in operating expenses. Travelers often prefer traveling by alternative mode for the reasons below.

**i.** According to Hu (1995), in a typical community, 20-40% of the total population and 10-20% of immature and adult cannot drive due to age constraint, disability, economic or vehicle failures. Insufficient modes of transport reduce the capability of people to access activities, and this allow drivers to drive them. National Household Travel Survey revealed that 5% of the whole trips were particularly to transport users (Hu, 1995).

**ii.** Majority of people do not drive for some trips due to economic, weakness, or other constrains. According to Peden (2004), good and realistic alternative to driving reduce driving by vulnerable groups such as; young people, people who are negatively affective by drugs or alcohol, those with dementia or other medical condition. Financial burden on much low-income class of people is because of high expense of automobile transport.

**iii.** People sometimes enjoy using alternative mode of transportation for healthy walking and cycling condition and provision for benefits through exercise or public transit commuting imposes less and often more comfortable (Buehler, 2011).

**iv.** Many societies benefit from available parking, road, insurance pricing and fuel or more sufficient management of road space that favours higher value trips and more sufficient mode in order to minimize parking cost, excess traffic, environmental pollution and accident. Therefore, it is fascinating to consider what mode is appealing to society, users, and the kind of automobile trip that is suitable travelling alternative. For instance, if public transit services, walking and cycling condition were better, the question now is “How much more would people rely on those modes and how much less automobile travel would occur?” In fact, automobile trip is much less in communities with alternative and



better transport option while cycling, walking, and public transport travel tends to be much higher. For instance, Guo and Gandavarapu (2010) investigate that, integrating the sidewalk network in a typical United State (U.S) town on moderate increases non-motorized travel by 16% and reduces automobile travel by 5%. Similarly, (Cervero and Arrington, 2008; Litman, 2009) explained that, transit-oriented communities' residents often use 2-10 times alternative mode more constantly and drive 10-30% lesser mile than residents of automobile-oriented neighbourhood. Even considerable travel deductions occur if enhancements in alternative modes is implement in confluence with encouragement such as; more effective roads, insurance pricing and parking. People depends more on alternative modes but restricted by poor cycling and walking conditions and sufficient public transit services. It implies that, in an optimal transport system, people would ante cede driving altogether and rely more on alternative modes.

### **2.6.1 Multimodal public transport hub**

According to Mark *et al.* (2008), every city depends on transportation to enable movement of people and goods from one place to another on either roads or other modes. While urban development boost in density and size, mobility is becoming a more critical issue for people. Travelling time is increasing today in major cities and transport framework is beneath greater tension than ever. Today, transit hubs are no longer places where travellers depart or arrive, because the facilities around the hubs made the centre a dwelling place and can deliver advance effect that inspire investment in the area, generates new revenue streams and aid economic activities.

The main aim of transportation is to transport people, goods as well as information and services through places, which comply by both physical and cultural constraints such as;

political boundaries, time, distance and topography (Butta and Abegaz, 2016). The basic requirement of life such as shelter, food and clothes cannot be achieved in any society without transportation. Transportation is specifically critical for the subsistence of human settlements while the subsistence of such settlements creates greater demand for transport. David and Glen (2001) opined that, transportation routes are construct for distributing resources between spaces where they are abundant and positions where they are scarce. It is a dynamic part of the social, political and economic life of every society because it plays a significant role in the spatial relationship between different localities globally, nationally and regionally. The significance of transportation can therefore see in the daily human activities regardless of where they live on the surface of the earth (Timothy, 2013).



Figure 2.26: Multimodal concept  
Source: David and Weisbrod, (2001)

Butta and Abegaz (2016) Opined that, a transport interchange also known as transport hub, is a place where passengers are exchanged between one vehicle to another or

between different mode of transportation. Example of public transport mode includes; tram stop, bus stop, train station, and ferry slip.



Figure 2.27: Public transport hub  
Source: Butta and Abegaz, (2016)

The benefits of public transport are many and they include; emit environmental pollutants, enhance energy efficiency, minimise the portion of land-use for transport purpose including parking and typically result in better physical environment in urban centres (Aderamo, 2010). According to (Banister, 2005) public transport has validated to be an efficient tool in combating congestion. The gains of public transport cannot be over-emphasised and government in third world countries are now giving it utmost priority.

## 2.7 Classification of Multimodal Public Transport

The previous section of this study has described the different TODs based on modes of transportation. This section will dwell on the different class of multimodal public transport hubs. Izuwah (2018) primarily classified multimodal transportation framework including mass transport modes as follows:

- i. **Rail based modes:** These include Metro rail corridor, Monorail, Light rail transit and integrated rail cum bus transit.



Figure 2.28: Trains at train station  
Source: Etu and Oyedepo, (2018)

- ii. **Road based modes:** They are Double decker buses, articulated buses, Trolley buses, Regular buses, Express buses, and Mini buses.
- iii. **Marine services** (ferry service)



Figure 2.29: Ships at harbour  
Source: Etu and Oyedepo, (2018)

## 2.8 Background of the Transport Sector in Nigeria

The growth of the transport scheme in most developing countries such as Nigeria, can trace back to colonial period. The networks of road, water, and rail that are develop for the importation and exportation of goods and cash crops were design in the most

economical way viable and subsequently proved inadequate. The Post-colonial era following independence came with a review of plans and transportation became an instrument of unification and socio-economic development in the country. The discovery and exploration of petroleum resources also spearheaded the development of the transport system in Nigeria.

International freight movement is principally by sea while Air Transportation is the main passenger carrier and accounts for an increasing freight by value. Past shortage of resources resulted in the inadequate maintenance of all the transport sub-sectors causing the Government in the past to focus more on rehabilitating the roads, as it remains the major mode of transportation. Presently, our dependence on roads has resulted in a rapid deterioration of the network, affecting the economy as goods, services are delay, and high transport costs translate into a high cost of goods and services (Santhosh, 2011).

## **2.9 Public Transport Situation in Nigeria**

The last two decades has witness a severe transport problem cause by the inflow of population in to the urban centre (Rodrique, 2017), developing industries and inadequate of transport facilities to meet the demand. Aderamo (2010) concluded that, the problem manifest in terms of traffic congestion, parking problem, accident, and waiting time for buses. Nigeria is facing overall shortage of public transport service compare to the demand. The public owned transport service in some states of Nigeria where ever they exist are insufficient and the private sector operators of para-transit transport system are deficient and discomposed.

Two distinct public transport systems were recognised in Nigeria, these include; “The various para-transit services provided by the private sector and the municipal bus service provided by the government owned transport corporations”. Transportation in Nigeria has been overpowered by the private sector who operate in an unrestrained manner and provide aimless and undependable service. There are no clearly defined routes being biased by these private operators. This contrast sharply with the condition of most cities of the advanced countries where public owned bus operators have the monopoly in the provision of public transport (Aderamo, 2010).

#### **2.10 Benefits of Efficient and Effective Multi-modal Transport in Nigeria**

Etu and Oyedepo (2018) highlight some of the benefits associated with effective MTS which have been summarised as:

- i. It helps in facilitating a dependable and effective transport system as one of the factors that plays a critical role in the economic growth of a nation due to the provision of adequate access to the nation which in-turn fosters effective operation of retailing, manufacturing, housing market and labour.
- ii. The multimodal system of transportation is a system that covers various modes of transport and has the capability to contribute to a smarter, cleaner, and more sustainable transport, shifting mobility of goods and passengers from roads making optimal use of infrastructure and decrease costs (Rudan, 2002).
- iii. Multimodal transport helps to create more employment opportunities thereby aiding poverty alleviation and increasing the standard of living (Rondinelli and Berry, 2000).

- iv. Better transportation infrastructure facilities in terms of environmental security and standards could limit the venture environmental calamities. In addition, the removal of congestions that existed previously could potentially reduce air pollution through a more energy efficient transportation logistics system (Stefan *et al.*, 2014).
- v. Increase in public transport use: once the customers are satisfied with the built image of the transport system, the shift of the public transport system becomes easier.

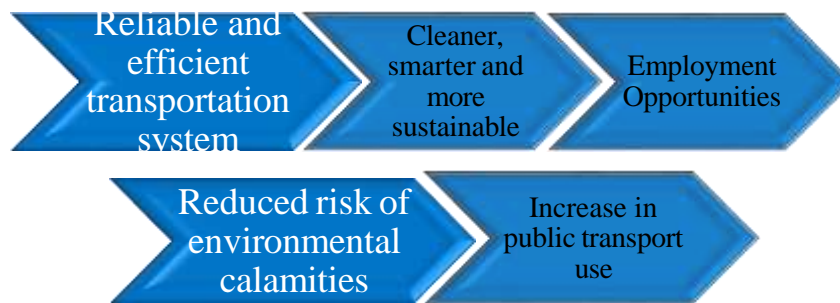


Figure 2.30: Overall benefits of transport integration (multimodal transportation)  
Source: Etu and Oyedepo, (2018)

### 2.11 Public Transport Patronage

Kofi and Kwaku (2014) revealed that, in recent time, public transport become the most commonly used mode of transportation. Therefore, the manner in which public transport are deliver as well as their quantities are important due to their outcome both in behaviour and attitude of travellers and their demand for service. According to Barnum *et al.* (2008) factors such as, efficiency and services productivity are critical in this respect as they influence transport demand and patronage.

Polat (2012) plead that, public transport service are precise and important, as they are not only require but also demanded by people as part of the necessities of people live in modern times. Public transport service is the basic tools of mobility for a significant

percentage of the population in the countries that constitute one among the driving forces of social and economic life.

Polat (2012) went further to explain that, the personality of public transport services conforms their own patronage or demand characteristics. These characteristics require to be known earlier for better understanding of factors that affect the requisition. Matas (2004) revealed that, public transport environment is vital and interactive. It involves a combination of different modes of transportation, various class of users, e.g. “Leisure travellers, students, and workers” and users with various traveling aspiration, different travelling frequency and time. The subsistence of different modes of transportation make it accessible transition among those modes for passengers. Polat (2012) explained that, the patronage or demand for public transport service in such environment is also inconsistent and vital.

Furthermore, Polat (2012) plead that, the demand for public transport depends on time, for example, in the morning and evening time, the demand seems higher and even more condensed, but often reduce in the remaining time of the day. The rush hours requisitions mostly come from students and workers, other demands come from the remaining parties such as, tourist, shoppers and other leisure seekers.

In addition, Polar (2012) discussed that, various expectations of public transport services come from individual travellers’ type based on the travel purpose and time. Nevertheless, the service quality of public transport became one of the major issues for many, most especially in large cities, because of definite number of vehicles in service and users



having limited time, he further state that, the key factors of public transport service demand depends on the availability of alternative modes of transport.

According to Polat (2012), public transport services demand determinants, which includes; service quality, availability and cost of alternative travel mode, travel: ‘waiting time, walk access time and accessibility of transport, in-vehicle journey’, fare, comfort, time of travel, reliability, level of reliance to public transport and lastly purpose of travel.

The time of travel is consider as revealing factors that influence both the selection and use of single mode of public transport among others. Golob *et al.* (1972) explained that, its significance is because travellers cannot add to their travelling time indefinitely. Polat (2012) opined that, time of travel includes, ‘walk or access time, several components within the public transport framework, journey and waiting time’, are the three main factors of travel time, each of the factor has different merit for travellers. For example, in the view of (Horn, 2003) for a common public transport user, the price covers most of these cost factors such as, ‘waiting time at interchange and stops, access time to service point and final destination and travel time at vehicles which in its perfectness influence the travellers assessment of public transport service.

Finally, the degree of dependability of bus service is one of the important determinants of patronage and preference. Bus dependability as defined by (Polat, 2012) refers to the level of reliability and confidence of passengers in a bus service. These includes characters such as, assurance and affordability. Passengers should be able to depend on these services and be capable to see that they are obtainable on steady basis and are long termed. Other components such as service capacity and frequency can also determine the

functionality of public transport services and hence effect the dependability. Polat (2012) concluded that, travellers often find those services dependable if the service capacity available is inefficient to meet their current demand.

## **2.12 Relationship between Multimodal Public Transport and Transit Oriented Development**

Trans-link Strategic Planning and Policy (2012) stated that, the capacity to leverage travel design by changing the built environment is a continually research content in land-use and transportation planning field. For the last two decades, researchers demonstrated a clear links between the travel action and build environment including trip length and mode choice. This approach summarised the link through a concept called “The 6-D’s concept of transit-oriented communities, in which each of the D’s refer to an element of build environment or Transportation Demand Management (TDM). They serve as a shell for the design guidelines and are explain below as follows;

### **2.12.1 Destinations: coordinate land-use and transportation**

Transit oriented communities harmonize land-use and transportation in two different important ways; at the neighbourhood scale they positioned newest development along logical direct corridors so that most destination will be on the way to other destination. While, at the regional scale they positioned the highest densities of development and the most consequential destination at the intersection of several frequent transit corridors (Chandra, 2013). Transit can provide direct, fast and cost-effective access to displace destination for more people as soon as transportation and land-use were well harmonized (Hasibuan, 2014).

### **2.12.2 Distance: create a well-connected street network**

A well-connected roadway network reduces travel distance, making it much easier for people to conveniently travel or walk to where they wanted to go, or to easily link with transit en-route to their destination (Mamun, 2013).

### **2.12.3 Design: create places for people**

The design of transit-oriented communities requires the consideration of people need in one way or the other (Suzuki, *et al.*, 2013). People of all abilities and ages should be capable to enjoy and access a comfortable public arena regardless of whether they are pushing a trolley, walking, catching a bus, using a mobility device or cycling (Gutierrez, *et al.*, 2011).

### **2.12.4 Density: concentrate and identify activities near request transit**

Transit oriented communities concentrate most development and growth within a short walk of frequent transit stations and stops (Jun, 2013). Higher frequency of jobs, homes and other related activities provide a market for transit, permitting frequent service to function effectively. The form of development contrast from community to community base on local character, need and goals, and there is no approach to attaining a suitable level of density to support transit (Van-wee, 2002).

### **2.12.5 Diversity: encourage a mix of uses**

Transit oriented communities inspire a mix of land-use at both the corridor scale and neighbourhood. A mix of land-use aid to produce complete walkable neighbourhood within transit stops and stations and similarly patronize a transit system that is well exploit throughout the day (Fainstein, 2005).

### **2.12.6 Demand management: discourage unnecessary driving**

Transit oriented communities apply Transportation Demand Management (TDM) strategies to dispirit unwarranted driving to advance cycling, walking and transit (Tal and Gohen, 2011). Transportation demand management (TDM) provides motivation for travellers to shift automobile trips to other modes in different ways such as, setting a suitable price or parking or route usage, increasing travel option, providing information and marketing and allocating more route space for cycling, transit and pedestrian uses (Meyer, 1999).

### **2.13 Summary/Deduction**

From the chapter above, the study concluded that, transportation is considered as an important sector of economy in Nigeria. Therefore, it is a key determinant of life and organiser of the detailed planning of the build environment that is earlier failing the lawful anticipation and desires of the vast generality of Nigerian citizens. The accumulated effect of noise pollution, air pollution, road traffic accident, health damage, economic losses and fundamental inability to deliver accessibility have marked out the transport sector as a failure of market and non-market similarly.

### **2.14 Conceptual Framework**

Based upon the literature review, the author identifies the basic requirements for addressing contribution of TOD Strategies towards improving patronage of multimodal transport hubs. The model connects all the theoretical concepts which ultimately represents the below conceptual framework. The theoretical model is aligned with the research questions; the model emphasizes the independent and dependent variables. It

shows how various factors influence the patronage of multimodal transport hubs as shown in Figure 2.31 below.

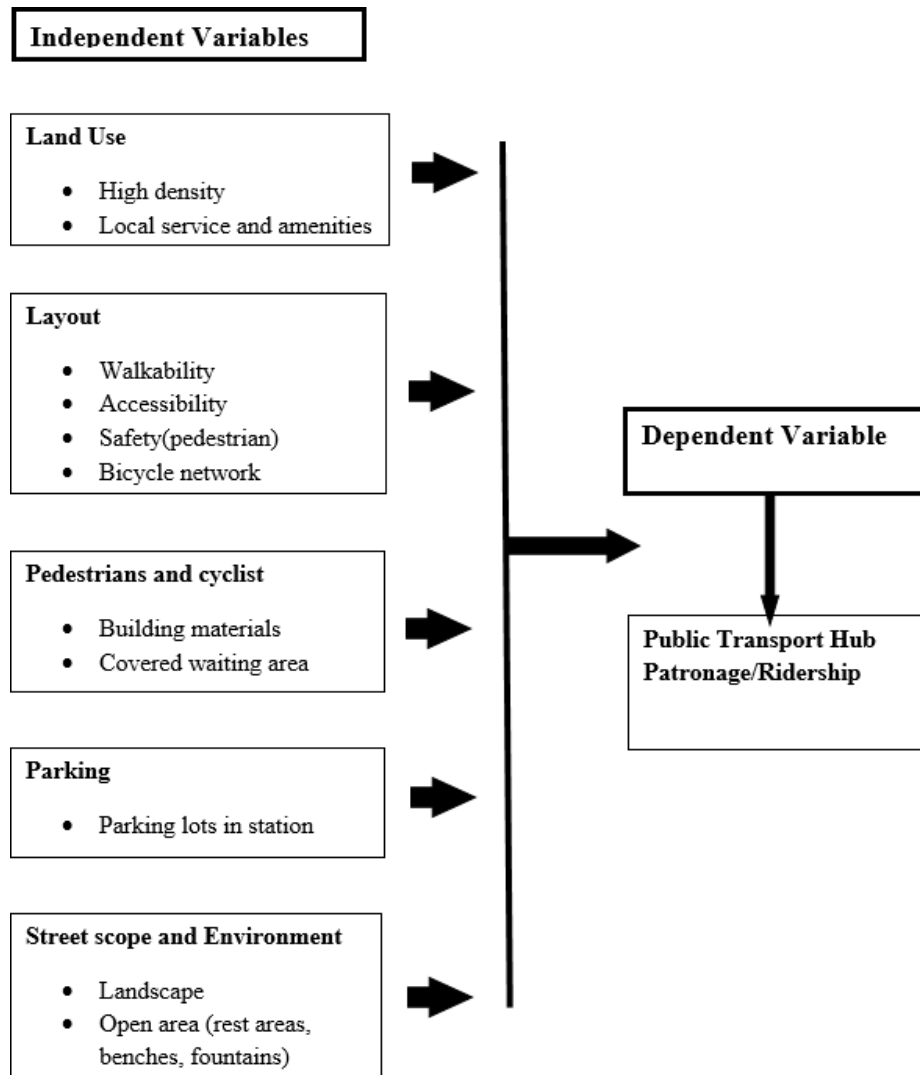


Figure 2.31: Conceptual framework  
Source: Researcher's field work, (2020)

## **CHAPTER THREE**

### **3.0 RESEARCH METHODOLOGY**

#### **3.1 Research Design**

The research employed a descriptive research design to impose the factors that leverage public transport hub sponsorship within the people of Abuja particularly those who patronize these services and those available at the individual train terminals while conducting the interview. The research design approach was selected to assist the researcher in collecting necessary data to examine possible association between the factors and study the present condition of Abuja public transport hubs. The researcher employed both qualitative and quantitative research approach and was descriptive in nature. A descriptive research simply refers to the description of the state of affairs as it exists at present (Kothari, 2004). This involves the use of fact-finding missions and field surveys.

#### **3.2 Research Strategy**

Quantitative data provides objective data and fact (Maina *et al.*, 2016) while the Qualitative data provides a more in-depth explanation and reasons behind established phenomena. The Purpose of this study was to assess the impact of transit-oriented strategies towards improving multimodal transportation hub patronage and this purpose is to be achieve by two objectives. First is to find out the condition of existing train and bus station hubs in Abuja, Nigeria. The second objective is to investigate passenger requirement for public transport patronage.

Case study research approach is one of the main tools for the qualitative study (Robert, 2014). Therefore, the case study approach is capable for the qualitative part of the

research method. A case study is also relevant to research strategy when focusing on a real-life situation. The research will find the data from different transit hubs and their relation to different Transit Oriented Development strategies. To this end, the case study is suitable to draw a comparison of multiple cases (Crewsell, 2013). Moreover, the case study is flexible to modify the design and data collection on the research.

Quantitative analyses were employed in form of survey questionnaires seeking demographic information on gender of passengers, frequent use of public transport, preferred mode of transportation, private vehicle ownership, income, residential location, satisfaction with public transport (in terms of accessibility, walkability, security); satisfaction with functionality, spaces, services and environment around hubs.

### **3.3 Population of the Study**

The Federal Capital Territory Abuja public land transport system caters for about 1.4 million commuters (Oniyangi, 2012). The research targeted possible riders/commuters of age between 15 and 60 years living within the city of Abuja and have once used public transport. People in the chosen age range have a groove travel behaviour and have probably made public transport as their mode of transportation (Table 3.1). In line with table 3.1 for determining sample size, for a given population of 1.4 million, a sample size of 384 would be needed to represent a cross-section of the population, therefore in a population of 1.4 million, 400-sample size was adopted to take care of distribution error.

**Table 3.1: Respondents distribution**

<b>Area Council</b>	<b>Population of Commuters</b>	<b>% of Commuters</b>	<b>NOQD</b>	<b>NOQR</b>	<b>% of Questionnaires Returned</b>
<b>Abuja Municipal</b>					
<b>Area</b>	772,868	55	221	217	56
<b>Bwari</b>	228,266	16	65	61	16
<b>Gwagwalada</b>	157,912	11	45	43	11
<b>Kuje</b>	96,790	7	28	26	7
<b>Kwali</b>	85,791	6	25	23	6
<b>Abaji</b>	58,373	4	17	15	4
<b>Total</b>	1,400,000.00	100.0	400	385	100

Source: Researcher's field work, (2020)

### 3.4 Sample Size and Sampling Procedure

The research adopts purposeful sampling technique as the process of selecting a suitable population of interest and developing a regular way of choosing that are not based on advanced knowledge of how the result would appear will be used to select the public transport hubs because it is the typology of the research. This selective process covers the selection criteria based on the function and location of the train station and bus terminals. The Train stations in the case studies were selected because they are the major train stations that provide public transport service in Abuja, which is the area of study for this research. Since this study focus on multimodal public transport, bus terminals were also selected randomly for the qualitative study. International case studies are selected because there are no current standard bus terminals in the city of Abuja. There are no particular methods considered for selecting this particular bus terminal since the focus of the case study is to assess what exists on ground.

In line with (Krejcie and Morgan, 1970) table for determining sample size, for a given population of 1.4 million, a sample size of 384 would be needed to represent a cross-



section of the population, therefore in a population of 1.4 million, 400 sample size was adopted to take care of distribution error.

### 3.5 Instruments for Data Collection

Data would be obtained from the respondents with the use of structured closed-ended questionnaires. The questionnaire was designed to seek information from the possible passengers of train station hubs in Abuja, who for the purpose of this research are considered as the users. Systematic random approach would be employed in selection of respondents (Table 3.1). The questionnaire seeks responses on issues relating to the reason for patronage of public transport and the reason for non-patronage.

Using the variables that were established from literature reviews, questions were structured to answer the early stated research questions. The research employs a 5-scale Likert response questions in the questionnaires. The questionnaire was designed in seven parts. Part A consists of the general information namely; gender, age and education level. Part B has the dependent variables, part C, D, E, and G focused on the independent variables of the study namely; Land use, Layout, Pedestrian and cyclist, Parking, Street scope and environment.

Table 3.2: Response scaling method

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
(1)	(2)	(3)	(4)	(5)

Source: Mcleod, (2019)

### **3.6 Data Analysis and Presentation**

Data analysis as a strategy used to limit, arrange and to give meaning to the data collected. The data collected through questionnaire from the respondent would be analysed with MS Excel tools. Percentages, tables and cross tabulation will be used to analyse quantitative data. The study adopted 5-point measurement scale (1-strongly disagree to 5-strongly agree) to allow individual expression on how much they agree or disagree with a statement, and to rank qualitative data numerically for ease of analysis. Tables and charts will be use to present the data from the questionnaire survey while photographs, sketches and written reports will be used to present case study data.

To assist users and passengers in addressing their individual needs during the planning stage demands a comprehensive understanding of the current empirical records. Largely, user-based needs at intersections of different transport means are clearly defined based on the service level, organizational level, transport, times cost information and comfort level in relationship to usability and accessibility for all prospective users.

## **CHAPTER FOUR**

### **4.0 DATA ANALYSIS, PRESENTATION AND RESULT DISCUSSION**

#### **4.1 Data Analysis**

The study employed a descriptive analysis research approach using a mixed-method technique through two-survey research, which involved case studies using field observation schedule and self-administered questionnaire developed and used to gather research data for analysis and presentation in this chapter. The research data was collected base on the study objectives as stated above in the previous chapter of this research. Charts, tables, graphs, and statistical instruments were used to analyse the collected data. Five samples of transport hubs were selected for this study, to analyse users' satisfaction of public transport hubs in the study area. 400 number of questionnaires were distributed to draw out the overall users' perception and factors that influenced their satisfaction in the use of Abuja public transport hubs. 80 number of respondents were recorded in each of the selected transport hub and questionnaires were distributed, representing 100% of the total questionnaire shared. A total of eight-transport station was selected for this research work, four international and four national case studies.

#### **4.2 Objective One: Condition of Existing Transport Hubs in Nigeria (Case Study).**

As part of the objectives of this study was to propose a design of multi-modal transportation hub that, integrate Transit Oriented Strategies. Before incorporating the idea of multimodal transport hub into the design, case studies were carried-out and the findings were applied in the design of multimodal transport hub to demonstrate the suitability of transit-oriented strategies.

The case studies selected are listed and discussed in the next title below;

- I. Idu train station Abuja, Federal Capital Territory (FCT).
- II. Oshodi transport interchange, Lagos State.
- III. Ikeja bus terminal, Lagos State.
- IV. Panmure bus and train station, Auckland, New Zealand.
- V. Dalmanock station, Glasgoe City, United Kingdom.
- VI. Southern Cross railway station, Docklands Melbourne, Victoria, Australia.

#### 4.2.1 Case study one: Idu train station Abuja, Federal Capital Territory (FCT).

The Abuja transit station in Idu is a Federal Government owned transport system in Nigeria, launched on 12<sup>th</sup> January, 2018 and opened for passengers' access in the following week. The station phase connects the Abuja City Centre down to Nnamdi Azikiwe International Airport, terminated at the standard gauge railway station in Idu.

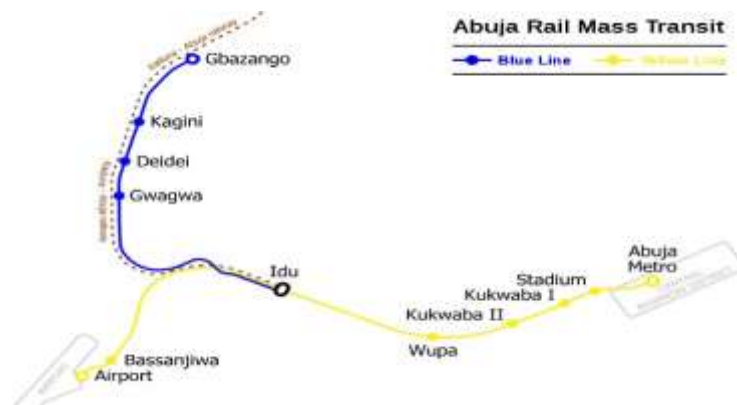


Figure 4.1: Abuja metro light rail network  
Source: Urbanrail.net, (2020)

**Location:** Idu in Abuja Municipal Area Council, Abuja, Federal Capital Territory.

**Contractor:** China Civil and Engineering Construction Company.

**Duration:** Early, 2015.



Figure 4.2: The station location map  
Source: Google earth pro, (2020)



Figure 4.3: The station rail track  
Source: Sunnews Online.com, (2020)



Figure 4.4: The station building  
Source: Sunnews Online.com, (2020)

The marked circle on figure 4.2 above shows the terminal building at Idu, Abuja metro station (Interchange). The interchange was designed with three terminals, the first terminal made provision for inter-city transportation in which all buses going out of Abuja dropped and took passengers on arrival. The middle terminal was exclusively for the Bus Rapid Transit scheme (BRT), and made provision for passengers' shifting from Abuja to other areas within the city. The last terminal made provision for passengers' dwelling

from Abuja to Kaduna, among others. Plate I and II below shows the waiting and train ride section respectively.



Plate I: Idu station building interior showing waiting area and passenger's exit  
Source: Researcher's field work, (2020)



Plate II: Train ride, Abuja (Idu) to Kaduna (Rigasa)  
Source: Researcher's field work, (2020)

#### ***4.2.1.1 Findings at Idu train station, Abuja.***

The study reveals that, Abuja (Idu) metro train station light rail network is a 128km line with standard gauge railway track and had a total of 9-stations connecting the Federal Capital Territory, Abuja with the commercial capital of the Nation, Kaduna.

Base on the study carried out, the following observation were made;

- i. Lack of recreational and entertainment facilities within the terminals, for passengers' convenience.
- ii. Insufficient lift design, compare to the population of estimated passengers daily. There is need for additional mode of transporting physically challenge passengers from waiting area to train ride.
- iii. Insufficient seating facilities in the waiting area.
- iv. No provision for parking spaces, which result to extreme traffic congestion.
- v. No provision for weather protection in ticketing stands, in case of rain and other climatic conditions.

#### **4.2.2 Case study two: Oshodi transport interchange, Lagos.**

The Lagos state government under the administration of governor Akinwunmi Anbode plans to construct a transport interchange to unite 13 inter-cities and inter-state bus parks into 3-bus terminals in Oshodi, Lagos State. Each of the three terminals would include some standard recreational facilities to cater for both workers and passengers such as, ticketing stands, driver lounge, parking areas, rest rooms, loading bays and waiting area among others.

**Location:** Oshodi Pedestrian Overpass, Orile Oshodi, Lagos.

**Contractor:** Planet Project Limited.

**Duration:** 2016.

**Capacity:** Over 3-million yearly.

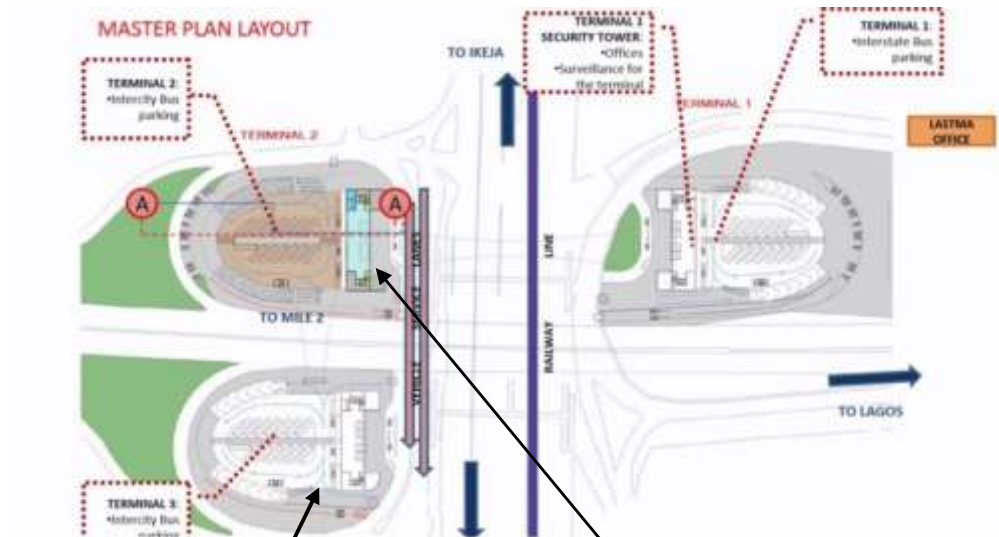


Figure 4.5: Oshodi transport interchange master plan layout  
Source: Researcher's field work (2020)



Figure 4.6: Oshodi terminal building  
Source: Autoreporting.com, (2020)



Figure 4.7: Oshodi pedestrian overpass  
Source: Autoreporting.com, (2020)

The red mark on figure 4.5 above shows the three terminals at Oshodi transport interchange, Lagos State. The interchange was designed in such a way that each of the terminal would work independently. The first terminal made provision or inter-city transportation, in which all the buses going out of the state will take and drop people on arrival (see Plate III and IV). The second terminal that is immediately opposite to the first



terminal and was exclusively for the bus rapid transit scheme (BRT), which made provision for people shifting from Oshodi to Abule Egba, LASU, Okokomaiko, among others. The third terminal was located beside the second terminal and made provision for people navigating Oshodi to Lagos Island, Surulere, Ikorodu, Victoria Island, and so on.



Plate III: Interchange interior of the waiting area.  
Source: Researcher's field work, (2020)



Plate IV: Interchange loading bays.  
Source: Researcher's field work, (2020)



Plate V: Interchange buses parking.  
Source: Researcher's field work, (2020)

#### ***4.2.2.1 Findings at Oshodi transport interchange, Lagos Nigeria.***

The study reveals that, Oshodi transport interchange Lagos State, has three terminals equipped with Close Circuit Television (CCTV) and monitors to enable passengers predict the arrival and departure buses.

Based on the studies carried out, the following observations were made;

- i. The interchange has 18-lifts and 3-Escalators for the three terminals to enable passengers' movement within the terminals.
- ii. The interchange has the capacity to transport 300,000 passengers on a daily basis.
- iii. The concept behind the interchange is for people to be able to travel to different parts of Lagos and West African ports in a very safe, secure, comfortable, and of course very reliable environment.
- iv. The terminals were linked with the skywalk (Pedestrian Bridge). The skywalk is standing on air and the longest of any type in Nigeria with a length of 159m.
- v. The idea of making the building iconic is to attract more passengers to use public transport.

#### 4.2.3 Case study three: Ikeja bus terminal Lagos, Nigeria.

The Lagos state bus terminal was located in Ikeja the capital city of Lagos, on the road to the Local Airport behind the existing railway track in the city, adjoining the state general post office, Ikeja teaching hospital, in the entire commuter village neighbourhood. The terminal was designed to transport an estimate of over 5,000 passengers' daily and provide access to many destinations that includes Ojata, Lekki, CMS, Mary land, Iyana-ipaja, Oshodi among others.



Figure 4.8: Lagos terminus railway station.

Source: Urbanrail.net (2020)

**Location:** Agege Motor Road Ikeja, Lagos State, Nigeria.

**Landmark:** 1.14 hectare.

**Duration:** 2018

**Capacity:** 7,000 Passengers' Daily.

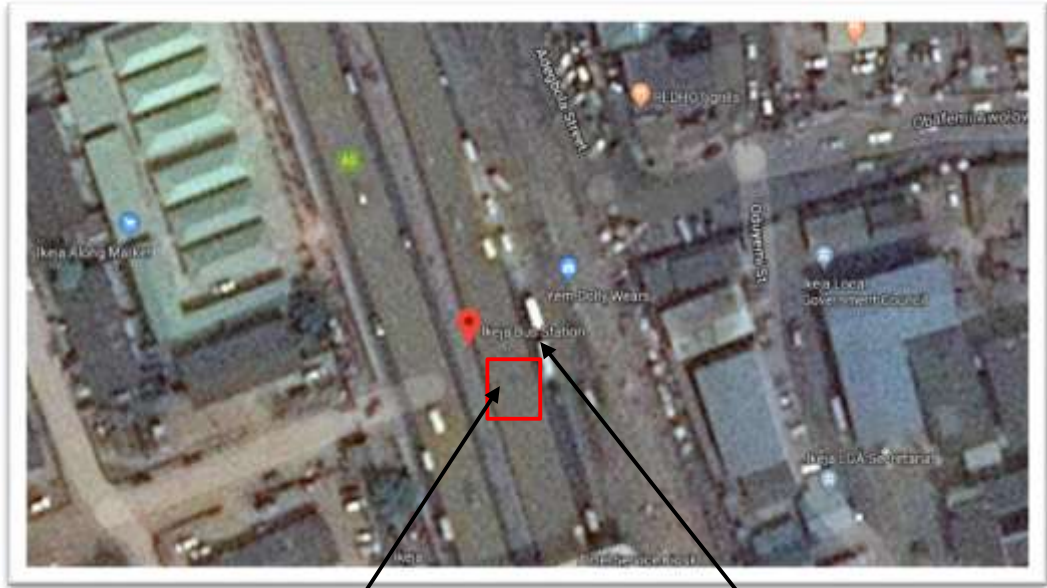


Figure 4.9: Ikeja terminal location map  
Source: Google Earth pro (2020)



Figure 4.10: Ikeja terminal building  
Source: Nairaland, (2020)



Figure 4.11: Ikeja along bus stops  
Source: Nairaland, (2020)

The square marked on figure 4.9 above shows the bus terminal building that serves as the hub for entire transport activities within the Ikeja zone, Lagos State. The bus terminal was design to remodel the face of Ikeja public transportation and to cater for 70,000 passengers' daily across over 22 destination in the State. The terminal covers a land area of 10,000 square meter, and was equipped with standard recreational facilities that includes food court, ATM galleries, fully air-condition, free Wi-Fi, shops, and

conveniences, among others with elaborate waiting area and parking lots (see Figure 4.12 and Figure 4.13 below)



Figure 4.12: Ikeja terminal reception/waiting area  
Source: dnstories.com, (2020)



Figure 4.13: Ikeja terminal buses parking lots  
Source: dnstories.com, (2020)

#### ***4.2.3.1 Findings at Ikeja bus terminal Lagos, Nigeria.***

The study reveals that, Ikeja as the administrative capital of Lagos State and the central business district with a population of about a million, it is a gateway to the state with international and local wing of the Murtala Muhammad Airport.

Based on the studies carried out, the following observation were made;

- i. The main concept behind the design of the terminal is to solve the challenges of public transport in Ikeja and Lagos State in particular.
- ii. The terminal building was equipped with readily available technology to ensure that passengers get a better travel experience, which will provide the riders with real time update for bus schedule, arrival and departure times, and possible disruption.
- iii. Provision of adequate facilities for passengers' comfort on arrival, ticketing stands, waiting and departure areas.
- iv. Covered loading bays, to provide protection from weather condition such as sun and rain (see Figure 4.14).
- v. Provision of adequate parking lots for buses of over 500 at a time.



Figure 4.14: Ikeja terminal cover loading bay.

Source: dnstories.com, (2020)

#### 4.2.4 Case Study Four: Panmure Bus and Train Station Auckland, New Zealand

The Panmure bus and train station is located on the North island main trunk line in New Zealand city. The station was existing since '1930' directly opposite to the current location, but later relocated to where it is now in the late 2007. The station design was to cater for the eastern line service of the Auckland railway network.

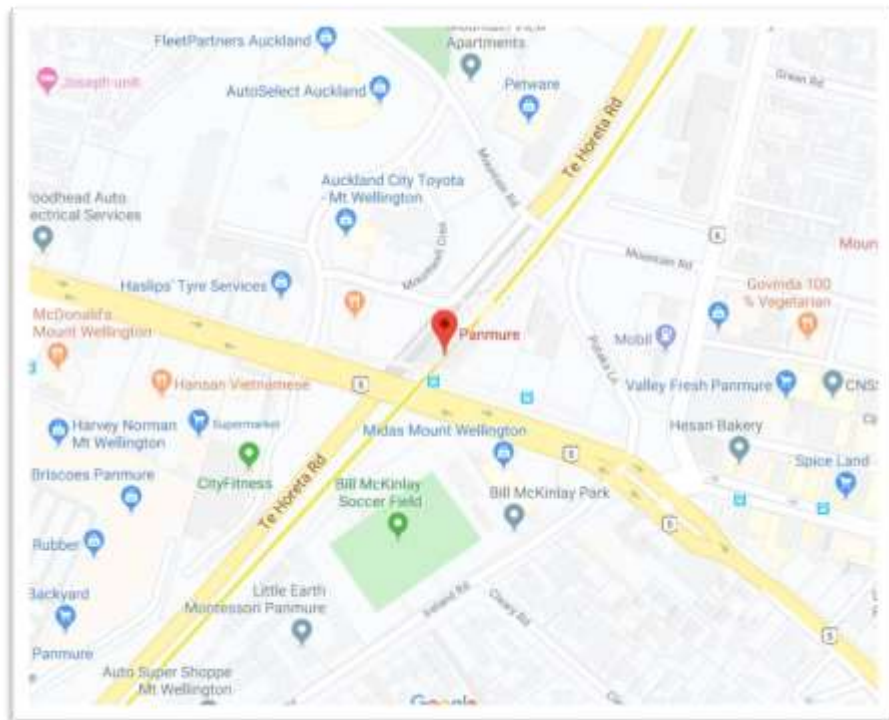


Figure 4.15: Panmure station location map.  
Source: Google earth pro, (2020)

- Location:** Ellershie-Panmure highway panmure Auckland.
- Client:** KiwiRail (Track and Platforms), Auckland Transportation.
- Duration:** Opened on 16 Nov 1930.
- Capacity:** 3,700 boarding daily.



Figure 4.16: Panmure station layout plan.  
Source: Google earth pro, (2020)



Figure 4.17: Panmure rail track  
Source: Google earth pro, (2020).



Figure 4.18: Panmure station building  
Source: Google earth pro, (2020)

Figure 4.17 and 4.18 above shows the station building and pedestrian plaza added to the station platform on May 2012. The pedestrian plaza was located over part of the platform and the station building placed adjacent to the platform. The new development provide access from the car park and bus stops to both platforms via stairs and escalators (see Figure 4.19 and Figure 4.20 below).





Figure 4.19: Station train loading bay.  
Source: Transport.govt.nz, (2020).



Figure 4.20: Interior of the station platform.  
Source: Transport.govt.nz, (2020).

#### ***4.2.4.1 Findings at Panmure bus and train station Auckland, New Zealand***

The study reveals that, Panmure Bus and Train Station features a large bus terminal with 16 routes, but regardless the strong improvement in the city transportation, the overall share of travel in Auckland by public transport is still quite low.

Based on the studies carried out, the following observation were made;

- i. The station concourse over the track, act as a bridge for passengers and baggage to flay over.

- ii. Lack of standard recreational and entertainment facilities within the station, for passengers' convenience.
- iii. An elevator over rail concourse linking bus and train platform
- iv. The station design incorporates two mode of transportation, designed with Train loading bay underneath buses loading bay.

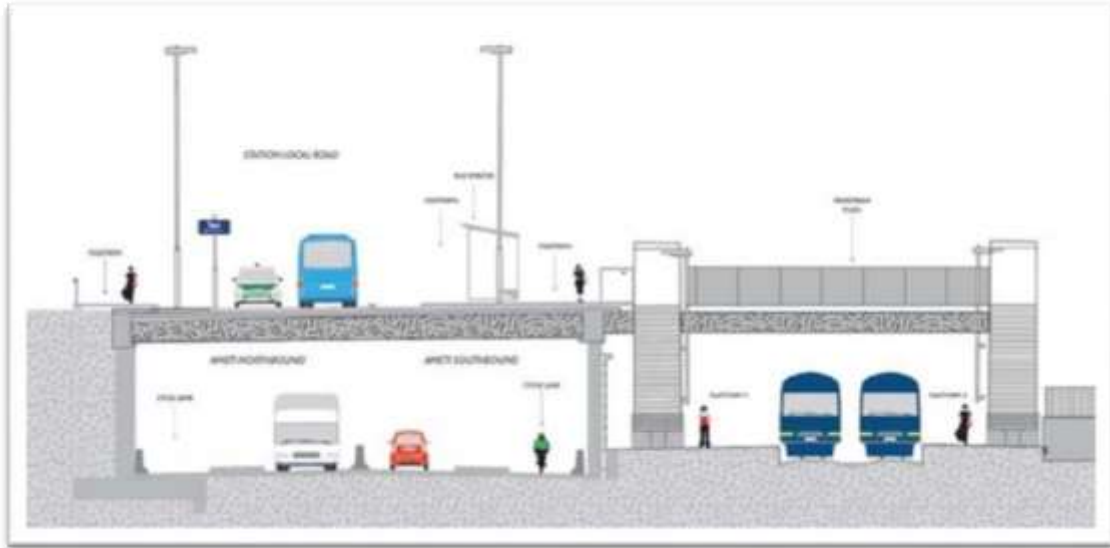


Figure 4.21: Section through Panmure bus and rail track  
Source: Transport.govt.nz, (2020).

#### 4.2.5 Case study five: Dalmanock station Glasgoe City, United Kingdom.

The Dalmanock metro railway station was located at the Swanston street Glasgoe, Glasgoe city, United Kingdom. The station was constructed over 100 years ago with 2 platforms. The metro station concept was to retain the initial Victorian design approach to maintain its historical and Architectural significance.

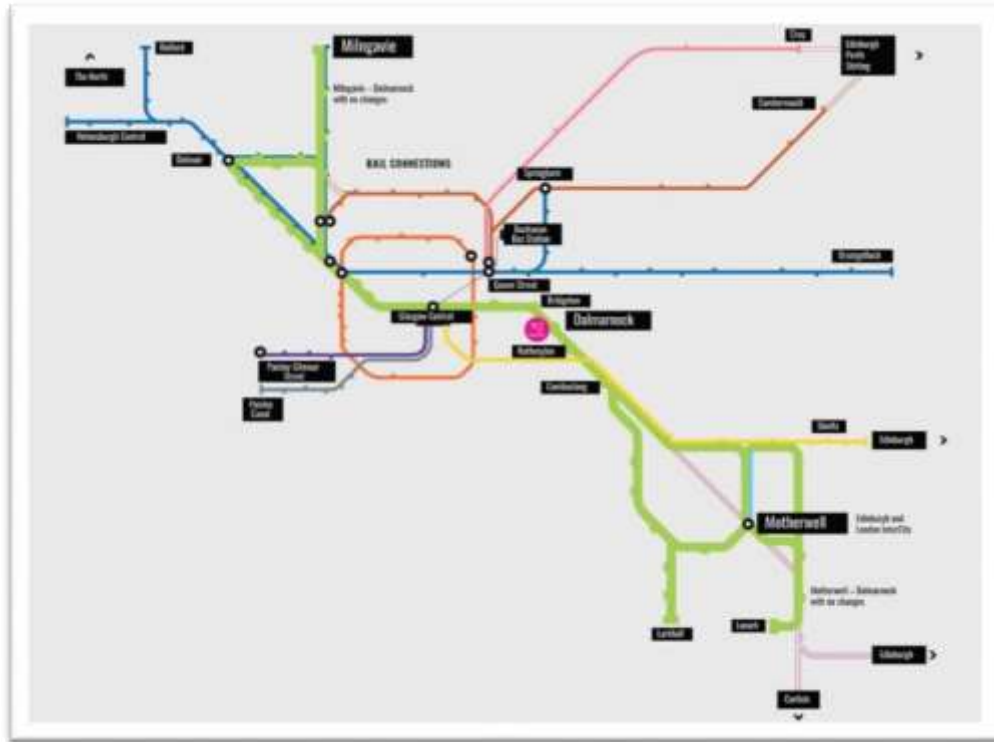


Figure 4.22: Dalmanock station function chart  
 Source: <https://www.archidaily.com>, (2020)

**Location:** Dalmanock, Glasgoe, Glasgoe City G04, United Kingdom.

**Duration:** opened on 2013.

**Landmark:** 600m<sup>2</sup>

**Contractor:** ATKINS



Figure 4.23: Dalmanock station location map  
Source: Google earth pro, (2020)



Figure 4.24: Dalmanock station platform  
Source: Achidaily.com, (2020)



Figure 4.25: Dalmanock station rail track  
Source: Archidaily.com, (2020)

#### ***4.2.5.1 Findings at Dalmanock metro rail station Glasgoe, Glasgoe City, United Kingdom***

The study reveals that, Dalmanock metro rail station Glasgoe was designed with 2-platforms placed opposite one another, and to serve the entire population of Dalmanock passengers who made public transport as their mode of choice.

Based on the studies carried out, the following observation were made;

- i. The station has limited facilities and was not very accessible for less mobility passengers

- ii. Lack of public utility facilities such as Waiting room, and Automobile ticketing machine.
- iii. Some parts of the station-building interior have problem of lighting and ventilation.
- iv. The station faced a challenge of disrupted train service during the recent floods, due to poor drainage system.

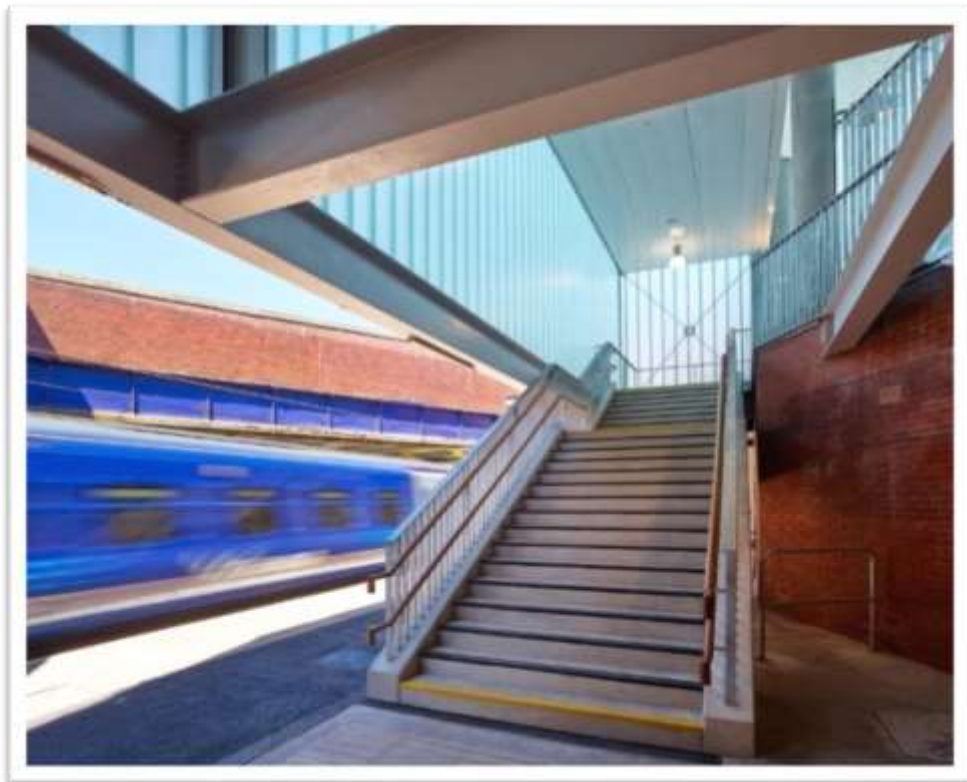


Figure 4.26: Dalmanock station concourse interior.  
Source: Google earth pro, (2020)

#### **4.2.6 Case study six: Southern Cross railway station in Docklands, Melbourne Victoria, Australia.**

The Southern Cross railway station also known as Spencer Street Station was located in Dockland Melbourne, Victoria City. It is the biggest railway station in the area with up

to 22 rail tracks. The station operates, maintained and owned by the ‘Infranexus particularly known as AssetCo, under a public-private partnership.

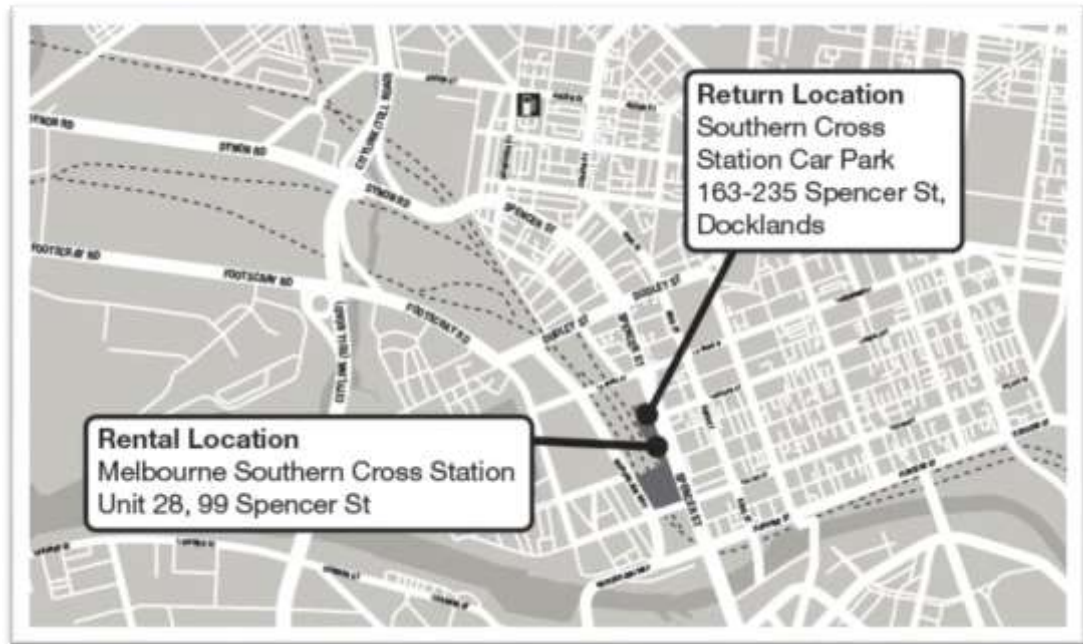


Figure 4.27: Malbourne city drop off instruction.  
Source: <https://www.apexrentals.com.au>, (2020).

- Location:** Along Spencer Street Docklands Melbourne, Victorian, Australia.
- Duration:** Rebuild on 2015
- Tracks:** 22 tracks
- Architect:** Nichola Grimshaw and Jackson Architecture.



Figure 4.28: Melbourne station location map.  
Source: Google earth pro, (2020).



Figure 4.29: Melbourne platform building  
Source: skyscanner, (2020).



Figure 4.30: Melbourne station rail tracks.  
Source: skyscanner, (2020).

The Southern Cross station design was to ease passengers' circulation and improve staff working environment. Figure 4.29, 4.30, 4.31, and 4.32 shows the most attractive part of the station design is the 'Dune-Like roof' the covers the entire city blocks. The roof concept was generated from the requirement of the station and plays a critical role as part of the environmental envelop.



Figure 4.31: Melbourne roofing structure of the new spenser street.  
Source: Skyscanner, (2020).



Figure 4.32: Melbourne passengers waiting area.  
Source: Skyscanner, (2020).



#### ***4.2.6.1 Findings at Southern Cross station Docklands Melbourne, Victoria, Australia.***

The study reveals that, Southern Cross Station Melbourne was equipped with 22-tracks with 16 platforms and are numbered from east to west. Platforms 1 & 2 are suited with ‘Dual gauge track’, allowing both standard gauge inter-state trains V/Line broad gauge trains. While platforms 3-16 are exclusively broad gauge.

Based on the studies carried out, the following observation were made;

- i. The station design employed the use of modern materials that includes steel, coated glass panel, and dune like roof design.
- ii. The concept behind the roof design was to develop a response to the hot external climate and the internal need for diesel and ambient cooling through natural ventilation system.
- iii. The roof span up to 34,000 square meters with a height of 23m to cover the station.

#### **4.3 Objective Two: Passengers Perceptions of the Existing Public Transport Hubs.**

In line with above research objective, a study was carried-out to evaluate passenger’s satisfaction with the service quality attributes of public transport hubs in Abuja, Nigeria. The study was conducted using a mixed-method research technique through two-survey research that involved quantitative and qualitative data collection methods. A survey was conducted, and five (5) samples of transport terminal buildings were selected for the study, which includes Dutse-Bwari axis, Lugbe-Kuje-Gwagwalada axis, Kubwa-Zuba-Suleja axis, City Centre axis and Nyanya-Karu-Mararaba axis. A random selection of 400 public transport users was made to draw out the overall users’ perception and factors that influence their satisfaction in the use of public land transport terminal buildings in Abuja, using a self-administered questionnaire. The data collected was analysed using

descriptive statistics and findings were presented inform of tables and charts (see Table 4.3, 4.4 and 4.5) illustrating passenger’s perceptions on quality attribute of facilities and service provided in Abuja land transport terminal buildings.

**Table 4.1: Measurement Scale, Assessment Value and Scores**

S/n	Assessment Value	Score
1	Strongly Agreed	5
2	Agreed	4
3	Undecided	3
4	Disagree	2
5	Strongly Disagree	1

Source: Researcher’s field work, (2019)

Table 4.1 above shows the measurement scale of the variables used to collect data for the research work. A 5-point Likert measurement was employed to rank qualitative and numerical data for ease of analysis.

**Table 4.2: Respondents Distribution across Five Selected Transport Hub**

Area Council	Population of Commuters	% of Commuters	NOQD		% of Questionnaires Returned
			NOQD	NOQR	
<b>Abuja Municipal Area</b>					
	772,868	55	221	217	56
<b>Bwari</b>	228,266	16	65	61	16
<b>Gwagwalada</b>	157,912	11	45	43	11
<b>Kuje</b>	96,790	7	28	26	7
<b>Kwali</b>	85,791	6	25	23	6
<b>Abaji</b>	58,373	4	17	15	4
<b>Total</b>	1,400,000.00	100.0	400	385	100

Source: Researcher’s field work, (2019)

**Table 4.3: Age Distribution of the Respondents**

<b>Age Group (yearly)</b>	<b>Number of Respondents</b>	<b>Percentage of Respondents</b>
15-25	79	19.75%
25-35	117	29.25%
35-45	109	27.25%
45-55	57	14.25%
55-Over	38	9.5%
	400	100%

Source: Researcher's field work, (2019).

**Table 4.4: Employment Status of the Respondents**

<b>Employment Status</b>	<b>Number of Respondents</b>	<b>Percentage of Respondents</b>
Government Sector	101	25.25%
Private Organization	85	21.25%
Self-employed	59	14.75%
Unemployed	96	24%
Pensioner	24	6%
Students	35	8.75%
	400	100%

Source: Researcher's Field Work, (2019).

**Table 4.5: Public Transport Hubs Measures of Service Quality Attribute**

<b>Variable Code</b>	<b>Variable Description</b>
P1	Terminals are available and accessible
P2	Terminals are adequate in terms of space
P3	Good health and safety measures within terminals
P4	Good security measures within and around terminals
P5	Restrooms and conveniences are available at terminal
P6	Standard retail shops and restaurants are available at terminals
P7	Short waiting time at terminals
P8	Terminals are well maintained
P9	Availability of users' complaint and feedback system
P10	Adequate number of ticketing stalls
P11	Adequate parking space
P12	Traffic management in and around the terminal
P13	There is need for more transport terminals
P14	Satisfied with overall service and condition of public transport facilities

Source: Researcher's Field Work, (2019).

#### **4.4 Discussion of Results**

Table 4.6 below shows the presentation of descriptive statistics of general satisfaction with public land transport terminal buildings in Abuja and various factors influencing the same, on a Likert scale of 1 – 5 (1-Strongly disagree, 2-Disagree, 3-Undecided, 4-Agree and 5-Strongly agree). The study discovered that most of respondents were dissatisfied with existing public land transport terminal buildings. Only 2% percent of the respondents strongly agreed with the availability and accessibility of the terminal buildings, though 24.75% percent agreed and 15.5% percent were recorded 'undecided'. Majority of them were found to be 'Disagree', about 31.25% of the respondents, and 23.75% percent 'Strongly disagree'. Therefore, out of the 400 respondents, only 26.75% are satisfied,

15.5% are Undecided and 55% percent were not satisfied with the current public land transport terminal buildings in Abuja.

Figure 4.33, below shows the statistical frequency distribution of respondents' feedback of the general desire and factors that influence the individual quality attributes of facilities and services for their satisfaction with the present public land transport terminal building in Abuja, (See Table 4.6 and Figure 4.33). The table shows that the quality attributes of facilities and services of public land transport terminal buildings that influence users' comfort were also pitifully perceived. Take for example; variable P8 (Terminals were well Maintain), having a mean score of 1.99 (<5.0), obtained 32% percent 'Strongly Disagree', 48.5% percent 'Disagree', 8.5% percent were 'Undecided' and 11% percent goes under 'Agreed', none of the respondents were strongly satisfied with the existing transport terminal buildings in Abuja. Therefore, the study revealed that, more than 80% percent of the respondents are dissatisfied with the maintenance services of the Terminal buildings, which is in line with the findings of (Straddling *et al.*, 2007) and (Andaleeb *et al.*, 2007) that comfort has the greatest impact on user's satisfaction. Similarly, 80% respondents recorded that transport terminal buildings in Abuja were ill-maintained, 8.5% of the respondents were marked Undecided, and close to 82% of the respondents marked for the need of more transport terminal buildings in Abuja. Therefore, 3 variables, P1 (Terminals are available and accessible), P8 (Terminals are well maintained), and P13 (There is need for more transport terminal building), had a mean score of 2.42, 1.99, and 4.06, respectively. However, only 2-variables partially met the expectation of passengers in Abuja. The first variable is P7 (Short waiting time at terminals), with a mean score of 2.33, while the second variable is P12 (Traffic management in and around the terminal), with a mean score of 2.6. This finding can be supported by that of Faulks (1990) in the

study of bus provision in developing world cities. However, none of the variables make the ‘5’ point mean score, only variable P13 (There is need for more transport terminal building) has a high mean score of 4.06, in which more than 80% of the correspondent were strongly agreed with the need for more transport terminal buildings (see Figure 4.34, 4.35, and 4.36)

**Table 4.6: Absolute and relative frequency distribution of Abuja public transport hubs satisfaction and factors affecting same.**

Variable Code	Strongly Agreed		Agreed		Undecided		Disagree		Strongly Disagree		Mean
	#	%	#	%	#	%	#	%	#	%	
P1	8	2%	99	24.75%	62	15.5%	125	31.25%	95	23.75%	2.42
P2	8	2%	41	10.25%	85	21.25%	181	45.25%	85	21.25%	2.27
P3	14	3.5%	37	9.25%	87	21.75%	169	42.25%	93	23.25%	2.28
P4	16	4%	55	13.75%	95	23.75%	174	43.5%	60	15%	2.48
P5	8	2%	28	7%	60	15%	180	45%	124	31%	2.04
P6	0	0%	37	9.25%	64	16%	188	47%	111	27.75%	2.07
P7	20	5%	60	15%	50	12.5%	171	42.75%	99	24.75%	2.33
P8	0	0%	44	11%	34	8.5%	194	48.5%	128	32%	1.99
P9	0	0%	25	6.25%	65	16.25%	190	47.5%	120	30%	1.99
P10	8	2%	55	13.75%	95	23.75%	165	41.25%	77	19.25%	2.38
P11	16	4%	58	14.5%	69	17.22%	162	40.5%	95	23.75%	2.35
P12	18	4.5%	90	22.5%	77	19.25%	141	35.25%	74	18.5%	2.60
P13	128	32%	194	48.5%	54	13.5%	24	6%	0	0%	4.07
P14	0	0%	49	12.23%	44	11%	189	47.25%	118	29.5%	2.06

Note: # = Number of Respondents, % = Percentage of Respondents.  
Source: Researcher’s field work, (2019).

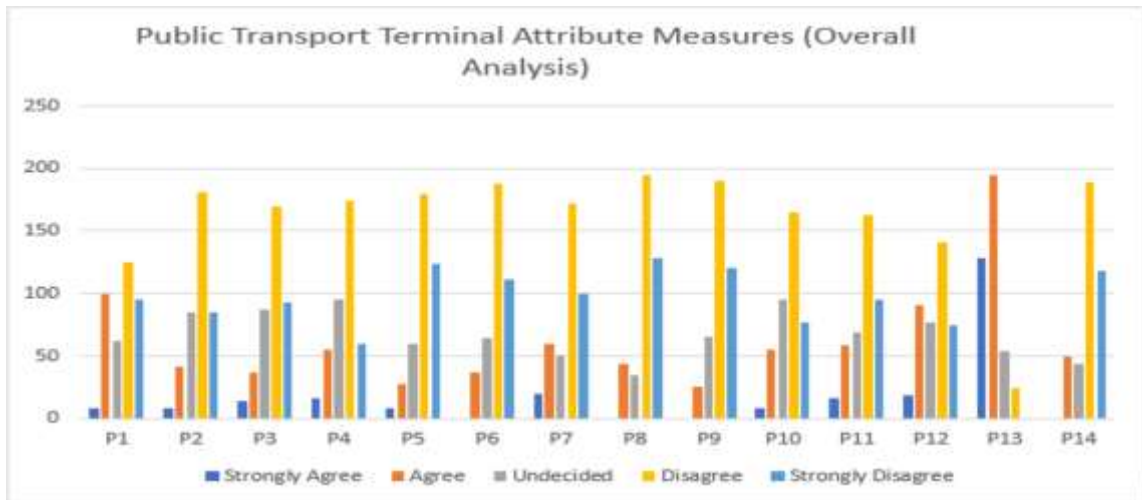


Figure 4.33: Bar-Chart presenting public transport terminal attribute measures  
Source: Researcher’s field work, (2019).

**Table 4.7: Level of passenger’s satisfaction with public transport service and factor affecting same.**

Variable Code	Variable Description	Mean
P1	Terminals are available and accessible	2.24
P2	Terminals are adequate in terms of space	2.27
P3	Good health and safety measures within terminals	2.28
P4	Good security measures within and around terminals	2.48
P5	Restrooms and conveniences are available at terminal	2.04
P6	Standard retail shops and restaurants are available at terminals	2.07
P7	Short waiting time at terminals	2.33
P8	Terminals are well maintained	1.99
P9	Availability of users’ complaint and feedback system	1.99
P10	Adequate number of ticketing stalls	2.38
P11	Adequate parking space	2.35
P12	Traffic management in and around the terminal	2.60
P13	There is need for more transport terminals	4.07
P14	Satisfied with overall service and condition of public transport facilities	2.06

Note: 0-1 Strongly Disagree, 1-2 Disagree, 2-3 Undecided, 3-4 Agree, 4-5 Strongly Agree.

Source: Researcher’s field work, (2019).

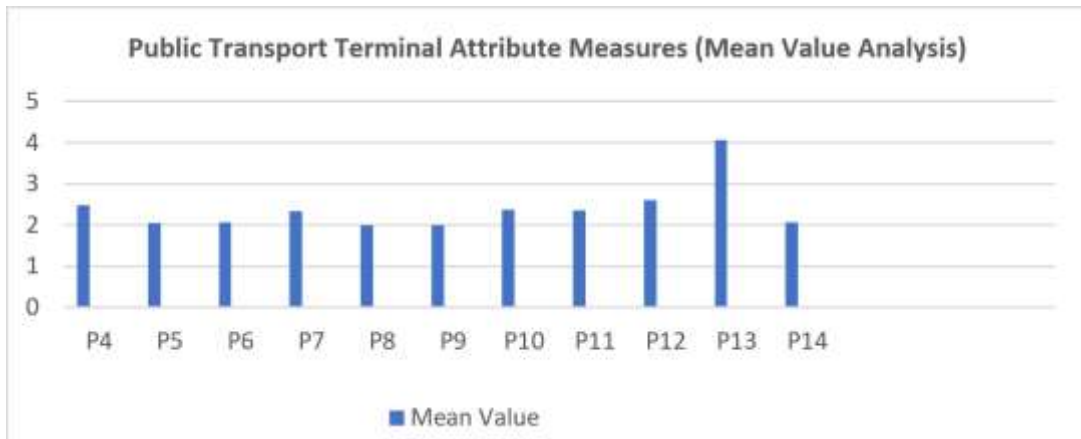


Figure 4.34: Bar-Chart presenting public transport terminal attribute measures (mean value analysis)  
Source: Researcher’s field work, (2019).

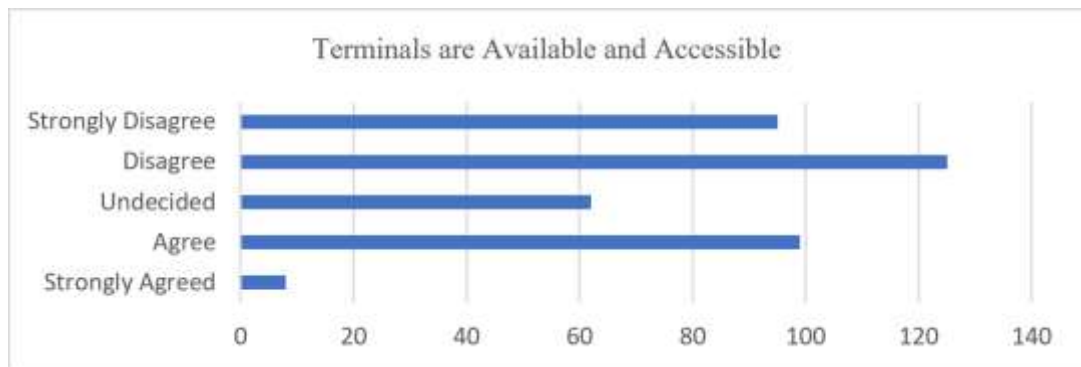


Figure 4.35: Bar-Chart presenting ‘terminals are available and accessible’  
Source: Researcher’s field work, (2019).

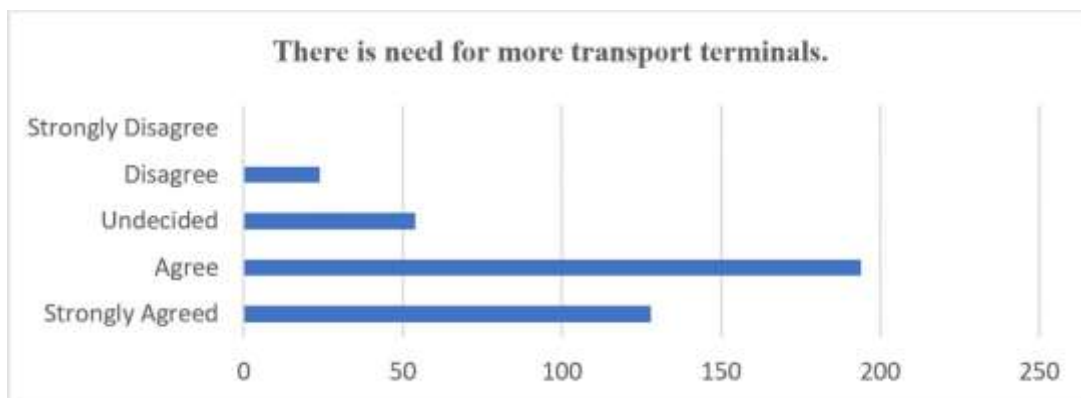


Figure 4.36: Bar-Chart presenting ‘there is need for more transport terminals’  
Source: Researcher’s field work, (2019)



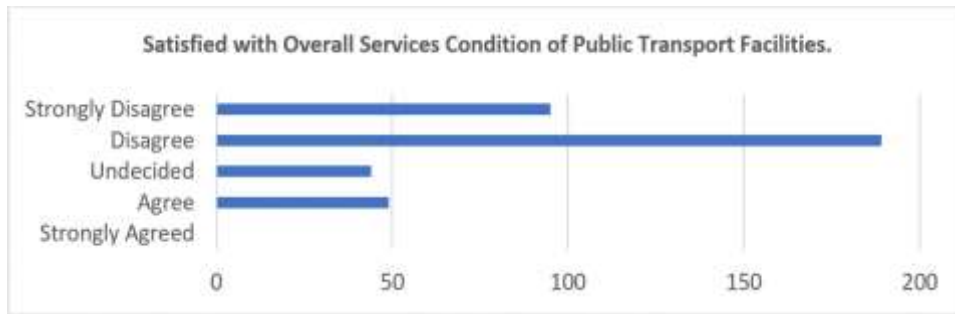


Figure 4.37: Bar-Chart presenting ‘satisfied with overall service condition of public transport facilities  
Source: Researcher’s field work, (2019).

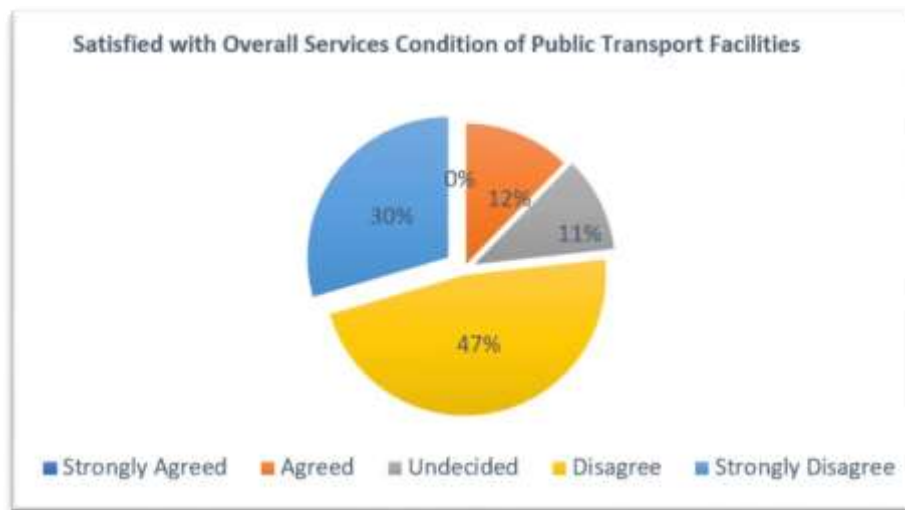


Figure 4.38: Pie-Chart presenting ‘satisfied with overall service condition of public transport facilities  
Source: Researcher’s field work, (2019).

#### 4.5 Findings

The findings of the study revealed that, out of 14 variables analysed, 12 quality attributes of facilities and services of public land transport terminal buildings in Abuja were unsatisfactorily recorded by the respondents. 2-variables (P7 and P12) partially met the passengers’ anticipation; however, even for the 2-variables pointed out above, more than 35% of the respondents were undecided.

## **4.6 Objective Three: The Design of Proposed Multi-modal Transport Hub that Integrate Transit Oriented Development Strategies.**

### **4.6.1 The design brief**

In recent years, sustainable development has gained favour in various disciplines, most especially in the field of urban design and planning. As part of this progress, researchers and designers introduced the concept of transit-oriented development (TOD), hoping to limit the dependence on personal vehicles and achieve sustainable development for cities. The population of Abuja is growing and the city economy is thriving, making the city a promising regional core centre. Implementation of transit hub is necessary in such city to allow residents, visitors, and travellers to live a healthier life style by using alternative transportation other than cars. The goal of this proposal is to apply TOD principles to the Abuja transit station.

As part of the objective of this study, a prototype design of transit hub facility is required to serve as a corrective measure, with a sole aim of providing an excellent working environment through the application of transit-oriented development principles. This will promote identity and redefine the public transport sector of the area.

### **4.6.2 Site selection criteria**

Site selection is the process of finding location that suite desired conditions set by the selection criteria. The following are the variables used in selecting the propose site.

#### **I. Accessibility:**

The site selected should be located in a locality from which various activities of the site would be accessible by both foot and vehicle. The selected site is located at the transit interchange centre of the Federal Capital Territory Abuja, and can be access easily by





Figure 4.41: Local development authority permit  
Source: Researcher's field work, (2020)

#### **IV. Nature of the ground soil:**

The ground soil of the site should be good enough to carry the load of such structure type and maintain stable for a lifetime.



Plate VI: Ground soil type  
Source: Researcher's field work, (2020)

#### **V. Available facilities**

The site should be in a locality where various standard facilities are available, which includes community services such as, police and fire protection, cleaning of waste and street cleaning, utility services such as water supply, gas, electricity and drainage system.

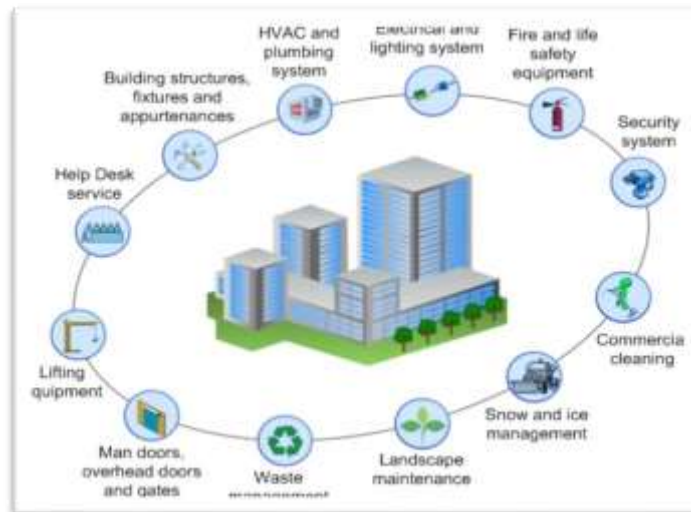


Figure 4.42: Standard Environmental Facilities  
 Source: Researcher’s field work, (2020)

**VI. Purpose of building:**

This is the most important factor to consider before selecting a site for any purpose. The site should be selected keeping in view the general scope or the purpose of building, and the basis of the extent of privacy required.

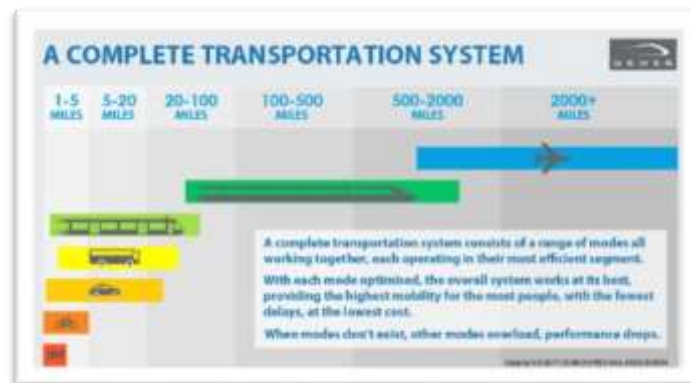


Figure 4.43: Multimodal transport system.  
 Source: Researcher’s field work, (2020)

**4.6.3 Site location**

The site is situated on the latitude 9°5'25.71<sup>11</sup> and longitude 7°28'43.77<sup>11</sup>, in the Federal Capital Territory of Nigeria, Abuja. The site is located at GC21 Aminu Kano Crescent,

Wuse, adjoining Federal Ministry of Education Headquarter, Ministry of Foreign Affairs, Eagle Square and Head of Service FCT Abuja.



Figure 4.44: Site location map  
Source: Google earth pro, (2020)

#### 4.6.4 Site selection justification

The proposed site selected is on a boundless area space initially reserved for such type of development within commercial and institutional layout. Hence, drive the decision of chosen the site for propose Multimodal public transport hub which is illustrated in Figure 4.5.

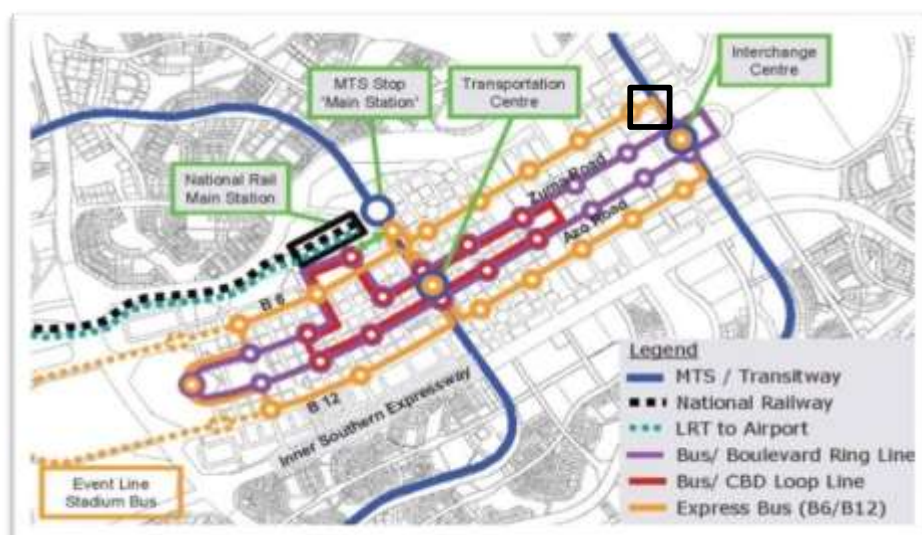


Figure 4.45: Propose station layout  
Source: Google Earth pro, (2020)

#### 4.6.5 Site climatic condition

The Federal Capital Territory, Abuja witness a tropical climate. The summer period has much rainfall than the winter period. The city usually experiences an average temperature of 25.7°C annually. Precipitation usually falls in September, making December the driest month of every year with 1mm of rain, averaging 284mm, showing a difference of 283mm annually. The warmest month of the year is usually experience in April with a recorded temperature of 28.5°C, while the coldest temperature is usually recorded in August, averaging 23.9°C, often haven 4.6°C difference every year.



Figure 4.46: Detailed Abuja climate graph  
Source: Skyscanner, (2020)

#### 4.6.6 Site analysis

Every site irrespective of its terrain, shape, size and topography offers itself to be taken advantage of in the design process. Hence, the need for environmental and site analysis is necessary, as a principle of design apply to ensures that building is design as an integral part of the site regardless of its terrain and shape.

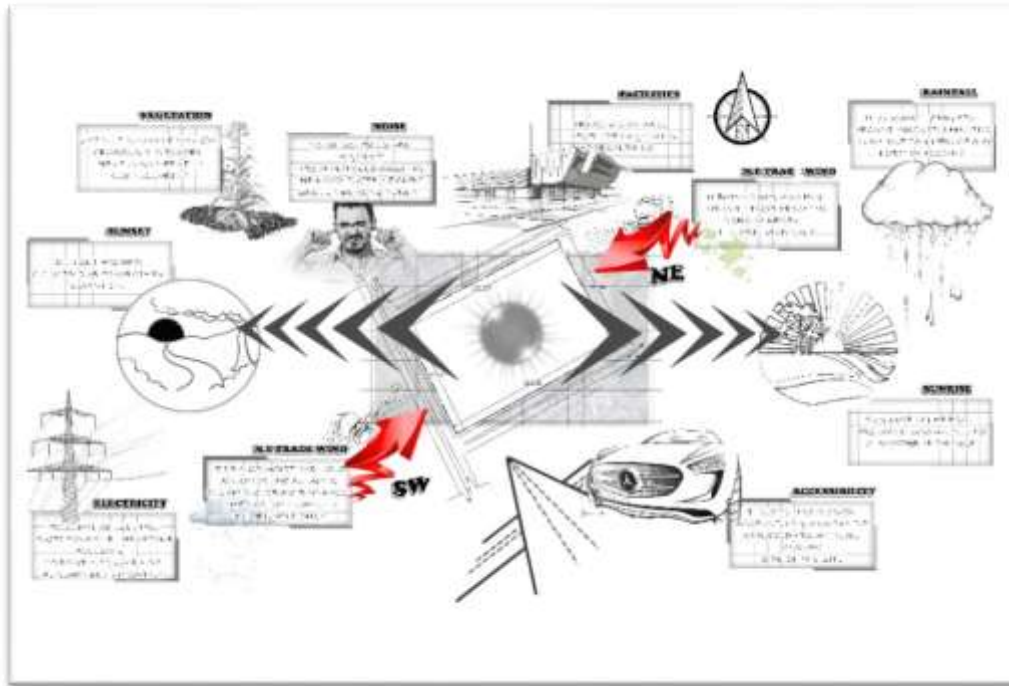


Figure 4.47: Site analysis  
 Source: Researcher’s field work, (2020)

#### 4.6.7 Design considerations

##### 4.6.7.1 Transit oriented development strategies

The proposed design aims at applying transit-oriented development strategies in Multi-modal Public Transport Hubs in Abuja, to increase public transport ridership by limiting the use of personal vehicles and promote sustainable urban growth. Some principles of transit-oriented development applied in the design includes;

- i. Locate station in a place with high ridership potential and development opportunities.
- ii. Generate range of densities with highest at stations, diminishing down to existing neighbourhood.
- iii. Proper design of pedestrian connection to surrounding development.
- iv. Locate a public plaza directly approaching one or more side of the station building.



- v. Design retail and cape streets along main pedestrian connection leading to station entrance.
- vi. Minimize parking at station
- vii. Enhance vehicular connections, by connecting different mode of transportation in a station.
- viii. Integrate a comprehensive bikeway network and parking areas.

#### ***4.6.7.2 User's satisfactions***

The proposed design of transport hub facility would cater for the public transit hub users' services in the Federal Capital Territory, Abuja. According to Oliver (1997) satisfaction can be describe as contentment of duty to customers. Diverse research studies and review of papers concerning users' satisfaction on public transport hubs were carried out to develop a desirable public transport hub. Department of Transport (2003) discovered that, elevated frequency of reliable services and fares that place value for money as important need of most public transport users. The proposed Multi-modal public transport hub design would focus on users' comfort, security, safety and cleanliness of the terminals as the top priority, followed amenities, information and lastly access and connection of different modes of transportation.

#### **4.6.8 Design concept**

The design concept adopted seeks to provide a design that overcome the challenges or problems of public transport mentioned in the chapter one of this thesis above. In achieving the research aim, a bus concept was employed for the proposed design after critical consideration of all the research objectives outlined above. The idea behind the design was derive from the form of a bus. The Hub has a twin form of this bus like

structure due to the need for the design. From the concept, the simplicity was achieved by reducing the complicated nature of the design to the nearest minimum.

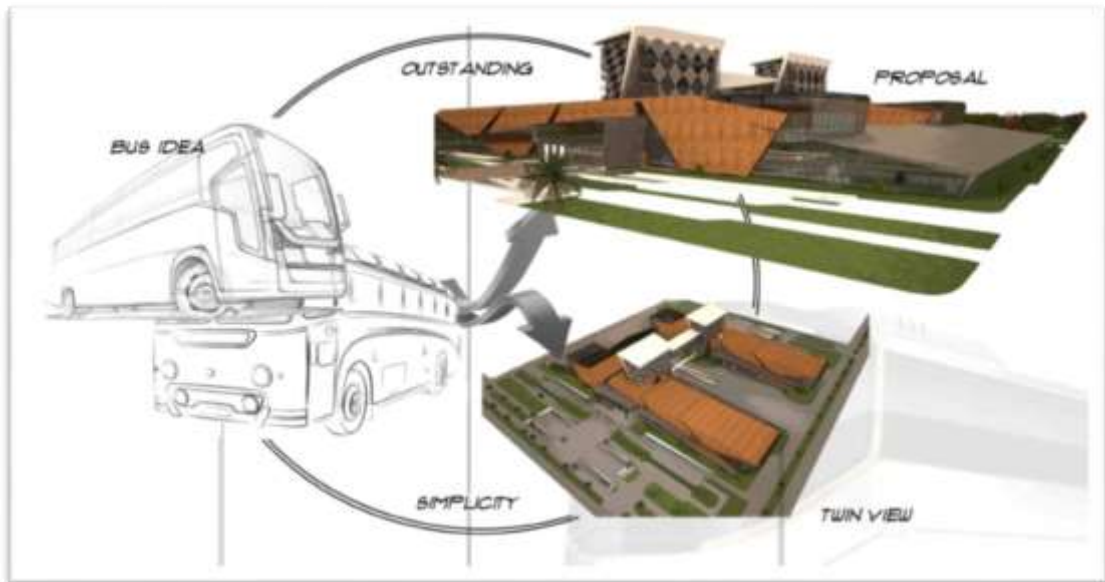


Figure 4.48: Concept development  
Source: Researcher's design proposal, (2020)



Figure 4.49: Site location map  
Source: Researcher's design proposal, (2020)

The site location map on figure 4.49 above was use as a guide to design the site plan shown on figure 4.50 below.

The site zoning was use in the determination of the position of the spaces shown in the site plan. Parking spaces were not shown on the site plan, as the design employed a Basement parking for both buses, small vehicles, train platforms, and passengers' drop-off.

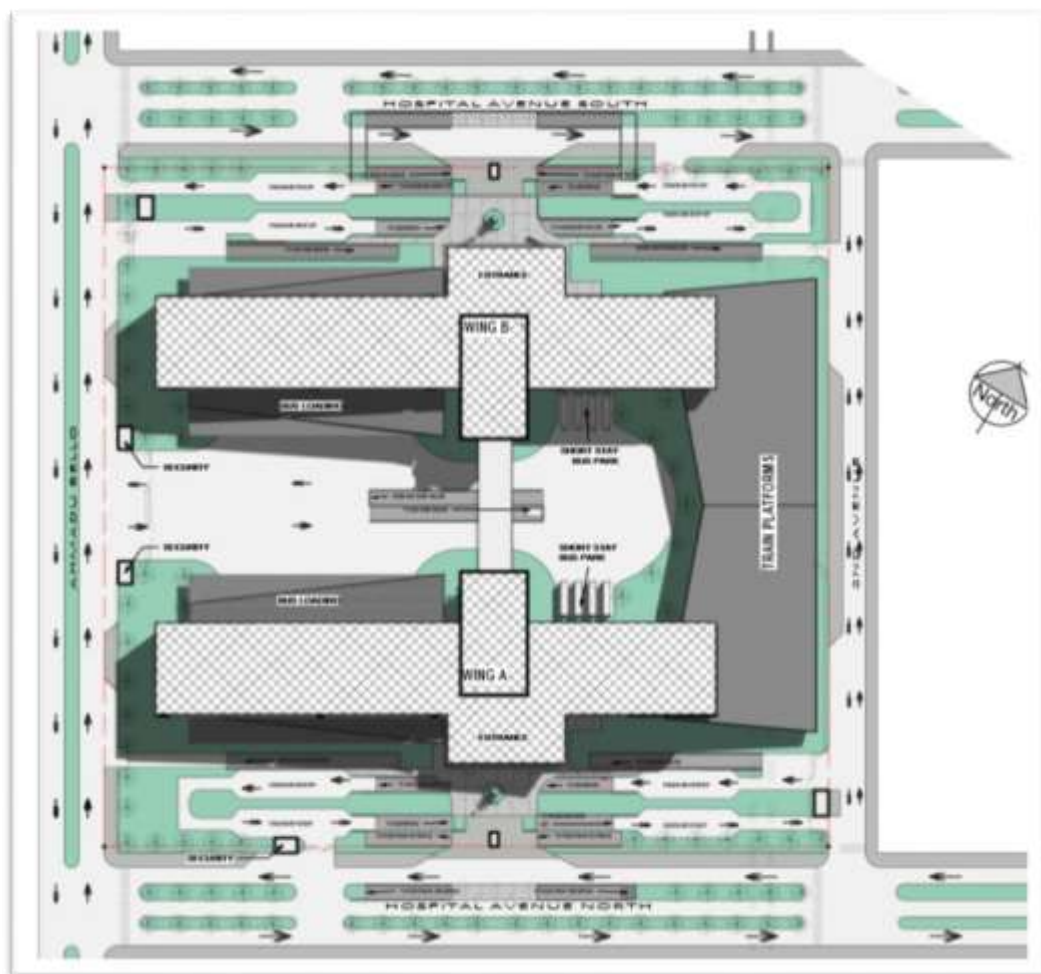


Figure 4.50: Proposed design site plan  
Source: Researcher's design proposal, (2020)

The plan was positioned on the site as illustrated on figure 4.50 above. Parts of the site were highlighted at the ground level of the design and blow-up of some sections to show more details view of the plans.



Figure 4.51: Proposed basement floor plan  
Source: Researcher's design proposal, (2020)

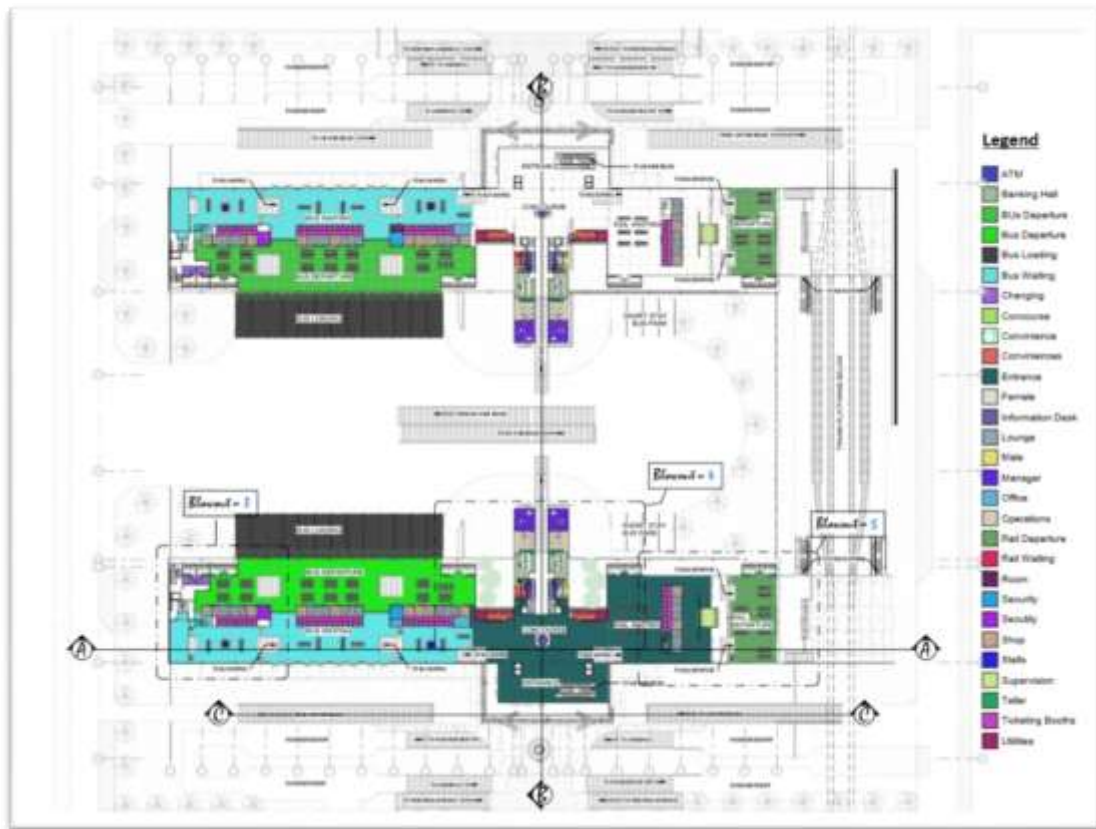


Figure 4.52: Proposed ground floor plan  
 Source: Researcher's design proposal, (2020)

The blow-out plans of the terminal building shown on figure 4.53 below has its emphasis on free flow movement, which is also flexible. The main entrance was connected from the terminal entrance. Immediately you enter into the main entrance, main waiting area, access stairs and lift were easily visible and accessible, with standard recreational facilities in and around the terminal.

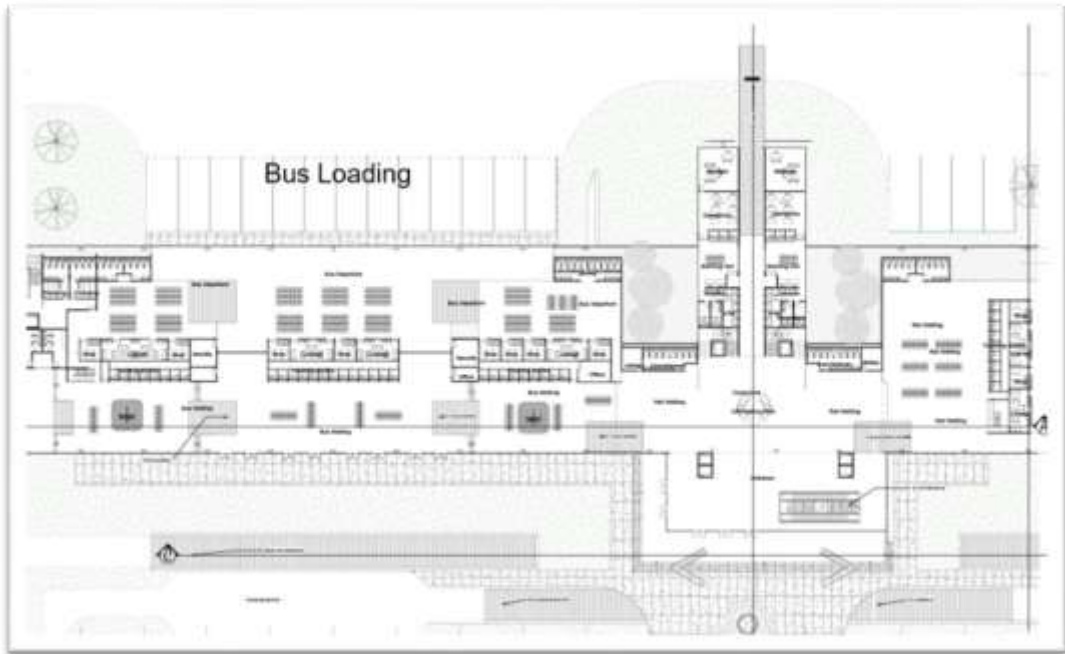


Figure 4.53: Proposed ground floor plan blowout  
 Source: Researcher's design proposal, (2020)

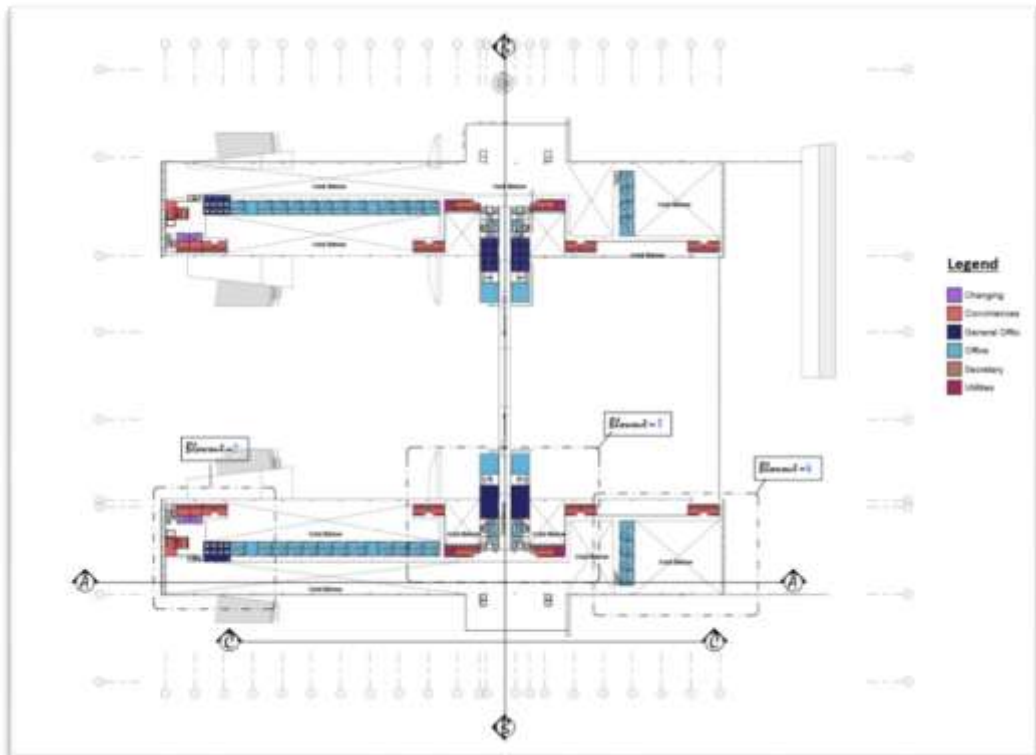


Figure 4.54: Proposed mezzanine floor plan  
 Source: Researcher's design proposal, (2020)

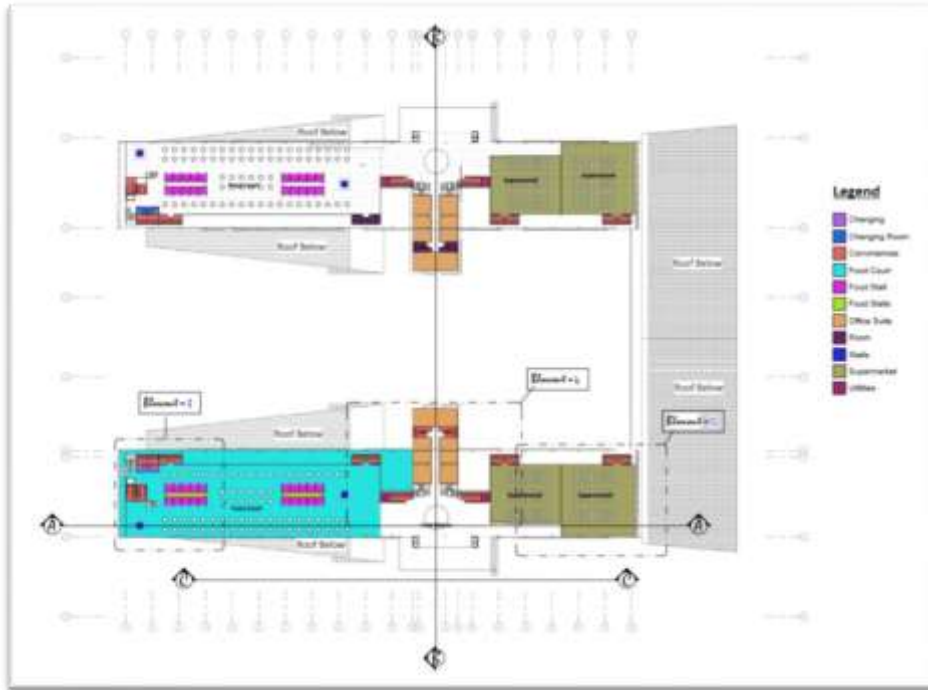


Figure 4.55: Proposed first floor plan  
 Source: Researcher's design proposal, (2020)

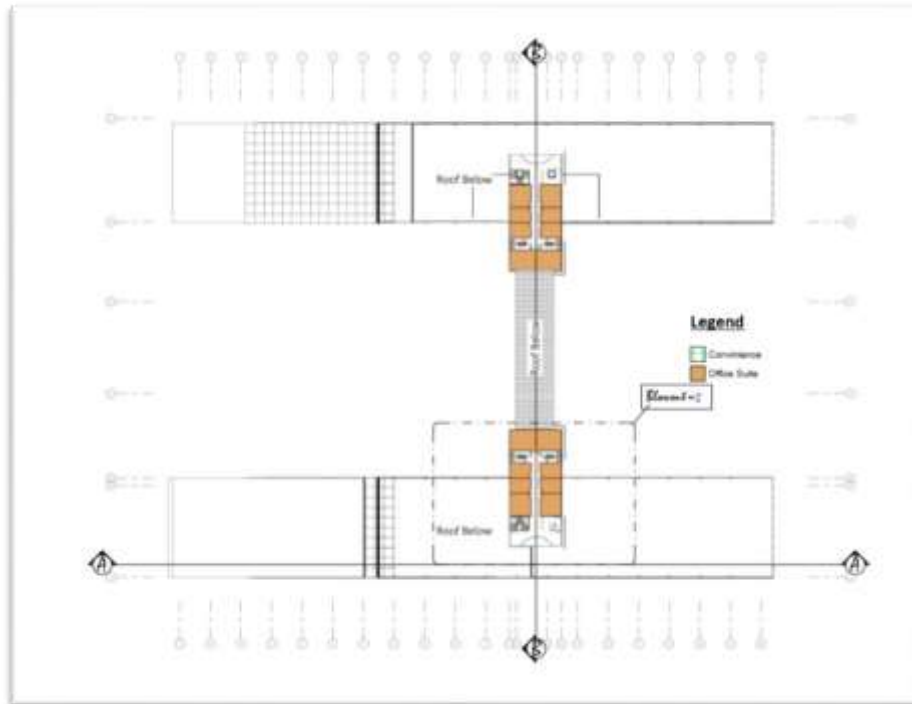


Figure 4.56: Proposed second floor plan  
 Source: Researcher's design proposal, (2020)

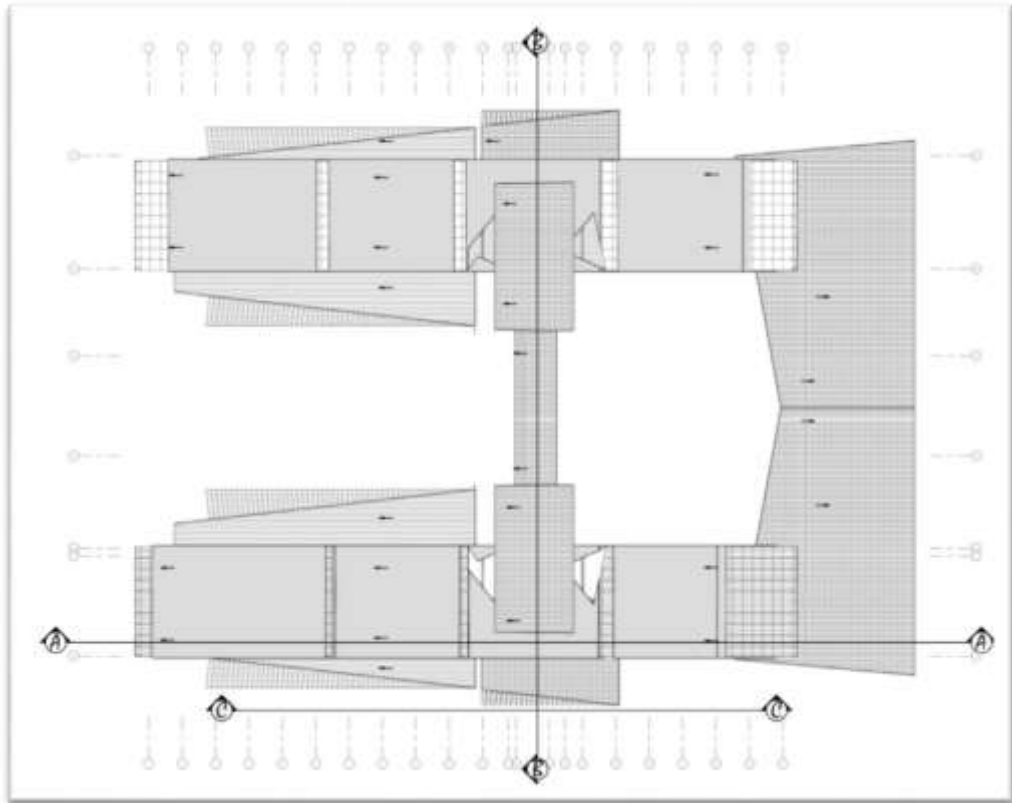


Figure 4.57: Proposed roof plan  
Source: Researcher's design proposal, (2020)



Figure 4.58: Proposed 3d view.  
Source: Researcher's design proposal, (2020)



#### 4.6.9 Construction

The design employed the use of modern construction materials comprises of steel, coated glass panel, and undulating roof design.

The following construction method and materials are employed for the proposed project.

##### 4.6.9.1 Structural system

For the purpose of this project, the design employs a steel portal frame structural system comprising column and horizontal or pitch rafters, connected by moment resisting connections. A very common structural system that provide a clear span un-obstructive by brazing. A Roof pitch of  $6^\circ$  would be adopted with frame spacing of 7.5m, and Haunches in the rafters at the eaves and apex.

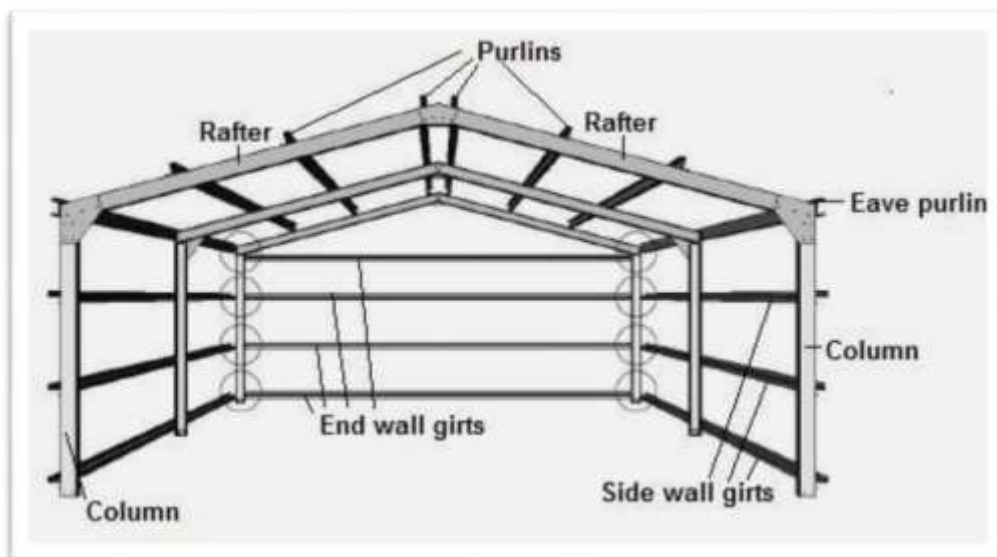


Figure 4.59: Typical portal frame structure.  
Source: Steelconstruction.info, (2020)

##### 4.6.9.2 Floors

For the purpose of this proposal, reinforced concrete cast in-situ floor slab 150mm thick, at 6:4:1 aggregate, water and cement mixing ratio, with reinforcement size subject to

engineers' specification, finished with stone and ceramic base floor finishes such as marble and granite.

#### **4.5.9.3 Walls**

Composite materials comprise of Reinforced concrete and masonry, Composite wood (Plywood), Reinforced plastic (Fibre reinforced polymer and fiberglass), Ceramic matrix composite (Composite ceramic and metal matrices), Metal matrix composites and Plastic-coated paper were employed for both load and non-load bearing partition. These materials were made from two or more constituent materials with significantly different physical and chemical properties that when combined produced a material with characteristics different from the individual components

The choice of these materials was due to their thermal and chemical resistance as well as electrical insulation properties. Unlike the conventional materials, while composite materials are lighter, they can also be stronger than other materials. For instance, reinforced carbon fibre can be up to five times stronger than 1020 grade steel and only one-fifth of the weight, making it perfect for structural purposes.

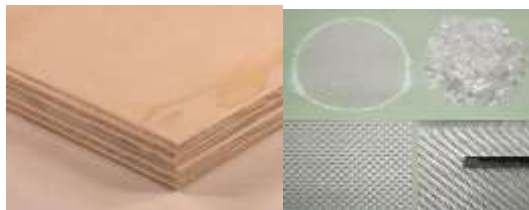


Figure 4.60: Typical composite walling materials.  
Source: Compositebuild.com, (2020)

#### **4.5.9.4 Roof**

For the purpose of this proposal, a composite roofing system with long span steel roof framing which provides the terminal with open spaces was employed. The roof was

designed to accommodate both welded and bolted connections, with an exposed structural steel roof-framing member that creates a dynamic rhythm of light and shadow inspired by tree-lined streets. Provision of Architectural exposed structural steel (AESS) would enhance the unique Architectural expression of the structure and was used prominently throughout the waiting spaces to achieve the desired visual quality.

In the concourse, the tapered steel plate girders span over 18m and include complex double curvature geometry to sculpt a roof structure that corresponds to the surrounding environment.

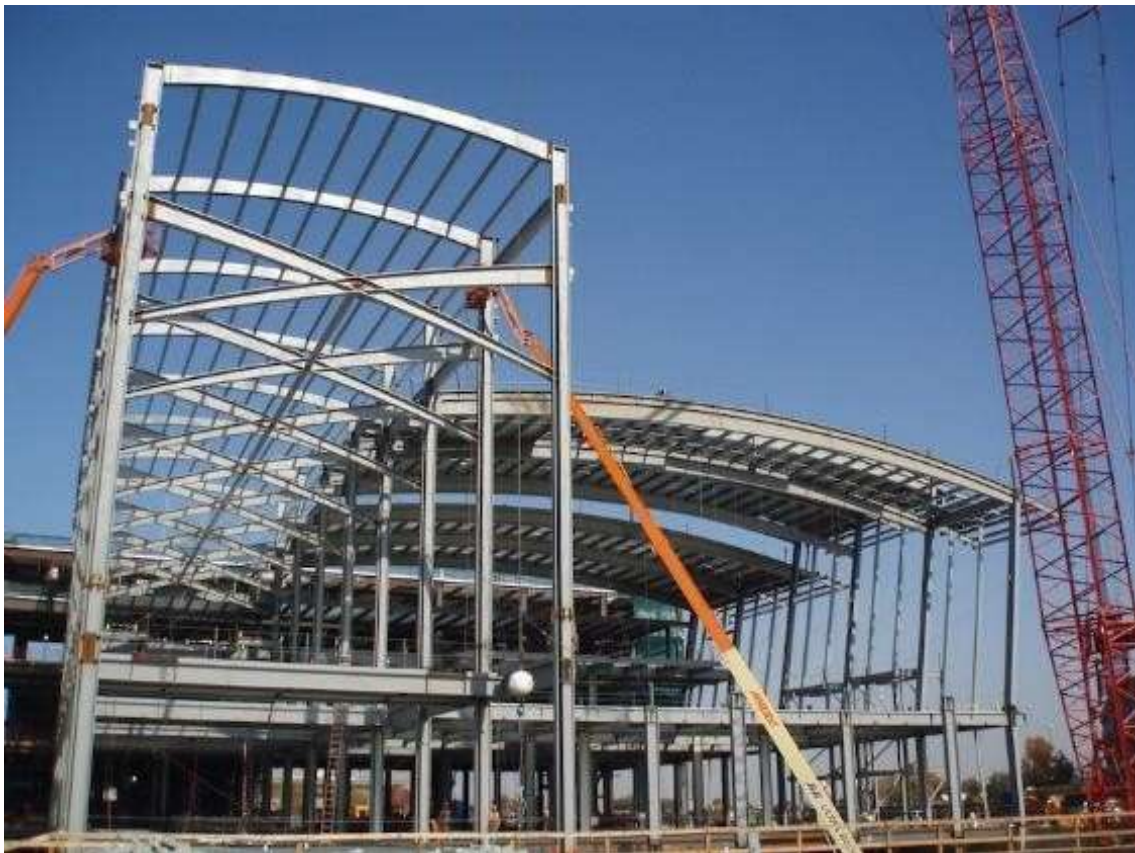


Figure 4.61: Example of a typical composite roofing system

Source: Compositebuild.com, (2020)

## CHAPTER FIVE

### 5.0 CONCLUSION AND RECOMMENDATION

#### 5.1 Conclusion

Taking into consideration, the present conditions of Abuja public land transport terminal buildings, it is foremost that professionals in the building industry and all other stakeholders should begin to take into consideration the basic principles of Transit Oriented Development strategies in the planning and design of any public transport terminal buildings. This will help in providing adequate solution to the problems facing the current public land transport terminal buildings, hence create a friendly environment for all. The population of the study area was extremely large, about 1.4 million commuters were discovered from a study of 'Bus Mass Transit Services in Abuja' carried-out by (Oniyangi, 2012), and was challenged with a myriad of problems such as dilapidated facilities in and within the terminal building as well as inadequate services of the public land public land transport operators, resulting in individual motorization. Hence, the adoption of Transit Oriented Development Strategies (TOD's) principles such as Location consideration, Enhancement of vehicular connections, Pedestrian design consideration, provision of communal facilities, parking consideration and space articulation would enhance the adequacy and comfortability of Abuja public land transport terminal buildings.

Based on the study carried-out by the researcher to evaluate users' perceptions on the current public land transport terminal buildings, it was discovered that close to 75% of the total respondents were not satisfied with the present public land transport terminal buildings in Abuja. More than 80% of the respondents strongly agreed with the need for more public land transport terminal building.

Hence, the proposed Multi-modal public land transport terminal design would incorporate the application of Transit Oriented Development Strategies (TOD's) in providing solutions to the aforementioned problems in the Abuja public land transport terminal building, and to produce an iconic structure that would serve as a tourist centre of the city, and attract more people to make public transport system as there mode of choice.

## 5.2 Recommendation

In line with the findings of this study, the following recommendations were made to the Ministry of Transportation for Federal Government of Nigeria, in order to improve the patronage and efficiency of the public land transport system in Abuja, Federal Capital Territory.

- i. The design of any transport facility should incorporate the application of Transit Oriented Development Strategies to achieve a better living and comfortable environment.
- ii. Comfort and security on board is a major concern of Abuja commuters; thus, basic level of comfort and check on pick pocketing and on-board theft must be established and monitored by the ministry of transportation to ensure that the Abuja public land transport terminal buildings abide by them.
- iii. The ministry of transportation should collaborate and cooperate with other stakeholders to increase the frequency of public transport terminal buildings services in the city to reduce the passengers' waiting time as well as walking distance to terminals.

- iv. Terminal buildings should develop on the lines of green infrastructure with elegant design and sufficient benches and shelters should be provided at each terminal to ensure a comfortable resting place for commuters.
- v. The result of this study reveals that, most of the terminal buildings in Abuja were lacking in cleanliness, therefore operators should pay serious attention to the maintenance of the facilities and do the needful to improve the same.
- vi. The result of this study also reveals that public land transport terminal buildings in Abuja are lacking rest rooms for users' convenience, the ministry of transportation in collaboration with other stakeholders should make provision for adequate conveniences at the terminal buildings for users' satisfaction.

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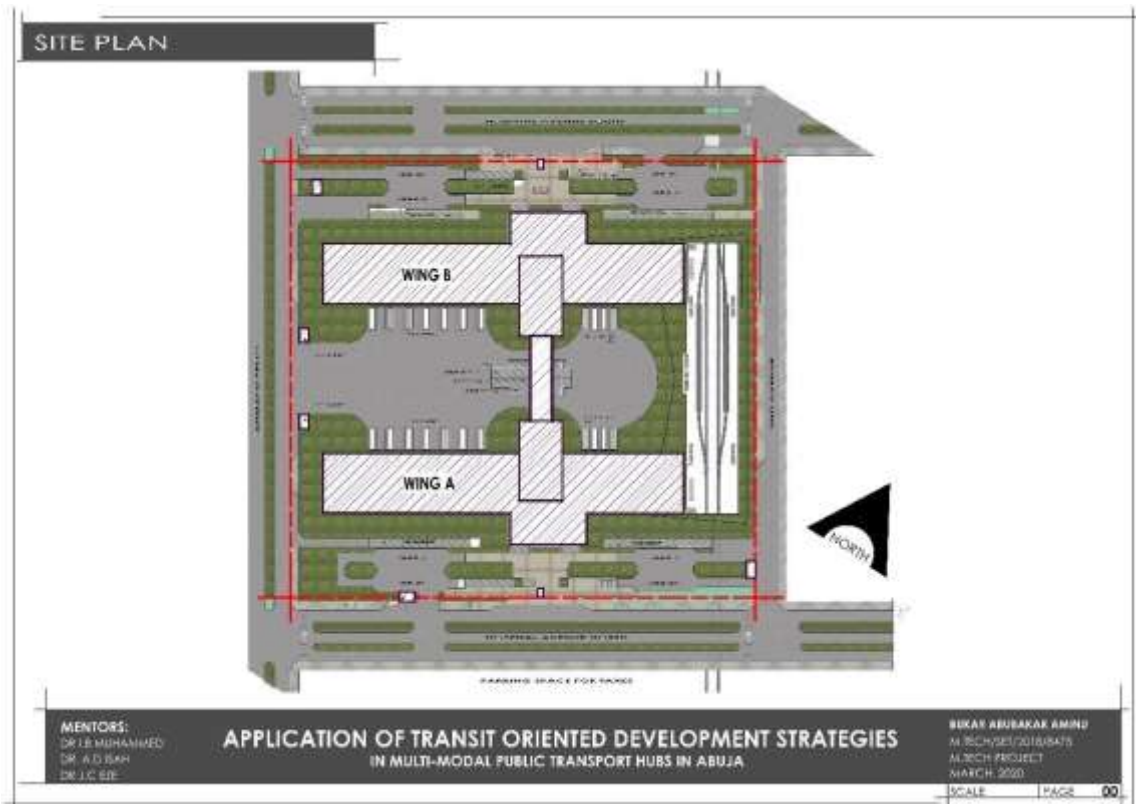
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## APPENDICES

### Appendix A: Site plan

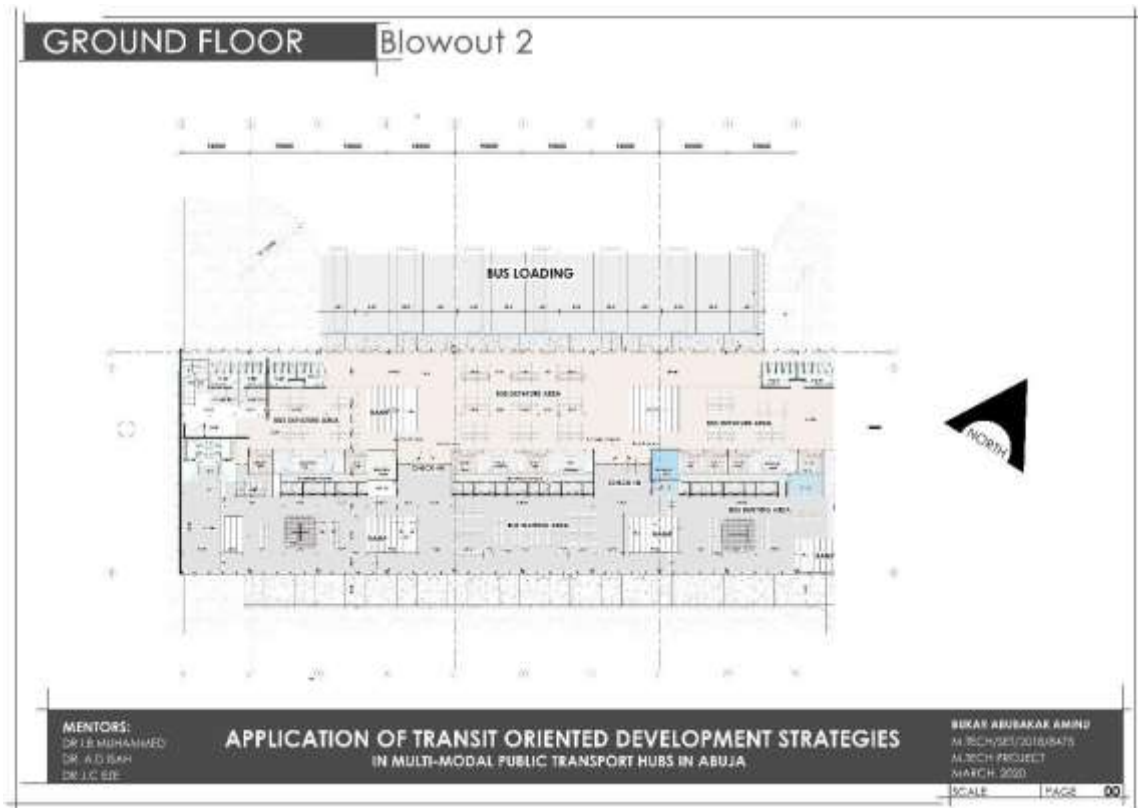


### Appendix B: Ground floor plan

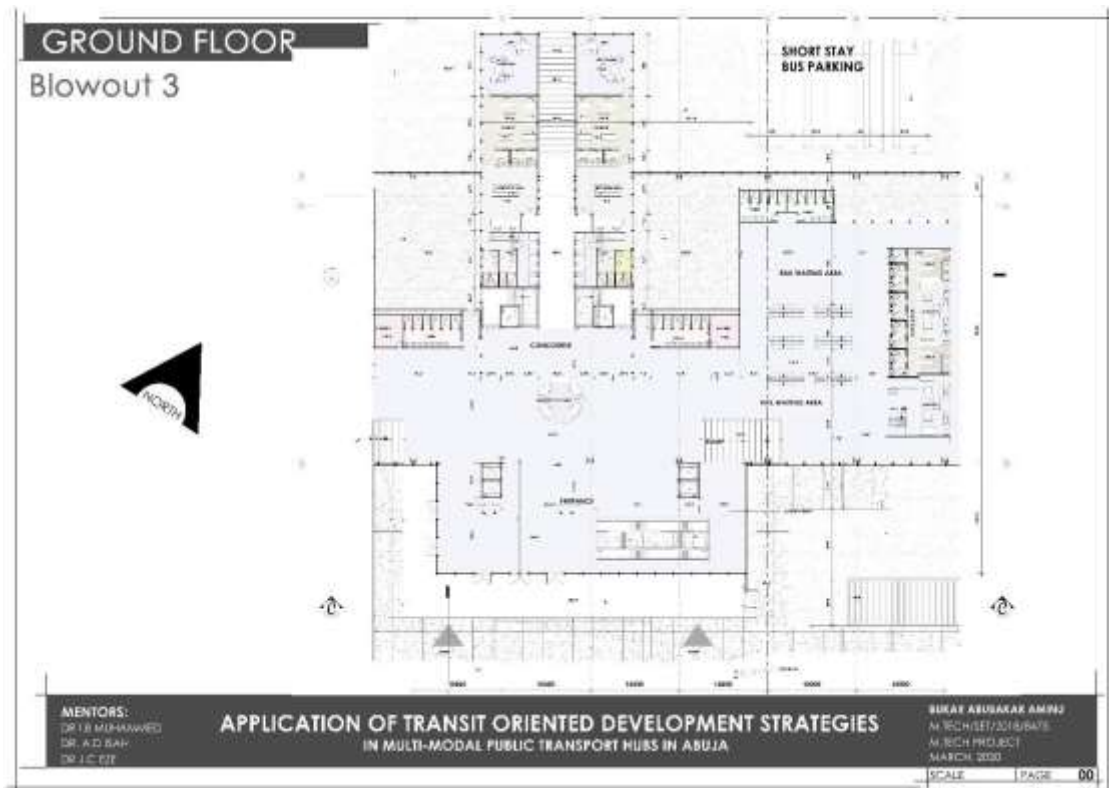




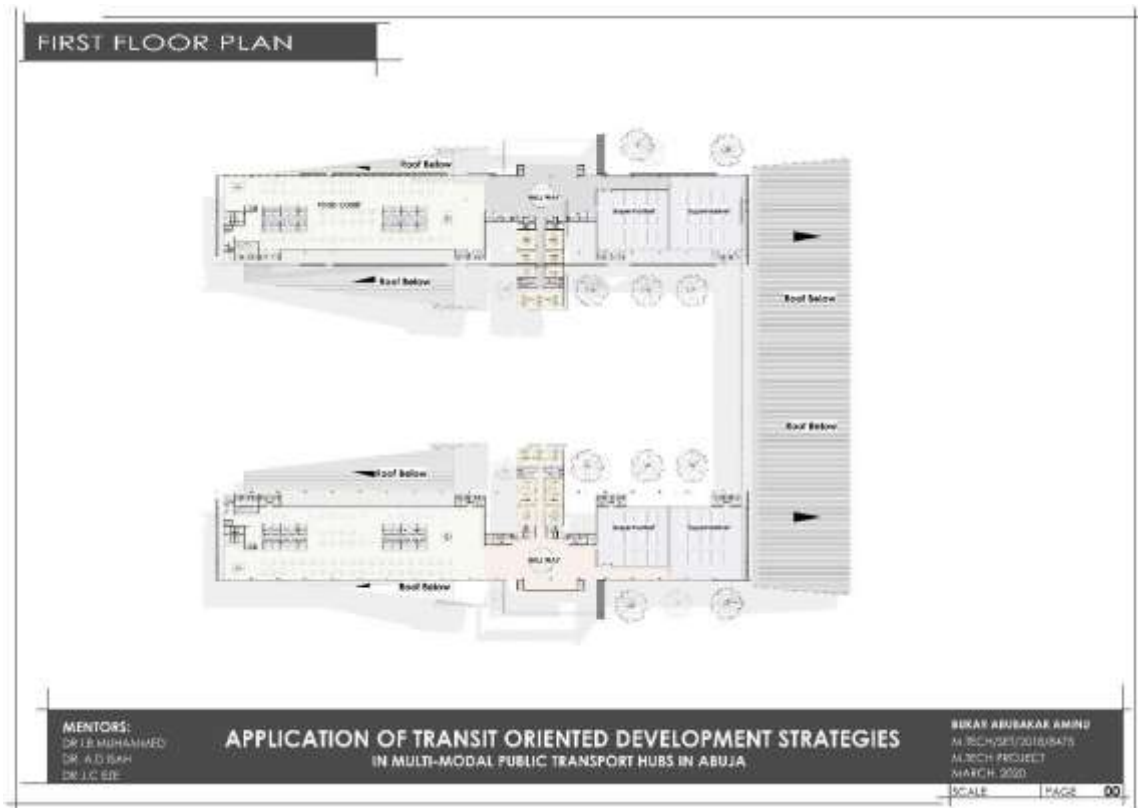
**Appendix C: Ground floor plan (blowout)**



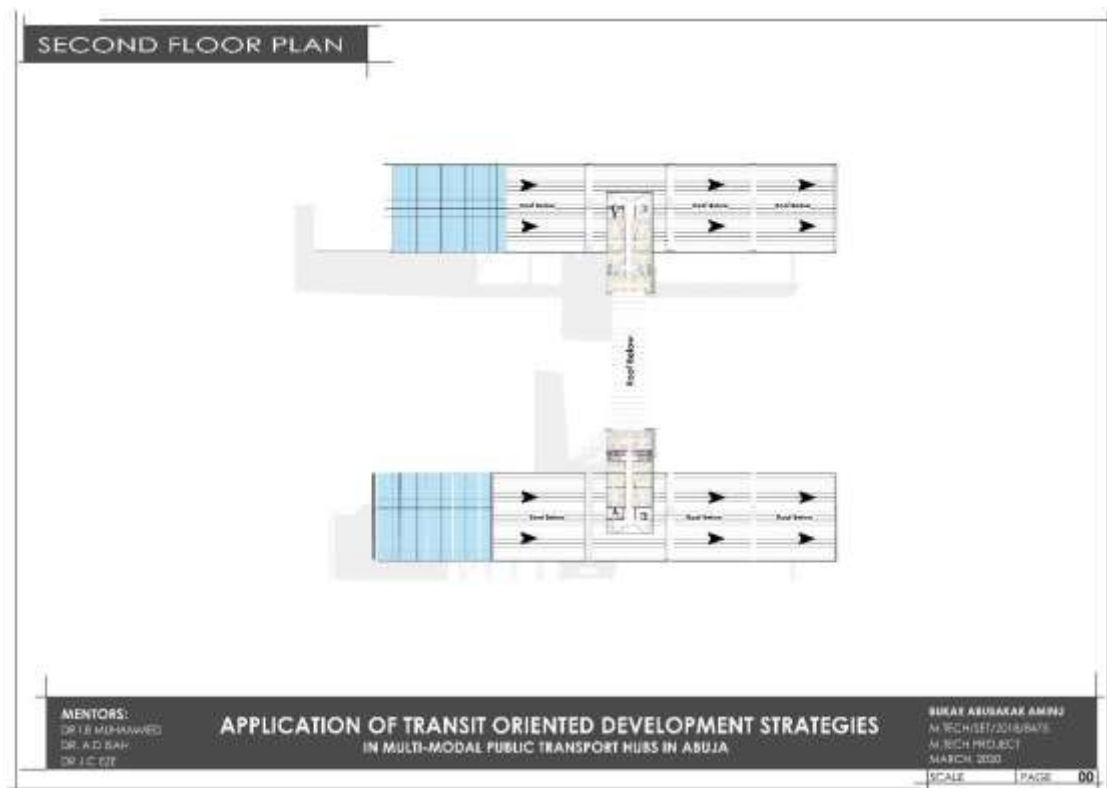
**Appendix D: Ground floor plan (blowout 2)**



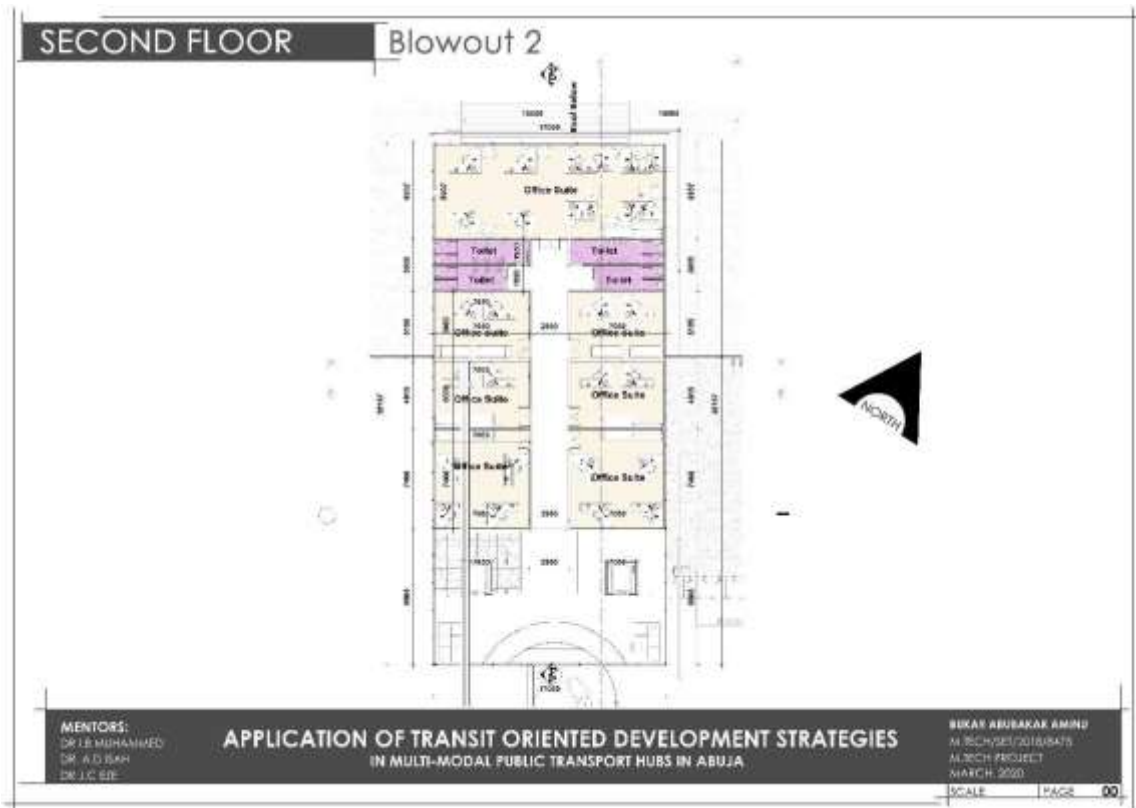
## Appendix E: First floor plan



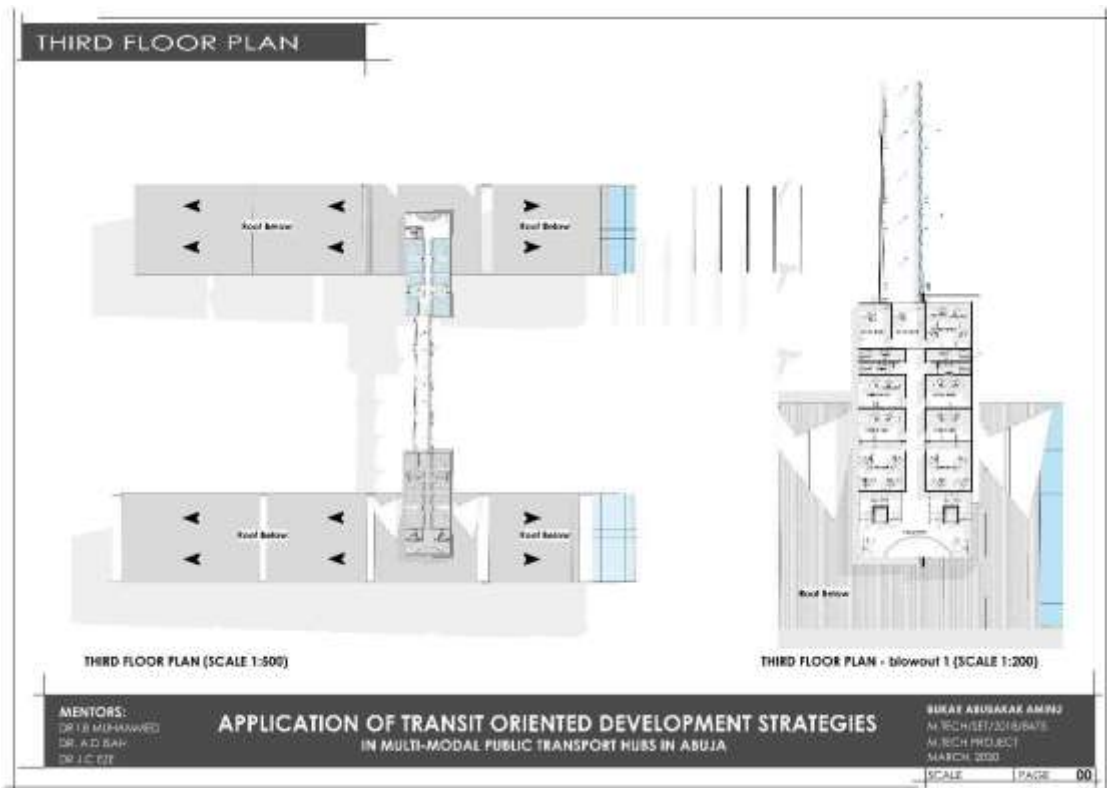
## Appendix F: Second floor plan



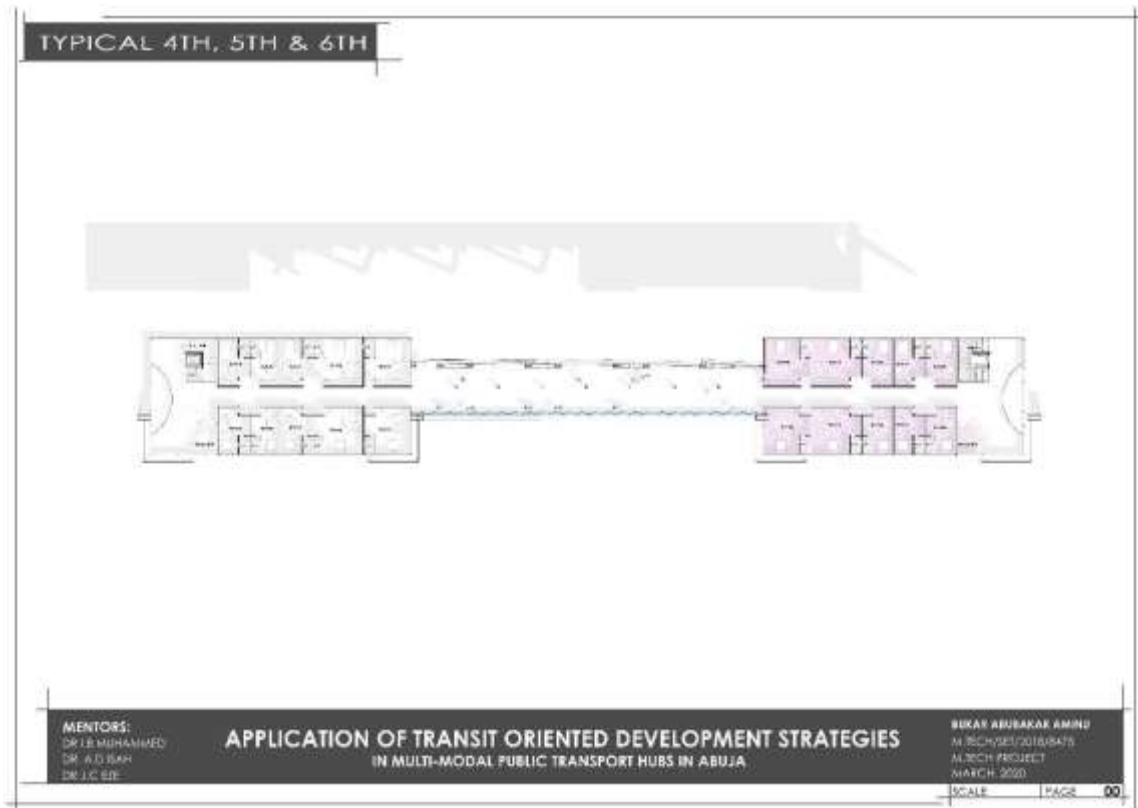
**Appendix G: Second floor plan (blowout)**



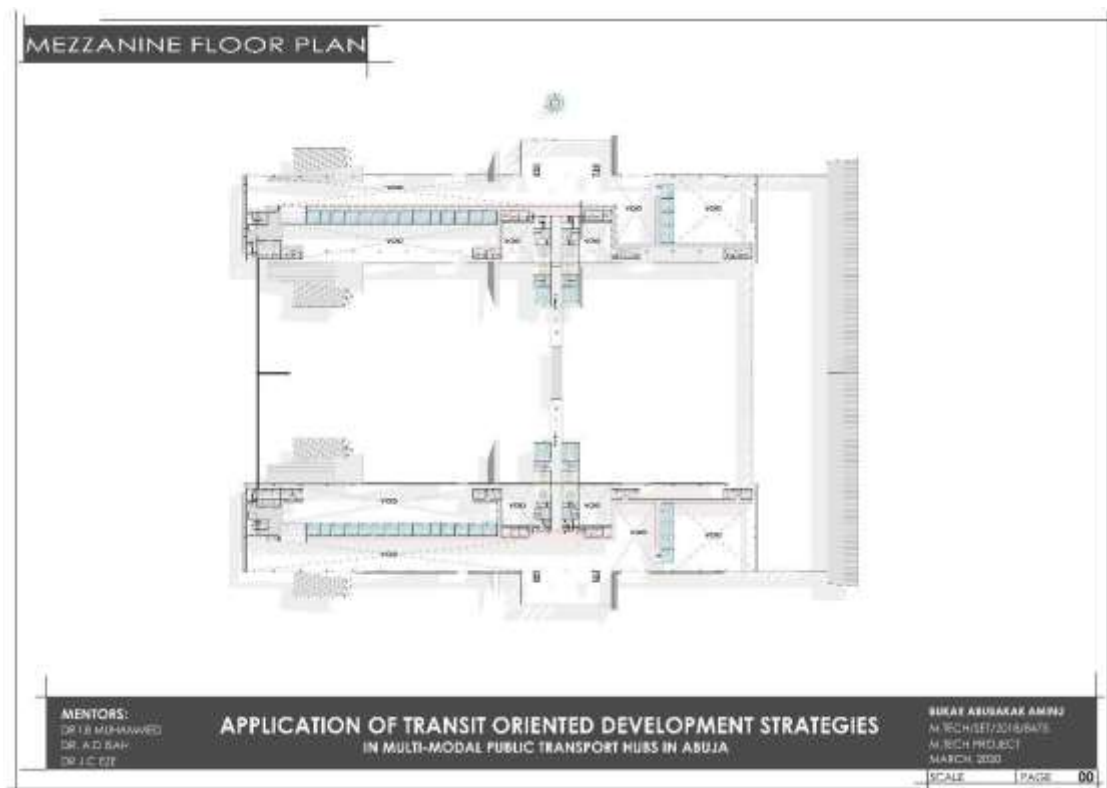
**Appendix H: Third floor plan**



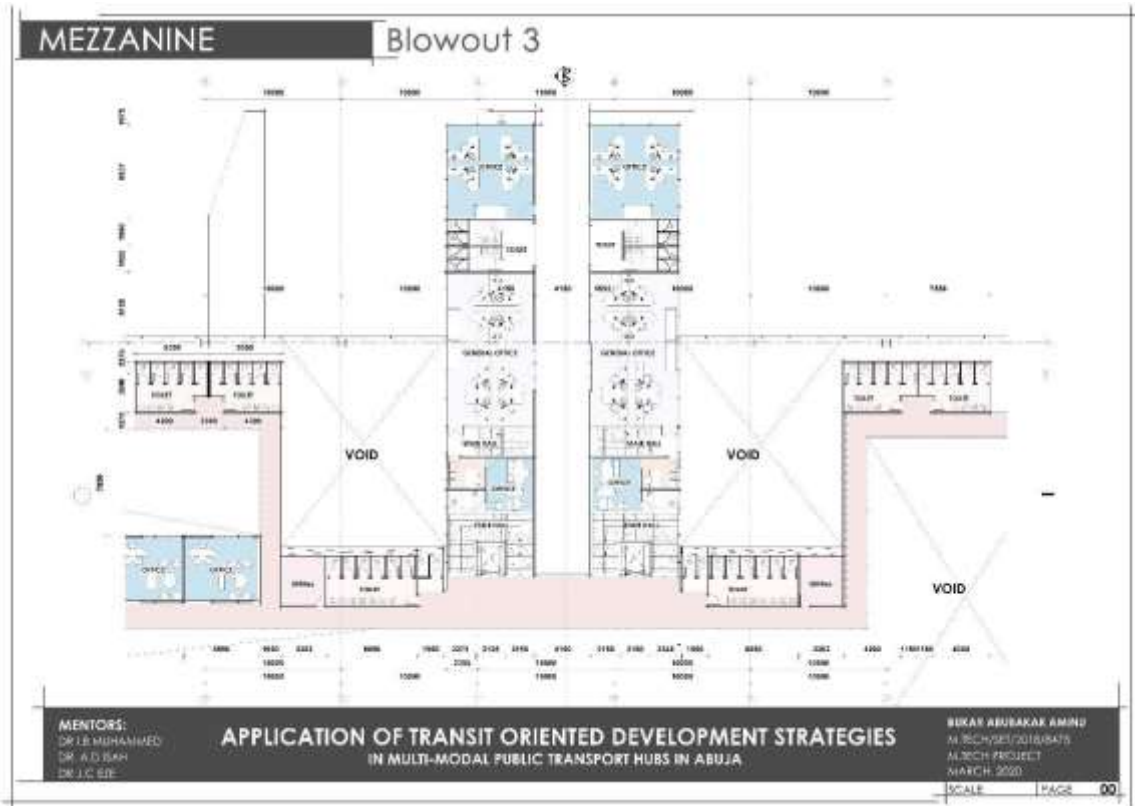
## Appendix I: Typical 4th, 5th, and 6th floor plans



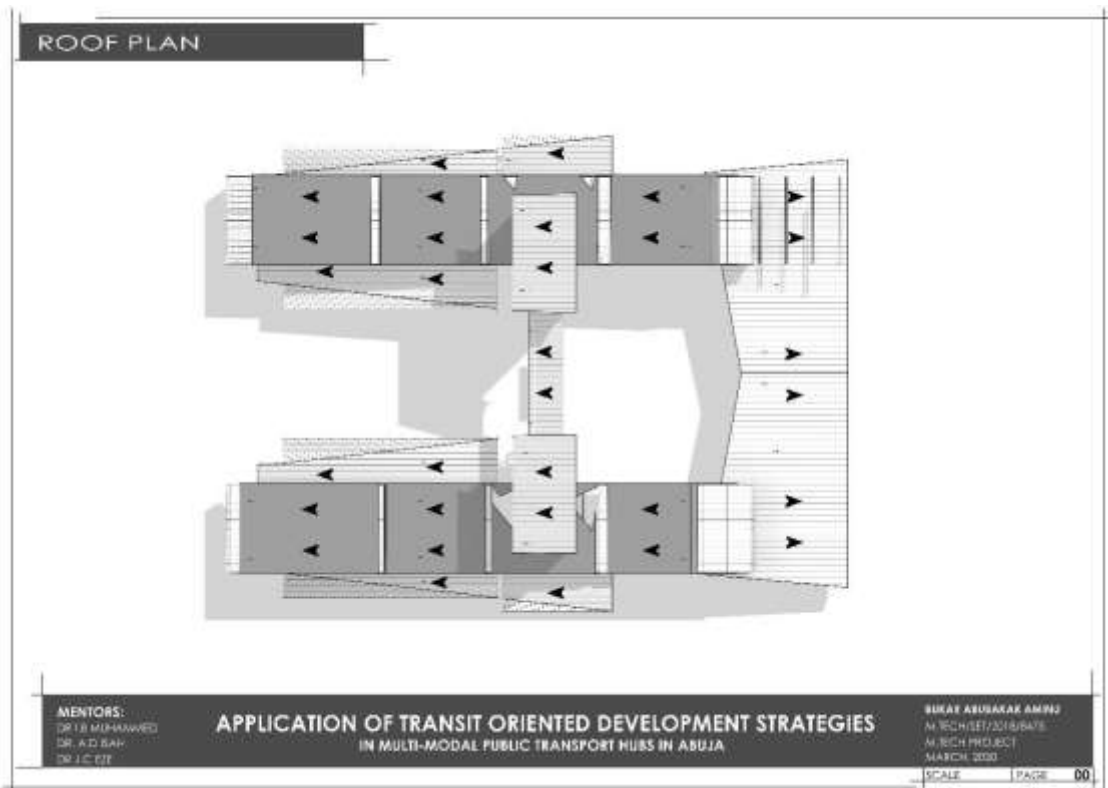
## Appendix J: Mezzanine floor plan



**Appendix K: Mezzanine floor plan (blowout)**



**Appendix L: Roof plan**





## Appendix O: Elevations (sheet 2)



## Appendix P: Working drawing

