

**ASSESSMENT OF PARKING SPACE MANAGEMENT: THE CASE OF
FEDERAL CAPITAL CITY, ABUJA**

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**A THESIS SUBMITTED TO THE POST GRADUATE SCHOOL,
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ABSTRACT

The research assesses the Parking space management in Federal capital city, Abuja with a view to establishing challenges and providing appropriate recommendations. Data for the study were obtained through a semi-structured questionnaire, observation, monitoring, recording and document review. A total of 387 copies of a questionnaire were administered and purposive sampling techniques was adopted. The data was analyzed using descriptive technique with the use of table, chat and Map. The findings from the study showed that the parking problems within the study area were associated 65% to the On-street parking, 31% of the parking problem are Off-street parking and 4% of the parking problems are temporary parking. The On-Street parking predominantly occurs around the Converted Commercial Developments. Among the various commercial activities in the area, Plazas which constitutes 25% on-street parking and 21% off-street parking, Offices also has 14% on-street parking and 16% off-street parking, Hotel in the study area constitutes 7% of on-street parking and 9% of off-street parking, Petrol station also constitutes 5% on-street parking and 6% off-street parking, Banks constitutes 10% on-street parking and 8% off-street parking, Eateries in the study area constitutes 7% of on-street parking and 11% of off-street parking, Recreation centre constitutes 18% on-street parking and 20% off-street parking, and lastly, the Market constitutes 14% on-street parking and 10% off-street parking respectively. The impact of parking space were revealed, such as, Traffic congestion has 47% impact on parking and it is the highest as compared to others, accident has 31% of impact on parking, Environmental pollution has 15% impact on parking and 7% impact on parking is constituted by Obstruction to fire operation in the respective area of study. The factors responsible for parking problems were identified to include, inadequate parking facilities, the concentration of activities and facilities in FCC, non-implementation of the FCC transportation policy, and the violation of building codes and zoning regulations. The study concluded by suggesting the management strategies for the efficient management of the transportation system in FCC, Abuja by enforcement of Traffic Rules and Regulations by Disciplined Law Enforcement Agent, Introduction of public parking garages, Enlightenment of parking space users, Introduction of Information Technology, and strengthening of the Department of Development Control.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Study

The viability of any urban activity system is dependent upon interactions of transport systems and infrastructure (Madu, 2017). In this regard, the transport system provides two fundamental functions: Movement of persons and goods, and the provision of access to land-based activities. Transport services are therefore not demanded and utilized for their sake but are derived from the desire to use other services, thus making transport complementary to or a derived demand arising from the use of other services in an urban area (Ogar, 2015).

With the rapid growth of vehicular traffic in recent years, the planning of the city has been faced with a number of new problems. Old streets have to be widened in order to accommodate the increasing number of cars. New streets and highways have to be constructed to enable the cars develop full speed(Walter, 2015). Meanwhile, all these extensive activities in the widening and highway construction have proved not to be enough to relieve traffic congestion or to improve traffic flow along the main thoroughfares within the city at large.

Walter (2015), in his study also observes that the problem of keeping the cars on the move is definitely related to the question of where to put them when they come to rest. Parking is a critical component of transportation policy and management for any local, but especially for the large central cities. The policies and management practices affecting parking lead to outcomes that, in turn, can affect land use, air quality, traffic congestion, travel behavior, safety and economic development, not to mention revenue lines. Yet, effectively managing parking is an ongoing battle for the large central cities as they face competing, and sometimes contradictory, objectives along with an ever-increasing demand for space (Allison, 2002).

The availability and cost of a parking space is an important determinant of whether or not people choose to drive to a particular destination, and also whether they choose to own a car at all. However, the ownership of parks has evolved over the years; parks are now owned by both government and private individuals. Rye and Koglin (2014), identified three rising parking management problems which are; onstreet parking in a place where parking demand exceeds supply, pre-construction and ongoing operating expenses of providing off street parking facilities and issues of enforcing on street parking in a place where parking management were not enacted before.

On street parking has pose a lot of negative impact to the pedestrian, streets merchants and drivers. In fact studies has shown that on street parking has led to reduction in stream speed or road capacity, compromising of road safety, cause sight obstruction of incoming vehicles and difficulties for drivers to notice pedestrian crossing (Rudjanakanoknad, 2010; Chen et al 2017; Box 2004 and Cao et al 2017).Gattis (2000), argues that in maneuvering vehicle in a narrow bordered vehicle parked road, drivers need to be extremely careful to control car postures and thereby avoiding vehicle pedestrian conflicts.

United kingdomHouse of Commons Transport Committee(2013), recommends that parking enforcement requires a balancing of competing demands. This includes; improving safety on the roads, local environs improvement, quality and accessable public transport, taking into consideration the disables and older ones needs, and managing traffics.

Several penalties have been described to prevent vehicles users from violating parking rules, this punishment could be in monetary or impounding of vehicle. In fact in developed countries parking charges is a source of revenue to the government. Studies have shown that fines has generated a

lot of income for some local authorities this result to public resentment (RAC, 2005; University of Birmingham, 2005).

Over the years, income has increased leading to increase in vehicle ownerships and consequently reduction in urban space (Mingardoet *al.*, 2015), the consequence of parking issues result to urban transportation planning.

Belmore 2019 and Economist 2017 argues that there is a paradigm shift in parking planning, in the past paradigm assumed that “transportation” means driving, parking lots should almost never fill, parking costs should be borne indirectly by governments and businesses, and every destination should satisfy its own parking needs. However the goal was to maximize parking supply and minimize parking price. However, the new paradigm aimed to provide optimal parking supply and prices. Also, new technology has also enabled underground parking system and in the future autonomous vehicles may affect parking demand (Deluca, 2018).

Federal Capital City (FCC) is considered as the most delicate and most problematic in terms of the use and management of parking. This is as a result of myriads of commercial activities in the city which attract high population and motorized traffic more than any other cities in Nigeria. This gives rise to complex traffic problems in the FCC. These problems can only be solved through appropriate and well-articulated planning policies and actions on a sustained basis. It is therefore necessary that parking facilities are covered in urban transportation management exercises through proper evaluation. The proper location of the facilities within the commercial areas based on standards ensures effectiveness while non-conformity to standards affects their efficient utilization. Good management of parking facilities in planned commercial Districts of the Federal Capital City, (FCC) will promote efficiency and sustainability in the smooth running of the city (Madu, 2017).

1.2 Statement of Research Problem

Abuja has very elaborate proposals meant to ensure smooth traffic movement and parking. Osoba, (2012), stated that vehicular traffic movement and availability of parking space (garage bus lay byes) becomes more important when critically viewed from the level of huge investment that has been pumped to the road sector by successive Governments. This is borne out of its suitability for fast movement of vehicles as a result of free flow of traffic and the increase in road capacity due to provision of parking space and laybys. The road transport operation is a circulatory system that must be a continuous process and any infringement at any point along the line will affect the whole system and hinders the effectiveness.

The impact or problem of parking space and traffic management in terms of vehicular free flow remain stagnant or rather slow movement particular in Federal Capital City, (FCC) Abuja.

The occurrence of this parking space problem and the factors responsible require investigation to determine possible solutions. The Federal Capital City is developed at the take-off of the Federal Capital Territory, Abuja. FCC comprises of six districts. It is characterized by large number of commercial activities primarily along the major streets. The commercial activities have been on the increase over time mainly through land use conversion across the Districts. Studies have shown that developed areas are characterized by off-street and On street parking. The On-street parking is very common leading to congestion, environmental pollution and traffic accidents, etc (Humphreys et al, 1978; Chen et al 2017). Also, Shoup (2006) quantified this effect in congested downtowns and revealed that traffic cruising for parking can oscillate between 8% and 74% of the total traffic and that cruising time can vary between 3.5 and 14 minutes.

Madu (2017), Indicated that the FCT (Abuja) has face a lot of parking issues particularly FCC, districts are considered as the most delicate and most problematic in terms of the use and

management of parking. This is as a result of myriads of commercial activities in the district which attract high population and motorized traffic more than any other district within the Federal Capital Territory (FCT). The problems faced in regards to parking space in Federal capital city can only be solved through appropriate and well-articulated planning policies and actions on a sustained basis. It is therefore necessary that parking facilities are covered in urban transportation management exercises through proper evaluation. The proper location of the facilities within the commercial areas based on standards ensures effectiveness while non-conformity to standards affects their efficient utilization

In particular, Ogar (2015) has studied urban transportation problems associated with the distortion of the Abuja Master Plan. The contribution of this study is in complementing earlier studies by focusing on characteristics of parking in commercial zones of Abuja as bases to better understand the challenges. This study will therefore seek to explore these and related issues using FCC as a case study. It will further examine the characteristics and problems of parking space and the forces that account for observed shortcomings. However, because of the criticality of assessing parking space problem, the study seeks to answer the following questions below.

1.3 Aim and Objective

The aim of this research is to assess parking space management in Federal Capital City (FCC), Abuja.

The objectives of the study are to:

- i. Examine the characteristics of parking space in FCC, Abuja.
- ii. Identify the parking space infrastructures or facilities available in the study area

- iii. Identify the causes of parking space problem in the study area.
- iv. To identify the impact/problems of parking space associated with FCC, Abuja.

1.4 Research Question

- i. What are the characteristics of parking space in FCC, Abuja?
- ii. What are the parking space infrastructures or facilities available in the study area?
- iii. What are the causes of parking space problem in the study area?
- iv. What are the impact/problems of parking space associated with FCC, Abuja?

1.5 Justification of Study

Parking space management has put authorities responsible worldwide on their toes to provide policy to guide irregular parking by drivers and motorist. The study will examine the parking characteristics, facilities and identify the challenges facing the study area, so as to proffer solution to the parking space management in FCC, Abuja. The outcomes of this study shall provide the following:

- i. Help to guide the Authority responsible for the parking space, to determine the level of functionality and conditions of the park and the need for improvement of deficit services.
- ii. The users of the parking lots will be guided and be informed on how to park and beat the challenges common with parking space in FCC, Abuja.
- iii. The outcome of this study has a great impact and importance to the management of the parks in the FCC, Abuja. The effective and efficient parking space will help to encourage urban sustainability.

iv. The outcome of this study shall provide guidelines and information for researchers who may want to carry out study on parking space management.

1.6 Scope and limitation of the Research

This study covers FCC, Abuja, which constitute, Wuse District, Maitame District, Central District Area, Asokoro and Garki District. The study only focuses on the parking of commercial areas in the study area which includes, Wuse Market parking lot, Old Berger parking space, Mabushi parking space, Federal secretariat, Parade ground parking space, Area 1 parking space, Central Car wash, Cultural centre, High court, and Zone 4 parking area and the characteristics, facilities, also the challenges of Parking space in FCC, Abuja. Also the perception of vehicle users will be examined.

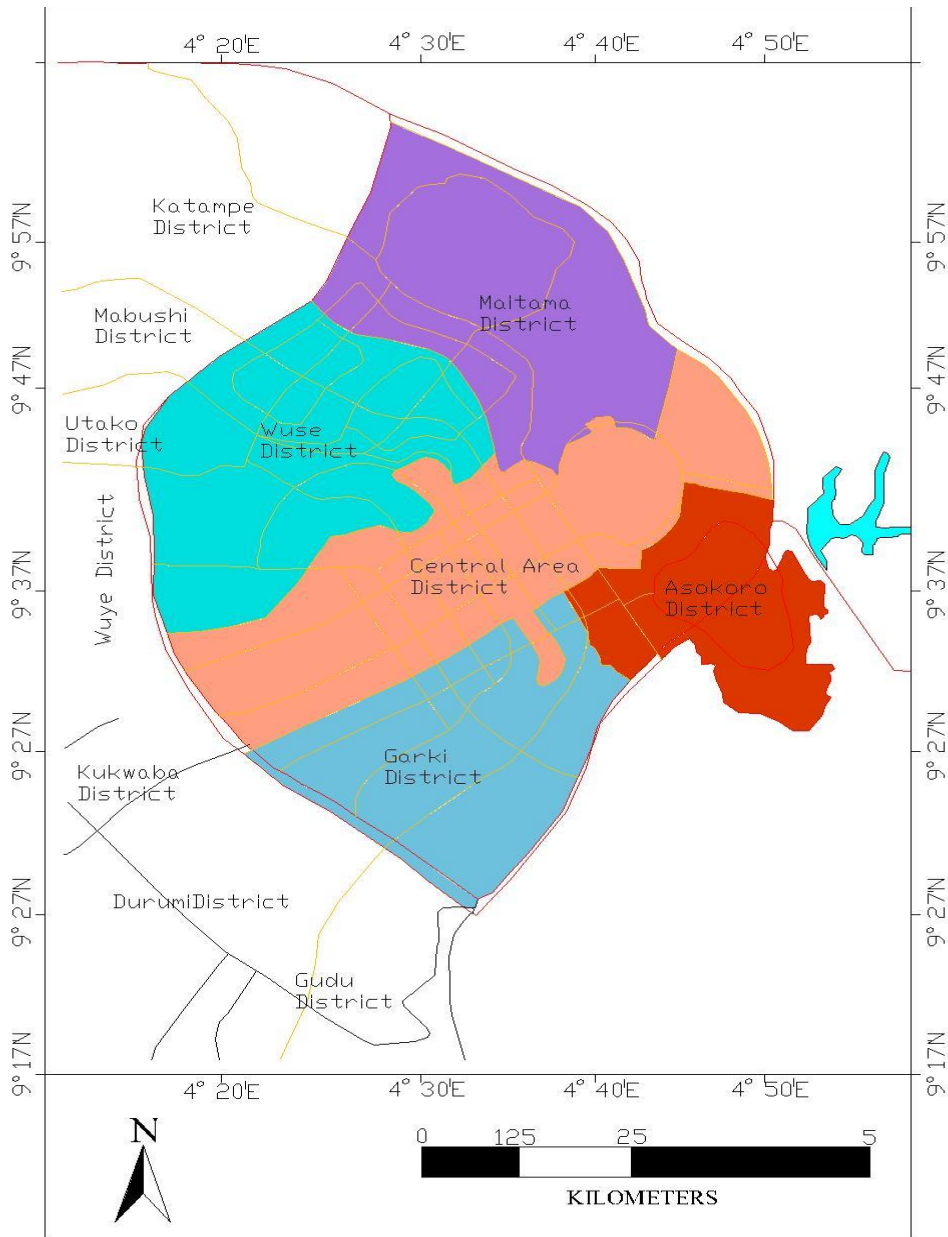


Figure 1.0: Map of FCC, Abuja.
 Source: AGIS, 2020.

1.7 Description the Study Area

The Territory is located just north of the confluence of the River Niger and Benue River. It is bordered by the States of Niger to the West and North, Kaduna to the North east, Nasarawa to the East and South, and Kogi to the Southwest. Lying between latitude 8.25 and 9.20 north of the equator and longitude 6.45 and 7.39 east of the Greenwich Meridian, Abuja is geographically located in the center of the country. The Federal Capital Territory has a landmass of approximately 8,000 sq.kms of which the actual city occupies 250 sq.kms (Madu, 2017). It is situated within the Savannah region with moderate climatic conditions, with a population of 776,298 in 2006 (NPC, 2006), and with annual growth rate of 10% the current population can be projected to be 3,478,585 in 2021 using the formula below (NPC, 2006 and Authors Projection, 2021).

$$P = P_0 * e^{rt}$$

Where

P = Total population after time,

P₀ = Starting population (776,298),

e = eular number annual = 2.71828

r = % rate of growth (10%), and

t = number of years (15).

Therefore, $P = 776,298 * 2.71828^{0.1*15}$

P = 3,478,585.

Abuja is a centre for political and administrative functions of the country. It is governed by municipal government and the city economy is supported by the presence of real estate, postal system, airports business, rail and high way business. However, population is attracted to this city

because the city being the centres of governance many people visit the city to get political appointment while others may be visiting Abuja for Work (Babangana, 2020).

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Conceptual Definition

Parking spaces are very important to cities like Abuja, Lagos, Port Harcourt, Kano etc. **A city must have enough parking spaces** to provide their residents and their visitors a place to park their car. Since cars are a main factor in transportation, a city must meet the needs of the drivers. If people can't find a place to park, or if they have to pay too much for parking, these people probably won't come back to your city to do some more shopping, dining or spending money in any other way. Also residents must have enough place to park their car nearby their house and workplace, absence of parking space do cause traffic congestion, pollution and accident, which are common with public parking in FCC, Abuja.

2.2.1 Parking

Parking is the act of stopping and disengaging a vehicle and leaving it unoccupied. Parking on one or both sides of a road is often permitted, though sometimes with restrictions. Some buildings have parking facilities for use of the buildings' users. Countries and local governments have rules for design and use of parking spaces (Babangana, 2020).

Parking in order words can be expressed as an act that takes place at the terminal/terminus, whereby the vehicle waits or stops at designated point, either to load or unload passengers/cargos to continue or end its journey. At times, the vehicle stops at the park for resting or end of journey, such parks can be either public or private.



Plate 2.1: Vehicle parked at Central Bussines District, within Mortgage House Building.

Source: Author 2021

The Public Parking Space is the one associated with the public usage, both private and general vehicles uses the park as for stopping and disengaging a vehicle and leaving it unoccupied.

The Private Parking Space are commonly found at individuals' home or private organization where the owners alone used for parking his/her/their vehicles.

2.2.2 Types of Parking (Parking model)

1 On-street parking; The word actually explains itself: On-street parking means parking your vehicle on the street, anywhere on or along the curb of streets, in contrast to parking it in a parking garage. In some streets you can always park your vehicle on the street, but sometimes there are

restrictions. Mostly these restrictions are presented on traffic signs. Sometimes you're only allowed to park on one side of the street, and sometimes you're not allowed to park your vehicle at all. There are also on-street parking situations where you need a parking permit to park so as to make sure people follow these rules and restrictions, cities hire enforcement officers (Osoba, 2012).



Plate 2.2: On-Street parking at Aguyi Ironsistreet, Maitama.

Source: Author, 2021.



Plate 2.3: On-street parking at SheuShagari way, Maitama

Source: Author 2021

2. Off-street parking; Off-street parking means parking your vehicle anywhere but on the streets. These are usually parking facilities like garages and lots. Off-street parking can be both indoors and outdoors. Off-street parking also includes private lots, garages and driveways (Osoba, 2012).



Plate 2.4: Parking on parade Ground Area 10, Garki Abuja.

Source: Author, 2021.



Plate 2.5: Off-Street parking at CAC Building Maitama, Abuja

Source: Author, 2021.

2.2.3 Parking Enforcement Officers or Administrator

People who work in parking space enforcement are commonly known as **parking attendants**, parking enforcement officers, etc. At places with parking meters they're also known as meter attendants, parking inspectors or traffic wardens. Here in Abuja, the Union or Agberos are the major parking enforcement agency that are popularly found at the public parking space in FCC, Abuja and they usually puts on the union reflective jackets as a symbol of identification and authority (Madu, 2017).

Madu, (2017). Further that, the enforcement officers make sure that people follow the parking rules and regulations. As a member of the traffic department, they are appointed to issue tickets for parking violations. Normally when a parking enforcement officer notices a parking violation, he prints a **ticket** and places a copy of the ticket on the windshield of the car for the owner to find. This way the car owner knows he can expect a fine. After writing the ticket, the parking enforcement officer files the ticket to the local authority and a few weeks later the driver receives the official fine by mail, but in Wuse here, the enforcement officer/agent will ensure immediate compliance as to the ticket payment or fine without go come.

2.2.4 Car Parking Techniques

1.Parallel parking; Parallel parking means parking your car in line with the other cars parallel to the curb, front bumper to rear bumper. Parallel parking usually occurs on the side of streets where there are no parking facilities, because it leaves enough room for the traffic to pass. Parallel parking is a challenge to some people, because it requires a certain technique different than driving right into a parking space(Parking Network, 2020).



Plate 2.6: shows parallel parking

Source: Britishparking.co.uk (2017).

2.2.4.2 Perpendicular parking

Perpendicular car parking means parking the cars side by side, perpendicular to a wall, curb or something else. You see this type of parking mostly in parking bays and garages, because you can park many cars on limited space(Parking Network, 2020).

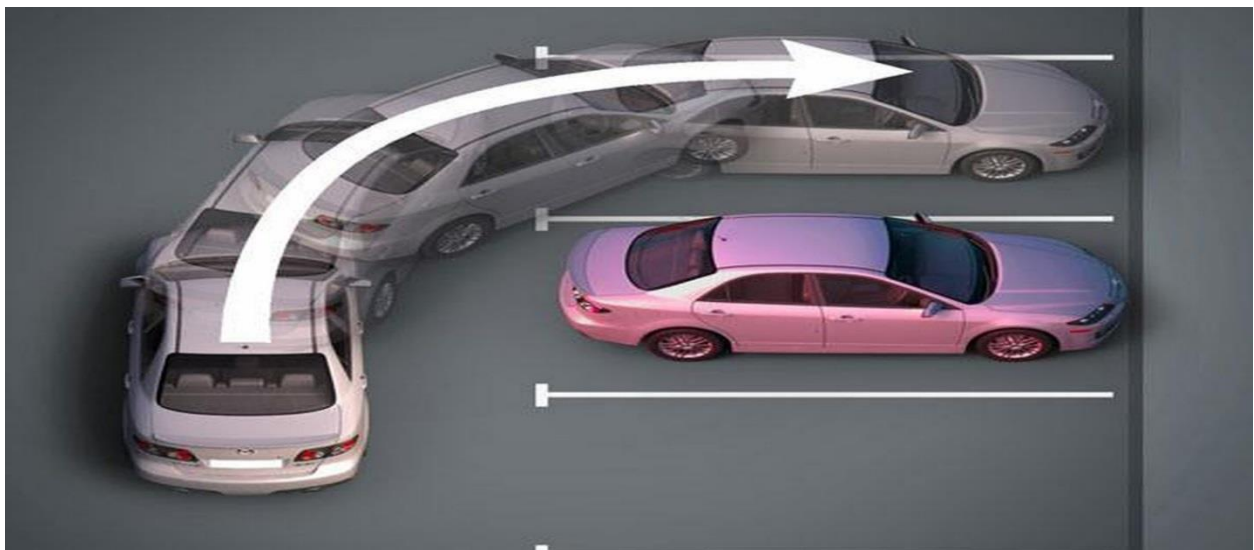


Plate 2.7: Perpendicular parking

Source: Alamy.com (2017)

2.2.4.3 Angle parking

Angle parking is similar to perpendicular parking, except the cars are aligned in an angle(Parking Network, 2020).

2.2.4.4 Double parking

Double parking means that someone has parked their car in a certain way that prevents another car from departing. Double parking can happen in different situation (Parking Network, 2020).

2.2.4.5 Double parking on-street

This type of double parking is illegal and you can get fined for it. Double parking on-street means that you park your car parallel to a car that is parked next to the curb. Double parking in this situation means that the car parked next to the curb cannot depart because it is blocked by your car, and often your car also blocks the traffic flow. Unfortunately, double parking on-street is quite common in larger cities. Sometimes the people who double park their car even leave the hand break off so that people can push their car forward or backwards a bit if it blocks them(Parking Network, 2020)..



Plate 2.8: Onstreet-Double parking at Wuse II, Banex Plaza Abuja

Source: Author, 2021.

2.2.4.6 Double parking in parking garages with attendees

In this situation, double parking is used to be able to park as many cars as possible in the parking garages. It's a different situation than on-street, because in this situation the cars are parked by attendees (or valets). The attendee holds on to the keys of all cars. If one needs to get out and it's block by another car, the attendee simply brings the keys to both cars and moves the car that blocks the other (Parking Network, 2020).

2.2.4.7 Parking on more than one parking space

The term “double parking” is sometimes also used to indicate the situation where a car parks over the lines that separate the parking spaces and therefor taking more than one parking space (Parking Network, 2020).

2.2.5 Parking Facilities

Parking facilities can be both indoor and outdoor, public or private. It can be a parking garage, or a parking space that belongs to the property of a person’s house (Chen, 2017).

2.2.5.1 Different types of parking facilities

1. Parking lot

A parking lot is an **area that is assigned for parking**. Normally, the parking spaces are marked on the ground with white or yellow lines that form squares that each fit one car. Parking lots are common near shops, bars, restaurants and other facilities that require parking. There are parking lots that are open throughout the year, but there are also improvised parking lots that are specially assigned for an event. For example, when there is a music festival that only happens once a year people can decide to open a nearby meadow to provide parking spaces for the visitors of that particular music festival (Chen, 2017).

2. Parking garages

A parking garages is also called car park, parking structure, parking building, parking ramp, parkade or parking deck (Chen, 2017).

2.2.5.2 There are several types of parking garages:

i. Single level parking garage

A single level parking garage is a parking garage that only has only one floor.

ii. Multilevel or multi-storey parking garage

Multilevel or multi-storey parking garages are parking garages that have multiple floors to park at. The design of a multilevel parking garage can be very different. The most common design is a garage with ramps to move from one level to another. Less common are parking garages that use lifts to go from level to level. Then there are also parking garages with robotic systems that move cars from one level to another. The floors of the parking garage can either go up, down or both (Chen, 2017).

iii. Underground parking garage

An underground parking garage has levels below the surface and none above ground. Most often underground parking garages are located in city centers where there's not much space available to build a parking facility, but there is a big need to build one (Chen, 2017).

iv. Automated parking garage

The car park operates as followed: You drive your car onto a platform in the garage. Then the **automated parking system will move your car** to the available parking space somewhere in the tower. The cars can be moved vertically and horizontally with the use of **hydraulic or mechanical lifts**. There are several benefits to a multilevel parking facility with an automated parking system. For example you can stack more cars in a compact space because the cars are parked by robots. Also parking spaces can be smaller because no one needs to get in or out of the vehicle and people don't park it themselves; the robotic system doesn't need as much space to park a car than a human does. You do need to clean the equipment every once in a while, plus at least

one to four times a year someone needs to check the equipment to see if it all still works properly. The number of times for a service check depends on the equipment that is used (Chen, 2017).

3. Carports

Carports are usually **located on people's driveways next to their house**. These carports are covered places where one or more cars can be stalled. They are private property that comes with the house. Car ports do not have four walls: Normally they only have one or two walls and sometimes they are attached to a wall of the house it belongs to. Car ports offer protection from bad weather conditions like rain and snow(Parking Network, 2020).

4. Parking spaces on the side of the street

Also parking spaces on the side of the road where metered or **spaces that are laid out for the use of parking**, are considered parking facilities. Commonly you can identify such spaces because there are one or more squares lined out with yellow or white paint that fit one car. You as a driver are supposed to park your car in between the squares. In other areas there aren't any parking spaces drawn on the streets. This usually only happens in residential areas where it isn't crowded(Parking Network, 2020).

5. Automated Parking System (APS)

An **Automated Parking System or APS** is a mechanical system that moves cars from the entry to an available parking space. It uses multiple levels and stacks cars vertically to use as less land as possible to park as many cars as possible. It's entirely automatic and doesn't require any staff.

Automated Parking Systems are sometimes also called:

- Mechanical Parking System
- Robotic Parking System
- Rotary Parking System

- Automatic Parking
- Stacker Parking, Etc.

Automatic parking systems are very **space efficient**. You can simply stack all the cars plus the parking space doesn't have to be as wide as in a conventional parking lot. You can stack more cars in a compact space, because cars are moved by platforms and lifts. The system doesn't need as much space to park as a human does. There's no need for ramps, pedestrian areas etc(Parking Network, 2020).

6. Semi-Automated Parking System

Parking Network, (2020), explained a **Semi-Automated Parking System** uses a mechanical system to move cars to their parking space, only it needs a human action to work, either by the driver or an attendant. This action can be as simple as pushing a button.

Advantages for customers:

- No need to search for available parking spaces
- No need to walk through the parking garage
- Time saving
- Consistent parking experience
- Your car is parked safe and secure (no worry about theft / damage)

Advantages for municipalities / Property owners:

- Space efficiency
- Environmental friendliness (No driving around inside)
- Visual impact increased
- Increases public safety (Less opportunity for theft, accidents, assault)
- Money-saving advantages

- i. No people inside means no litter / fights / accidents / etc.
- ii. No people inside means no need for signs / lighting / pedestrian areas / etc.
- iii. Cars inside aren't driving but are moved automatically, which means no need for an expensive ventilation system
- iv. No need to employ staff (except for occasional maintenance)

2.2.6 Parking Control

2.2.6.1 Access and revenue control

An Access Control System (ACS) **manages the access in and out of a parking facility**; the parker must present a valid parking credential. Revenue control involves transient and non-transient parker management and includes payment at the time of parking. Typically it refers to the servers, terminals and kiosks used for payment and gate control in a garage (Belmore, 2019).

2.2.6.2 Transient

A parker who pays for parking on a **short term basis**, typically daily or less. Transient customers typically pay for the amount of time used versus a set period of time to park (e.g. a month, a semester etc.) (Belmore, 2019).

2.2.6.3 Non-transient

Non-transient parkers are people that use a permit or credential to park on an **ongoing basis** (e.g., monthly parker). This can be in an access controlled facility or in a surface lot with no gate.

A **Revenue Control System** is a system for managing and auditing the payments of transient and non-transient parkers in a parking lot or facility (Belmore, 2019).

2.2.6.4 Access and Revenue Control (ARC), also known as **Parking Access and Revenue Control (PARC)**, is available in verifying levels of functionality and complexity. Access and revenue systems allow parking owners and operators to control access and collect parking revenues

from users. Available in varying types of equipment platforms, ARC systems, when combined with policy and procedure, can speed entry and exit from a facility and secure revenues through audit records (Belmore, 2019).

2.2.7 Access and revenue control equipment

1. Barriers

A barrier or gate is the hardware used to **control access** to a facility or lot (Parking Network, 2020).

2. Alarms

Alarms are used in access and revenue control systems. These are **system generated messages** that indicate potential problems with equipment or operational rules that have been broken (i.e. vehicle entered lane and then blacked out) (Parking Network, 2020).

3. Car Park Management Systems (CPMS)

This represents multiple parking technologies beyond revenue and access control, which typically applies to off-street parking facilities. Other systems represented by CPMS include meter revenue systems, parking guidance systems, systems that track occupancy and other systems that do not necessarily include access and revenue control (Parking Network, 2020).

4. Ticket Validator

A ticket validator electronically **encodes validations** either onto the original transient ticket or onto a separate magnetic stripe validation ticket. Encoding stations are a basic offering in PARCS.

A **magnetic stripe** is a strip of magnetic media that is usually found on a credential such as a credit card or hotel key. A magnetic stripe can store a small amount of data (Parking Network, 2020).

5. Magnetic Stripe Reader (MSR)

This is a hardware device that reads magnetic stripes and converts information stored there to data that can be used by a computer or controller (Parking Network, 2020).

6. Encoding Station

This is a computer with encoding software that is **connected to a ticket validator**. These are typically used to allow a cashier to update the magnetic stripe of a parking ticket with new information (rate, payment, etc.) (Parking Network, 2020).

7. Exit Verifier

This is hardware in a lane where the customer inserts a dispensed ticket showing that he paid. The hardware **verifies payment** and raises the gate. An exit verifier is also known as an exit station (Parking Network, 2020).

8. Central Cashier

A central cashier can be a **person (cashier) or pay station**. The customer takes their ticket after it is processed and inserts it into an exit verifier. A central cashier staffed by a person may also take citation payments and sell permits. The key is that it is centrally located and not typically located in a lane (Parking Network, 2020).

9. Entry Lane Station

This is an in-lane cashier station or booth in the entry lane to a facility that may be used to **collect payment for parking**; dispense token, ticket, or other item indicating time of entry or validity of vehicle; or detect permits or other permission to enter (Parking Network, 2020).

10. Automated Pay Station (APS)

The automated pay station allows for **automated ticket processing** in central cashiering facilities. It can supplement and / or replace cashiers. Sometimes these stations are called pay on foot – or pay in lane machines. The Automated Pay Station can accept multiple forms of payment and provide receipts (Parking Network, 2020).

11. Lane Controller

These are the electronics in the hardware associated with a lane. It **choreographs the activity** in the lane, activating and deactivating equipment based on triggers such as vehicle presence. The lane controller often sends and receives data from an online central database to allow access to the facility (Parking Network, 2020).

12. Counting System

This is a system used to **track the number of parkers** using sensors (loops, infrared, cameras etc.) that vehicles pass through or over. A counting system is also referred to as an occupancy system (Parking Network, 2020).

13. Loops

Loops are **sensors** that are placed in the ground of a lane or level of a parking facility to detect a vehicle passing overhead. They track occupancy and enable ticket dispensers or permit readers by identifying the presence of a metal object passing over the loop. Two-loop (or three-loop) systems can provide directional logic for vehicles entering or exiting a facility. Two-loop means that two loops are laid in the ground next to each other (Parking Network, 2020).

14. Monitoring System

This system allows the user to **view system-generated activity**, alarms and occupancy within a facility via the Parking Access and Revenue Control System (PARCS) (Parking Network, 2020).

15. Facility Management System

A Facility Management System or FMS is the computer system and software that provides real-time reporting, monitoring and controlling of the Parking Access and Revenue Control Systems (PARCS) (Parking Network, 2020).

2.2.8 Anti-Passback or Passback Control

This is a setting that requires Access Control System (ACS) users to **enter and exit in proper sequence** with their parking credential (i.e. entry, exit, entry, exit etc.). Anti-passback is typically selectable as 'hard' and 'soft' (Parking Network, 2020).

i. Hard anti-passback

Hard anti-passback setting rejects the ACS users that are out of sequence and should be set an alarm at the ACS controller and Facility Management System (FMS). In this situation an alarm means a system generated message that indicates a potential problem with equipment or operational rules that have been broken (Parking Network, 2020).

ii. Soft anti-passback

This setting allows the out-of-sequence ACS user to enter and exit, but reports and records violations with an alarm at the FMS for follow-up by the parking manager. Soft anti-passback provides a more patron-friendly experience while monitoring for misuse. This setting should be unique for each user (Parking Network, 2020).

In both the hard and soft mode, each out-of-sequence event is reported as an exception transaction in the daily ACS access log. Many systems have the capability to clear the anti-passback condition via a password-protected resynchronization of the user's account.

2.2.9 Parking Guidance System / Way finding

This system is typically internal to a parking facility and **provides guidance to open parking spaces**. These systems can include dynamic signage and individual floor and space availability indicators. Newer generation parking guidance systems detect individual space occupancy with stall sensors and can also share information with GPS-enabled vehicles and smartphone apps, which extend them beyond a parking garage or surface lot. It can guide traffic searching for parking spaces through a city which improves the traffic flow (Parking Network, 2020).

2.2.10 Automatic Vehicle Identification (AVI)

This system is often used in access and revenue control. The system enables **automatic identification of a vehicle** when it enters a parking facility so it can be authorized and permitted to enter and exit. AVI access methods include RFID, LPR and Proximity cards (Parking Network, 2020).

1. Radio-Frequency Identification (RFID)

RFID is an automatic identification method that relies on storing and remotely retrieving data using devices called RFID tags or transponders. RFID is used mainly in access and revenue control facilities and is another form of permit (Parking Network, 2020).

2. License Plate Recognition (LPR)

This is a vehicle identification technology that uses **cameras** to take pictures of license plates, read the images via character recognition software, and convert the images into text that a computer can read. LPR is common in access control, tolling and stolen vehicle detection applications.

Sometimes LPR is called ANPR, which means Automatic Number Plate Recognition (Parking Network, 2020).

2.2.10.3 License Plate Inventory (LPI)

This is a process that uses License Plate Recognition or the manual collection of license plate information via handheld devices to **count and keep track of vehicle license plates**. It can be used in both controlled access and open facility environments to keep track of vehicles accessing a facility (Parking Network, 2020).

2.2.10.4 Proximity Cards

A Proximity card is a **smart card** that can be read without being inserted into a reader device (Parking Network, 2020).

2.2.11 Parking Service

1. Valet parking

Valet parking is actually the opposite of finding a parking space on your own: It means that **someone else parks your car for you**. This person is called a valet. The valet parking service is often offered at restaurants, [hotels](#), stores and other businesses. The service can be an additional service on the house, or you as a customer have to pay a fee. The advantage for the businesses that offer valet parking, is that you can stack more cars in your parking facility. You don't have to deal with people double parking and you can even park two cars deep (with one car blocked). The valet holds all the keys so he can move one car in order to remove the other. A valet parking service usually gives the customer a feeling of luxury, because someone else parks their car when they enter, and pick it up whenever they want to leave. Most of the times, the valet receives tips from customers (Parking Network, 2020).

2.Park & Ride

Park and Ride facilities are parking facilities that are **usually just outside the city center, with direct public transport connections to the city center**. These Park and Ride facilities are meant for commuters and other people who want to go to the city center. By adding these facilities, you can reduce the amount of traffic in the center. Also, drivers looking to park their car won't have to deal with the stress of finding a parking space in a crowded city center and having to pay more money for parking for the same amount of time as outside of the city center (Parking Network, 2020).

3.Meet & Greet parking

Meet and Greet parking services are usually offered at **airports**. You drive your car to the airport where a chauffeur is waiting for you. You can go inside and the chauffeur will drive your car to the designated parking space. When you return, the chauffeur has already picked up your car from the parking facility and is waiting for you. Meet and great parking is **convenient for people with lots of baggage or children en who don't want to have the hassle of carrying everything from the parking space to the terminal**. Normally you book the service by filling in a form where you enter at what specific spot and what time you want the chauffeur to pick up your car and bring it back again. If you return at the airport, after you collected your baggage, you can give the chauffeur a call and he will bring the car back to you and hand over the keys. You will most probably have to pay a fee for this service (Parking Network, 2020).

2.2.12 Parking Restriction

1. Pay for parking

Sometimes you have to pay to park your car. Paying for a parking space has become very normal, especially in city centers. Pay for parking can be a restriction in both on- and off-street parking situations (Belmore, 2019).

2. Parking meter

[Parking meters](#) manage payment for the parking space. In most on-street parking situations where you have to pay for parking, you will find a parking meter. A parking meter is a **device to collect money for parking**. In most situations there is a time limit to park at a parking meter. The classic parking meters only allow cash for payment method. Parking meters only serve one parking space at a time. Sometimes people park at a meter that still contains money from the previous person who parked there. This means there is still time on the meter and the person can park for free for this period of time. Normally, this isn't allowed but happens anyway. It's also not allowed to put money if it's not your car that's parked in the space (Belmore, 2019).

3. Smart parking meter

Nowadays you see more and more smart parking meters. The difference between the classic parking meters and the smart parking meters, is that smart parking meters give you as a customer **more** [payment options](#). For example, you can pay by phone or by credit card (Belmore, 2019).

4. Pay and Display or Parking Pay Station

Pay and displays means that the person who parked the car, has to walk to the nearest parking machine and buy a ticket. The ticket is placed on the dashboard of the car and enforcement officers audit by looking in vehicles for receipts. So you **pay for a parking ticket and display it on the dashboard of the car**. The **printed ticket** often says where you parked, who the parking operator

is, the date and time you printed the ticket and the expiry time. Usually you can pay an certain amount of money to park for a certain amount of time, and you as a customer can choose how much you want to pay and therefor how long you want to park your car. These pay and display systems can be used both on- and off –street. The difference between a Pay and Display meter and a normal parking meter as discussed before, is that these Pay and Display systems serve **multiple parking spaces**, as a normal parking meter only serves one parking space. Also, people cannot take advantage of parking spaces that have time left on the meter, since everybody has to have their own ticket displayed in the car (Belmore, 2019).

5. Time limits

Sometimes you are only allowed to park for a limited amount of time or only between certain hours of the day. This is usually corresponded with signs at the parking place. There are also situations where you have to pay for parking between certain hours of the day, and that the other hours are free. These zones are called **Controlled Parking Zones**. There is also a difference between short term parking spaces and long term parking spaces. At short term parking spaces you are only allowed to park for a short period of time, in contrast to long term parking spaces. Short term parking is typically used near businesses to provide parking for customers while encouraging turnover (Belmore, 2019).

6. Disk Parking

On some places where a parking time limit is set, **the time limit is monitored with the use of parking disks**. The owner of the car that is parked, uses this disk to indicate the time when he parked his vehicle. He then places the disk on the dashboard. Patrolling enforcement agents can now see at what time he parked the car and therefor for how long the car is parked. Disk parking is used at places where there is a time limit set for parking, but no charge (Belmore, 2019).

7. Coupon parking

Coupon parking is a **combination of disk parking and pay-and-display parking**. The car owner has to purchase a book with coupons in advance. When he parks on a parking space with a time limit, he has to tear off a coupon and fill out the current date and time. Then he places it on his dashboard so enforcement officers can see what time he has parked the car. The difference between coupon parking and disk parking, is that a disk is reusable and a coupon can only be used once (Belmore, 2019).

8. Alternate-side parking

Alternate-side parking refers to a traffic law which states **on which side of the road you are allowed to park**. Sometimes there are also time limits. An example: On this side of the road you are not allowed to park between 9 am and 5 pm. This parking restriction is commonly communicated with traffic signs (Belmore, 2019).

9. Disabled parking space

Disabled parking spaces, also known as **handicapped parking spaces**, are spaces that are reserved for people with a disability. You're only allowed to use these parking spaces if you have a permit. You can request a disabled parking permit, also called **Blue Badge**, at the city council. You qualify for a disabled parking permit when your mobility is affected due to illness, age, infirmity or disability (Belmore, 2019).

10. Residential parking space

Residential parking spaces are only meant for **people who live in that particular residential area**. This means that the spaces are not available for visitors. For example, people who live in the city center are allowed to park their car, but people who visit the city to go shopping, aren't allowed to or have to pay to park. Normally residents have to request a parking permit by their city council.

They have to place this permit on their dashboard so it's visible to the enforcement agents. Only residents get the parking permit, so only residents are allowed to park at these parking spaces. Other people will get fined. There are variations to this type, e.g. **employee parking spaces**(Belmore, 2019).

11. Permit

A permit is anything that allows a driver to park in a designated area: Also referred to as permission or credential. This can be decal, hangtag, RFID, virtual (database record), etc. **Permitless Parking** is a parking system that relies on license plate recognition to read pre-registered license plates that serve as parking permits or access credentials. **Credentials** allow access to a facility or to park in a certain on-street area (i.e. residential parking pass) and references to access control systems(Belmore, 2019).

2.2.13 Parking Payment Option

1. Pay with cash

The [first parking meters](#) only accepted coins. Nowadays, you can still pay with coins (and paper money) at most parking meters and terminals. However, other payment options are integrated more and more. The disadvantage of paying with cash, is that you always have to carry loose change with you. Another disadvantage of paying by cash is that you have to determine the amount of time you want to park in advance: You insert the coins before you go your way, but you don't always know exactly how long you will be gone. This means that sometimes you pay for time you don't actually spend, or you are so caught up in what you're doing that you exceed the time limit. In Abuja, payment with cash is the most popular form of payment (Parking Network, 2020).

2. Pay by Disk

On some places where a parking time limit is set, the time limit is monitored with the use of parking disks. The owner of the car that is parked, uses this disk to indicate the time when he parked his vehicle. He then places the disk on the dashboard. Patrolling enforcement agents can now see at what time he parked to car and therefor for how long the car is parked. Disk parking is used at places where there is a time limit set for parking, but no charge (Parking Network, 2020).

3. Pay by Coupon

Coupon parking is a combination of disk parking and pay-and-display parking. The car owner has to purchase a book with coupons in advance. When he parks on a parking space with a time limit, he has to tear off a coupon and fill out the current date and time. Then he places it on his dashboard so enforcement officers can see what time he has parked the car. The difference between coupon parking and disk parking, is that a disk is reusable and a coupon can only be used once (Parking Network, 2020).

4. Pay by phone

This is a type of parking operation that enables a customer to pay using a cell phone or mobile application. The pay-by-cell phone provider charges the customer for parking fees and reimburses the parking operator. Enforcement officers audit by checking online databases for valid plates. Actually they could name this one “pay by smartphone”, because it only applies to smartphones that have a connection to the internet. In most situations you have to pre-register on the internet or download an app (Parking Network, 2020).

5. Extend by phone

This is used in conjunction with pay by phone and meters to allow parkers to add time to their parking sessions via phone. Typically, the meter will send a text message alerting the parker that his time is about to expire. Parkers can add time by texting back (Parking Network, 2020).

6. Pay by plate

Pay by plate is a type of parking operation that requires the customer to pay at a pay station in advance. The customer enters his license plate number at the station and makes the payment. Enforcement officers audit by checking the pay station or going online to view a list of license plates marked as paid (Parking Network, 2020).

7. Pay by space

This parking operation requires the customer to pay at a pay station in advance. The customer selects his parking space location (usually numbered) at the station and makes the payment. Enforcement officers audit by checking the pay station for a list of paid spaces (Parking Network, 2020).

8. Pay on entry

Pay on entry is a system configuration where the customer pays for parking as he enters the facility. It is often used for event parking. Pay on entry systems can also be used to have customers pay a deposit and receive some portion of that money back on exit if there is more than one rate in effect at given time (Parking Network, 2020).

9. Pay on foot

Pay on foot requires a customer to pay for parking at a pay station before exiting the facility. Customers insert their tickets into a machine and make payment, and the machine returns their ticket. Customers return to their vehicles and drive to the exit lane, where they insert their tickets

into the exit station. The machine used in this process is also called a Automated Pay Station (Parking Network, 2020).

10. Pay on exit

This is any type of system configuration where the customer pays in-lane while leaving the facility. Payment may be made to a cashier or use credit card payment in the exit lane (Parking Network, 2020).

2.2.14 Effects of Parking space

Parking space has some effects like congestion, accidents, pollution, obstruction to fire-fighting operations etc.

1. Congestion. Parking takes considerable street space leading to the lowering of the road capacity. Hence, speed will be reduced, journey time and delay will also subsequently increase. The operational cost of the vehicle increases leading to great economical loss to the community (Osoba, 2012).

2. Accidents. Careless maneuvering of parking and unparking leads to accidents which are referred to as parking accidents. Common type of parking accidents occur while driving out a car from the parking area, careless opening of the doors of parked cars, and while bringing in the vehicle to the parking lot for parking (Osoba, 2012).

3. Environmental pollution. They also cause pollution to the environment because stopping and starting of vehicles while parking and unparking results in noise and fumes. They also aced the aesthetic beauty of the buildings because a car parked at every available space creates a feeling that building rises from a plinth of cars (Osoba, 2012).

4. Obstruction to firefighting operations. Parked vehicles may obstruct the movement of firefighting vehicles. Sometimes they block access to hydrants and access to buildings (Osoba, 2012).

2.2.15 Advantages of Parking space

Osoba, (2012) , expressed the following as the advantage of parking space

- Space effective space savings upwards of 70 percent.
- Freeing the space at ground level for better commercial use.
- Reduced total cost of ownership.
- Environmental friendly as ramps are avoided.
- Higher throughput and faster operations (capability to handle 40 to 60 cars an hour)

2.2.16 History of Parking space

i. First parking meter

In the early 1920s and -30s in Oklahoma City. There was no regulated parking anywhere yet. People would just park their cars in the streets and leave them there until they need them again. In shopping areas most of the parking spaces were occupied by employees who worked downtown, leaving no room for potential customers. **Traffic congestion problems** were common in big cities. It was hurting business, and soon people started to think about a way to regulate the parking time. Because merchants were complaining about the low traffic in the downtown area, they decided to ask **Carl Magee** for help. Magee immediately thought about a machine which we now know as the parking meter: A machine that sets certain amounts of time for parking. He organized a design contest at the University of Oklahoma to design this newfound parking meter. This was a challenge since the machine had to be operative in all kinds of weather, be vandalism-proof and cost-

efficient. There was a prize for the engineering student who could design this machine, but unfortunately none of the students' entries were approved (Parking Network, 2020).

The **first working parking meter** was designed by Holger George Thuessen and Gerald A. Hale. Hale and Thuessen started working on the parking meter in 1933 because of the assigned project by Carl Magee. They weren't students anymore, but since the contest didn't work out these two men were appointed. Thuessen was a professor at Oklahoma State and Hale an engineering graduate. The parking meter they designed was called **The Black Maria**.

After the contest Magee filed patent for his own design of the parking meter on May 13th, 1935.

This parking meter, based on the design of the Black Maria, is known as the **Park-O-Meter No.**

1. The first parking meter was installed in Oklahoma City on July 16th in the year 1935.

Magee wasn't the first one to file patent for a parking meter. The first patent for a parking meter was filed by **Roger W. Babson** on August 30, 1928. Babson was an entrepreneur in the early 20th century. Babson had the idea of creating a parking meter that gets its energy by using the power of the parked vehicle. There would be a connection to from the meter to the cars' battery. But Babson is not known as the inventor of the parking meter; it was never more than an idea.

Magee started the **Magee-Hale Park-O-Meter Company** to manufacture the parking meters. The company later changed its name to POM (the initials of Park-O-Meter) and is still active in manufacturing parking meters today (Parking Network, 2020).



Plate 2.10: Parking meter in Oklahoma city

Source: Britishparking.co.uk (2017)

ii. Parking Garages

As more people got cars, the need for a place to park it was growing bigger and bigger. Parking became a problem and cities were looking for a solution to **park as many cars as possible on as little space as possible.**

The first cars weren't as weather-resistant as today's cars. Back in the days they had open tops, leather seats and were very sensitive. Therefore, they had to be parked inside where they were safe from the cold, the rain and other bad weather conditions. The **first parking garages** looked like other buildings where people would store stuff. A car was by most people considered as a machine and nothing more than just a machine, in contrast with today's idea of cars. The parking garages blended in with the neighborhood; you couldn't really tell that they were places to store cars. Sometime;s parking garages were **horse stables**, where they would charge the same for parking a car as they did for stalling a horse (Shannon, 2007).



Plate 2.10: Federal secretariat (parking space)

Source: Author 2021.

iii. Automated parking system (APS)

The very first automated parking garage was built in **1905, Garage Rue de Ponthieu** in Paris, France. People needed more parking spaces, but there was less land available. This multi-story car park had an **internal lift**, which moved the cars from one level to another. On these levels a car park attendant would park the car in an available space; people didn't park their cars themselves. Garage Rue de Ponthieu wasn't a fully automated parking garage, but many consider this garage to be the first with automated elements and therefore the forerunner of the APS. Technically, it's a semi-automated parking garage (Parking Network, 2020).



Plate 2.11: Automate Parking system in Liverpool

Source: Britishparking.co.uk (2017)

2.2.17 History of Parking space in FCC, Abuja

The use of parking space is as old as the declaration of Abuja as the Federal Capital Territory in the early 90s, when there is a shift from Lagos. All the federal agencies or ministries were asked to move to Abuja and establish their base. Equally private firms like Bank subscribe to move and the growth of vehicle arise due to the changes that happened. Ever since, the need to park vehicles becomes vital and due to the growth in volume of traffic, the city begins to experience Traffic congestion, accident, environmental pollution, etc (Babangana, 2020).

Yusuf , (2015), expressed that, Parking space becomes the way forward to mitigate the challenges, and every building or offices, shops, fuelling station, markets, financial institution are developing parking lot for vehicles usage and the government are making parking space as a responsibility. Today, virtually every nooks and cranny of FCC, Abuja are equipped with parking space and as

the population increases, vehicle owners increases too and the available commercial parking space are getting congested and not well managed to curb the need for parking space.



Plate 2.12: Wuse Market Park, Abuja.

Source: Author 2021

2.2.18 Studying the effect of Parking Policy

Mitava (2012), stated that it is essential to understand why it is important to study the effects of parking policy interventions. Parking policy acts as glue between the implementation of land use and transport policies. Marsden (2006), observed that three specific objectives of ‘Regeneration’ of a specific part of an urban area, ‘Restraining’ vehicular traffic and ‘Revenue’ generation from the parking operation. Parking policy tries to contribute to the promotion of a more efficient uses of the transport network, lower emissions, higher densities and better, more inclusive urban design (Rye, 2007; Stubbs, 2002; Mitava, 2012). Mitava in his work presented a tool which has the capability to investigate the effects of parking policy intervention by considering various factors, which the users take into account while choosing a parking location in the case of the city of Enschede, the Netherlands. Mitava also developed a model which stimulates the choice of parking

lot using five location factors: parking charges, notice ability of the facility, condition of parking surface, type of winter provision, safety of the driver and the driver's vehicle assumed to concern vandalism and ease of searching a parking lot. He (Mitava) allocates trips entering a zone (parking demand) at morning and evening peak hours to parking locations (considering the trip purpose, the walking distance from parking location to destination and the parking location choice). The outcome of his research show the spatial balance of the parking system in the city as well as presents in detail the problem areas and parking lots which are over utilized or underutilized.

2.2.19 Parking Policy

Marsden (2006) presented the seven parking policies that are considered in transportation system for urban sustainability as follow, to:

1. Effectively manage and co-ordinate the existing on and off-street parking space through measures including the supply of space, maintenance charges and enforcement.
2. Encourage reductions in existing privately owned non-residential car parking spaces or the usage of these spaces, or both.
3. Introduce parking space standards to car parking associated with land use development.
4. Provide adequate cycle parking provision and facilities for cyclists.
5. Improve safety and personal security standards in parking lots.
6. Promote high quality facilities for people with mobility impairments in all parking areas.
7. Ensure that changes to parking provision do not undermine the economic viability of areas or adversely affect local roads and the environment

2.3 Theoretical review

2.3.1 System Behavioral Theory

System theory is an interdisciplinary field of science and the study of the nature of complex systems in nature, society, and science. More specifically, it is a framework by which one can analyze and/or describe any group of objects that work in concert to produce some results. This could be a single organism or an ecosystem, any organization or society, or any electro-mechanical or information artifact. Systems concepts predominantly refer to the science of systems that resulted from the Bertalanffy's General System Theory (GST), among others, in initiating what became a project of systems research and practice. It has long been used in sociology and biology and the area is often associated with cybernetics. Margaret Mead and Gregory Bateson develop interdisciplinary perspectives in system theory (such as positive and negative feedback in the social sciences) and recognized the applicability of systems theory to social relations (individuals) and social systems (culture) (Novak, G. 1998).

Here, the social behavioral theory is equally applicable to the public parking in Abuja, it considered the behavior of people within the FCC in respect to parking of vehicle and the relationship to congestion, accident, environmental effect, etc.

2.3.2 Urban Car Parking Model

This model is of significance important both at the local and at the strategic level of planning. Parking policy and supply play a major role in traffic management systems in dense urban areas. The amount and the location of parking affect, in particular, the level of service and congestion on access roads. Parking behaviour is characterized by complex dynamic relationship between multi-dimensional demands, performance and supply quantities (Feeney, 1986). The general approach has been extended (Le & Young, 1989) to take into account mixed land uses. The distinguishing features

of the models that should be used to investigate parking policy is that they should accurately represent these relationships.

2.3.3 Traffic Assignment Models

This model assigns vehicles to the traffic and parking network given an original destination matrix. Austin (1973) presented two processes for the allocation of parkers to parking stations in the Central Business District (CBD). Firstly using trip generating model to determine the number of trips destined to particular zones in the CBD. Parkers were then allocated to parking stations depending on the cost of parking and walking distance. The allocation of trips was in proportion to the composition cost associated with each origin and parking lotdestination pair. The capacity of the parking system was included by using an interactive procedure.

The Gur-beinborn model was part of a larger system used to analyse the impact of integrated transport systems management strategies in city centers. Included in the procedures were calculations of parking impedance for each parking location in the area, including illegal parking. The model included the amount of time spend looking for a parking space as an increasing function of the utilization level of the parking area. With this relationship, it was possible to describe and analyse the parking process within the framework of user-optimized equilibrium assignment (HUD, 2008).

In this model parking has been considered as daily system, arrival rate patterns vary throughout the day. Gut and Beimborn described the application of the model to a high-density section of Haifa, Israel. In the test case the sensitivity of parking behaviour was examined as it varied with the value of walk time, parking cost, parking fines, enforcement policies and level of travel demand.

2.3.4 Traffic Flow Theory

Wattle Worth (1976), there have been many significant development in traffic flow theory. Some of these developments have led to very useful relationship while some application has not been all that useful. He further said that probably, the most useful result of traffic flow theory is the development of the relationship among the macroscopic variables of traffic stream flow (flow rate, speed and density). Traffic Engineering uses the flow theory for the development of the level of services concept.

However, there has been some criticism of the traffic flow theory work regard the lag between the theoretical development and the application of some portion of the flow theory work. The traffic flow theories have largely looked into the basic relationship (why things happen). The traffic Engineers owe them a lot, for these theorists are physicists and mathematicians.

The fundamental characteristics of traffic stream flow are:

- a. Flow b. Speed c. Density

Wattle Worth (1976) defined rate (q) as the rate at which vehicles pass a point on a roadway. It is expressed in vehicles per hour (veh/hr).

$$q = \frac{\text{veh}}{\text{Hr}} = vph(v/hrvh^4)$$

The volume (Q) is also defined as the number of vehicles observed in a given time (T) volume is based on an actual count and expressed as vehicle.

2.3.5 Concentric Theory

An early theory designed to explain the land use structures of cities was presented by Ernest Burgess (1923). Burgess developed a concentric ring approach theorizing that a city expands from

its original centre in a series of concentric zones. This was a development of Von Thunen's explanation of rural land uses and values, put forward in the early part of the last century, and based upon the concept of a medieval village design. It was assumed that the central district would be used for intensive high rent uses such as office buildings, department stores and other retailers, financial institutions, hotels, theatres etc. The ring immediately surrounding the central district would be made up of a variety of uses including low rent workers residences for those employed in the central area as well as manufacturing, wholesaling, storage and similar activities which are related directly or indirectly to those activities carried out in the central zone, in which the traffic volume of vehicle is on high rate, as a result of the CBD development and activities, the parking space activities becomes vital to be considered in the urban planning of the FCC, Abuja.

2.3.6 Residential Theory

Theory in respect of residential location asserts that the typical householder wants convenience, adequate space and a pleasing environment (Ricks, 1970; Madu, 2017). Therefore, as well as the straight economic considerations applicable to industrial and commercial space we have the influence of a far more subjective factor. Personal preferences can be fickle and what may be desirable to one consumer may be undesirable to another. In addition "fashion" can play a significant role. Before the advent of modern transportation facilities, "convenience dictated that residential locations were very much tied up with proximity to a workers place of employment" (von Thunen, J. H. 1966). Today however, housing can be located almost anywhere within a large commuting zone, and the location, style and amenities are dependent on the workers personal "trade off" preferences along with willingness and ability to pay.

Therefore, the study adopt Concentric theory and residential theory as it best suit the research.

2.4 Empirical Review

Osoba, (2012), studied appraisal of parking problems and traffic management measures in Central Business District in Lagos, Nigeria. Findings from the research work revealed that parking problems and Traffic Management which leads to time delays and traffic congestion are as a result of inadequate parking space, traffic signs/signals, human factor indiscipline act and development of illegal stall at car park and recommendation was made for Parking Management, Parking design standard, parking control; traffic management for both vehicular and pedestrian, Land-use and Land development; enforcement of edict and bye-laws by statutory agencies. All Local Planning Authorities should specify and enforced the provision of parking space in conjunction with new building and also old building in CBD's should be refurbished to accommodate adequate parking space. Education and enlightenment programme are basic tools for achieving effective traffic management control.

Shoup (2006), suggests that this reliance on the available guidelines may be a product of a lack of instruction in planning education on how to set parking requirements, claiming both that “most texts in regional science, transportation planning, and urban economics...ignore parking” and that “somehow, the urban land use with the biggest footprint and a profound effect on the transportation system has been invisible to scholars in every discipline.” Marshall and Garrick (2006), recognized this claim, indicating that parking and its provision is often overlooked in planning academics.

The acceleration of urban motorization leads to worsening the urban traffic environment (Yanling, Xin, & Ming-chun, 2016). A fast-growing number of vehicles and limited parking lots form a sharp contrast and cause the phenomenon of “parking difficulty and parking disorderly” (Yanling et al., 2016). Parking facilities are also considered the indicator of sustainable and livable transport planning (Litman, 2015). The adaption of parking supply and demand management strategies offer solutions to the many problems faced by a sustainable transportation system,

including transit performance, delay reduction, travel time reliability and capacity utilization (Steiner, 2012). Urban centers which include a variety of spaces such as markets, offices, churches, shops, and other similar spaces often create massive parking demands which, when unmet, become the major reason of on-street parking due to the unavailability of required parking space (Aderamo&Salau, 2013). Indeed, parking problems are among one of the most discussed topics by the general public (Liu et al., 2012).

Aliyu, (2019). Conducted a study on Assessment of Parking Spaces in Mixed-used Buildings in Kano State, The study assess the efficiency parking space in mixed-use buildings, which can be achieved through analysing the quantity and sizes of the parking spaces provided, estimating the number of car users', and ascertaining the perception of users' on the available parking space. The study therefore recommends; the provision of the right parking spaces to the functions performed ratio, during the design stage, also, the issue of shared parking in order to reduce too much usage of scarce land for parking lots should be well planned, so as to tackle the challenges associated with parking space in mixed-used building in kano state.

Thwala et al., (2012) examines the causes of traffic congestion in Ibadan city and found the on-street parking one of them. They used questionnaire survey to collect data and utilized descriptive statistics technique to get desired results. In another study conducted in urban Ghana, lack of parking management systems and insufficient area for parking was found as the major cause of traffic congestion. This study also adopted descriptive statistics with the aid of Statistical Package for Social Sciences (SPSS) and suggested to improve the present traffic situations. As, parking difficulties are considered as the most notable urban transport problems (Thwala et al., 2012), a source to cause short or long run traffic congestion (Organisation for Economic Co-operation and Development (OECD) & European Conference of Ministers of Transport (ECMT), 2007) and

closely related to environment pollution (Liu et al., 2012).

Therefore, this study examines the existing parking space conditions of the study area and users and operators/administrator perceptions about the parking space conditions in FCC, Abuja. It is observed from the previous study that, no study has ever been done nor in recent at FCC. This is the research gap that this study fills, so as to proffer solution to the identified contemporary challenges facing FCC, Abuja.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Data Source

This study will rely on primary and secondary data. Secondary data will be sourced from published and unpublished sources. These will include extracts from maps, literature, reports, documentations, records and information from both technical and administrative departments of Development Control and agencies of the Federal Capital Development Authority (FCDA).

The Primary sources of data will involve the field work through observation, questionnaire administration and interviews.

Table 3.1: Data Requirements and Sources

Data Types	Data Requirement	Sources
Primary Data	Data on spatial pattern of FCC, Abuja	Field survey by visitation of study area and facilities.
	i. Characteristics (types) of FCC.	Field survey, Use of map in FCC.
	ii. Type of commercial activities.	Observation and recording.
	Data on Parking Characteristics.	Field survey.
	Impact of parking space	Questionnaire administration by observation and recording
	Determination of parking space demand and supply of the study area	Questionnaire administration by observation and recording
Secondary Data	Socio-economic characteristics of Operator and Users	Questionnaire administration by observation and recording
	Data on Policy, Guidelines and Measurement of parking	Literatures
	Parking space design capacity	Department of Development Control/ Parking space administrator, field survey
	Data on parking standards, issues and Management of parking in cities planning standards for parking in the FCT	Department of Development Control. Field survey
	Problem of parking and implications	Literatures

Source: Author design, 2021.

3.2 Research Design

This study adopted survey research design based on descriptive technique because it contributes positively towards testing and increasing the validity and reliability of the obtained data. The

survey research design is an evaluative approach for providing solution to specific problems under a given study.

3.3 Sample Size and Sampling Techniques

From the table 3.2 below shows the parking space capacity of the parks in the 11 popular parking space in FCC, Abuja, Federal secretariat park has 1500 parking capacity, Cultural Centre park has 1700 parking capacity, Parade ground park has 800 parking capacity, Asokoro General Hospital. park has a total of 700 parking capacity, Central Car-wash CBD park has 1200 parking capacity, Wuse Market park has 1400 parking capacity, Mabushi park has 500 parking capacity, Area 1 park has 300 parking capacity, Central park has 1600 parking capacity and Zone 4 park has 400 parking capacity.

Purposive sampling technique is to be adopted for this study in which selection of data is obtained from known group base on necessity to solve a problem under study. This is the reason for allowing opinion seeking of group of two (2) mentioned above i.e Users and Enforcement agent. The sample was taken from this population using Yamane Approach. The approach is valid for 95% confidence level and proportion of 0.5 and size sample is given as (Israel, 2003):

$$n = N / (1 + Ne^2) \quad (3.1)$$

Where:

n = Sample size base on normal distribution

N = Population value

e = Margin of Error

Using equation (3.1) sample size (n) is determined as:

$$N = 11,100$$

$$e = 0.05$$

$$n = \frac{11,100}{1 + 11,100(0.05^2)} = \frac{11,100}{28.75} = 386.09$$

The study needs approximately 387 respondents for its analysis.

The table 3.2 below: Statistical Sampling Method of Study

s/n	Location	Parking Capacity	space	No of questionnaire (Capacity/Total Capacity X 387)
1	Federal secretariat park	1,500		52
2	Cultural Centre park	1,700		59
3	Parade ground park	800		28
4	Asokoro general hosp. park	700		24
5	Central Car-wash CBD park	1200		42
6	Wuse Market park	1400		49
7	Mabushi park	500		17
8	Area 1 park	300		11
9	High Court park	800		28
10	Central Park	1600		56
11	Zone 4 park	600		21
	Total	11,100		387

Source: Field survey (2021)

Table 3.2 showed the numbers of questionnaires that will be attached to each parks. This is done using proportional method.

3.4 Instrument for Data Collection

The study used questionnaire as primary instrument to collect data from 387 respondents. The questionnaire was designed by the researcher using Likert Scale that is; Strongly Agreed (5 point), Agreed (4 point), Disagree (3 point), Strongly Disagree (2 point) and Undecided (1 point). The instrument was divided into two sections A and B. Section A provide general information such as place of work, gender, year of experience and age of respondents Section B was designed to reflect the objectives and research questions.

3.5 Validity and Reliability of the Instrument

The data instrument used was a questionnaire and was subjected to content validity by supervisors in the department of study. The instrument may be re-adjusted and restructured to have meaning content for answering the objectives of the study. The reliability is conducted using Pearson correlation in which pre-tested data was carried out to ascertain the degree of instrument reliability for this study. The measure of reliability is related by equation (3.2) as (Montgomery and Runger, 2014):

$$r_{xy} = \frac{\sum_{i=1}^n y_i(x_i - \bar{x})}{[\sum_{i=1}^n (y_i - \bar{y})^2 \sum_{i=1}^n (x_i - \bar{x})^2]^{0.5}} \quad (3.2)$$

Where:

r_{xy} =Sample correlation coefficient

y_i =Expected frequency

x_i =Observed frequency

\bar{y}, \bar{x} =Mean value of the observations

3.6 Method of Data Analysis

The data was analyzed using descriptive and inferential statistics. Using SPSS 16.0 as a tool, The inferential statistics called Regression (Coefficient) was determined. Regression analysis is a [quantitative research method](#) which is used when the study involves modelling and analysing

several variables, where the relationship includes a dependent variable and one or more independent variables. In simple terms, regression analysis is a quantitative method used to test the nature of relationships between a dependent variable and one or more independent variables. The basic form of regression models includes unknown parameters (β), independent variables (X), and the dependent variable (Y).

Regression model, basically, specifies the relation of dependent variable (Y) to a function combination of independent variables (X) and unknown parameters (β)

$$Y \approx f(X, \beta) \tag{3.3}$$

Regression equation can be used to predict the values of ‘y’, if the value of ‘x’ is given, and both ‘y’ and ‘x’ are the two sets of measures of a sample size of ‘n’. The formulae for regression equation would be

$$y^* = a + bx \tag{3.4}$$

Where,

$$b = \frac{n \sum xy - (\sum x)(\sum y)}{n(\sum x^2) - (\sum x)^2}$$

$$a = \frac{\sum y - b \sum x}{n}$$

3.7 Summary of Methodology

Table 3.3 shows the summary of methodology based on the objectives of the study

Table 3.3: Sampling Data of Study

Objectives	Data	Sources	Method of Data Collection	Method of Analysis
1. To examine the characteristics of parking space in FCC, Abuja.	Primary data	Field survey	Questionnaire	Descriptive/ Inferential analysis

2. Identify the parking space problems associated with FCC, Abuja	Primary data	Field survey	Questionnaire	Descriptive/ Inferential analysis
3. Examine the impact of parking space associated with FCC, Abuja	Primary data	Field survey	Questionnaire	Descriptive/ Inferential analysis
4. Identify the parking space infrastructures or facilities available in the study area	Primary data	Field survey	Questionnaire	Descriptive/ Inferential analysis
5. To suggest possible solutions to the identified challenges of the study area.	Primary data	Field survey	Questionnaire	Descriptive/ Inferential analysis

Source: Field Survey (2021)

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

This chapter discusses the results of the identified objectives. i. the characteristics of parking in FCC, Abuja . ii. The parking facilities/infrastructures available in the study area.iii. Identify the causes of parking space problem in the study area and iv. The impact of parking associated with FCC, Abuja.

4.1 Demographic Results

This section provides outcome of study based on allocated copies of questionnaire. Rate of return, gender and socio-economic characteristics of respondents were presented in the section.

Table 4.1 Distribution of respondents by the sampled parking lot in FCC Abuja.

s/n	Names of park	No of questionnaire received
1	Federal secretariat park	41
2	Cultural Centre park	48
3	Parade ground park	23
4	Asokoro general hosp. park	22
5	Central Car-wash CBD park	42
6	Wuse Market park	41
7	Mabushi park	14
8	Area 1 park	11
9	High Court park	25
10	Central Park	49
11	Zone 4 park	20
Total		336

Source; Field survey 2021.

Table 4.1 above shows the total number of questionnaire received. 336 copies questionnaire was received out of 387 questionnaire issued out. 285 questionnaire was obtained from users, out of 328 questionnaire issued to the Users of parking space in FCC Abuja. The observatory/traffic count questionnaire issued was 19 and they are all returned. While 32 copies questionnaire was returned from the operator/enforcement body of the parking space at the FCC, Abuja.

The reasons for the missing or uncompleted return of the questionnaire is not far from the haste of respondents, while some went away with the questionnaire and promised to return during break period. Some of the respondents pledged to return the questionnaire in the next 48hours or a day after, some comply while few didn't.

4.2 Socio-Economic Characteristics of the Respondents

Information on the socio-economic characteristics of the respondents were collected, analysed and presented in Table 4.2.

Table 4.2: Socio-Economic Characteristics of the Respondents in study area

Variable	Number of Respondents	Percentage %
Sex		
Female	94	30
Male	223	70
Total number of respondent	317	100
Age		
19-35	100	33
36- 50	133	42
51-59	84	25
Marital Status		
Single	81	26
Married	211	66
Divorced	10	3
Widowed	15	5
Qualification		
No Formal Education	96	30
Primary Sch	10	3
O-Level	90	28
Tertiary	121	39
Occupation		
Civil servant	156	49
Union/operators	32	11
Transporter/Driver	105	33
Trader	13	4
Employee of private sec	11	3
Income (per month)		
1-50,000	161	51
51,000-100,000	111	35
101,000-150,000	45	14

Source: Field Survey, 2021

Table 4.2 reveals that majority 70% of the respondents are males while their female's counterparts constitute about 30% of the sample population. The Table also reveals the age structure of the sample population indicates that 33% of the sample populations are between ages 19- 35, 42% (36-50), and 25.0% are between ages 51-60 years respectively.

Out of the 317 respondents, about 26% are single adults while majority 66% are married adults. Those who are divorced, widow constitute 3%, and 5% of the respondents respectively.

Information on the educational status of the population was also gathered analyzed and presented also in Table 4.2 above. The table reveals that about 30% of the study population has no form of formal education. About 3% of the population has primary education as their qualification while 28% have secondary school education (O-Level). Those with Tertiary education constitute 39% of the respondents in the study area. This implies that literacy rate is high in the study area.

Data on the occupation of the respondents in the study area was also collected, analyzed and presented in the table 4.2 above. The summary of the analysis shows that about 49% of the respondents are civil servant, union/operators constitute only 11%, while transporter/drivers account for 33% of the respondents. About 4% are traders, 3% are employers of private sector.

Income of respondents per month ranges from 1-50,000 naira which constitutes 51%, 51,000-100,000 naira earners are 35% and 14% of the respondents earns 101,000-150,000 naira per month.

4.3 Parking space characteristics

It is necessary at the initial stage of study to have data regarding the availability of parking space, up to what extent it is being used, how much is the duration of parking, assessment of parking demand, etc., for taking any effective actions for the furtherance of parking conditions. Different surveys are conducted to derive different properties related to parking which termed as parking characteristics or statistics. In general, following characteristics of parking are used (Gray et al., 2008).

4.3.1 Parking accumulation is the total number of vehicles parked at a particular interval of time. It is generally represented by the bar graph called accumulation curve/profile. It shows the variation in the parking accumulation for a given parking facility over a specified period of time

or survey period. Tong et al. (2004) developed a methodology to estimate the parking accumulation profile for whole day using surveys at parking lots and cluster analysis which consumes less time compared to observation surveys for whole day.

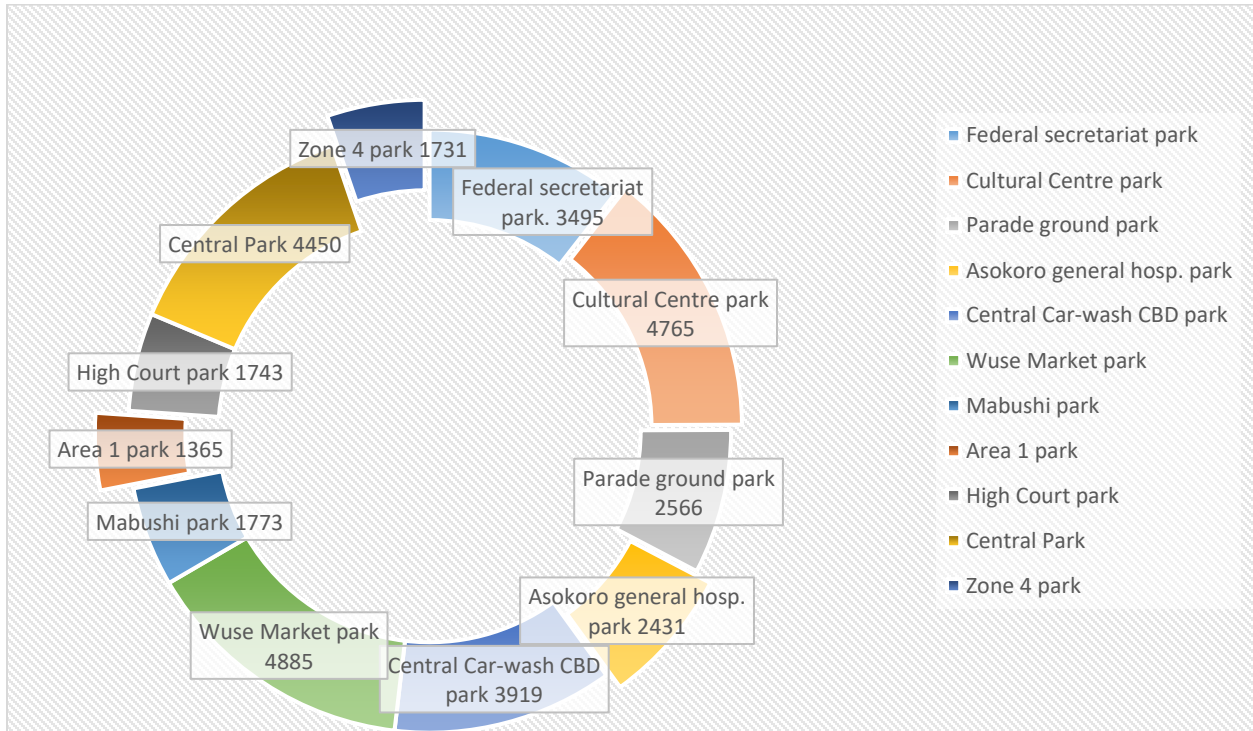


Figure 4.1: Parking Accumulation at FCC, Abuja.
Source: Authors survey 2021.

The figure 4.1 above shows the parking accumulation at FCC, Abuja. The Federal Secretariat park has parking accumulation of 3495, Cultural Centre Park has 4765, Parade Ground park has parking accumulation of 2566, Asokoro General Hospital park has 2431 parking accumulation, Central Car wash has 3919 parking accumulation, Wuse market has the highest parking accumulation of 4885, Mabushi park has 1773 parking accumulation, Area 1 park has 1365, High court has 1743 parking accumulation, Central park has 4450 parking accumulation and Zone 4 park has 1731 parking accumulation respectively.

4.3.2 Parking volume is the total number of vehicles parked through a given time duration or survey period. It is noteworthy that it doesn't account repetition of the same vehicle. So, it only reckoned the number of vehicles entered during the survey period.

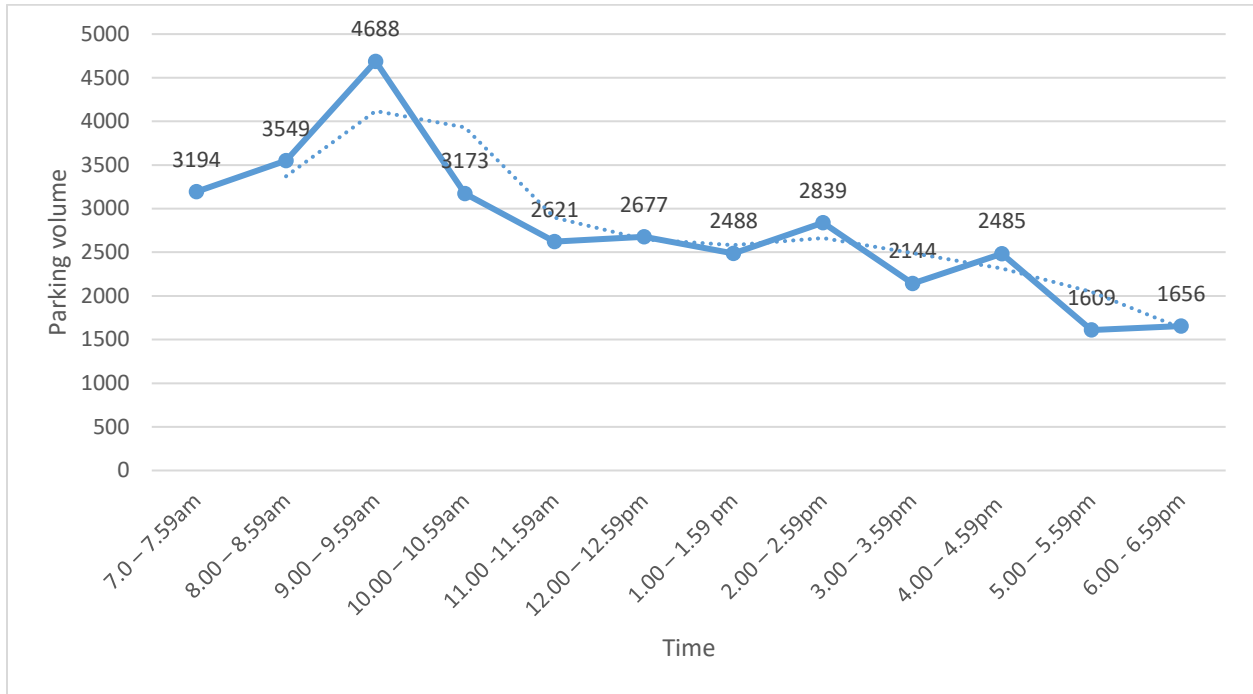


Figure 4.2: Parking volume at FCC, Abuja.
Source: Authors survey 2021.

The parking volume as expressed in figure 4.2, shows that 3194 parking volume at 7-7:59am, 3549 at 8-8:59am, 4688 is the parking volume at 9-9:59am and its equally the peak period of the parking volume, 3173 is the parking volume at 10-10:59am, 2621 is the parking volume at 11-11:59am, 2677 is the parking volume at 12-12:59pm, 2488 is the parking volume at 1-1:59pm, 2839 is the parking volume at 2-2:59pm, 2144 is the parking volume at 3-3:59pm, 2485 is the parking volume at 4-4:59pm, 1609 is the parking volume at 5-5:59pm, and 1656 is the parking volume at 6-6:59pm

4.3.3 Capacity is the total number of parking space/bays available for parking at a particular parking lot. The figure 4.3 below shows the design capacity of respective parking space under study area. The study reveals that, Zone 4 parking space has a design capacity of 600, Central parking space has capacity of 1600, Mabushi parking space has capacity of 500, High court parking space has capacity of 800, Area 1 parking space has capacity of 300, Wuse market parking space has capacity of 1400, Central car wash CBD parking space has a capacity of 1200, Asokoro general hosp. parking space has capacity of 700, Parade ground parking space has a design capacity of 800, Cultural central parking space has a capacity of 1700 and Federal secretariat parking space has a design capacity of 1500 respectively.

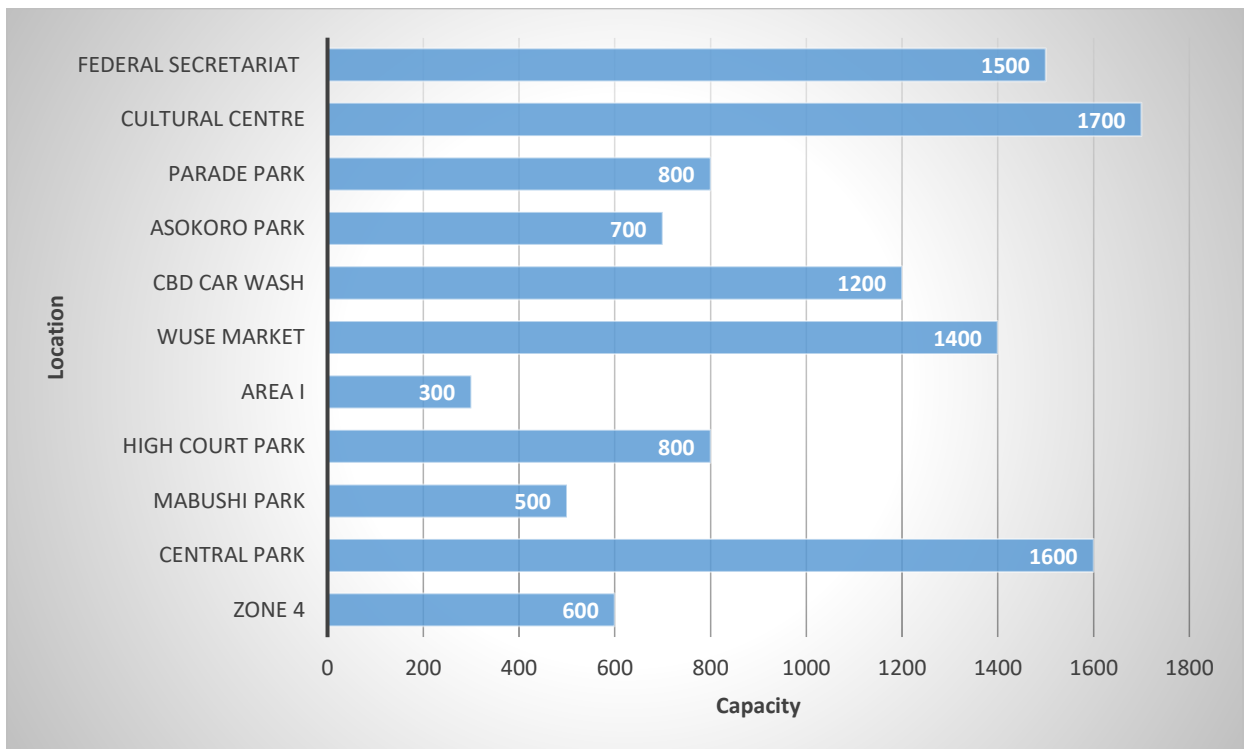


Figure 4.3: Design Park Capacity of study area
Source: Authors survey 2021.

4.3.4 Occupancy factor or parking index for particular parking facility is the total number of parked vehicles at a specified duration, i.e., accumulation divided by the capacity. It is also obtained by

dividing the parking load by the capacity for a given time interval. It is a measure of efficiency of

Location	Parked vehicle (Accumulation)	Capacity	Parking index (P.i)=Accumulation (P.a)/Capacity (C)
Federal secretariat park	3495	1500	2.3
Cultural Centre park	4765	1700	2.8
Parade ground park	2566	800	3.2
Asokoro general hosp. park	2431	700	3.5
Central Car-wash CBD park	3919	1200	3.3
Wuse Market park	4885	1400	3.5
Mabushi park	1773	500	3.5
Area 1 park	1365	300	4.6
High Court park	1743	800	2.2
Central Park	4450	1600	2.8
Zone 4 park	1731	600	2.9

parking lot and how effectively it is being utilized.

Table 4.3; Parking index of the study area

Source: Authors survey, 2021.

$P.i$ (Parking index)= $p.A$ (Parking accumulation) / C (Capacity)

$$P_i = P_a / C$$

The parking index the area under study are revealed in the table 4.3 above. Federal secretariat has a parking index of 2.3, Cultural Centre Park has a parking index of 2.8, Parade ground has a parking index of 3.2, Asokoro general hosp. park has a parking index of 3.5, Central car wash CBD has a parking index of 3.3, Wuse market has a parking index of 3.5, Wuse II has a parking index of 3.5, Area 1 park has a parking index of 4.6, High court park has a parking index of 2.2, Central park has a parking index of 2.8 and Zone 4 park has a parking index of 2.9.

4.3.4 Parking load represents the total area under the accumulation curve. It is generally obtained by multiplying the number of vehicles occupying parking space for the particular time interval with that time interval. It is expressed as vehicle-hours.

Parking load (P.l)= Vehicle occupying parking space (Vop) x Time (t) (v.hrs).

Table 4.4: Parking Load.

Location	Vehicle occupying parking space	Time (7am-6.59pm)hrs	P.l = Vop x t(v/hrs)
Federal secretariat park	3495	12	41940
Cultural Centre park	4765	12	57180
Parade ground park	2566	12	30792
Asokoro general hosp. park	2431	12	29172
Central Car-wash CBD park	3919	12	47028
Wuse Market park	4885	12	58620
Mabushi park	1773	12	21276
Area 1 park	1365	12	16380
High Court park	1743	12	20916
Central Park	4450	12	53400
Zone 4 park	1731	12	20772

Source: Authors survey, 2021.

The parking load is expressed in table 4.4 above, The Zone 4 park has a parking load of 20772, Federal secretariat park has a parking load of 41940, Cultural centre parking load is 57180, Parade ground park has a parking load of 30792, Yahuza park has a parking load of 29172, Central park has a parking load of 53400, the parking load of High court park is 20916, Area 1-park has 16380 as its parking load, Mabushi parking load is 21276, Wuse market park has a parking load of 58620 and Central car wash has a parking load of 47028 respectively.

These different parking characteristics are used to assess an existing configuration of parking areas or spaces and determine the adequacy and efficiency. It gives an idea about how long the parking space is occupied.

4.3.5 The Parking Method (Parking Characteristics).

Parking surveys are intended to supply all information required for suitable parking and terminal facilities effectively. Parking in both the business districts during the survey were under taken through the two basic parking methods, namely: On-Street and Off-Street parking facilities. On-Street Parking: Is the adequate space for vehicles at the side of the road. Terminal Is a parking space whether at the earth or off-street in a lot, garage, shopping center or private driveway. Bus-stop is a parking space provided for motorists along the road way in the Central Business Districts and also at designated place.

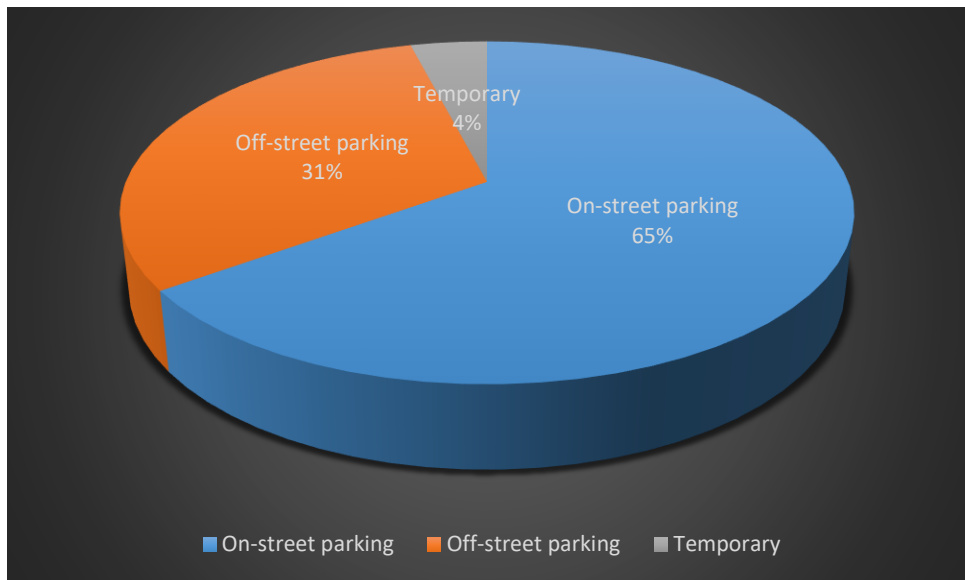


Figure 4.4: Parking Method
 Source: Authors survey 2021.

The respondents response as shown in figure 4.4, shows the types of parking method popular in the area of study. The pie chat shows that 65% of the parking are On-street parking, 31% of the parking are Off-street parking and 4% of the parking are temporary parking. This implies that major parking in the study area are On-street and Off-street parking.

Majorly both On-street and Off-street parking are observed in the study area (FCC, Abuja).

Table 4.5: Shows On-street and Off-street parking associated with the commercial development in the study area.

Commercial Developments in study area	On-street parking count	Percentage (%)	Off-street parking	Percentage (%)
Plazas	5750	25	2100	21
Offices	3200	14	1600	16

Hotels	1300	7	879	9
Petrol filling stations	1130	5	650	6
Banks	2376	10	820	8
Eateries	1678	7	1100	11
Recreation centre	4150	18	2070	20
Market	3300	14	1014	10
	22884	100	10233	100

Source: Authors survey 2021.

The table 4.5, shows some of the commercial developments in the study area includes, Plazas which constitutes 25% on-street parking and 21% off-street parking, Offices also has 14% on-street parking and 16% off-street parking, Hotel in the study area constitutes 7% of on-street parking and 9% of off-street parking, Petrol station also constitutes 5% on-street parking and 6% off-street parking, Banks constitutes 10% on-street parking and 8% off-street parking, Eateries in the study area constitutes 7% of on-street parking and 11% of off-street parking, Recreation centre constitutes 18% on-street parking and 20% off-street parking, and lastly, the Market constitutes 14% on-street parking and 10% off-street parking respectively. Therefore, we can express that the shortage of off-street parking facilities encourages on-street parking in the commercial areas.

4.3.6 Parking Gap, the gap shows the difference between the parking demand and the design capacity (supply) of the parking space, under study.

The table 4.6 below shows the parking gap between the parking demand and the design capacity (supply) of the study area. The federal secretariat park has 9% gap or short fall in the demand for parking space, cultural centre park space has 14% short fall, Parade ground has 8% short fall of parking supply, Yahuza park has 8% short fall of parking supply, Central car wash park has 12% short fall of parking supply, Wuse market parking space has 16% short fall of parking supply, Mabushi parking space has 6% gap parking supply, Area 1 park space has 5% gap of parking supply, High court parking space has 4% short fall of parking supply, Central park space has 13% short fall of parking supply and Zone 4 has 5% gap of parking supply. As revealed, the gap simply

tells that there is need to build more parking space or increase the design capacity of the parking space, so as to be able to accommodate more vehicles wanting to use the parking facilities.

Table 4.6: shows the Parking Gap between the Parking (Demand) and Design capacity (Supply) of the study area.

Location	Cumulative vehicle parking (Demand)	Design Capacity (Supply)	Gap	Gap percentage (%)
Federal secretariat park	3495	1500	1995	9
Cultural Centre park	4765	1700	3065	14
Parade ground park	2566	800	1766	8
Asokoro general hosp. park	2431	700	1731	8
Central Car-wash CBD park	3919	1200	2719	12
Wuse Market park	4885	1400	3485	16
Mabushi park	1773	500	1273	6
Area 1 park	1365	300	1065	5
High Court park	1743	800	943	4
Central Park	4450	1600	2850	13
Zone 4 park	1731	600	1131	5

Source: Authors survey 2021.

4.4 Impact/Problems of parking space associated with FCC, Abuja.

Parking has some effects as identified in FCC, Abuja like congestion, accidents, pollution, obstruction to fire-fighting operations etc.

1. Congestion: Parking in FCC, Abuja takes considerable street space leading to the lowering of the road capacity. Hence, speed will be reduced; journey time and delay will also subsequently increase. The operational cost of the vehicle increases leading to great economical loss to the community.

2. Accidents: Careless maneuvering of parking and un-parking leads to accidents which are referred to as parking accidents. Common type of parking accidents occur while driving out a car from the parking area, careless opening of the doors of parked cars, and while bringing in the vehicle to the parking lot for parking.

3. Environmental pollution they also cause pollution to the environment because stopping and starting of vehicles while parking and un-parking results in noise and fumes. They also aced the aesthetic beauty of the buildings.

4. Obstruction to firefighting operations Parked vehicles may obstruct the movement of firefighting vehicles. Sometimes they block access to hydrants and access to buildings.

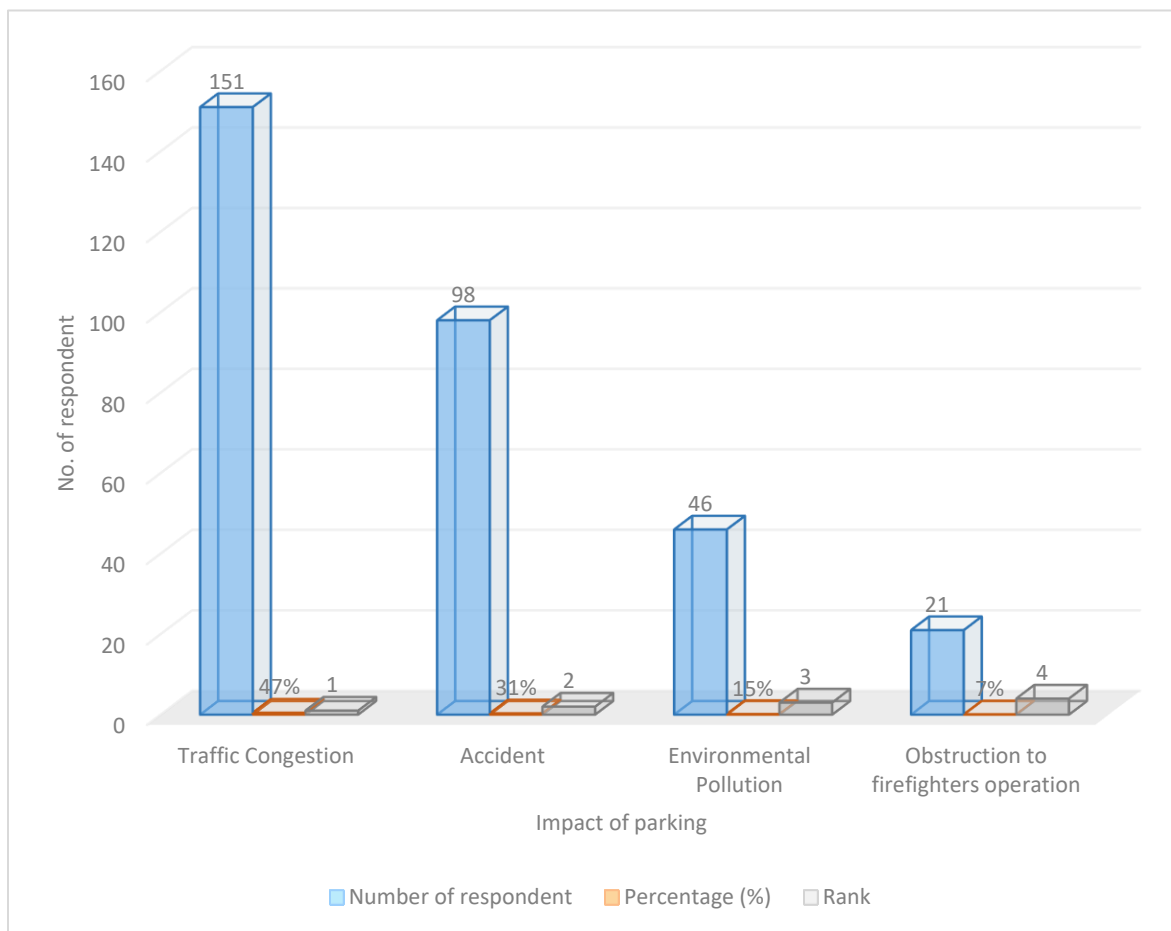


Figure 4.6: Impact of packing at FCC, Abuja.
Source: Author survey, 2021.

Figure 4.6 shows that, the Traffic congestion has 47% impact on parking and it is the highest as compared to others, accident has 31% of impact on parking, Environmental pollution has 15% impact on parking and 7% impact on parking is constituted by Obstruction to fire operation in the respective area of study. Furthermore, the impact of parking in the study area are ranked, Congestion is ranked 1st, Accident is ranked 2nd, Environmental pollution is 3rd and the 4th ranked is Obstruction to fire operation.

4.5 Causes of Parking Problems

Parking problem in FCC, Abuja means actually that there is a gap between parking demand (number of cars in need for parking spaces) and parking supply (number of parking spaces sufficient to cars in need to park). This gap is due to several reasons:

- i. FCC, Abuja have been planned with narrow streets where there were few cars moved. Also, population densities of these cities at that time were not so high compared with the current densities of the same cities and of the same areas. As city streets cannot be changed or altered over time, except for some important reasons and in limited cases, these narrow streets become responsible for accommodating all kinds of vehicles in high densities for moving and parking load which exceeds their planned capacities.

ii. The concentration of activities and facilities in FCC, Abuja, which require high rate of cars in the same area such as concentration of commercial facilities with office buildings and governmental institutions in the city.

iii. The old plan of FCT wasn't for the recent population growth, and the existing traffic volume, therefore, there is a miscalculation of parking demand expected in the FCC areas due to the unexpected elevated rate of car ownership especially among the population of high and middle-income classes. This is due to the failure of mass transit system offered in these new areas to make the people of these classes depend on it in their working or leisure trips.

iv. Also, in the plans of FCC, Abuja, the tendency in providing parking spaces depends always on off-parking and parking areas on street level. There are no lands allocated for parking structures with several floors to absorb the increasing number of cars searching for parking at least in areas with concentrated facilities.

v. In FCC, Abuja. The violation of building codes and zoning regulations which stipulates, for each area, specific uses of buildings and specific numbers of floors with provision of garages in basements. This violation contributes to change all calculations set by planners for providing sufficient parking spaces for cars in these areas.

4.6 Parking facilities

In FCC, Abuja, Parking facilities can be both indoor and outdoor, public or private. It can be a parking garage, or a parking space that belongs to a person's house. Normally, the parking spaces are marked on the ground with white or yellow lines that form squares that each fit one car. Parking

lots are common near shops, bars, restaurants, Offices and other facilities that require parking. There are parking lots that are open throughout the year, but there are also improvised parking lots that are specially assigned for an event.

The parking facilities identify in FCC, Abuja includes

- i. On-street parking
- ii. Off-street parking
- iii. Private car park
- iv. Public car park.

Availability of Parking Facilities

Table 4.7 below, shows that the respondents in the study area are involved in off-street parking, which are very near to their destination and close to the carriageway. In assessing the adequacy of the parking facilities in FCC, Abuja 32% of the respondents believe that they are adequate respectively.

On-Street Parking is being practiced in both business districts, which 57% of the respondents believes its quick and easy to access by motorist. The private vehicles engaged in parking along the stretch of the roads in the areas. The Government also designated some spaces within the business districts for On-Street parking. However, the spaces are provided for the use of private cars only. These facilities are not laid out into lots and thus give rise to chaotic traffic situation and result to traffic congestion.

Table 4.7 Availability of parking space facilities

Parking facilities	No of response	Percentage (%)
On-street	181	57
Off-street	102	32

Public park	21	7
Private park	13	4
Total	317	100

Source; Author Survey 2021.

4.5.2 Usage of the Parking space facilities

Figure 4.7 revealed that 35% of the respondents uses the parking facilities because its nearness to their destination. While 31% and 23% of the respondent’s uses the facilities due to lack of parking space at their destination and to avoid traffic congestion respectively and lastly, 11% uses the parking facilities due to security reasons.

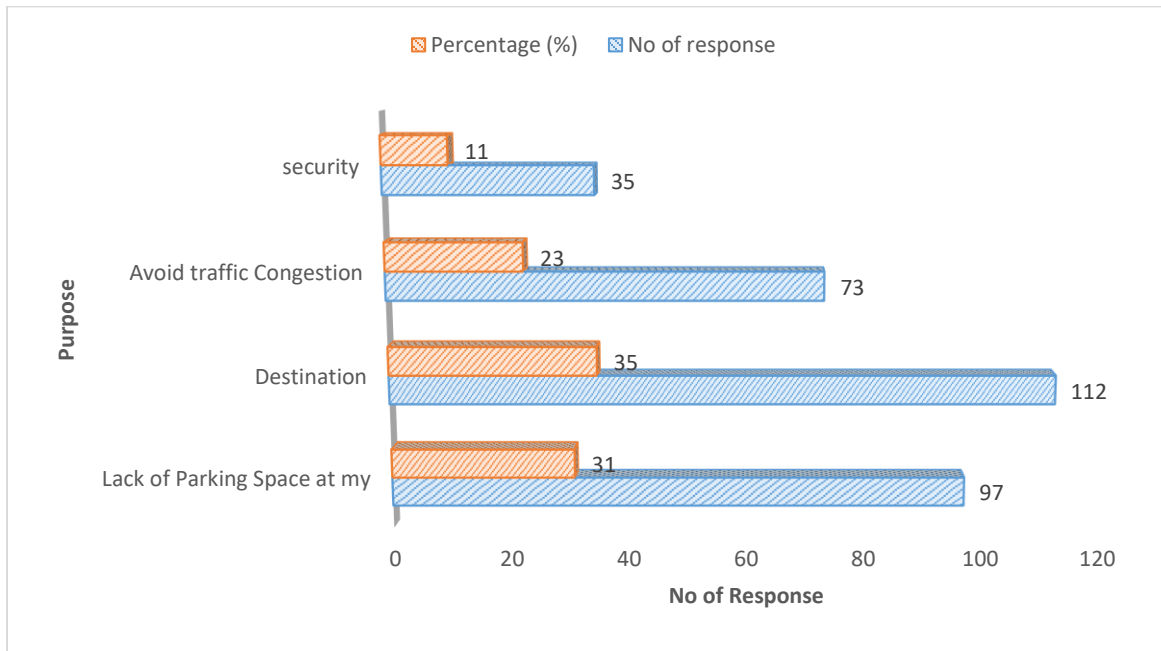


Figure 4.7: Facilities usage purpose

Source; Author Survey 2021.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Findings

The Assessment of parking management in FCC, Abuja have been examined thoroughly and problems inhibiting adequate and smooth parking in the area identified. The problems were looked

into in terms of the activities and parking characteristics (model) that exist within the converted areas and those areas designated for commercial use.

On the other hand, FCC, Abuja which is predominantly for commercial and office activities which are majorly affected by off-street and on-street parking problems. Off-street parking constitutes lesser problems within most of the study area which do not have adequate parking facilities for the high corresponding demand. While the On-street parking on the other hand, constitutes the most problems of parking being experienced in the commercial city. Among the various commercial activities in the area, Plazas generated the highest off-street and on-street parking at 25% and 21% respectively. The Plazas also commands the highest demand for on-street parking. The Petrol Filling Stations generated the least on-street and off-street parking in the area at 5% and 6% respectively. The parking accumulation reveals that, Wuse Market parking space has 4885 as the highest, while Area 1 park has the lowest parking accumulation of 1365. The parking volume 4688 occurred between 9am-9.59am as revealed in figure 4.2, also within 6pm-6.59pm the lowest parking volume of 1656 are recorded. The design parking space capacity reveals that, Cultural centre parking space has the highest capacity of 1700 and Area 1 parking space has 300 capacity which is the lowest design parking capacity in the area of study. The parking method overall result also revealed that the highest level of off-street and on-street parking generated in the study area are at 31% and 65% of total respectively. The causes of on-street parking are majorly due to insufficient parking space or off-street parking facilities, conversions and high volume of commercial activities. As table 4.6 reveals the Parking gap, that 16% is the highest gap which is recorded for Wuse market parking space, and Zone 4 parking space has 4% as the least parking gap.

The study revealed the nature of problems experienced as a result of parking in FCC, Abuja. These include: congestion, road accident, environmental pollution, and obstructions to firefighting operation. The impact of parking at FCC, Abuja reveals that Traffic congestion constitutes 47% which is the highest and Obstruction to firefighting is 7%. Plazas which mostly fell along the study area are grossly congested. This is due to method of parking and of commercial activities around them. The study area is equally prone to accidents and pollution as a results of carbon di oxide exhausted from the vehicles. When most roads in the study area are congested especially during peak periods, accesses to other exit streets are affected with difficulties to ply on. During this period, users of the study area are exposed to environmental hazards such as noise and fumes. Apart from parking problems, there are some implications. These include: blockade of foot paths and curbs, disorganization of traffic lights, loss of man hour, overstretching of available facilities and loss of revenue. The problem of parking can be explained in the following: non-provision of other types of parking facilities, outdated land use design, poor planning and enforcement of traffic regulations in the FCC, Abuja compromise and non-conformity to standards, in FCC, Abuja Plan.

5.2 Conclusion

The required parking space posed by the various parking characteristics in FCC, Abuja and the corresponding problems had been revealed and explained in this study. Federal capital city have always being the busiest and problematic commercial areas and had been used to showcase the numerous parking problems in other cities of Nigeria in general. Most of parking problems experienced in the study area were caused through off-street and on-street parking but mostly by the latter. Most of the off-street parking facilities in the area were highly demanded for because

they were in short supplies, thereby leading to the overstretching of the facilities. This led to vehicle owners parking on-street. The various policies, concepts, standards and management of parking were reviewed from other cities while the problems caused by parking characteristics were identified. The identification of parking problems in FCC, Abuja led to the proffering of adequate policy proposals and recommendations for corrective actions. This study helped in providing solutions to many parking problems in major cities of Nigeria and to deter property owners, businessmen and government agencies from aiding corruption and conversion of original land uses to another. Government has a big role to play towards revisiting the plan of the study area which is characterized by the change of use, congestion, accidents, environmental pollution, and obstruction of firefighters (accessibility). therefore, this study will provide avenue for government's timely review of FCC Plans. Federal Capital City fell short of modern methods and systems of parking and they could easily bounce back if adequate modern parking facilities were provided where these had been recommended accordingly in this study. The study also provided the basis for proper urban management, land use and urban administration which could bring about possible directions for other research work. Finally, it had provided the enabling research and reference document for scholars in planning and urban management studies.

5.3 Recommendations

The study recommendations are as follow:

In light of the findings of this research work, the following recommendations are suggested to enhance parking management in Federal Capital City, Abuja so as reduce and possible eradicate the problems of parking space confronting the study areas.

1. Federal Capital Development Authority (FCDA) should specify and enforced the provision of parking space in conjunction with new building. And also old building in FCC should be refurbished to accommodate adequate parking space.

2. Federal Capital Development Agency should ensure strict compliance of contravention to fit in, in order not to affect the land use Master plan.

3. Enlightenment and Educational awareness are basic tools for achieving effective traffic management control in Federal Capital City, Abuja. In FCC, Abuja most motorist are not conversant with the traffic rules and regulations and disobedience to traffic signs/signals resulted into traffic congestion, accident, obstruction of access in most of the roads. However, the laudable educative programmes embark upon by Government and Private Organization will help to change the attitude of motorists.

4. Location of Parking Facilities in FCC, Abuja: The space for parking vehicles is a basic requirement in FCC due to its commercial activities. Parking facilities must be provided to help the area perform its prime function, that of accessible, attractive and profitable market place. Therefore parking facilities should be located at easily accessible off-street point and convenient to the motorist ultimate destination. Off-Street parking should be provided in meeting the demand, these are parking facilities that are located completely out of the roadway. Good access streets should serve the facility and it is desirable to locate facility such that no exit or entrance is within a distance of at least 50m from intersection. This is in conformity with road design concept. On-Street parking can only solve a part of parking problem of major cities if properly manage. In

Federal Capital City, Abuja the problem of management does not encourage on-street parking. For a suitable parking and satisfactory answer to traffic congestion in FCC, i.e particularly the studied area, various types of off-street parking facilities become unavoidable. The types of off-street facilities to be considered are:

i. Surface Car Parks ii. Multi Storey Car Parks iii. Roof Parks iv. Under-ground Car-ground Car-parks. These facilities are costly to provided and maintain. However, the service rendered is so enormous to traffic management.

5. Enforcement of Traffic Rules and Regulations by Disciplined Law Enforcement Agent: Indiscriminate use of road facilities is very common amongst motorist and very often, the uncoordinated manner through which the road system is used creates further crisis. Thus, the need for an effective means of enforcement. To this end, Police and the traffic Management Authorities are the frontlines in traffic laws. They should be mandated to enforce the rules and regulations binding the vehicular traffic operations without any fear or favour in order to mate out penalties and punishment to defaulters.

6. Introduction of Information Technology in study area: The use of computers and other information technological tools like communication gadgets and radar for traffic monitoring are highly relevant for solving complex issues relating to parking problem and traffic management.

5.4 Contribution to the knowledge

i. The study was the first of his kind to be carried out in the year 2021, using FCC, Abuja.

- ii. The study reveals that, the Parking demand in FCC, Abuja is more than the Supply.

- iii. The research also revealed that, there is great statistical significant relationship between parking space and traffic congestion in FCC, Abuja.

- iv. The study reveals that, the insufficient or non-availability of off-street parking space encouraged the on street parking in FCC, Abuja.

5.5 Area for Further Study

This study was carried out in Federal capital city, Abuja and the research revealed the various parking characteristics and the problems which they contribute in the study areas. Due to the scope of the study and the limitations of the study, the results are not able to represent the generalized situation for all urban cities in Nigeria e.g Kano, Lagos, Port Harcourt. This study only looks at the characteristics of parking, the impact or problems associated with them and parking facilities. However, further studies could focus on the following:

- i. The use of multi-storied and underground parking system in FCC, Abuja to mitigate parking and transportation challenges

- ii. Examine the factors responsible for the conversions of buildings in FCC, Abuja and the effect on parking management.

- iii. The Impact of Public Private Partnership in parking management in Federal Capital City, Abuja.

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**Appendix I: Federal University of Technology Minna,
Centre for Human Settlements and Urban Development.**

**Questionnaire survey on Assessment of Parking Space Management, The case of Federal
Capital City (FCC), Abuja.**

ENFORCEMENT PERSONNEL/OPERATORS QUESTIONNAIRE

This questionnaire is meant to obtain information on Parking Space Management in FCC, Abuja.

The questionnaire is essentially for research purposes and all responses will be treated with
utmost confidentiality and it will be used only for academic purpose. Thank you.

SECTION A: General Information

Name of Parking space
Name of interviewer:
Rank/Designation:
Date

SECTION B: Socio-Economic characteristics of operators

(1) Age

(a) 1-18years (b) 19 – 35 years (c) 36 – 50 years (d) 51 – 59 years (e) 60 years & above

(2) Sex:

(a) Male (b) Female

(3) Marital Status: (a) Single (b) Married (c) Divorce (d) Widow/Widower

(4) What is your highest Educational qualification?

(a) No formal education
(b) Primary
(c) Secondary
(d) Tertiary

(5) Income:

(a) N1 – 50,000 (b) N51,000 – 100,000(c) N101,000 – 150,000 (d) N151,000 – 200,000 (e)
N201,000 – 250,000 (f) N251,000 and above

SECTION C: Parking Space Operational Characteristics Information

1: What are the types of parking?

a) On-street parking
b) Off-street parking
c) Temporary parking

2. Whats the design capacity of the park?

- a) 0-500
- b) 501-1000
- c) 1001-1500
- d) 1501-2000
- e) 2001 above

3. Is their Equipment for parking? a. Yes b. No

4. What are the type of parking space equipments available?

5. What is the parking space design capacity?

6. What is the ownership structure of the parking space?

- a. Union owned operated
- b. Private owned operated
- c. Government owned operated
- d. Others, specify

7. Are you licensed to operate?

- a) Yes
- b) No

8. Who regulate your operational activities?

- a) AMAC
- b) FCDA
- c) Union
- d) Police force
- e) Others specify.....

9. Do you charge for parking? a. Yes / b. No

10. How much do you charge for parking space?

11. What is the basis of pricing/charging fare?

- a) Time
- b) Days
- c) Flat rate
- d) Monthly rate
- e) Others specify.....

12. How do you collect parking charges?

- f) a. Cash
- g) b. POS
- h) c. Automatic
- i) d. others, specify

13. Kindly rates the following impact of packing space in Federal Capital City (FCC), Abuja.

[SA] Strongly Agree, [A] Agree, [DA] Disagree, [SD] Strongly Disagree and [U] Undecided

Impact of Parking Space	SA	A	DA	SD	U
Accident					
Traffic congestion					

Pollution					
Obstruction of Fire fighter					

14. Kindly rates the following challenges associated with Enforcement of Parking space Management in Federal Capital City (FCC), Abuja.

[SA] Strongly Agree, [A] Agree, [DA] Disagree, [SD] Strongly Disagree and [U] Undecided

Challenges	SA	A	DA	SD	U
1. Wrong/Illegal parking					
2. Weak enforcement					
3. The cost of maintaining park is very high					
4. Accident					
5. Absence of Adequate parking handling facilities					
6. Traffic congestion					
7. Double parking					
8. Refusal/Avoidance to pay for parking space					
9. Lack of traffic law					
10. Scarcity of change					

15. What do you think are the solutions to the challenges above:

- i.**
- ii.**
- iii.**
- iv.**
- v.**
- vi.**
- vii.**

Appendix II

Federal University of Technology Minna, Centre for Human Settlement and Urban Development.

Questionnaire survey on Assessment of Parking space Management in Federal Capital City (FCC), Abuja

USERS QUESTIONNAIRE

This questionnaire is meant to obtain information on Assessment of Parking space Management in Federal Capital City (FCC), Abuja. The questionnaire is essentially for research purposes and all responses will be treated with uttermost confidentiality and it will be used only for academic purpose.

Thank you.

SECTION A: General Information

Name of Parking space

Name of interviewer:

Date

SECTION B: Socio-Economic Characteristics of Users

(1) Age

- (a) 1-18years (b) 19 – 35 years (c) 36 – 50 years (d) 51 – 59 years (e) 60 years & above

(2) Sex:

- (a) Male (b) Female

(3) Marital Status: (a) Single (b) Married (c) Divorce (d) Widow/widower

(4) What is your highest Educational qualification?

- (a) No formal education
(b) Primary
(c) Secondary
(d) Tertiary

(5) What is your Occupational type?

- (a) Transporter/Drivers
(b) Artesian
(c) Employee of private sector
(d) Civil servant
(e) Traders
(f) Unemployed

(6) Income:

- (b) N1 – 50,000 (b) N51,000 – 100,000(c) N101,000 – 150,000 (d) N151,000 – 200,000 (e) N201,000 – 250,000 (f) N251,000 and above

SECTION C: Parking Space Users Questionnaire

Please tick as appropriate:

(7) Type of passenger

- a. Arriving
- b. Departing

(8) Type of parking

- a. On-street
- b. Off-street
- c. Temporary

(9) Purpose of Trip make per day

- a. Commercial centre
- b. Work
- c. Market
- d. Recreation
- e. Religion

(10) Where are you coming from?.....

(11) Where are you going to?.....

(12) Queuing time to park?

- a. 1 – 10 minutes
- b. 11 – 20 minutes
- c. 21 – 30 minutes
- d. 30 minutes and above

(13) Do you pay fare for parking?

- a. Cash
- b. Swipe card
- c. Automatic
- d. Others

(14) How much do you pay as your fare for parking?.....

(15) How does the fare charge?

- a. Per hour
- b. Minutes
- c. Days
- d. Months
- e. Flat rate
- f. None of the above

16. Kindly rates the following impact of packing spacein Federal Capital City (FCC), Abuja.

[SA] Strongly Agree, [A] Agree, [DA] Disagree, [SD] Strongly Disagree and [U] Undecided

Impact of Parking Space	SA	A	DA	SD	U
Accident					
Traffic congestion					
Pollution					
Obstruction of Fire fighter					

17. What are the challenges encounter at the parking space with service rendered: [SA] Strongly Agree, [A] Agree, [DA] Disagree, [SD] Strongly Disagree and [U]Undecided

Challenges	SA	A	DA	SD	U
1. Traffic congestion					
2. Accident.					
3. Environmental pollution					
4. Lack of access					
5. Wrong/ Illegal parking					
6. Scarcity of space					
7. Lack of parking facilities					
8. Too long waiting time					
9. There is no security					
10. Weak enforcement					

18. What do you think are the solutions to the challenges above:

- viii.
- ix.
- x.
- xi.
- xii.
- xiii.
- xiv.

Appendix III: OBSERVATORY SURVEY FOR PARKING / TRAFFIC COUNT

NAME OF PARKING SPACE.

TIME OF SURVEY.....

DATE OF SURVEY.....

Type of Passenger	6-6.59am	7-7.59am	8-8.59am	9-9.59am	10-10.59am	11-11.59am	12-12.59pm	1-1.59pm	2-2.59pm	3-3.59pm	4-4.59pm	5-5.59pm	6-6.59pm
Arriving													
Departing													
No. Of vehicles arriving													
No. Of vehicles departing													