

**OPTIMIZING CARRYING CAPACITY PLANNING FOR SUSTAINABLE
TRANSPORT INFRASTRUCTURE: A SPATIAL DISTRIBUTION OF CAR PARKS IN
THE UNIVERSITY OF LAGOS, MAIN CAMPUS.**

BY

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Abstract

Effective parking infrastructure is a critical component of urban transportation systems, especially in land-use-intensive environments such as university campuses. This study assesses the spatial distribution and carrying capacity of car parks at the University of Lagos, Nigeria, in light of increasing vehicular traffic and inadequate parking supply. Using a mixed-method approach, the research integrates geospatial data acquired from aerial imagery, GPS field surveys, and user questionnaires with secondary sources to evaluate parking demand, facility management, and policy frameworks. A total of 70 parking sites with an aggregate capacity of 2,313 vehicles were identified, revealing substantial deficits in supply relative to demand. Key challenges include the absence of centralized management, poor policy enforcement, and a lack of intelligent transport systems (ITS) to streamline usage. Recommendations include implementing a digital parking guidance application, revising spatial allocation standards, and introducing dynamic pricing schemes to optimize utilization. These findings underscore the need for integrated parking strategies that align with smart city goals and sustainable mobility frameworks on university campuses.

Keywords; Parking Infrastructure, Carrying Capacity, Intelligent Transport Systems (ITS), Urban Transport Planning, and Smart Parking Solutions

Introduction

Urban mobility systems face increasing complexity due to the surge in private vehicle ownership, infrastructural limitations, and land-use competition challenges that are particularly pronounced in densely populated institutional environments such as university campuses. As essential components of transport infrastructure, parking facilities serve not only as end points in trip chains but also as influential determinants of traffic congestion, spatial planning, and sustainability outcomes (Litman, 2019).

In Nigeria, rapid urbanization and institutional expansion have amplified pressures on university transportation systems. The University of Lagos (UNILAG), situated within the metropolitan hub of Lagos State, exemplifies this strain. With a constantly growing population of students, staff, service providers, and visitors, the demand for vehicular access and convenient parking continues to outpace infrastructural capacity. This mismatch between parking demand and supply results in congestion, inefficient space utilization, prolonged cruising in search of spaces, environmental pollution, and loss of productivity.

Despite the application of various reactive measures such as vehicular restrictions, clamping, and fines, parking management on campus remains inadequate. These interventions have not addressed the root issues of poor allocation, lack of integrated strategy, and the absence of technological solutions. Furthermore, limited data on the spatial distribution and capacity of car parks across campus hinders evidence-based planning and the implementation of scalable innovations like electronic parking systems or intelligent transport solutions. In response to these critical challenges, this study aims to evaluate and improve the utilization of car parking facilities in the University of Lagos main campus through a comprehensive assessment of the current situation.

Specifically, the study seeks to identify and map the spatial distribution and carrying capacities of existing car parks, assess user challenges related to parking accessibility and usability, determine the institutional responsibilities for car park management, and examine the existing policy and regulatory frameworks guiding car park usage and enforcement. It also aims to recommend innovative, scalable, and data-driven strategies for enhancing parking efficiency and promoting sustainable campus mobility.

To achieve these objectives, the study is guided by the following research questions:

1. What is the number, spatial distribution, and carrying capacity of car parks within the University of Lagos main campus?
2. What challenges do users face regarding car park accessibility, availability, and usability?
3. Which departments or administrative units are responsible for the planning, maintenance, and regulation of campus car parks?
4. What policy frameworks currently exist to govern car park usage and enforcement?
5. What innovative and data-driven strategies can be adopted to enhance the efficient and sustainable use of parking facilities on campus?

Globally, urban centers and institutions have adopted strategies such as multilevel parking structures, electronic guidance systems, and Intelligent Transport Systems (ITS) to optimize parking and reduce search times (Shoup, 2005; Kepuska & Alshamsi, 2016). However, the adoption of such technologies in Sub-Saharan Africa, including Nigeria, remains limited due to policy, institutional, and financial constraints.

This research therefore employs a mixed-method approach, merging geospatial analysis, field surveys, and stakeholder interviews. It contributes to the broader discourse on sustainable campus mobility and offers practical, evidence-based recommendations that can serve as a model for other higher education institutions in Nigeria and across Sub-Saharan Africa.

Study Area

The University of Lagos, Main Campus was founded in 1962, just two year after Nigerian Independence from Britain, it was one of the first five Universities created in the country. It is located between Latitudes 6° 30' 15" North and 6° 31' 20" of the Equator and Longitude 3° 23' 05" and 3° 24' 20" East of the Greenwich Meridian.

The University of Lagos, Main Campus shares boundary with the Akoka and Ilaje communities to the North, Abule-Oja /Abule-Ijesha communities to the West, Onike and Iwaya communities to

the South and the Lagos Lagoon to the East. The University of Lagos, Main campus is largely surrounded by the scenic view of Lagos lagoon and it is on an Eight hundred and two (802) acres of Land in Akoka, which is used for both academic and residential purposes. The University of Lagos, Main Campus takes the major part of its acquired property, but to its North-western part is the Federal College of Education, the Home for physically handicapped children, the Lagos State Low-Cost Housing (Pilot Project), the St. Finbarr's College and the State Government Primary School at the Main Gate are all occupying about 65 acres of University of Lagos, Main Campus property. There is also a Church Headquarter close to the Second gate of the University of Lagos, Main campus. Its proximity to and being surrounded by these various land uses and having a drive-through traffic increases the demand for parking in the University of Lagos, Main Campus.

The University of Lagos, Main Campus which comprises of Nursery, Primary and Secondary School, Undergraduate Students, Postgraduates Students, Academic and Non-Academic Staffs, some of which reside within the School Premises. All their activities attract a lot of traffic and requires Car Parking.

Fig. Error! No text of specified style in document..1: Map of the University of Lagos, showing car parks and activity places



Source: Olayinka & Victor (2021)

Figure 1: The Study Area

Literature Review

Theoretical Framework

A sound understanding of urban parking dynamics requires a multidisciplinary conceptual approach. Two key theoretical frameworks underpin this study: the Transport System Model and Ullman's Spatial Interaction Theory.

Transport System Concept

The transport system functions as the connective tissue of urban areas, facilitating the movement of people, goods, and services across spatially distributed nodes of activity. According to Rodrigue et al. (2006), a functional transportation system comprises both "hard" infrastructure (e.g., roads, parking lots) and "soft" systems (e.g., policies, information flows) that jointly enable mobility. Parking facilities, though often overlooked, are integral nodes in these systems, serving as both origins and destinations of trips and significantly influencing urban accessibility.

Spatial Interaction Theory

Ullman's (1956) theory of spatial interaction explains the movement of people and goods between areas based on three key principles: complementarity, absence of intervening opportunities, and transferability. These principles are particularly relevant to parking studies within urban campuses, where land use patterns, accessibility, and cost of movement determine user decisions. The uneven spatial distribution of parking lots and variations in their utility underscore the importance of aligning demand with supply in geographically and functionally differentiated spaces like university campuses.

Empirical Review

Evolution and Typologies of Parking Systems

Historically, the evolution of parking infrastructure mirrors the growth in automobile usage. In the early 20th century, surface parking lots dominated cityscapes, eventually giving way to structured parking systems and, more recently, smart parking technologies (Jakle & Sculle, 2004). Modern

parking solutions now range from multilevel garages and robotic parking to automated guidance and e-payment systems. These advancements are intended to reduce land consumption, improve traffic flow, and enhance user convenience (Kempf & Sinha, 2019).

In campus environments, parking infrastructure must accommodate diverse user groups, students, staff, and visitors each with distinct temporal and spatial demand patterns. Balsas (2003) notes that universities, akin to small cities, must adopt comprehensive transport planning frameworks to manage internal circulation and parking stress.

Parking Demand and Land Use

Parking demand is strongly linked to land use types and intensity. Commercial, institutional, and recreational areas generate varying volumes and durations of vehicle parking (Litman, 2019). On university campuses, facilities such as lecture halls, dormitories, and administrative offices each exert different pressures on parking supply (Shoup, 2005a). Notably, Rye (2010) highlights that parking demand is a function not only of physical infrastructure but also of user behavior, transport policies, and socio-economic factors.

In Nigeria, unregulated parking and poor spatial planning exacerbate congestion and reduce access efficiency in institutional settings (Okoko, 2006). The lack of integrated land use and parking policies results in mismatch between supply and demand, particularly during peak hours.

Challenges of Parking in Urbanizing Campuses

As urbanization intensifies, the spatial and demographic expansion of campuses often outpaces the growth of supporting infrastructure. Soyebó and Ajayi (2015) observe that this imbalance contributes to chronic parking shortages, unauthorized parking, and traffic bottlenecks. Similar challenges are reported in studies across Sub-Saharan Africa, where universities face increased motorization amid infrastructural stagnation.

Moreover, private vehicle ownership among university students and staff driven by socio-economic mobility has surged without commensurate planning. Shoup (2005) likens the spatial behavior of large university campuses to that of mid-sized cities, emphasizing the need for comprehensive parking strategies, including pricing, enforcement, and technology-based solutions.

Intelligent Transport Systems (ITS) and Smart Parking

Smart parking is an emerging concept that integrates technology to optimize parking efficiency. ITS applications use sensors, real-time data, and mobile platforms to inform drivers of parking availability, thus reducing cruising time and environmental impact (Kepuska & Alshamsi, 2016). Wireless Sensor Networks (WSNs), RFID-based entry systems, and GIS-powered mapping are commonly used in advanced contexts.

Despite their promise, these technologies remain underutilized in most African institutions due to budgetary, policy, and technological limitations. However, their integration into parking management holds significant potential for improving user experience, minimizing land use, and promoting sustainable campus mobility.

Parking Policy and Regulatory Interventions

Effective parking policies align infrastructure planning with enforcement, pricing, and user education. Developed cities apply zoning laws, minimum parking requirements, time-based tariffs, and restrictions on on-street parking to manage congestion (Arnott & Rowse, 1999). In campus settings, similar strategies include designated staff/student parking zones, digital permits, and penalties for illegal parking.

In the Nigerian context, parking policies remain fragmented. As observed in UNILAG, enforcement mechanisms (e.g., fines and clamping) exist but are inconsistently applied, and policy awareness among users is low. A more structured framework involving stakeholder engagement, transparency, and digital integration is essential for system-wide improvements.

Summary of Gaps in Literature

While international studies provide robust models for parking management, few have explored the application of these systems in West African university settings using empirical geospatial methods. Additionally, there is limited documentation of how spatial data, user behavior, and policy can be integrated to improve parking outcomes in rapidly urbanizing institutions.

This study seeks to bridge these gaps by providing a geospatial and institutional analysis of car parking at the University of Lagos, with a focus on translating findings into actionable recommendations grounded in intelligent transport solutions and sustainable campus planning.

Research Methodology

Research Design

A mixed-method research design was adopted to provide a robust and comprehensive evaluation of the spatial distribution and management of parking infrastructure. By integrating quantitative and qualitative approaches, the study ensured a multidimensional analysis, enhancing both the reliability and validity of the findings through triangulation of data sources. The research process began with spatial data acquisition, which involved the systematic mapping and inventory of existing car parks within the study area to establish a spatial baseline. This was followed by user surveys, where structured questionnaires were administered to vehicle users to capture their experiences, challenges, and perceptions regarding the available parking facilities.

To complement the survey data, key informant interviews were conducted with university security personnel and facility managers to gain institutional insights into parking management and enforcement strategies. A policy review was also undertaken to examine relevant institutional regulations governing parking, providing a contextual understanding of the administrative framework in place. Finally, all findings were integrated through data synthesis and spatial analysis using Geographic Information Systems (GIS) and statistical tools, allowing for a comprehensive assessment of spatial patterns, user experiences, and policy implications related to parking infrastructure.

Data Sources and Types

Data for this study were obtained through a combination of geospatial techniques, remote sensing resources, and social research instruments to ensure a comprehensive understanding of the parking infrastructure on campus. Geospatial data were collected using a Garmin GPS 72 device to record the geographic coordinates of all identified car parks. The location and boundaries of each site were mapped using high-resolution satellite imagery and subsequently verified through detailed field reconnaissance. Aerial photographs further complemented the spatial data by assisting in the identification of surface features and the accurate delineation of parking site boundaries. To understand user behavior and perceptions, structured questionnaire surveys were administered to a diverse sample of users, including students, staff, and visitors across both academic and service zones of the campus. These surveys aimed to capture data on parking habits, user preferences, and the challenges encountered in daily parking routines. Additionally, key informant interviews were conducted with personnel from the university's security department, facility management unit, and relevant administrative offices to provide institutional perspectives on parking policy, enforcement, and infrastructural limitations.

In addition to primary data collection, secondary data were also reviewed to enrich the study's analytical framework. These included relevant policy documents, campus layout plans, published and unpublished literature, and precedent studies on urban parking, particularly within educational institutions. This background information was instrumental in contextualizing the findings and supporting comparative analysis with similar environments.

Sampling Strategy

The study employed a non-probability purposive sampling technique to capture responses from relevant users within the campus. A total of 77 questionnaires were administered one per each identified department or major user group with adjacent car parks ensuring broad representation across different land-use functions. Participants were selected based on their direct interaction with the parking facilities.

Data Processing and Analytical Tools

A range of software tools and analytical methods were employed to process and analyze both spatial and non-spatial data, ensuring accurate interpretation and presentation of the research findings. ArcGIS 10.7 was the primary tool used for generating spatial maps, analyzing the locations of car parks, and estimating distribution patterns and proximity to key facilities across the study area. Google Earth Pro supplemented this process by providing high resolution satellite imagery, which facilitated preliminary mapping and spatial verification. To ensure compatibility and accuracy in spatial analyses, the Franson Coordinate Converter was utilized to convert Universal Transverse Mercator (UTM) coordinates into geographic latitude and longitude for seamless integration into the GIS environment.

For the analysis of non-spatial data, particularly questionnaire responses, SPSS and Microsoft Excel were employed to conduct descriptive and inferential statistical analyses, including frequency distributions and cross-tabulations. These tools enabled the identification of trends and patterns in user behavior and perceptions. Additionally, Microsoft Word was used for documentation, interpretation of results, and preparation of the final report for publication.

Ethical Considerations

Participation in the study was voluntary, and respondents were informed about the purpose and scope of the research. Anonymity and confidentiality of all personal data were maintained throughout the research process by ethical research standards.

Methodological Framework Summary

The overall workflow of the methodology is presented in Figure 1 (not shown here but can be referred to from the original project). It illustrates the sequence from data acquisition to data integration, analysis, and recommendation generation.

Results and Discussion

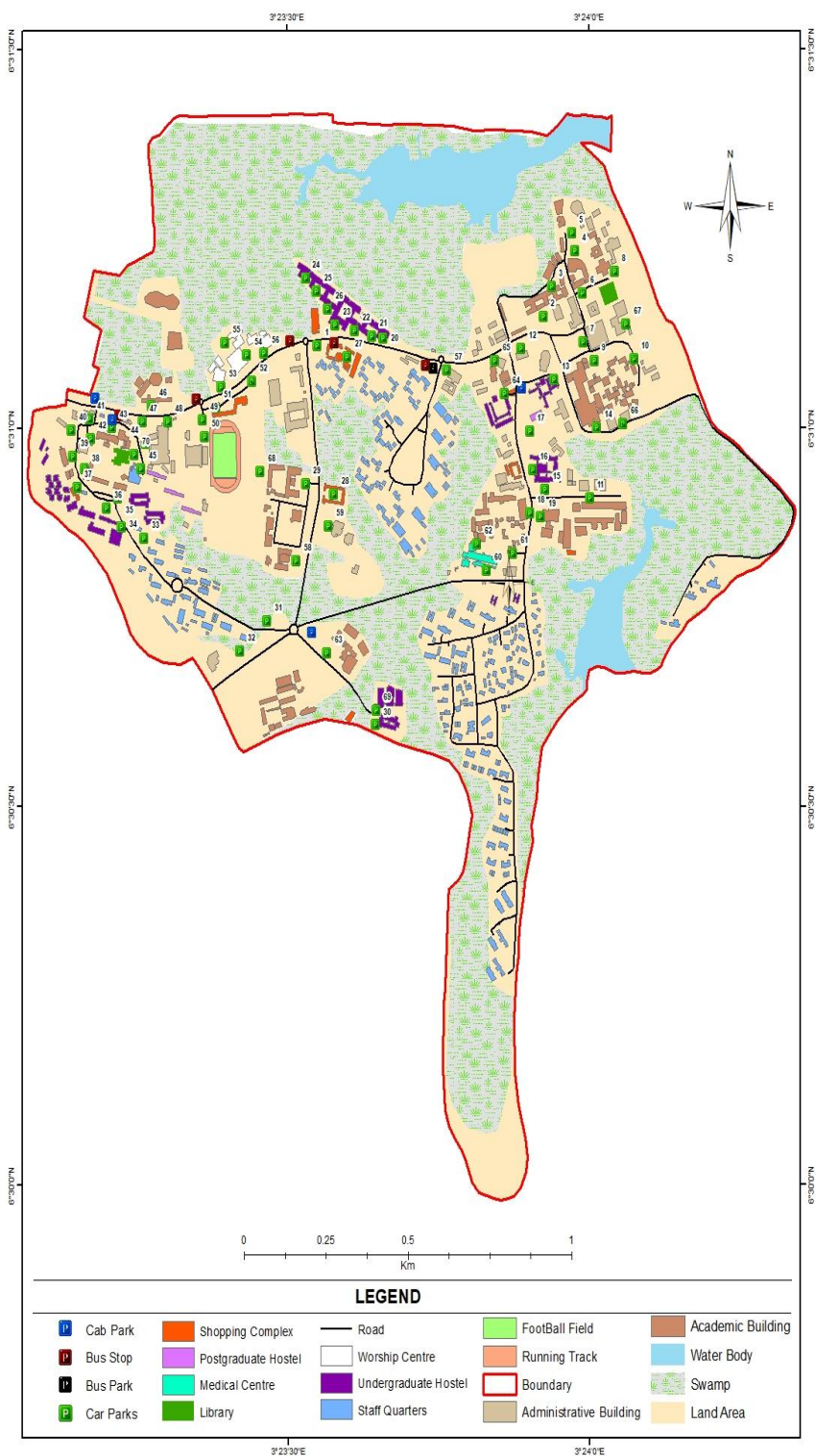
Overview of Parking Infrastructure at the University of Lagos

The spatial analysis identified 70 formal car parks distributed across the University of Lagos main campus, with a total carrying capacity of 2,313 vehicles. These facilities are unevenly distributed across land-use zones, with the majority clustered around academic, administrative, and residential areas. The Faculty of Arts (118 slots) and the Faculty of Science (113 slots) had the largest capacities, while many student residential and commercial areas had considerably fewer spaces.

The spatial distribution, mapped using GIS tools, revealed that most car parks are not strategically aligned with areas of highest vehicular demand. Key activity nodes such as lecture halls, banking areas, and the medical center experienced frequent overcapacity, indicating a mismatch between parking supply and demand.

This finding supports prior research (e.g., Shoup, 2005; Litman, 2019) highlighting that institutional campuses often suffer from inefficient spatial planning and an over-reliance on static infrastructure without adaptive systems.

Car Parks in the University of Lagos



Source: Olayinka & Victor (2021)

Table 1: Vehicular traffic volume on the University of Lagos main campus

2018				2019		
	Main gate	2nd gate	Total	Main gate	2nd gate	Total
Cars	4980	2448	7428	4881	3198	8079
Buses	866	2	868	665	303	968
HDV	36	8	44	25	36	61
Motorcycle	88	67	155	68	103	171
Bicycle	42	34	76	102	28	130
Total	6012	2559	8571	5741	3668	9409

SOURCE: FIELD WORK

A field-based vehicle count at the University of Lagos revealed a significant increase in vehicular traffic between 2018 and 2019. In 2018, a total of 8,571 vehicles were recorded entering through both the main and second gates, compared to 9,409 in 2019. Cars remained the dominant mode of transport, increasing from 7,428 in 2018 to 8,079 in 2019. While bus entries decreased at the main gate (from 866 to 665), the second gate recorded a sharp increase (from 2 to 303), resulting in an overall rise in bus traffic. Motorcycle entries also rose slightly from 155 to 171. Notably, bicycle usage increased significantly from 76 in 2018 to 130 in 2019, suggesting a growing interest in non-motorized transport. Heavy-duty vehicle entries remained relatively low. The upward trend in overall vehicle counts highlights increasing mobility needs on campus and the need for improved transportation and parking infrastructure.

Carrying Capacity and Utilization

On average, each car park accommodates 33 vehicles, but utilization varies significantly by time of day and activity zone. Table 1 (recreated from the original document) shows that peak-use areas consistently exceed their carrying capacity, especially during the 8:00–10:00 AM and 4:00–7:00 PM periods, which coincide with academic schedules and religious or commercial events.

Approximately 65% of respondents reported difficulty in finding parking spaces, with 67% unable to park at their preferred location. Additionally, 54% reported that a lack of parking had caused

them to be late for scheduled appointments. These inefficiencies reflect both capacity constraints and the absence of real-time information systems.

The findings align with global studies suggesting that up to 30% of urban congestion is caused by cruising for parking (Arnott & Rowse, 1999), and further support the need for demand-responsive parking policies.

User Perceptions and Behavioral Patterns

Analysis of 77 questionnaire responses revealed the following key insights:

- **Parking Duration:** 36% of Users Park for over five hours, mainly staff and postgraduate students. Long-term parking reduces space turnover and limits availability for short-term users.
- **Search Time:** 50% of respondents reported searching for parking between 5 to 15 minutes daily, increasing time costs and traffic volume on campus roads.
- **Walking Time to Destination:** Nearly 55% of users walk more than 5 minutes from parking to destination, reflecting poor alignment between parking locations and campus mobility flows.
- **Parking Satisfaction:** Only 12% of respondents rated the current system as 'very good', while 64% recommended a complete overhaul through a new parking system integrated with digital tools.

These patterns indicate a high level of dissatisfaction and suggest strong user support for smarter parking solutions, such as mobile guidance systems, dynamic pricing, and reservation-based access.

Table: 2 Carrying Capacity of the available car parks in the University of Lagos

ID No	Locations of Car Park	Carry Capacity	Geo-coordinates	
			X-Coordinates	Y-coordinates
1	Access Bank	20	543394	720473
2	Front of Faculty of Arts	118	544084	720543
3	Back Faculty of Arts	54	544109	720616
4	Faculty of Business Administration	80	544180	720704
5	Unilag Guest House	26	544170	720748
6	Faculty of Law	79	544204	720601
7	Senate Building	80	544205	720481
8	Senior Staff Club	25	544301	720652
9	Faculty of Engineering	49	544240	720436
10	Lagoon Front	12	544360	720441
11	Faculty of Sciences	113	544225	720102
12	Bookshop	70	544016	720465
13	Mariere Hostel	13	544117	720391
14	Back of Faculty of Engineering	15	544246	720274
15	Back of Jaja Hostel	60	544088	720123
16	Front of Jaja Hostel	15	544051	720170
17	GTBank	46	544042	720264
18	Front of Staff School	45	544042	720066
19	Dept. of Chemical Engineering	50	544076	720056
20	Eni Njoku Hostel (1)	4	543595	720491
21	Eni Njoku Hostel (2)	4	543560	720495
22	Eni Njoku Hostel (3)	4	543508	720509
23	Shodeinde Hostel (1)	11	543448	720522
24	Fagunwa Hostel	14	543359	720637
25	Madam Tinubu Hostel	12	543391	720606
26	Makama Bida Hostel	12	543426	720562

27	Unilag Main shopping complex	34	543484	720445
28	Faculty of Social Science Shopping Complex	60	543444	720110
29	Faculty of Social Science	60	543358	720136
30	Honors Hostel	5	543572	719551
31	Unilag Consult	40	543241	719803
32	HRDC	20	543157	719728
33	Biobaku Hostel	8	542864	720003
34	UNILAG Tennis Club	10	542796	720030
35	Kofo Hostel	30	542784	720102
36	Queen Amina Hotel	25	542751	720077
37	Faculty of Education Complex	12	542660	720126
38	Faculty of Education (2)	15	542683	720173
39	Faculty of Education (1)	5	542648	720202
40	El-kanemi Hostel	10	542642	720267
41	Dir. of Property Mgt., Dev. & Inv.	15	542698	720295
42	Faculty of Education (3)	6	542703	720246
43	Faculty of Education (Main)	63	542766	720273
44	Back of Multipurpose Hall	43	542869	720234
45	Henry Carr Hostel	12	542855	720173
46	Faculty of Environmental Science	42	542888	720327
47	Wema Bank	18	542859	720288
48	Front of Multipurpose Hall	53	542937	720287
49	Outside Sport Centre	42	543043	720291
50	Inside Sport Centre	20	543049	720251
51	Student Union Building	80	543084	720321
52	Amphitheatre	27	543195	720386
53	Catholic Church	20	543100	720372
54	Chapel	53	543178	720450
55	Back of Chapel	60	543111	720479

56	Mosque	35	543230	720455
57	CITS	35	543789	720412
58	Department of Creative Arts	66	543330	719948
59	UNILAG Publishing Centre	12	543428	720032
60	Medical Centre	43	543910	719926
61	Women Society Children School	50	543991	719967
62	Medical Centre (2)	12	543880	719989
63	Inside DLI	25	543424	719725
64	Moremi Hostel	20	543966	720356
65	Department of Mass Communication	6	543935	720436
67	Julius Berger Hall	10	544327	720283
68	School of Maritime Studies	9	544335	720526
69	Back of Faculty of Social Science	54	543219	720165
70	Women Society Hostel	5	543573	719584
71	School of Post Graduate Studies	12	542836	720208
	TOTAL CAPACITY	2313		

Source: Olayinka & Victor, May 2021

The University of Lagos accommodates a total of 2,313 vehicles across 71 designated car parks, strategically distributed throughout academic, administrative, residential, and recreational zones. High-capacity parking areas are notably concentrated around academic buildings such as the Faculty of Arts (172 combined spaces), Faculty of Sciences (113 spaces), and the Student Union Building (80 spaces), reflecting higher vehicular demand in these locations. In contrast, residential areas like Eni Njoku and Biobaku Hostels have significantly fewer parking slots, often fewer than 10, indicating a possible mismatch between student accommodations and parking provision. Each location is mapped with precise geo-coordinates, offering valuable data for spatial analysis and planning. This comprehensive dataset supports informed decision-making in campus mobility management, helping to identify gaps, optimize land use, and improve traffic flow. Integration into a Geographic Information System (GIS) would enhance visual representation and facilitate efficient planning for future infrastructural developments.

Institutional and Policy Framework

Responsibility for parking facilities within the University of Lagos is highly decentralized, involving various administrative units such as faculty management, the Dean of Student Affairs, religious institutions, bank authorities, and UNILAG Security. This fragmented structure limits the development of a coordinated parking strategy across campus. For instance, faculty areas are managed internally, while hostel car parks fall under student affairs. Religious centres like the mosque, chapel, and church operate independently, and banks manage their own parking. UNILAG Security oversees several strategic locations, including the Senate Building, bookshop, and major access routes. The absence of a unified management system hinders efficient policy enforcement, regular maintenance, and infrastructural upgrades. It also creates disparities in parking quality and availability. A centralized framework would improve oversight, enhance safety, and promote equitable access to parking, supporting a more organized and sustainable transport system within the university environment.

Table: 3: Departments Responsible for the Car Park in the Study Area

ID No	Locations of Car Park	Department Responsible
1	Access Bank	Bank Management
2	Front of Faculty of Arts	Faculty Management
3	Back Faculty of Arts	Faculty Management
4	Faculty of Business Administration	Faculty Management
5	Unilag Guest House	Guest House Management
6	Faculty of Law	Faculty Management
7	Senate Building	UNILAG Security
8	Senior Staff Club	Guest House Management
9	Faculty of Engineering	Faculty Management
10	Lagoon Front	UNILAG Security
11	Faculty of Sciences	Faculty Management
12	Bookshop	UNILAG Security
13	Mariere Hostel	Dean of Student Affairs
14	Back of Faculty of Engineering	Faculty Management

15	Back of Jaja Hostel	Dean of Student Affairs
16	Front of Jaja Hostel	Dean of Student Affairs
17	GTBank	Bank Management
18	Front of Staff School	UNILAG Security
19	Dept. of Chemical Engineering	Faculty Management
20	Eni Njoku Hostel (1)	Dean of Student Affairs
21	Eni Njoku Hostel (2)	Dean of Student Affairs
22	Eni Njoku Hostel (3)	Dean of Student Affairs
23	Shodeinde Hostel (1)	Dean of Student Affairs
24	Fagunwa Hostel	Dean of Student Affairs
25	Madam Tinubu Hostel	Dean of Student Affairs
26	Makama Bida Hostel	Dean of Student Affairs
27	Unilag Main shopping complex	UNILAG Security
28	Faculty of Social Science Shopping Complex	Faculty Management
29	Faculty of Social Science	Faculty Management
30	Honors Hostel	Dean of Student Affairs
31	Unilag Consult	UNILAG Security
32	HRDC	UNILAG Security
33	Biobaku Hostel	Dean of Student Affairs
34	Queen Amina Hostel	UNILAG Security
35	UNILAG Tennis Club	Dean of Student Affairs
36	Kofo Hostel	Dean of Student Affairs
37	Faculty of Education Complex	Faculty Management
38	Faculty of Education (2)	Faculty Management
39	Faculty of Education (1)	Faculty Management
40	Elkanemi Hostel	Dean of Student Affairs
41	Dir. of Property Mgt., Dev. & Inv.	UNILAG Security
42	Faculty of Education (3)	Faculty Management
43	Faculty of Education (Main)	Faculty Management
44	Back of Multipurpose Hall	Dean of Student Affairs

45	Henry Carr Hostel	Dean of Student Affairs
46	Faculty of Environmental Science	Faculty Management
47	Wema Bank	Bank Management
48	Front of Multipurpose Hall	Dean of Student Affairs
49	Outside Sport Centre	UNILAG Security
50	Inside Sport Centre	UNILAG Security
51	Student Union Building	UNILAG Security
52	Amphitheatre	UNILAG Security
53	Catholic Church	Catholic Management
54	Chapel	Chapel Management
55	Back of Chapel	Chapel Management
56	Mosque	Mosque Management
57	CITS	UNILAG Security
58	Department of Creative Arts	Dean of Student Affairs
59	UNILAG Publishing Centre	UNILAG Security
60	Medical Centre	UNILAG Security
61	Women Society Children School	UNILAG Security
62	Medical Centre (2)	UNILAG Security
63	Inside DLI	UNILAG Security
64	Moremi Hostel	Dean of Student Affairs
65	Department of Mass Communication	UNILAG Security
66	Julius Berger Hall	Dean of Student Affairs
67	School of Maritime Studies	UNILAG Security
68	Back of Faculty of Social Science	Faculty Management
69	Women Society Hostel	Dean of Student Affairs
70	School of Post Graduate Studies	UNILAG Security

Source: Olayinka & Victor, May 2021

Although several policies exist including fines for illegal parking, vehicle clamping, and traffic rules their enforcement is inconsistent. Table 4' outlines penalty structures, yet most users perceive these as reactive rather than proactive.

This echoes findings from Soyebó and Ajayi (2015), who argue that without centralized parking management, regulatory interventions tend to be ineffective and sporadic.

Table: 4 Current Policies for Road/Car Parks Users in the University of Lagos

S/N	Offence	Mulct	Amount (N)
1	One Way	Payment	15,000
2	Illegal Parking	Payment	5,000
3	Learning how to Drive on Campus	Payment	10,000
4	Reckless Driving on Campus	Payment	10,000
5	Using Phones while Driving on Campus	Payment	3,000
6	Accident	Repair and Payment	10,000

Source: Olayinka & Victor, May 2021

Estimation of Parking Demand on the University of Lagos Main Campus

An accurate estimation of parking demand is essential for effective transport infrastructure planning, particularly in large institutional environments such as university campuses. On the University of Lagos main campus, recent empirical data point to a significant mismatch between available parking supply and actual vehicular traffic demand.

According to field observations carried out in 2019, a total of 9,409 vehicles entered the campus through its main and second gates on a typical weekday. Of this figure, 8,079 vehicles were private cars, accounting for approximately 86% of the total vehicular inflow. Since private cars typically require independent parking spaces, particularly for long-duration stays, this figure serves as a robust proxy for daily peak parking demand.

In contrast, the spatial inventory of parking infrastructure conducted across the campus identified a total of 70 designated parking facilities with a combined carrying capacity of only 2,313 vehicles. This results in a daily parking deficit of 5,766 spaces, meaning that only about 28.6% of the vehicles that enter the campus can be accommodated in official parking spaces. The remaining 71.4% either resort to informal parking, cruise for extended periods searching for spaces, or face delays due to unavailability.

This deficit is further substantiated by user survey responses, where 65% of respondents reported difficulty in locating parking spaces, and 50% stated that they typically spend between 5 to 15 minutes searching for available spots. Additionally, 36% of users, predominantly academic staff and postgraduate students, indicated that they park for over five hours daily, thereby reducing turnover and compounding scarcity during peak hours.

The implications of this imbalance are multifaceted. It contributes to traffic congestion within the campus, encourages unauthorized or unsafe parking practices, increases environmental pollution through extended idling and circulation, and reduces productivity due to delayed appointments and extended walking distances.

To address these challenges, there is a pressing need for a dual-pronged approach: expanding the effective supply of parking through multi-level facilities and shared-use optimization, and implementing demand management strategies such as dynamic pricing, digital guidance systems, and enhanced promotion of non-motorized transport and shuttle services. A transition towards data-driven and technology-enabled parking systems is essential for improving space utilization, reducing congestion, and enhancing mobility efficiency on campus.

Technological Gaps and Potential for Smart Parking Systems

Currently, UNILAG lacks a formal Intelligent Transport System (ITS) or smart parking infrastructure. However, the proposed integration of a mobile application highlighted by the study presents a feasible solution for improving parking allocation and compliance.

The app, designed for the campus environment, could leverage GPS data, parking sensors, and administrative inputs to provide real-time information on available spaces, duration limits, and

policy updates. Such systems have been successfully deployed in universities globally (e.g., MIT, University of British Columbia), demonstrating improvements in space utilization, time savings, and user satisfaction (Kepuska & Alshamsi, 2016).

Discussion and Implications

The findings of this study affirm that UNILAG's current parking infrastructure is under strain from increasing motorization, fragmented governance, and outdated management approaches. Without strategic interventions, these inefficiencies are likely to worsen due to campus expansion and continued reliance on private vehicles.

The study contributes to urban transport literature by:

- Demonstrating the application of GIS and survey data to parking analysis in African institutional contexts.
- Highlighting the practical need for integrated parking policies linked to real-time technology systems.
- Reinforcing the importance of demand-responsive planning in dynamic academic environments.

Moreover, this research provides a replicable framework for other urban campuses experiencing similar challenges, particularly in developing countries where car ownership is increasing without proportional investment in parking infrastructure.

This study evaluated the spatial distribution, carrying capacities, and utilization patterns of car parks within the University of Lagos main campus using a mixed-method approach that integrated GIS analysis, field observations, and user surveys. The findings reveal a persistent imbalance between parking demand and supply, aggravated by fragmented management structures, weak policy enforcement, and the absence of intelligent parking systems.

A total of 70 parking facilities were identified, with a cumulative carrying capacity of 2,313 vehicles. However, peak-hour demand consistently exceeded available spaces in high-traffic zones, resulting in excessive cruising times, unauthorized parking, and traffic congestion. Survey

responses further highlighted user dissatisfaction, long walking distances from car parks to destinations, and frequent delays due to inadequate parking availability.

Institutional responsibilities for parking are dispersed across multiple administrative units, complicating coordinated planning and regulation. Although enforcement measures such as fines and vehicle clamping exist, their limited implementation has failed to significantly improve user compliance or optimize space usage.

The study concludes that the University of Lagos campus parking system lacks a comprehensive, user-centered strategy aligned with principles of sustainable mobility. Without a shift toward integrated, technology-supported solutions, these inefficiencies will continue to undermine transport performance, campus productivity, and environmental sustainability.

Recommendations

To address the observed deficiencies and support sustainable transport planning within institutional environments, the following recommendations are proposed:

1. Develop a Campus-Wide Smart Parking System

Implement an intelligent transport system (ITS) that integrates GPS mapping, mobile applications, real-time occupancy data, and sensor-based parking guidance. This platform should offer:

- Real-time availability of parking slots
- Zone-based reservation and payment options
- Predictive analytics to guide future planning

2. Centralize Parking Management and Policy Coordination

Establish a unified Parking and Mobility Unit under the university's physical planning division, tasked with:

- Harmonizing regulations across departments

- Managing daily operations, data collection, and user engagement
- Enforcing compliance through digital monitoring and ticketing systems

3. Optimize Existing Infrastructure through Spatial Planning

Redesign underutilized or inefficiently located parking spaces by:

- Creating multi-level structures in high-demand zones
- Encouraging shared use of spaces across departments
- Introducing drop-off/pick-up points and short-term parking zones

4. Implement Dynamic Pricing and Access Controls

Introduce demand-responsive pricing models based on duration, location, and user category (staff, student, and visitor). Combine this with:

- Peak-hour surcharges to discourage long-term occupation
- Priority parking permits for carpooling and low-emission vehicles

5. Promote Non-Motorized and Public Transport Options

To reduce pressure on parking infrastructure:

- Expand pedestrian walkways and safe cycling routes across campus
- Improve internal shuttle services
- Discourage on-campus driving by first-year students or low-occupancy vehicles

6. Conduct Periodic Audits and Monitoring

Establish a monitoring framework with annual audits to assess:

- Usage patterns and user satisfaction
- Compliance levels
- Environmental and operational efficiency indicators

Policy Implications

This research provides actionable insights for institutional and urban mobility planners, especially in contexts with limited infrastructure budgets and rapidly growing demand. The proposed solutions are scalable and adaptable for other university campuses across Sub-Saharan Africa and beyond. By integrating geospatial analytics and user feedback into planning, decision-makers can achieve more resilient, inclusive, and data-driven parking strategies aligned with global best practices.

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