Car Park Suitability Mapping in Federal Polytechnic Oko, Anambra State, using Geospatial Techniques

Enweluzor Ogochukwu Vivian
Department of Surveying & Geoinformatics,
Federal Polytechnic Oko, Anambra State

Abstract:- **A common major problem at higher institution- university campuses, polytechnic, monotechnics and colleges of education in Nigeria today, concerns lack or inadequate persistent parking spaces. This situation** *sparingly demands relevant observation in changing of palpable and land clearing expansion adjacent to the numerical and social- economic growth pertaining to institution in addition to neighboring communities* **At Federal Polytechnic Oko, Anambra State, Nigeria, the trend** *occurs within the quadrangle for which extremely fascinate mere traffic jam the magnitude as well as consequent given rise significantly by act appertaining to position demands.* **This research evaluate the demand for parking spaces in the Federal Polytechnic Oko, Anambra state, through investigating parking utilization lots available, survey of unused land areas, users behavioral parking facilities, mode of car parking, and propose a systematically designed parking lots with the unused land available within the institution. This paper also analyzed the situation which reflects an inadequate pricing mechanism for parking which results to consistent monopoly providers of parking services (involving a cost – benefit approach). This systematic parking proposed design map was achieved through the use of downloaded satellite imagery from goggle earth pro and field survey operations updated through ArcGIS 10.3 software. Also the proposed designed map will be distributed to all higher institutions of learning in Nigeria to serve as a guide for quest of creating more parking lots.**

Keywords:- *Constraints in Vehicle Parking, Monopoly Parking Services, Satellite imagery, Proposed Designed Parking lots.*

I. INTRODUCTION

Vehicular parking activities are part and parcel of a roadway system, but the agglomeration of vehicles within and around the lecture hall / classrooms in Federal Polytechnic Oko increases everyday due to high increase in demand for purchase of automobile within the recent past 2-3 years by both lecturers, non -academic staff and students is tremendously alarming. It has been observed that parking of vehicles is a major issue of Director of Transport (DOS) and security Department (SD) to control the menace and havoc caused by traffic jams within the institution due to unsuitable parking lots causes. Debasish and Mokaddes (2017) have observed that an acute increment rising in motor vehicle possession as well as inadequate conveyance structure gives advance into extensive adjacent road stopping appeal dominantly into an abatement unproductive lane breadth, flow rate, generating irrelevant grid lock. At Federal Polytechnic Oko there is also lack of real-time information about parking availability which limits the drivers to avoid different car negotiations due to inadequate space for such vehicular activities. With the rapid growth in traffic patterns and space utilization, there is a need for parking survey and analysis to ease out the problems of informal parking activities and traffic interference (He at al., 2012; Cats et al., 2016). This problem was accomplished by the use of geospatial techniques and land survey approach to aid the new proposed car suitability designed map for general parking structure and curb monopoly parking in the institution.

II. AIM AND OBJECTIVES

The overview goal of this research is to evaluate general parking structure, demand for parking spaces and using geospatial technique to produce a designed map of parking lots in the Federal Polytechnic OKo, (main Campus) Anambra State. This were achieved through the following objectives:

- To acquire a high-resolution satellite imagery of Federal Polytechnic Oko that shows the existing formal parking lots areas within the institution if any existed.
- To ascertain the area of the institution using ground survey method.
- To examine the land use pattern that influences the parking activities and used land available.
- To sample a survey (questionnaire) to ascertain the number of staff and students who own cars/ motorcycles etc.
- To propose a suitable designed parking lots with the unused land available within the institution.

III. STUDY AREA

Oko which is presented as one of the popular town in Anambra State South East, Nigeria is known for farming and hub for business activities. It derived its initial growth from her sister's town known to be Ekwulobia which lies east of Oko. Geographically, the city lies between the latitude of 06° 00'- 06° 30'N and longitude 07°00'-07° 30' E, and is about 60km away from Awka the capital of Anambra State. It has been estimated that Oko town has an average total land area of 9.8sq, km is approximately 3.5% of the total land area of Anambra State estimated population of 26, 325 from National population commission Awka. Oko is a peaceful town with its neighboring communities such as Amaokpala Ekwulobia, Isuofia, Ndiowu, and Omogho which attracts influx of great potential business merchant to invest in structural growth of the town. The town is located at the southern part of Nigeria.
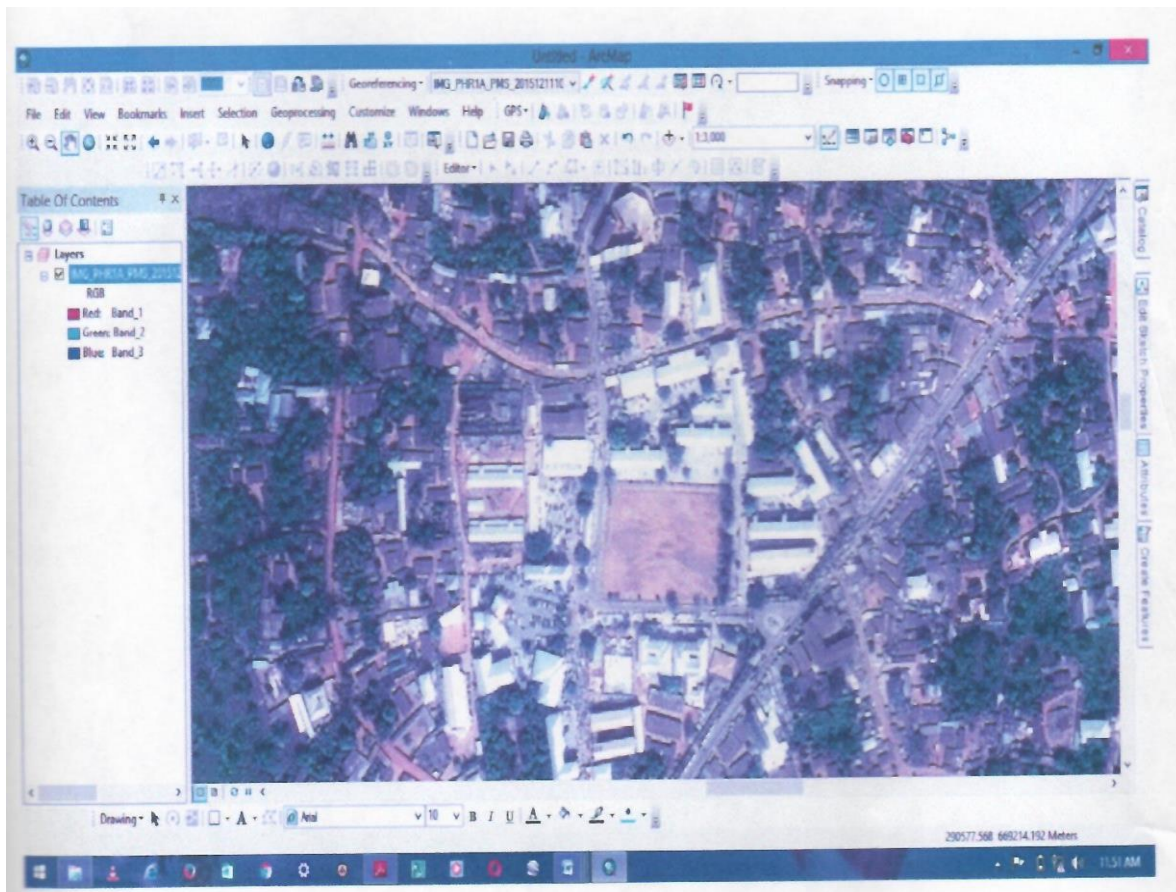
Fig. 1: Downloaded imagery of Oko. Source Google Earth Pro 2022

The key data source for this study is the satellite imageries of Oko from 2015- 2021 and participatory field survey of parking activities within the institution. The conceptual demand, related to the capacity number is deliberated making use of R = L/ SRP allocation technique based on the allowance around structure (S) floor area facing the main component position area (CPA), that exist cleave towards R = S/ CPA highways or curb blocks. The purpose of determination off- positioning in general according to Pande and Brian (2016) should consider the following:

- Breadth within highway
- Size within vehicle on the highway
- Attribute within speed/celerity and
- Structural of automobile
- Essence within purpose of coast allocation in addition to purpose role of on highway perturbed.

Traffic congestion (TC) impacts could be measured based on roadway width (RW) separated by length (L) quantity TC(RW/L). At expressway division, that is to say that the amount of related automobile (NA) with respect to one exposure eventually separated apart the strength volume (SV) of highway. NA- SV existed as universally described to same degree of figure for instance 0.8 01 1.2 and subsequently classify within quantity of resource differing A (expansive) directed towards D (crowded).

IV. METHODOLOGY

A high resolution satellite imagery was downloaded from internet web using Google Earth Pro. The imagery acquired was imported into ArcGIS 10.3 and digitized using the polygon menu to map out the major parking areas. Participatory personal field observation and calculation of parking structure were carried out using mobile car and stopwatch menu of GPS Gamine 78X for parking duration and geo-location data assemblage. The perimeter plan and landuse cover map were obtained from Department of Surveying & Geoinformatics OKo updated on the satellite imagery to aid the spatial trip generation and attraction analysis of the study.

V. DATA ANALYSIS

A. Land Use and Traffic Flow in Federal Polytechnic OKO

Federal polytechnic OKO is one of the higher institution in old Aguata Local government Anambra State, has about 13 neighborhoods including police station. The institution is fully populated with minimum number of seven (7) thousand students, five (5) thousand staff (both academic and non -academic) with 1, 070 cars and 200 motorcycles and tricycles. These group of people are the origin of traffic generation that are attracted to the main campus for daily business activities.

The township road design (federal high road from OKO to Umunze town) seems to complicate the traffic system as the Oko dual carriage road traverse the town and links the neighboring roads. The three Bypasses (Ekwulobia –OKO, Oko to Awka and Amaokpala-oko routes) also have direct link to the main campus through OKO federal highway road.

B. Federal Polytechnic Structure

A Tower at round about in the institution is the land mark used as the center of the school which has a third order geodetic control beneath it. The school main campus comprises of the Aso- Rock Building, Administrative Blocks 1&2, Department of Mass Communication Complex and CBT Blocks, school of General studies, School of Applied Art, football field and volley ball court, School of Environmental Design & Technology, School of Applied Science, Physics, Chemistry and Biology Laboratories, Micro Finance Banks, Auditorium, Medical Center and Water Factory etc. other departments not mention are

located at the permanent site of the school where there is enough space. The institution has four branches which include Main Campus, Permanent Site Campus, Ufuma Campus and Atani Campus. The monopoly park is the final stop for all commercial and resident vehicle. Other major activities in this core area were: Eke Market, street Market, Alex Ekwueme Complex, Hospital, three petrol filling stations, three banks, and many shops and offices. These were the points of attraction for the school, visitors, students, investors and commuters.

C. Existing On-Street/ Monopoly Parking Lots

Precisely in the main campus, there are no modern formal car parks apart from the commercial motor park at side-road parking, see Figure 2 for the side-road parking. The federal government or the school management has never deemed it relevant for mapping modern parking lots, hence the prevalence of on-street parking or monopoly parking menaces escalates on daily basis in the campus.
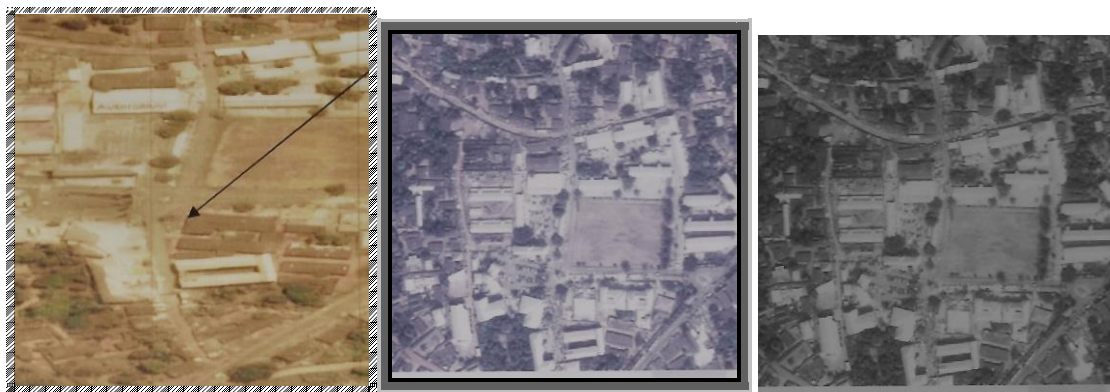

Fig. 2: Multi-temporal image of Federal Polytechnic Oko (2015, 2018 and 2021) source Google extract

The three (3) satellite imageries shows different gradual growths and development in terms of physical structures, open spaces and concentration of academic activities with influx of people and vehicular movement.

D. On-Street/Monopoly parking Relocation Challenge

Serial Number	Precincts	Road width (m)	Road lane	On-street parking 2015	2018	2021
I	Aso- Rock Building	6	Single Carriage	20	30	40
Ii	Administrative Block	5	Single Carriage	30	40	50
iii	Mass Com. CBT/complex	7	Single Carriage	21	28	40
iv	Medical Center	16	Dual Carriage	15	23	35
V	School of Env. D &T	16	Dual Carriage	30	36	50
vi	School of Applied Sc.	5	Single Carriage	40	45	58
vii	Mass Com. To Rear Gate	10	Dual Carriage	25	30	38
	Total			201	252	349

Table 1: Showing the on- street parking analysis on the main campus only

Based on table 1 above, it is observed that while the on-street parking around the administrative blocks and school of environmental design and technology (SED&T) systematically increases 60% from about 30 cars in the year 2015 to 50 cars at 2021 which demands the need for a suitable car parks. Generally, On-street / monopoly parking along roads is as result of increase in employment of staff, increase in-take of students and full academic activities

going on in the main campus giving rise to high risk in traffic jams and congested environment. As a result, this situation call for suitability car parking map for the main campus of the institution due to centralized activities going on there.

The table above aided the team to create a set – out design of the lots using computer aided drafting tool (AUTOCAD version 2007) on the processed image of the institution. The image was exported to AUTOCAD environment were available unused space were measured subdivide into parallel parking lots pattern which is the most common mode of on- street-side parking . After the design, the processed image was imported back to ArcGIS 10.3, where the Geospatial database querying was carried out for both spatial and non-spatial attribute of the parking lots designed.

The attribute database creation for non-spatial data created includes the roads, buildings, land used and unused, pillar numbers, dimensions of the lots and car width which was integrated on the derived map of the institution. During digitizing, the feature class were added to features for easy identification. Furthermore geospatial database queries were achieved by extracting relevant information from sets of spatial and attribute data. The following queries were performed on the database:

Summary of building in each school

- How many number of parking lots for each department will be created with the area of unused space?
- Which parallel width dimension is recommended for cars, tricycles and motorcycles?
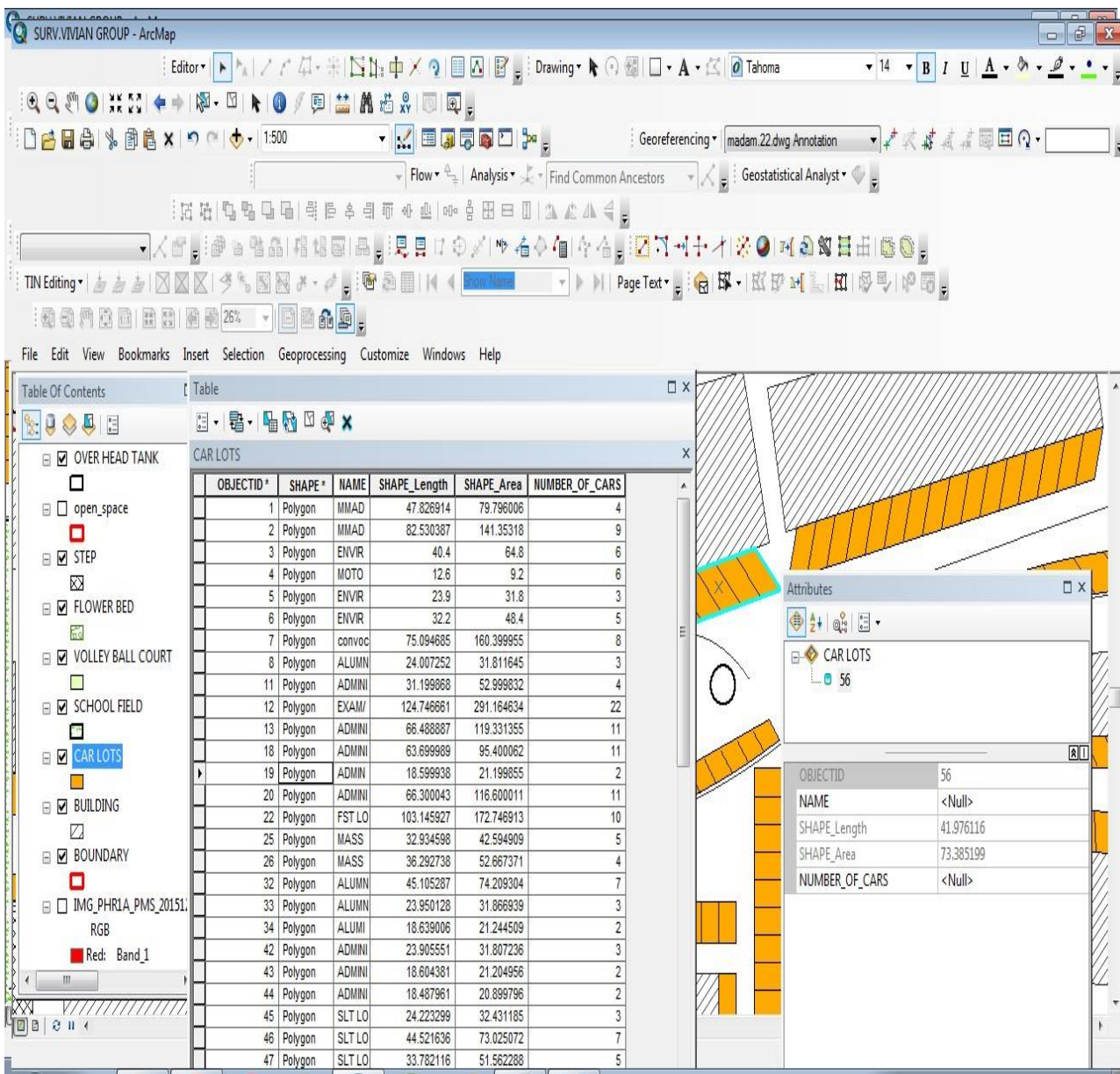- Which of the unused area will designed for motorcycle/ tricycle?
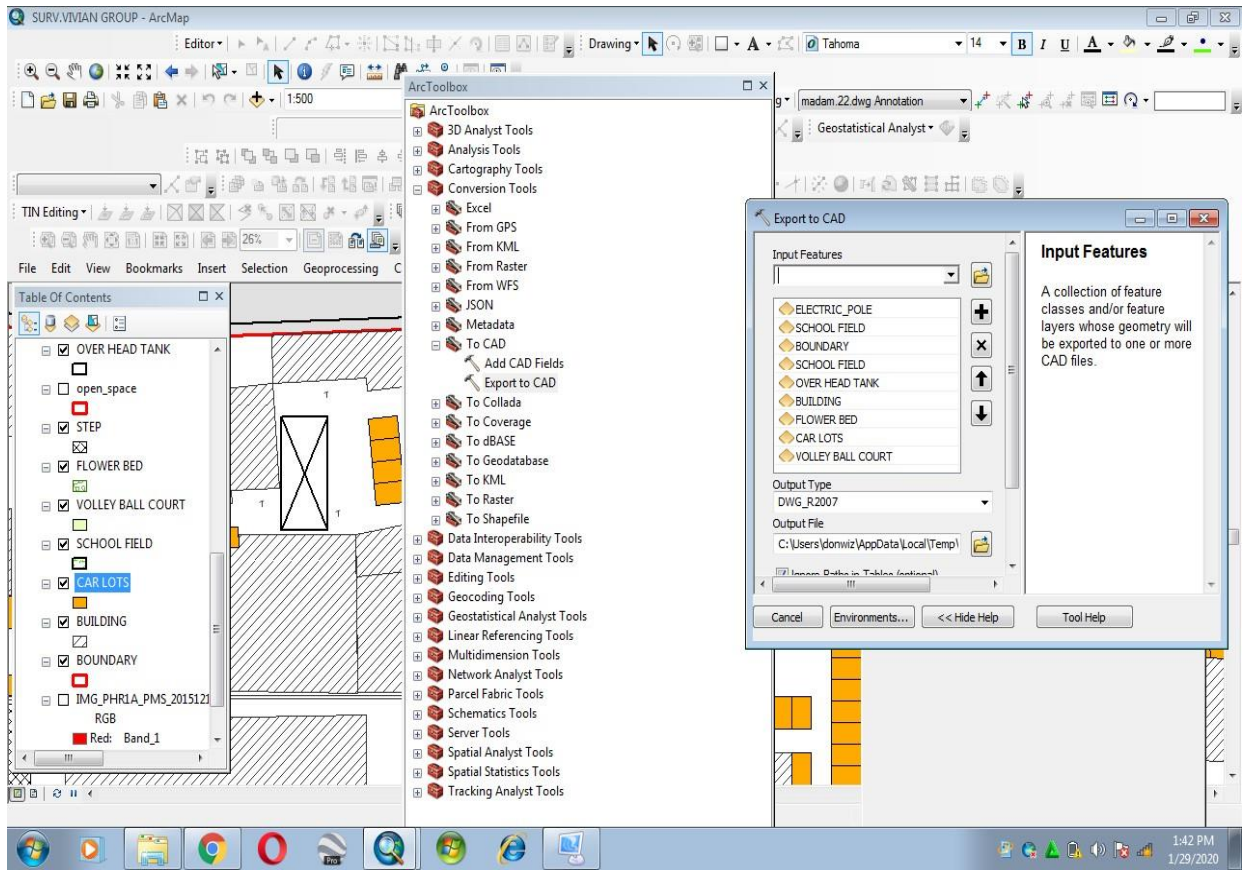

Fig. 3: Creation of Attribute data for the parking lots
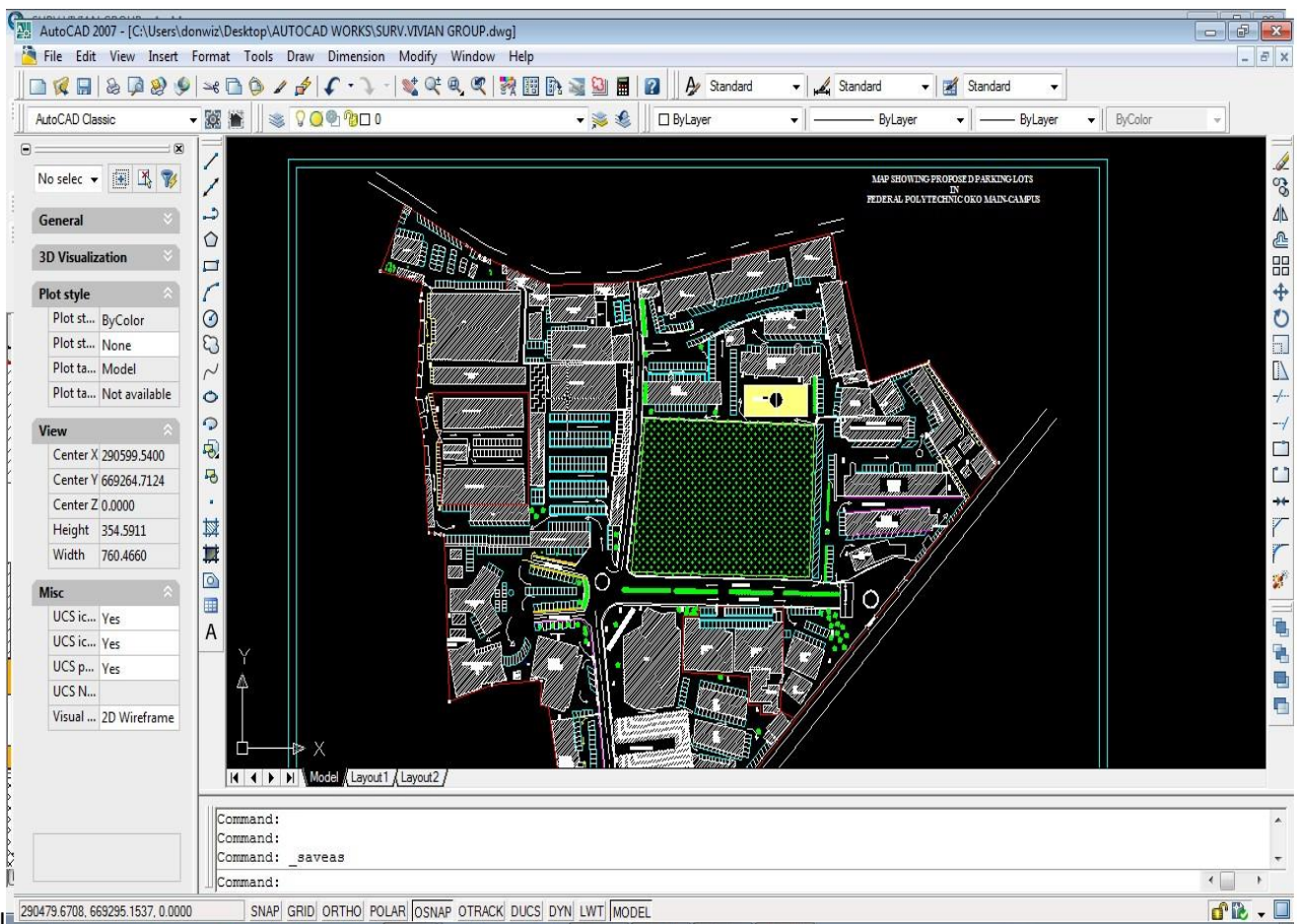
Fig. 4: Querying of the parking lots

Fig. 5: Shows the Map of Suitability Designed Car Parking Lots

VI. RESULTS/RECOMMENDATION

From the result of the map created using the unused space, its shows that the School of Environmental Design and Technology had total of 169 parking lots for cars with width 3.75 – 5.65 m and tricycles 2.58 -3m depending on the shape of the land and accessibility, also the administrative block has 100 parking lots with same dimension while laboratories has 43 lots and mass communication building/complex has the less number of parking lots with a total of 38. Furthermore, when compared the created parking lots against the number of car owners, its shows that 40% of the available lots is less sufficient over the working force. As regards to decongest the traffic in the main campus, the school management in collaboration with the Urban and Regional Planning and Surveying Department should team up to create a synergic environment for staff and reduced the effect of monopoly parking by re-locating some schools/faculties to permanent site where there is enough space to accommodate more capacity buildings and car parks. This study had help the school to determine the effective way of creating more efficient administration, welfare of its staff and the geospatial environment with a well -planned, oraganised physical structure and free vehicular movement.

Furthermore, a derived map and perimeter plan of the main campus of Federal Polytechnic Oko, was produced by Department of Surveying and Geo-informatics and copies were sent to Ministry of Land and Survey Awka and to the Director of Physical Planning Unit of the institution for immediate implementation. Again the coordinates of third order geodetic controls generated were documented for easy referencing.

VII. CONCLUSION

The overview of this work portrayed problems of on-street parking along the major route linking to other minor roads to various sections in the institution which has been greatly solved through the updated parking lots map produced by the researcher for utilization and implementation by both students and staff including visitors. This problem which has caused grid lock or traffic jam always in the institution had led to numerous automobile crashes and death of human along the route. Although the researcher produced the map at a scale of 1:2000 to make it portable and easier for students, staff and visitor's comprehension and implementation fast tracked. Similarly, the aim of this piece of project was achieved through the prescribed objectives stated at the commencement of the work using Arc GIS 10.3 and AutoCAD 2007 versions. This work was acknowledged by the Rector and the entire institution to curb out the everlasting solution of the dead-lock posed by on-street parking and modalities were set out by the Director of Physical Planning through the institution management.

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