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Management Issues and Facilities Management In Geographic Information System – The Case of the Activities of the Lagos Area Metropolitan Transport Authority (LAMATA)

Nwambunwo. J.O & Mughele.E.S

Department of Computer Science
Delta State School of Marine Technology
Burutu, Delta State
Nigeria

¹nwambunwo@yahoo.com ²prettysophie@yahoo.com

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Management Issues and Facilities Management In Geographic Information System – The Case of the Activities of the Lagos Area Metropolitan Transport Authority (LAMATA)

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ABSTRACT

This paper reviewed work and the progress made so far with the megacity project of the Lagos state government with special emphasis of the role of Geographic Information Systems and its application to the project. The milestones made as well as the challenges ahead for the project are identified. The Our review showed that the project is still a work-in-progress and a great deal of planning is required if Lagos State, Nigeria is to attain a world class mega-city status. The paper elucidate the production of thematic maps by the Lagos Metropolitan Area Transport Authority (LAMATA) that displays diverse scenarios ranging from land use pattern to transport route pattern thereby leading to the production of land use maps and route maps respectively. Challenges facing the project such as high cost process involving largely manual data conversion from paper maps or survey information , especially when high precision (meter or sub-meter) is required as is the case for utility and cadastral applications are mentioned. The paper conclude by recommending that the success recorded in using geographical information system in transport route in parts of Lagos State should be extended to other parts of the state and its environs.

Keywords: GIS, Lagos State, Mega City, Project, maps and LAMATA

1. INTRODUCTION

A Geographic Information System is a computer system that records, stores, and analyzes information about the features that make up the earth's surface. A geographic information system is characterized with the capacity to generate two- or three-dimensional images of natural features such as hills and rivers and with artificial features such as roads and power lines. Scientists use geographic information system images as models, making precise measurements, gathering data, and testing ideas with the help of the computer (Encarta, 2008). GIS is an acronym which is sometimes used to mean geographical information science or geospatial information studies or geographical information system; these later terms refer to the academic discipline or career of working with geographical information systems (Wikipedia, 2011).

For some organizations, such as local governments, geographic information system may represent a data and operational framework that affects and ties together most activities of the organization (Somers, 2008). Some organizations utilize Geographic information system with respect to volume of task they have to handle which ranges from using single tools to complete single task to using various tools to accomplish multiple task. Geographic information system operations are widely varied and characterized by diverse levels of operational tasks, user number, technology and organizational structure. GIS requires high expertise in its organizational and management approach, which differentiates it from other technologies.

The distinctive attributes that separates GIS from other technologies include but not limited to, the character and role of geographic data in organizational business administration, the present and future status and direction of geographic information system, the fusion, workability or compatibility of Geographic information system with other technologies in an organization, and the multifarious applicability of Geographic information system data.

The introduction of Geographical information system to an organization has organizational and technological impacts and implications that should be simultaneously addressed. A Geographic information system can become the driving force that ties your organizations together, especially for organizations that utilizes single department capabilities of providing data. (GIS Primer, 2008). A combination of a geographic information system organizational model and specific Geographic information system management strategies, characterizes an organization's particular geographic information system management approach (Somers, 1998).

The organizational role of a Geographic information system is highly varied. In some organizations, a new technological input redefines operations with corresponding organizational impacts. A business-operating environment is greatly influenced by a Geographic information system particularly in applications classed as business Geographic information system. The Geographic information system is limited by function, which necessitates the application of different relevant models. The relevance of a geographic information system (GIS) to an organization, could be either subtle or attention drawn to geographic information system (GIS). In as much as geographic information system plays extensive variety of roles in an organization, few Geographic information systems implementation types exist. Each situation characterized by varied impacts and implications. (Journal for housing research, 1998).

The Lagos Metropolitan area transport Authority (LAMATA) is charged with the responsibility of providing a quality transport system that will address that persistent problem of traffic congestion associated with a megacity. This is to be achieved by redefining the Lagos transport system (which includes road, light-rail, and water transport systems).

2. THE LAMATA INITIATIVE

The Lagos Metropolitan Area Transport Authority (LAMATA) is charged with the responsibility of providing policy direction for the advancement of the transport system of metropolitan Lagos was established in 2002 which is governed by a 13-member board, inaugurated in December 2003. The Lagos Metropolitan Area Transport Authority (LAMATA) aim to deliver improved and cost-efficient transport services for the teeming population of Lagos inhabitants.

To achieve this, Lagos metropolitan area transport authority works closely with the Ministry of Works (MOW), the Ministry of Transportation, the Lagos State Government, and the World Bank (Lagos state Govt, 2011). The ever increasing population in Lagos estimated between 12.5 and 15million with a population growth rate of 6 percent per year is continually characterized with severe traffic congestion (Lagos state Govt., 2011). The gradual over-population of the Lagos metropolis is leading to expansion into neighbouring Ogun State, with increased volume of commuter trips.

In recent times, Lagos state has been battling with varying socio-economic challenges which are traffic congestion, bad roads, poor and unattractive road based public transport system, sky rocketing transport fares; ineffective rail and water mass transit transport; unprecedented levels of road accidents and environmentally unacceptable levels of traffic –related emission and atmospheric pollution; growing menace of anti-social behaviour amongst transport operators which is obviously attributed to rapid and unplanned urbanization.

The economic, commercial and industrial status of Lagos has further increased population and aggravated the public transportation challenges that are directly proportional to the sprawling urban growth of Lagos. Lagos is socio-economically characterized with an active and vibrant local trading tradition, which is dominates Nigeria’s commercial sector. Lagos is home to a high proportion of Nigeria’s manufacturing industry with 45% of Nigeria’s skilled workforce residing in Lagos. Consequently, Lagos still maintains the long-term status of being Nigeria’s economic gateway by virtue of housing Nigeria’s principal commercial sea and airports (Lagos state Govt, 2011).

Existing inadequate infrastructure in Lagos has been pressurized to breaking point by the foremost status of Lagos. Outdated and dilapidated social and physical infrastructure required to support the escalating population and productive sectors has lead to abysmal levels of inefficiency and unproductively. For instance, in 1985, production costs in Lagos appreciated by 30%, which was instrumental in offsetting inefficacies of public sector services and infrastructure, transportation inclusive.

The relocation of the federal capital of Nigeria from Lagos to Abuja has not been in the best interest of Lagos. This has lead to the loss of some good revenue sources for public services. Inadequacies in the transportation system of Lagos has further worsened the plight of the poor in urban Lagos with an estimated domestic transport expenditure of about 20% of the house hold budget, which is second to expenditure on food (Lagos metropolitan area transport authority, 2008).

3. GEOGRAPHIC INFORMATION SYSTEM (GIS) IN LAGOS METROPOLITAN AREA TRANSPORT AUTHORITY(LAMATA)

Lagos metropolitan area transport authority (lamata) geographic information system (GIS) consists of raster and vector data and metropolitan Lagos is the extent of coverage.

Vector Data Include:

- Lagos State Road Network - Federal and State Highways totalling about 860 kilometres – (Attributes: - Road Names, Road Classification, Length, Ownership, Local Government Area, e.t.c.)
- Railway Lines
- Lagos State Facilities e.g. Markets, Schools, Hospitals, Bus Stops, Petrol Stations, Hotels, Churches, Mosques, e.t.c.
- Lagos State Water Bodies (Canals, Lagoons) and the Coast Line.
- Lagos State Land Use
- Lagos State Jetties & Landings (Functional, Non-functional)

Raster Data:

- Satellite Imagery - Digital Globe Quick Bird and Space Imaging IKONOS Satellite Imagery with a spatial resolution of about 0.7 metre and 1 metre respectively.

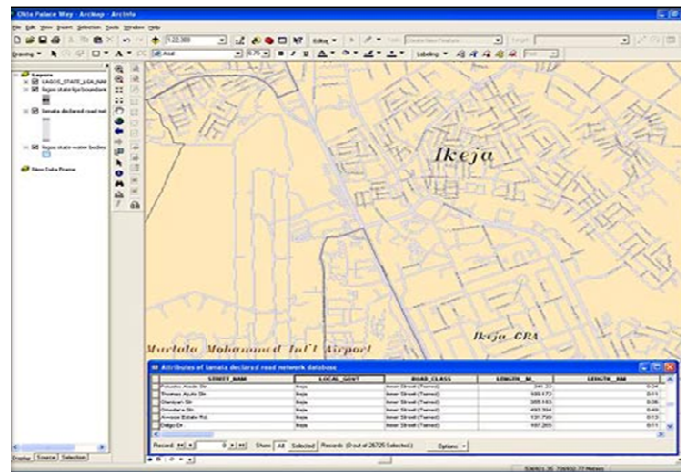


Fig. 1: Map and attributes of road network in Ikeja area of Lagos metropolis.
 SOURCE Geographic Information system department (2009).Lagos area metropolitan transport authority, Lagos, Nigeria



Fig. 2: Satellite Imagery of Surulere area of Lagos metropolis.
 SOURCE: Geographic information system Department (2009). Lagos area metropolitan transport authority, Lagos, Nigeria

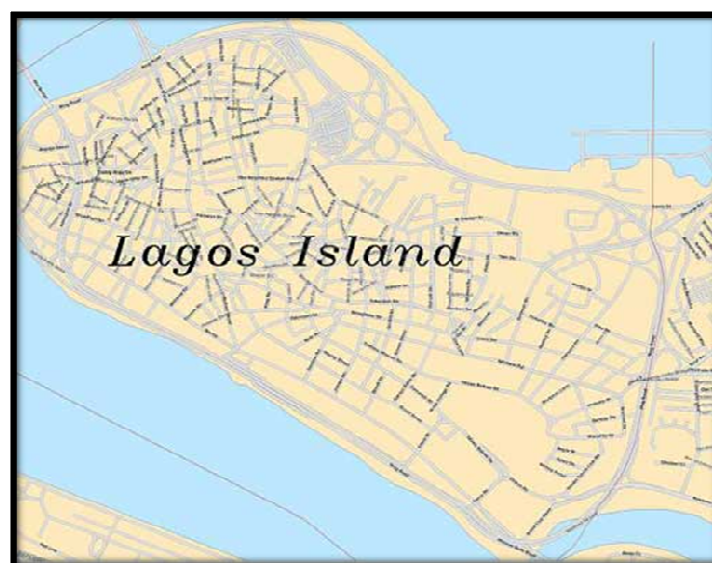


Fig. 3: Lagos Island LGA Road Network.
 SOURCE: Geographic information system department (2009).
 Lagos area metropolitan transport authority, Lagos, Nigeria

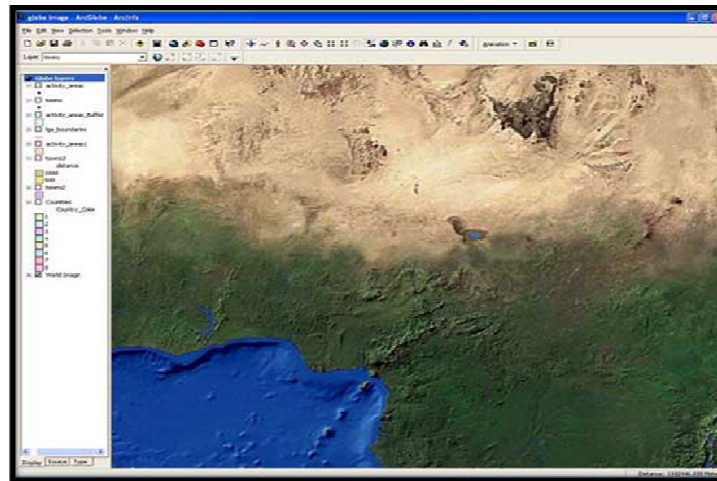


Fig. 4: DEM Image of Nigeria (Lagos State) Land Mass and Coast Line

SOURCE: Geographic information system department (2009).Lagos area metropolitan transport authority, Lagos, Nigeria

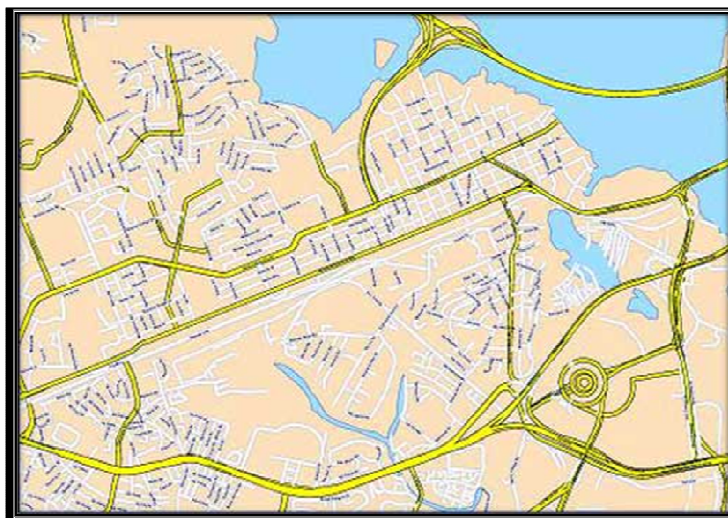


Fig. 5: Lagos Mainland LGA Road Network

SOURCE: Geographic information system department (2009).

Lagos area metropolitan transport authority, Lagos, Nigeria

3.1 The Mandate Of The Lagos Area Metropolitan Transport Authority (Lamata) Gis Includes:

- Developing A Robust On-Line Database Structure For Lamata Declared Road Networks: This includes spatial and attribute data along declared road network that will be regularly reviewed and updated from time to time, in concomitance with prevailing changes in land use occasioned by infrastructural development
- Geographic Information System (Gis) User (In – House) Training: getting staff to regularly update themselves with current trends and functionality of geographic information system through the organisation of seminars, workshops and inter-agency interactions with geographic information system firms.
- Produce Roads Furniture Map: The roads furniture map is used to reflect important sign posts on the road such as zebra crossings, stop signs, lane-diversion maps e.t.c. the road furniture map is a vital geographic information system tool needed for efficient traffic management.
- Produce a Population Density Map: A population density map will assist the Lagos area metropolitan transport authority (lamata) to visualize the degree of population distribution in the Lagos metropolis with a view of to bringing services where needed, and returns on investment.

- Produce A Simulation Map Of The Bus Rapid Transport Bus Routes: Simulation is a method of viewing the existing transportation performance in a city and seeing how this performance may change with growing demands. It is not possible to accurately predict the spatial processes on specific streets or intersections in detail due to varied factors. Looking at the performance of individual nodes at a citywide, geographically aggregated level is a better option.
First, a model is built to simulate existing conditions, and then performance can be assessed as traffic demands or controls. (Daganzo et al, 2007)
- Produce Local Government Area Maps: Needed to know the areal extent that will be serviced by the Lagos area metropolitan transport authority (LAMATA).
- Produce a Traffic Management Map (Route Planner): Traffic is a major challenge in Lagos state. A traffic management map is to assist the Lagos area Metropolitan Transport Authority to planning transport infrastructure towards traffic management.
- Produce a Nearest Facility Map: A nearest facility map entails the geographic location and spatial distribution of service facilities such as petrol stations, banks, car parks etc along transport routes or proximity to transport routes.

3.2 The Lagos Area Metropolitan Transport Authority (LAMATA) GIS Mandate's Objectives

- 1) To Develop a Database, Which Contains Data on all Elements of the Lagos Metropolitan Area Transport Authority (Lamata) declared Road Network: Deploying geographic information system in transportation at an enterprise level presents an opportunity to eliminate the traditional application-specific development pattern of information systems by providing a common data structure centered on transportation features. The solution is to embrace the diversity of applications and data requirements within a unifying enterprise data model for geographic information system that allows each application group to meet the established needs while enabling the enterprise to integrate and share data. The primary objective of this model is to allow frequent transaction-based data exchanges and updates, the type that an interactive organization is likely to need. As transportation agencies move toward a more integrated manner of doing business such as involving design units earlier in the project planning cycle, the need for data to cross former institutional or jurisdictional barriers will become greater. (J. Allison et al, 2000)
- 2) To Train End Users on the Use of Geographic Information System in Their Departments: Department-specific professional staff positions that require geographic information system usage need to be addressed separately.
- 3) Once geographic information system has been effectively integrated into the business processes of individual departments, employees with geographic information system skills become more valuable
- 4) Mapping Traffic Furniture in Lagos E.G. Traffic Lights, Zebra Crossings: the concept of highway asset management is becoming increasingly important for those responsible for attaining best value for managing highway networks. Asset management is not a new concept and most highway authorities are practicing elements of asset management
- 5) already.
- 6) However, the service wide application of asset management is a relatively new concept. Some key elements of asset management that need to be defined for each asset are: specification and location performance, condition and criticality planned maintenance Information on these elements is required to develop and refine financial and risk models, as well as contributing to the asset valuation process. More recently, with geo-referenced data being available within GIS systems, the concept of associative spatial maintenance has become a reality. This concept aims to identify, for any location where an asset requires maintenance, any adjacent assets in close proximity that do not necessarily require immediate attention, but where the maintenance can be simultaneously carried out within a budget efficient time frame (www.roadcodes.org,2008)
- 7) Mapping the Population Density of Lagos State by Local Government Areas: Population density (in agriculture standing stock and standing crop) is a measurement of population per unit area or unit volume. It is frequently applied to living, and particularly to humans. It is a key term used in geography.
- 8) Producing a Directional & Locational Guide Map of Local Government Areas in Lagos State: A map gives a miniature "picture" of a very large space. A map is a guide to a space you have not encountered before. Maps have distance, mountains, rivers, and shapes of places or destinations.
- 9) Production of A Map That Provides A Representation of Traffic Situations on Lagos Roads: Interaction between road users during road crossing involves decision-making and prediction of future states of the scene. To predict cooperation and competition of the temporary limited road space a dynamic driver decision model is needed. (Wieringa, 2004)
- 10) Capturing data of Agencies/Organizations with Sizeable number branches on a Map, for easy identifying and locating: Government agencies use public funds to collect and maintain data including location based or spatial data (geodata) in pursuit of their missions. The value of this important investment is often best realized by the widespread distribution and use of government held data

3.3. Mandate Implementation Strategies.

A critical element of a geographic information system (GIS) operation is Data which informs the vigorous policy quest and pursuit of accurate and current spatial data by the Lagos Metropolitan Area Transport Authority (LAMATA). This should result in a build-up, continual populating and maintenance of a reliable spatial database. The current infrastructural projects in Lagos is redefining the metropolitan landscape with a dire need for current and accurate spatial data that will be highly instrumental to planning, executing and delivering a world-class transport system befitting of a megacity. The data required by Lagos Metropolitan Area Transport Authority (LAMATA) is sourced by reliable geographical information system (GIS) vendors with proven track records of accuracy. It is worthy of note that geographic information system data (GIS) is usually characterized by accuracy issues, meaning that it is very unlikely for two geographic information system (GIS) operators to go to the field and obtain perfectly same spatial accuracy in their data, for reasons ranging human to natural factors.

With a current and accurate spatial database, the Lagos Metropolitan Area Transport Authority (LAMATA) is saddled with the responsibility of locating, identifying and collaborating with the end-users of geographic information system so as to bring about an effective transport system. The end-users of Geographic information system (GIS) include but not limited to transport systems developers (government and private agencies), construction companies, estate developers, Land registries etc. Based on efficient geographic information system, the Lagos Metropolitan Area Transport Authority (LAMATA), act as moderators to every institution whose activities hinges on transport development. This done by training the end-users of Geographic information system (GIS). Consequently, the end product of a Geographic information system (GIS) is usually the production of a map to reflect the spatial dimension of acquired data. A detailed map is required for effective transport planning, which will include plot and overlay data on road network.

4. POSITIVE IMPACT OF GIS ON LAMATA

The utilization of geographic information system (GIS) in the realization of a world class transport system is a remarkable working progress in metropolitan Lagos. Major successes has been recorded at pre-planning and post planning stages of the light rail and bus rapid transport (BRT) scheme. This has lead to the ease of vehicular mobility thereby reducing the previously high incidence of traffic congestion and its socio-economic consequences. In further elucidating on the successes recorded in transport system of metropolitan Lagos through the use of geographic information system (GIS), it is noteworthy to say that the most organized places or regions of the world are the most well-mapped-out.

It is in recognition of this fact that the Lagos Metropolitan Area Transport Authority (LAMATA) has produced thematic maps, displaying diverse scenarios ranging from land use pattern to transport route pattern thereby leading to the production of land use maps and route maps respectively. Abler et al in 1971 postulated that spatial patterns and spatial process are circularly causal.

This means that spatial pattern leads to spatial processes and vice versa. Understanding spatial patterns and spatial processes is very important in transport planning. it is on the strength of this that the Lagos Metropolitan Area Transport Authority (LAMATA) has use satellite imageries to monitor human and vehicular traffic which has positively influenced transport planning. The expansion of its influence in the Lagos metropolis is being felt with the parallel creation of bus rapid transport route alongside new road constructions and expansions.

4.1 Challenges

With the high cost of data by geographic information system vendors, the creation of spatial data has been a very high-cost process involving largely manual data conversion from paper maps or survey information, especially when high precision (meter or sub-meter) is required as is the case for utility and cadastral applications. It is highly challenging getting end users interested in learning geographic information system software: most geographic information system software is written from the vendor's perspective; oftentimes, a company selling geographic information system software has to 'idealize' a vast array of municipal geographic information system needs. The result is complex and overwhelming geographic information system software that does more than necessary for any given task. to the average municipal employee, geographic information system is just too complex. in addition, there can be a growing scepticism towards learning geographic information system technology since most municipal employees may have already developed some computer skills by using non-spatial 'data storage software' and are not interested in investing more time in learning new skills. this is exacerbated by the fact that geographic information system is often so different from the software they are accustomed to using (Cardenas, 2007).

Another challenge is inaccurate data from different geographic information system vendors, the problem with this business process is that getting the field-collected information back into the system of record can take anywhere from three days to three weeks to three months. All of the maps produced and printed during that time have the potential to be inaccurate or incomplete. All of the collaboration that occurs and business decisions that are made during that time are based on inaccurate or incomplete information. So not only is the current process time-consuming and prone to human error, it is also exposing organizations to greater risks. Populating the geographic information system database up to date: database development is a crucial requirement for the adoption and integrated use of geographic information system in any organization or establishment. Database development is very crucial in geographic information system modelling, analysis, and mapping as it allows all possible features in the specific map area to be captured, described and allow the possibility of running basic query languages for geospatial evaluation of the area of study (gumos, 2005). In the lagos area, metropolitan transport authority (lamata), high cost of data, inaccurate data from different vendors and inadequate geographic information system proficient manpower, makes an up-to-date status of the geographic information system database an uphill task.

5. CONCLUDING REMARKS

The megacity project of Lagos state is still a working progress, and a great deal of planning is required if Lagos state is to attain a world class mega-city status. The success recorded in using geographical information system in transport route in parts of Lagos, should be extended to other parts of the state and its environs, which includes Ogun state. Geographic information system should also find relevance in every structural and infrastructural development of Lagos state. The implication of this is that the harsh effect of every form of migration to Lagos which results in congestion will be brought to the barest minimum. Also, environmental issues which are prevalent in Lagos such as flooding can also be mitigated, land registry documentation system improved, facilities mapping and inventory improved and updated for effective and efficient taxation. In this 21st century, the importance of geographic information system in the structural and infrastructural development of any nation cannot be over-emphasised.

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