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A CADASTRAL GEODATA BASE FOR LAND ADMINISTRATION USING ARCGIS CADASTRAL FABRIC MODEL

A CASE STUDY OF UWANI ENUGU, ENUGU STATE, NIGERIA

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Presentation Outline

- Introduction
- Land Administration in Nigeria – An overview
- Cadastral Boundary Management
- Cadastral Fabric and ArcGIS Cadastral Fabric Model
- Typical Cadastral Database Workflow
- Case Study
 - Cadastral Geodatabase Design and Implementation
 - Loading of data into Cadastral Geodatabase
- Results , Discussions and Conclusion

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Introduction

- Land administration is the process of determining, recording and disseminating information about ownership, value and use of land when implementing land management policy (UNECE Report 196 – 9).
- Its has evolved over the years towards an integrated land management paradigm designed to support sustainable development.
- Land administration generally delivers four functionalities land mapping, land registration, land valuation and land development, each with specific data elements, with the cadastral system at the core.
- Cadastre systems in recent years have developed from manual inconsistent systems into automated systems that highly benefit from the advancements in the Geo-Information and Communication Technology (Geo-ICT).

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Introduction *Cont.*

- This has led to the modifications of existing data models to improve their capacity to deliver sustainably.
- The ArcGIS cadastral fabric model is one result of such modifications
- ArcGIS cadastral fabric is a dataset created in a Geodatabase and is used for managing cadastral land record information
- In this study, the modeling and implementation of a cadastral Geodatabase for Land Administration is presented
- The Cadastral geodatabase is based on ArcGIS Cadastral Fabric Model.

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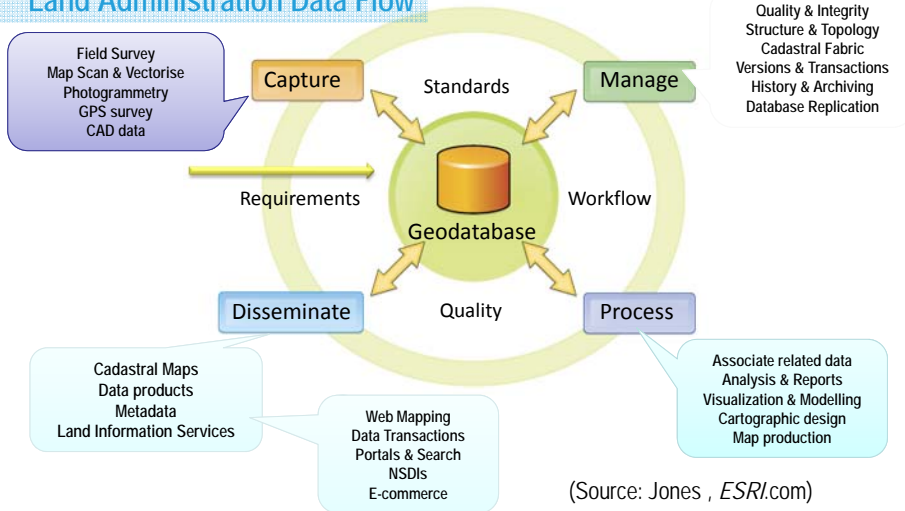
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Land Administration Data Flow



Land Administration in Nigeria – An overview

- Land administration and management in Nigeria is guided by the Land Use Act, Cap L.5 of 2004 (originally promulgated as Land Use Decree No.6 of 1978).
- Although guided by the Land Use Act, it is devoid of the attributes of an ideal land administration system.
- The current system is fraught with a number of problems.
- Prominent among these is the lack of adequate functional and coordinated land information system and networks underpin this weak system
- However several efforts are ongoing to revert the situation. Notable is the current Land Reform Programme initiated by the Present Federal Government

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Cadastral Boundary Management

- The establishment of the parcel fabric for cadastral registration has over the years evolved from the use plane table in the early 19th century in Europe, to the use of metes and bounds using a magnetic compass and a chain (Konecny et al, 2010).
- The parcel fabric established at that time may have been relatively consistent, but it lacked absolute accuracy because these surveys were not referenced to a geodetic survey control system.
- Nevertheless, the design of a tax cadastre became possible by these methods.
- This situation however changed dramatically, with use of modern technology in Geoinformatics in the 20th and 21st century. Some of the modern methods of establishing Cadastral boundaries are: *GPS – GNSS and Image Adjudication*.

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Cadastral Boundary Management _ Cont.

Cadastral Survey Options
(Source: Konecny et al, 2010)

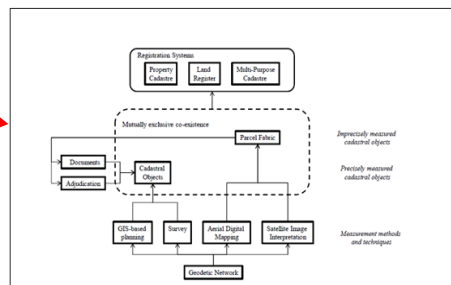
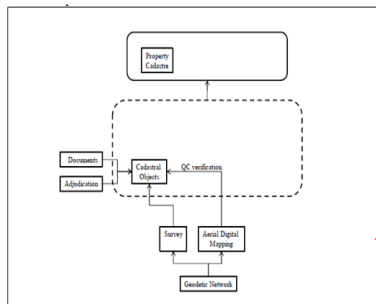


Figure 3.0: Cadastral Survey Options (Source: Konecny et al, 2010)

Cadastral boundary management scenario in Transformation Counties including Africa

Figure 3.0: Cadastral boundary management scenario in Transformation Counties including Africa. (Source: Konecny et al, 2010)



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Cadastral Fabric and ArcGIS Cadastral Fabric Model

Cadastral Fabric

- A cadastral fabric is a continuous surface of connected parcels
- Parcel polygons are defined by a series of boundary lines that store recorded dimensions as attributes in the lines table.
- Parcel polygons are also linked to each other by connection lines, for example, connection lines across roads. Because each and every parcel is either linked or connected, a seamless network of connected parcel boundaries, or cadastral fabric, is formed.



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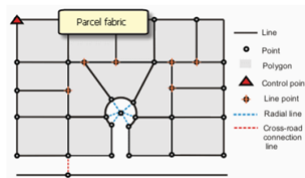
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Cadastral Fabric and ArcGIS Cadastral Fabric Model

ArcGIS Cadastral Fabric Model

- The ArcGIS cadastral Parcel Fabric model is a data model and geodatabase maintenance environment developed by Esri



Cadastral fabric data model (Source: ESRI.com; Doan, 2010)

- The model was as a result a long time of multiple collaborations in the cadastral domain

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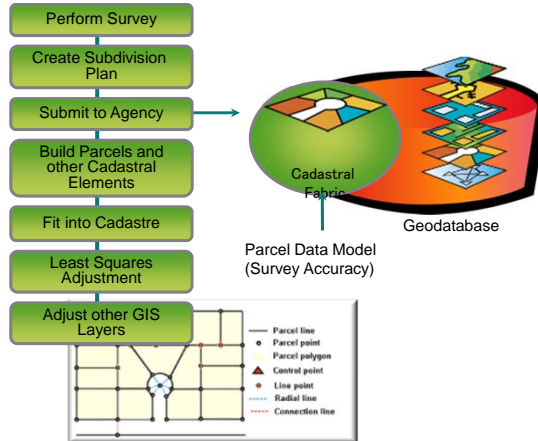
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Typical Cadastral Database Workflow



Typical Cadastral Database Workflow (Source: Jones , ESRI.com)



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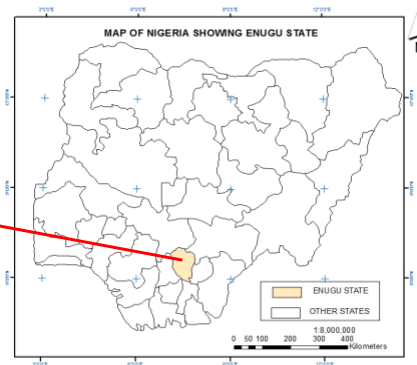
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Case Study : Study Area



Map of Enugu State showing the area of Study

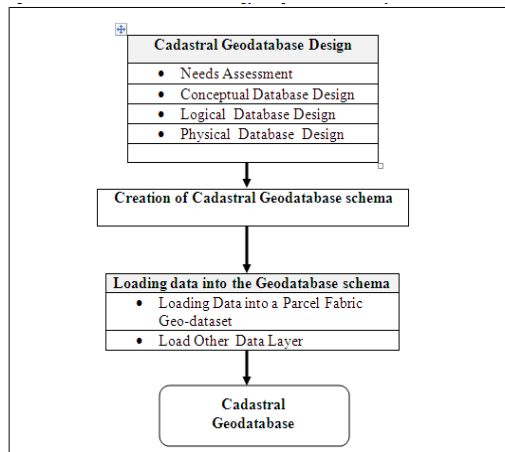


Map of Nigeria Showing Enugu State

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Case Study: Methodology of the Study



Case Study : Cadastral Geodatabase Design

- Model User's View of Data
- Select/Match Geographic Data with Geodatabase Model
- Organize Geodatabase Structure
- Unified Modeling Language (UML) Model of Geodatabase Features

Model User's View of Data

- **Needs Assessment and generation of needs assessment report**
- **Identification of data layers required to support Land administration functions**

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Cadastral Geodatabase Design : Model User View

Logical Data Groups	Data Layers
<ul style="list-style-type: none"> Imagery 	<ul style="list-style-type: none"> Scanned Maps Digital Orthophoto
<ul style="list-style-type: none"> Built Planimetric 	<ul style="list-style-type: none"> Building/Blocks Land use Zone Utilities Roads
<ul style="list-style-type: none"> Topographic 	<ul style="list-style-type: none"> DEM Spot Height
<ul style="list-style-type: none"> Cadastral Records 	<ul style="list-style-type: none"> Cadastral Fabric <ul style="list-style-type: none"> - Parcel line - Control - Parcels - Plans(table) - Line points - Points - Job(table) - Accuracy(table) - Adjustments(table)



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Design: Assignment of Geodatabase representation to data layers

- Assignment of appropriate Geodatabase representation to data layers
- Place logical data model objects into geodatabase elements

Geographic Representation And Matching Geodatabase Model for Data Layer.

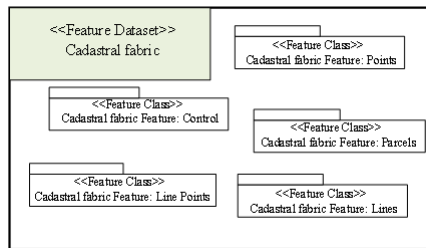
Data Layer	Spatial Type	Feature Class	Arc Info Class	Feature Dataset	Geodatabase
Imagery					Cadastral Geodatabase
-Orthophoto	Image		Raster	Imagery	
Built Planimetric					
-Building	Area	Building	Polygon Feature	Built	
-Land Use Zone	Area	Land use	Polygon Feature		
-Roads	Line	Roads	Line Feature		
Topography					
-DEM	Point	DEM	Point feature	Topography	
-Spot Height	Point	Spot Elevation	Point feature		
Cadastral Record					
Cadastral Fabric					
-Parcel line	Line	Parcel Lines	Line Feature	Cadastral Record	
-Control	Point	Control	Point feature		
-Parcels	Area	Parcels	Polygon Feature		
-Plans	Text		Object		
-Line points	Point	Line points	Point feature		
-Points	Point	Points	Point feature		
-Jobs(table)	Text		Object		
-Accuracy(table)	Text		Object		

Design: Organize Geodatabase Structure

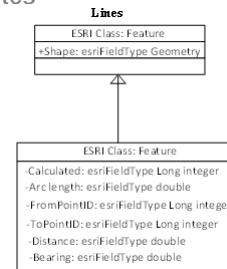
- Identified data layers were assigned to features classes and
- Grouped into logical feature datasets to obtain the final cadastral geodatabase layout.

UML Model of Cadastral Geodatabase Features

- Unified Modeling Language (UML) was utilized to build the Logical model for the cadastral Geodatabase.
- This includes , workspace views of feature dataset and
- Simple diagrams of feature classes and their attributes



Workspace View of feature Dataset

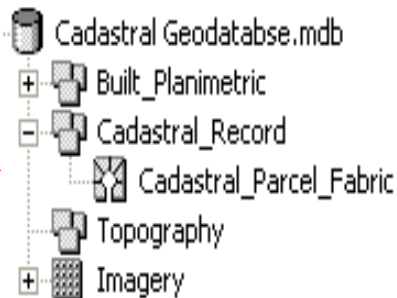


Simple diagrams of feature classes and their attributes

Creation of Geodatabase Schema

Cadastral Geodatabase Schema was created :

- Using ArcCatalog Wizard
- Unified Modeling Language (UML) and CASE Tools



Cadastral Geodatabase Schema

Loading of data into Cadastral Geodatabase

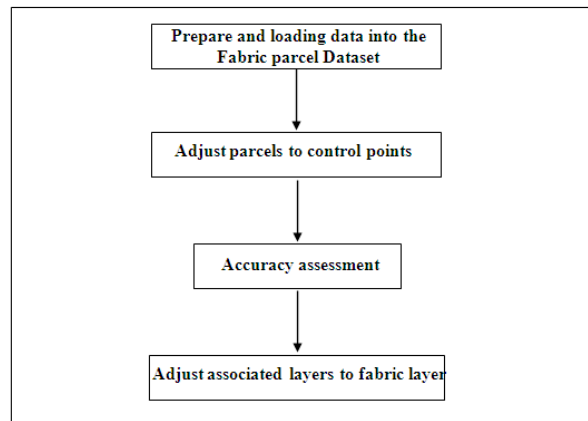
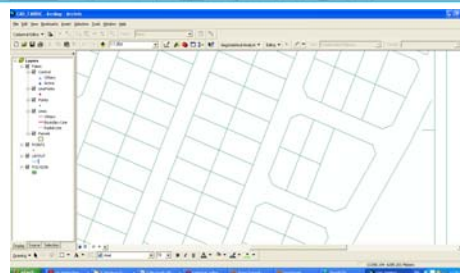


Figure 5.4: Workflow for Loading Data into Parcel Fabric Dataset

Results and Discussions



- ArcMap Interface to the cadastral Geodatabase
- The Cadastral Geodatabase can be maintained and queried using inbuilt tools in ArcMap
- The Cadastral Geodatabase can support the four functions of Land Administration



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Conclusion

- The paper has presented the modelling of cadastral geodatabase based on the ArcGIS cadastral fabric data model to support land administration
- The recent ArcGIS cadastral fabric technology provides the capability to manage continuous cadastral fabric efficiently in a geodatabase by migrating cadastres from existing databases
- With the geodatabase at the core, the four functions of land administration can efficiently be delivered

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