



A Review and Perspective on Parcel Data Models for Urban Planning

Yiqiang Ouyang
Prof. Dr. Ilir Bejleri

Department of Urban and Regional Planning
University of Florida

June 19-21, 2010



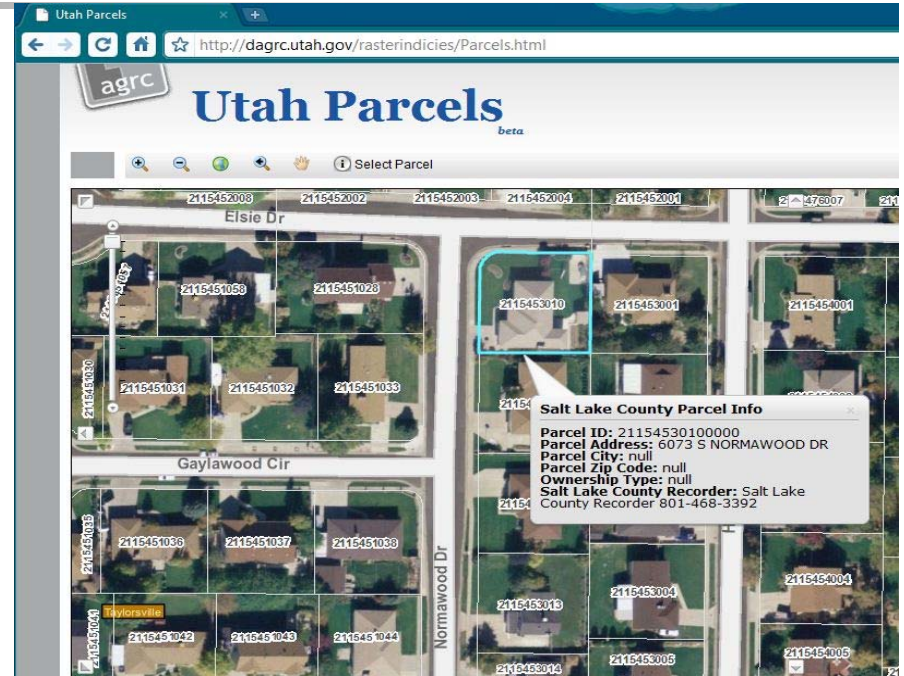
Content

1. Introduction
2. Parcel Needs Analysis in Urban Planning
3. Review on Parcel Data Models
4. Perspective on Parcel Data Model for Urban Planning
5. Conclusion and Future Work

1. Introduction



Source: <http://devblog.mapquest.com>



Source: <http://mapserv.utah.gov>

- Parcel Data: spatial depiction of individual plots of land



Application of Parcel Data

- Parcel data are increasingly important to addressing a variety of applications in
 - emergency response,
 - regional planning,
 - natural disasters,
 - natural resources management,
 -



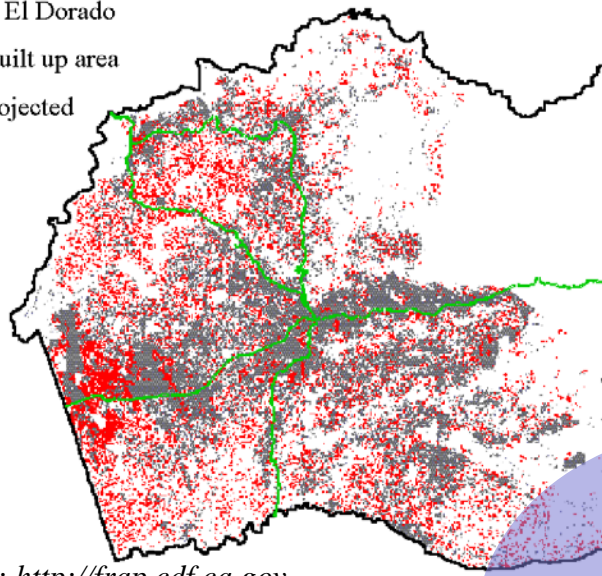
Parcel Data in Urban Planning

- Parcel data are intensively used for urban planning purposes in
 - land use modeling,
 - transportation planning,
 - municipal structure planning,
 - urban growth management
 - and development control
 -

Western El Dorado

Grey - built up area

Red - projected



Source: <http://frap.cdf.ca.gov>

Development Probability



Source: <http://www.gisdevelopment.net>

Spatio-Temporal Land Use Change

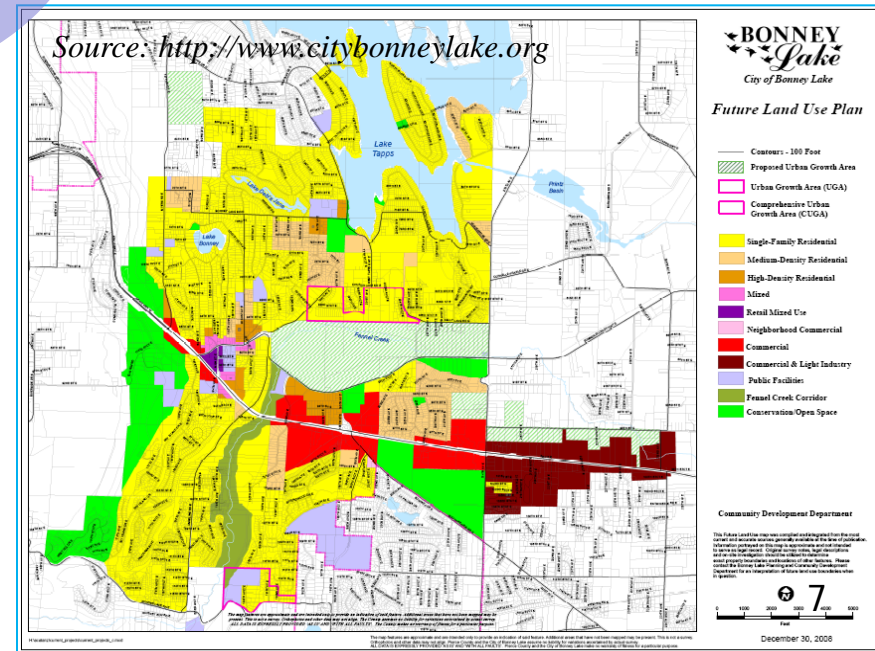
Parcel Based Urban Planning

Scenario Planning

Urban Growth Management



Source: <http://www.fhwa.dot.gov>



BONNEY Lake City of Bonney Lake

Future Land Use Plan

Community Development Department

December 30, 2008




Call for Parcel Data Model

How to structure the parcel information effectively and comprehensively to support different planning activities?



Parcel Data Model



Describe the information of the parcel itself and the parcel based information in certain planning applications



2. Needs Analysis of Parcel in Urban Planning

- Data Sources
- Spatial Needs
- Spatial-Temporal Change Support
- Attributes Needs



Data Sources

- Planning agencies in United States
 - Three States: Florida, Wisconsin and Maryland
- American Planning Association (APA) website
- APA LBCS and its GIS implementation
 - LBCS: land based classification standard
- Property Appraisers in Florida

Spatial Needs

- Geometry ranges from points to polygons
 - parcel centroid or other location
 - parcel boundary to building footprints
- Provide spatial situational information
- Polygon provides an effective means for representing and analyzing information





Spatio-Temporal Information

- Land use change is an essential process that occurs constantly
- Two aspects: geometry and attributes
 - Geometry: parcel split or combine...
 - Attributes: ownership, land use, housing units...
- Important to record and track the spatio-temporal info
 - monitoring city growth and urban sprawl
 - conducting the temporal analysis to forecast the future change or growth
 -

Attributes Needs

- Land Use Information
 - land use: the built environment, human use of land
 - land cover: natural features, vegetation, sacrificial geology, etc.
 - needed almost in every urban planning activity.



Source: <http://www.mapwise.com>



Attributes Needs (cont'd)

- Legal Information
 - Right
 - Restriction
 - Responsibility
- Land Value Information
 - assessed value, sales value
- Other Specific Parcel Based Information
 - Due to breadth of urban planning activities, special parcel based information may be used in specific urban planning areas.

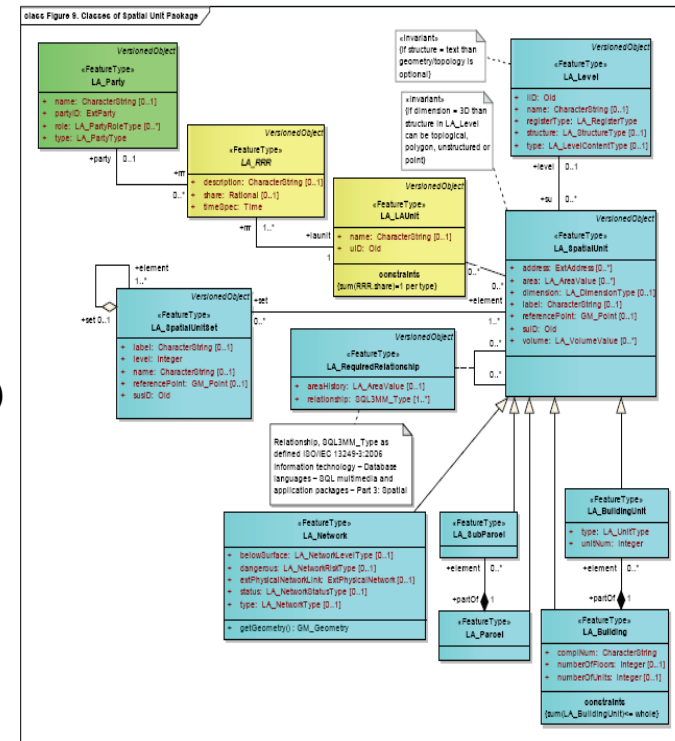


3. Review of Parcel Data Models

- Parcel data models at different levels
 - ISO/CD 19152 Geographic information - Land Administration Domain Model (LADM)
 - INSPIRE Data Specification on Cadastral Parcels
 - FGDC Cadastral Data Content Standard
 - Florida parcel data model
 - ESRI's ArcGIS parcel data model

ISO/CD 19152

- Defines a reference Land Administration Domain Model (LADM) covering basic information-related components of Land Administration
- Five basic packages
 - Parties (people and organizations);
 - Basic administrative units, rights, responsibilities, and restrictions;
 - Spatial units (parcels, 3D buildings);
 - Spatial sources (surveying);
 - Spatial representations (geometry and topology)
- Focused on rights, responsibilities and restrictions affecting land (or water), and the geometrical (spatial) components



Source: ISO 19152

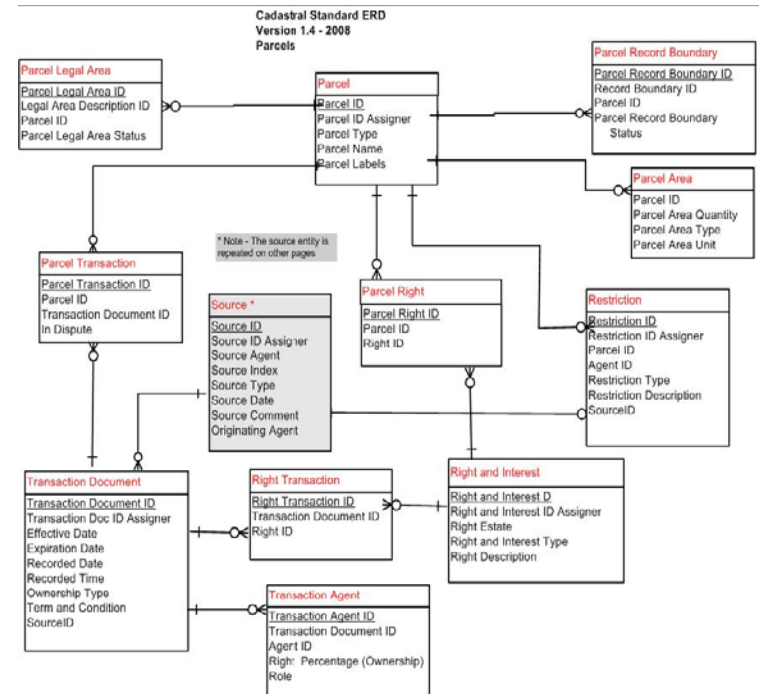


INSPIRE Data Specification on Cadastral Parcels

- Purpose: serve the generic information locators for environment applications in Europe.
- Cadastral parcel is the core element
 - described by some mandatory elements such as geometry, unique identifier, cadastral reference and the label of the parcels that support their identification on printed maps.
- Take into account of other ISO standards:
 - Geometry: ISO 19125-1
 - Topology: ISO 19107

FGDC Cadastral Data Content Standard

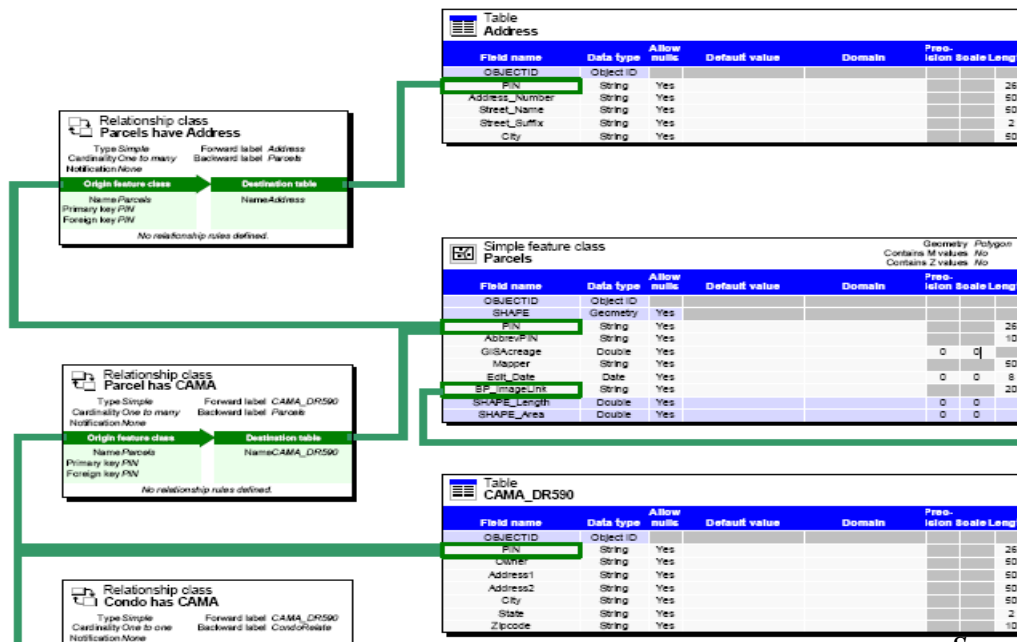
- Purpose is to facilitate data sharing at all levels of government and the private sector.
- Provides semantic definitions of objects related to land surveying, land records, and landownership information.
- The core model consists of three main components: Land Parcel, Legal Area Description and Agent



Source: FGDC Cadastral Data Content Standard

Florida Parcel Data Model

- Designed as part of the Florida cadastral mapping guidelines
- Serve the property tax administration.
- Focus on geometry aspects; doesn't include the land use, rights and restrictions information.





ArcGIS Parcel Data Model

- An implementation of the Cadastral Data Content Standard.
- Defines seven themes in the implementation:
 - **Corners:** comprises points that define the parcel boundary
 - **Boundary:** contains the lines form the edges of parcel areas
 - **Parcel Framework:** provides the supporting outline for parcel-related features
 - **Rights and Interests:** rights and interests of the parcel based on the ownership
 - **Administrative Areas:** areas used to manage or allocate resources and services in government
 - **Tax Parcels:** support the valuation of land administration
 - **Parcel Related.**



Comparison

Parcel Data Model	Geometry					Topology		Land Use		Spatio-Temporal Support			Legal				Land Value	Multi Purpose			Expandability	
	Point	Line	Polygon	Plan	3D object	Spatial Topology	Temporal Topology	Land Use	Land Cover	Geometry Change	Attribute Change	History Tracking	Rights	Interests	Responsibility	Restriction	Land Value	Land Administration	Tax	Environment	Urban Planning	Expandable
ISO/CD 19152	√	√	√		√	√	√						√	√	√	√						√
INSPIRE	*	*	*			√	√			√		√							√			√
FGDC	√	√	√										√	√		√						√
Florida Model	√	√	√																√			
ArcGIS	√	√	√	√		√				√	√		√	√		√	√	√				√



Parcel Data Models and Urban Planning Needs

- General
- Urban Planning Support
- Topology
- Spatio-Temporal Change Support
- Land Use and Land Valuation
- Expandability



Models Meet Planning (1)

- General
 - All the parcel data models have a geometry basis.
 - Most of them are very much focused on the legal part: right, restriction, responsibility.
 - None of these models have a special theme on urban planning.
 - Limited or no content of topology, spatial-temporal change information, land use and land value information.



Models Meet Planning (2)

- Urban Planning Support
 - No parcel model is focused on urban planning.
 - ISO 19152 could be expandable to application in planning.
- Topology
 - ISO 19152 and INSPIRE parcel specification states the issues of topological gaps and overlaps between parcels.
 - ArcGIS parcel data model also defines a set of topology rules over geometry elements.
 - FGDC model and Florida parcel data model don't have topology element.



Models Meet Planning (3)

- Spatio-Temporal Change Support
 - INSPIRE parcel specification records the lifespan of a spatial object.
 - ArcGIS parcel data model supports the spatial change of parcel.
 - Other parcel data models don't even mention the geometry and attribute change.
 - Except the INSPIRE, no history information is kept and could be tracked in the rest of the models.



Models Meet Planning (4)

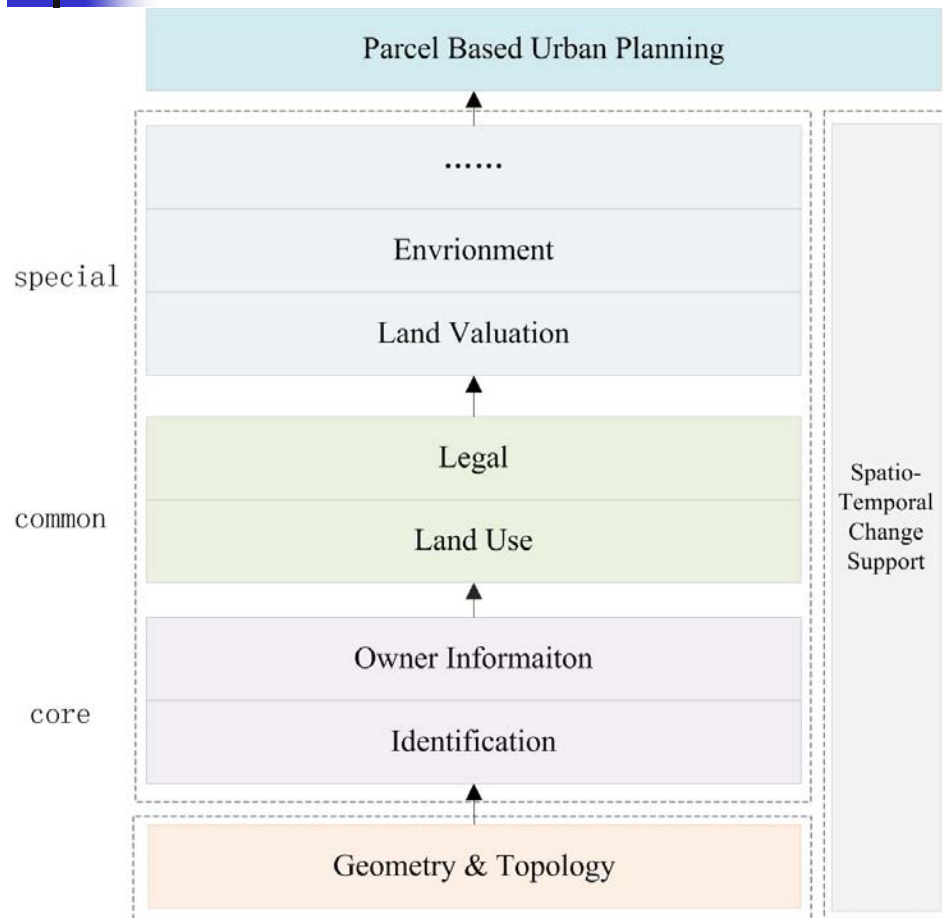
- Land Use and Land Valuation
 - No parcel data model integrates the land use and land value information in their definition.
 - In ISO 19152 and INSPRIE parcel model, land use is considered as external data theme.
- Expandability
 - Except for the Florida parcel data model, all other models are expandable.



4. Perspective of Parcel Data Model for Urban Planning

- The Proposed Model
 - integrates
 - parcel needs in parcel based urban planning and the advantages of current parcel data models.
 - is characterized by unity and extensibility
 - **Unity:** geometry, topology, legal, land use and other parcel based information will be unified.
 - **Extensibility:** extended for applications in different planning activities and in other areas beyond urban planning.

Framework



- Three Components
 - Geometry and Topology
 - Attributes
 - Spatio-Temporal Change Support.

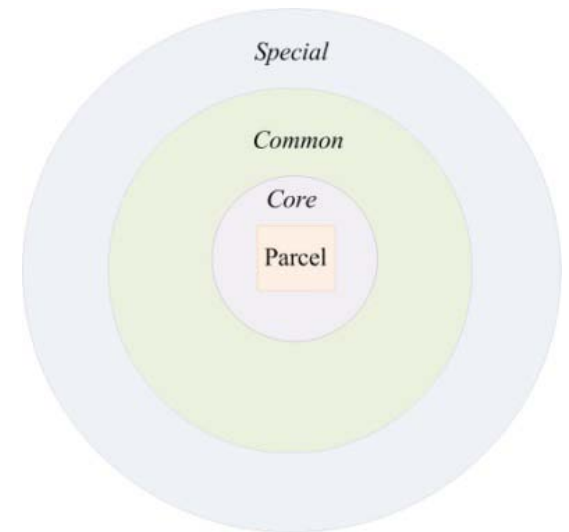


Model Components (1)

- Geometry and Topology
 - Functions:
 - provide the basis for locating the parcel attributes.
 - conduct the parcel based urban planning analysis and
 - visualize analysis result and planning scenarios.
 - Proposed Model Should
 - support the parcel geometry and topology integrity checking.

Model Components (2)

- Attribute Classification
 - Core
 - critical attributes required as a foundation for parcel based application
 - Common
 - general attributes for urban planning
 - Special
 - attributes for specialized planning application

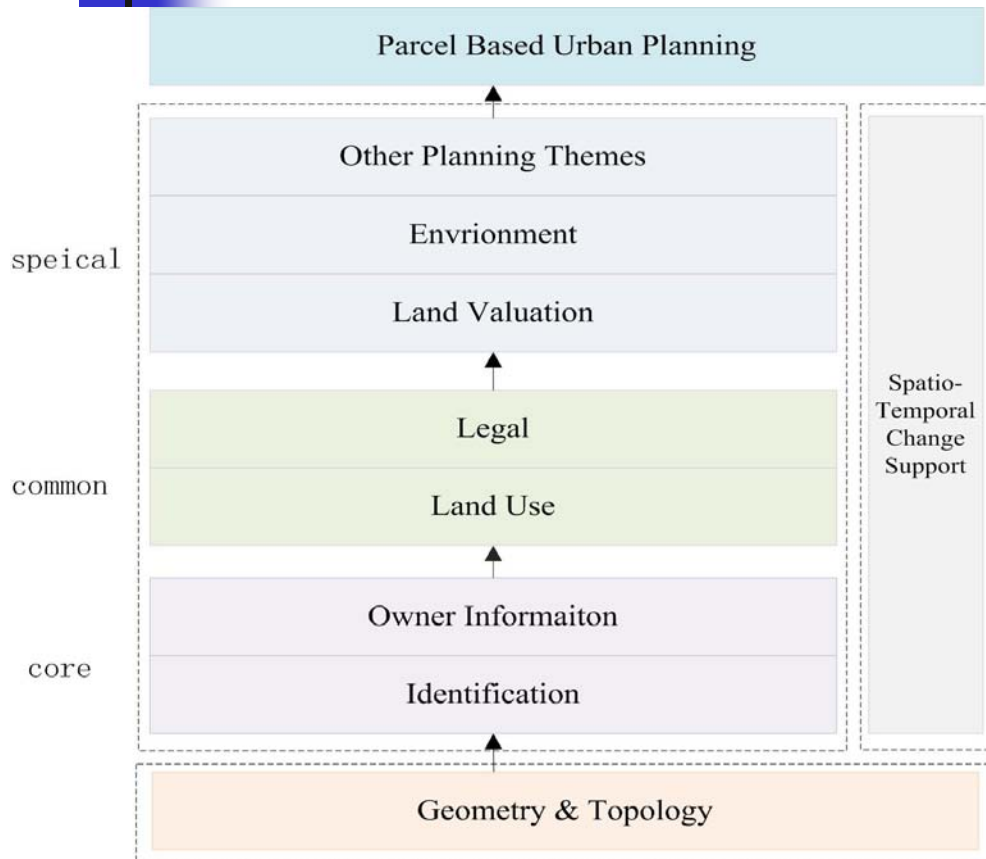




Model Components (3)

- Attribute Category Content
 - Core
 - Identification: parcel ID, area, physical address ...
 - Owner: owner's name, address, phone number...
 - Common
 - Land use: use status of the parcel, such as land classification, structures on the land
 - Legal: rights, responsibilities and restrictions
 - Special
 - Number of classes in this category is flexible

Model Components (4)



- Architecture of the attributes components in the model is very flexible
 - The core and common are required in parcel based urban planning,
 - while the special category is selectable, depending on the specific goals of any application



Model Components (5)

- The common attributes category would include attributes that are common for general urban planning but that don't apply in other non-urban planning areas.
- The content of each subcategory could be reduced or extended in practical planning.
- The subcategories could be extended in the special category-attributes for certain planning activities-according to the needs of planning applications. At this situation, a new subcategory is added.



Model Components (6)

- Spatio-temporal change support component
 - is based on the geometry and is integral in the entire process of a parcel based urban planning activity.
 - has the function of recording, managing and retrieving the geometry and attributes history information of any parcel.



Conclusion

- This research
 - analyzed the parcel needs in its application in urban planning,
 - made a comparative analysis of current parcel data model from urban planning perspective.
 - a perspective on parcel data model for urban planning is proposed based on the analysis of parcel needs and shortage of current parcel data model.



Future Work

- The future of this research
 - integrate the APA LBCS standard and spatio-temporal model in GIS area into the parcel data model.
 - make the detailed design and database design of the model.
 - and apply model in practical planning projects.
 - Two potential areas are affordable housing and transportation planning.



Thanks!

Comments? Questions?