

Computers, Urban Studies, and Urban Management

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Computers in Urban Planning and Management

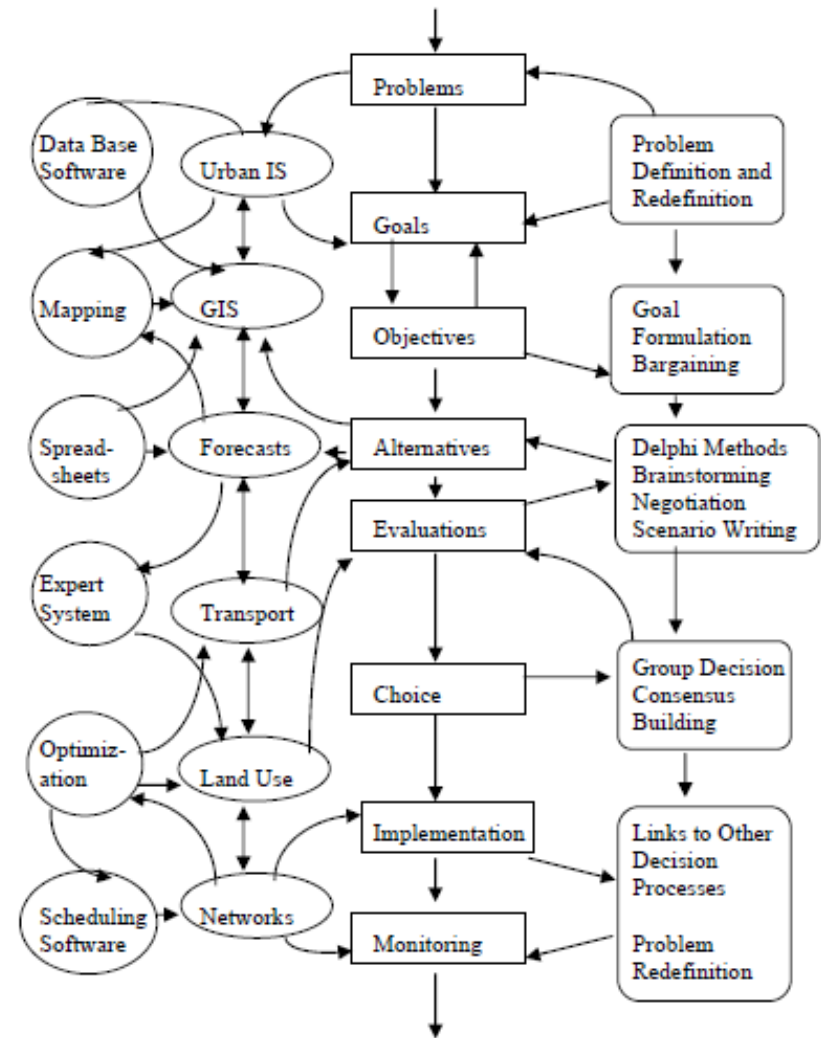
❖ The beginnings

- Computing devices used in public planning for 100 years
 - Transportation planning
 - Population and housing census
- Mainframe computers
- Hardware, software, and models were a bottleneck
 - Slow, not interactive (batch sessions)
 - Few variables
 - Coarse representation of the city region
 - “Fitting the reality to the model”

Computers in Urban Planning and Management

❖ The sequel

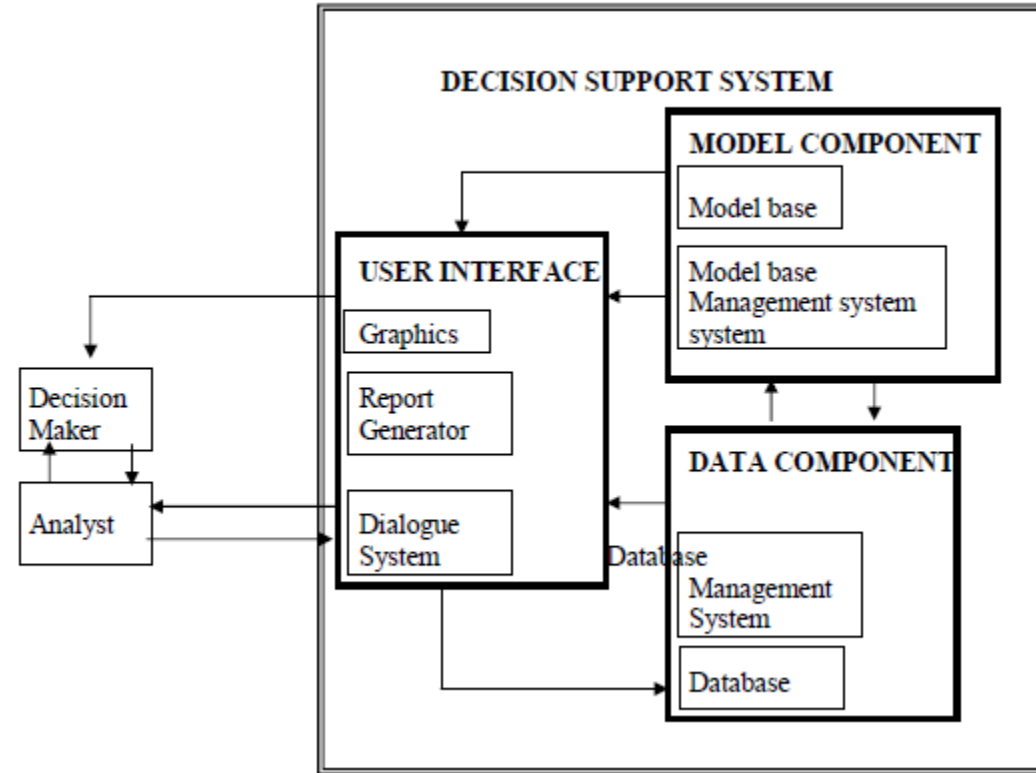
- Data collection and data management
- Data analysis and models
- Communication and data visualization
 - From operational models (that grew out of theory or physical science models) to **Planning Support Systems** (Britton Harris)



The Planning Process as a sequence of computable methods enabling decision support (Batty & Densham, 1996)

Planning Support Systems (PSS)

- ❖ Many planning problems are semi-structured
- ❖ Planning problems are inter-related
 - Partial or holistic view
 - Modular structure
 - Common “language”, with shared data, shared vision, interoperable modeling tools
 - Collaborative environment to solve multifaceted problems (group DSS)



Sustainability

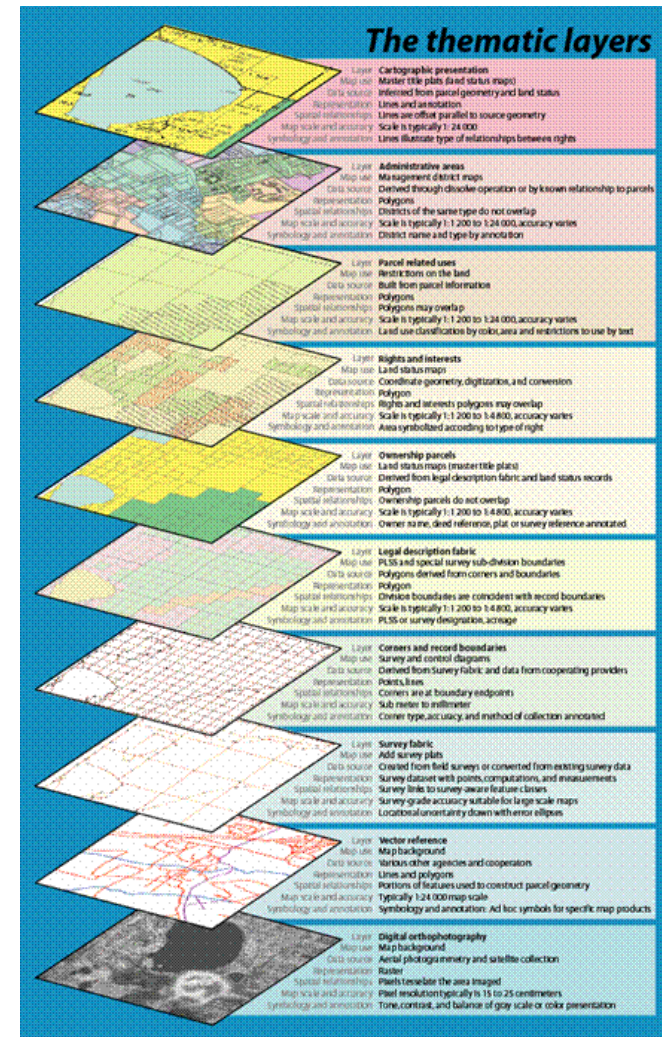
- Environmental
- Social
- Economic

(Lolonis, 1990)

Data Collection and Management

❖ Geographic Information Systems (GIS)

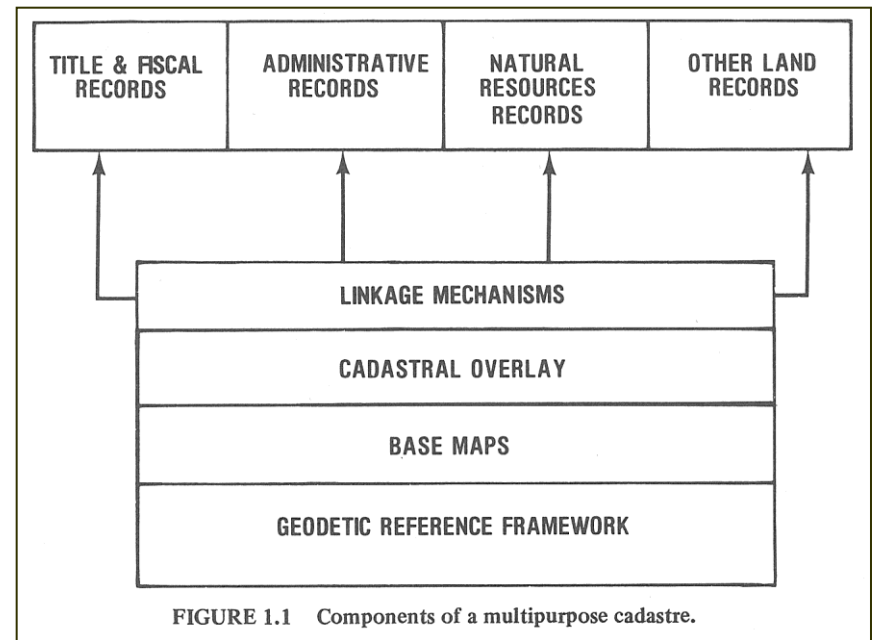
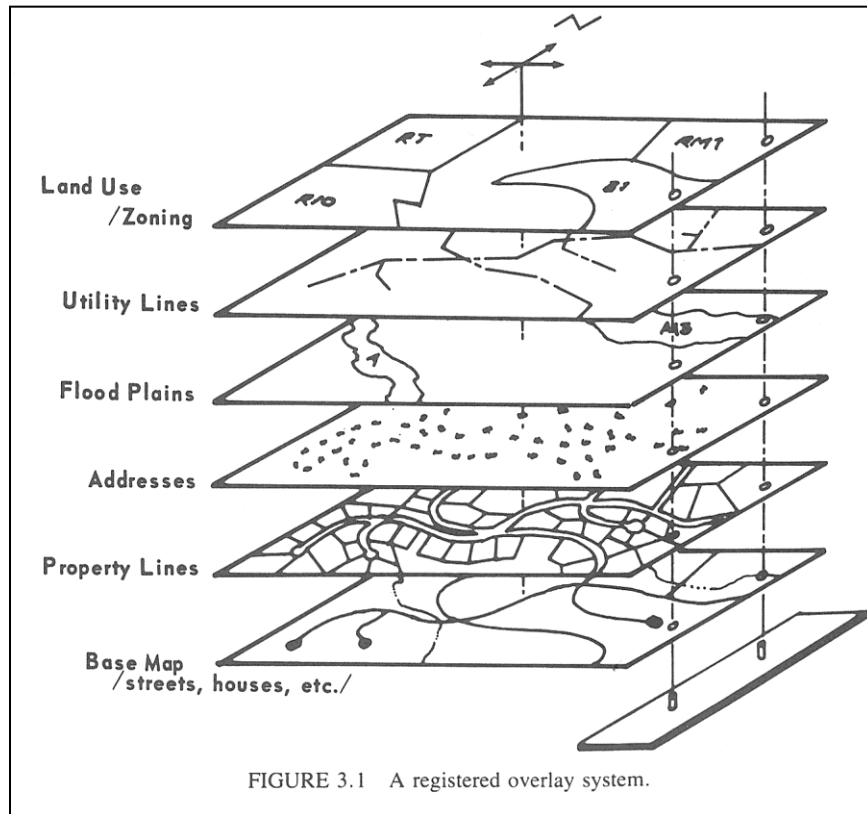
- Computer-based information systems
- Data is organized/referenced by their location
- Started from need in Land Information Systems
- Enterprise GIS: framework for integrated workflow



Data Collection and Management

❖ Cadastral systems

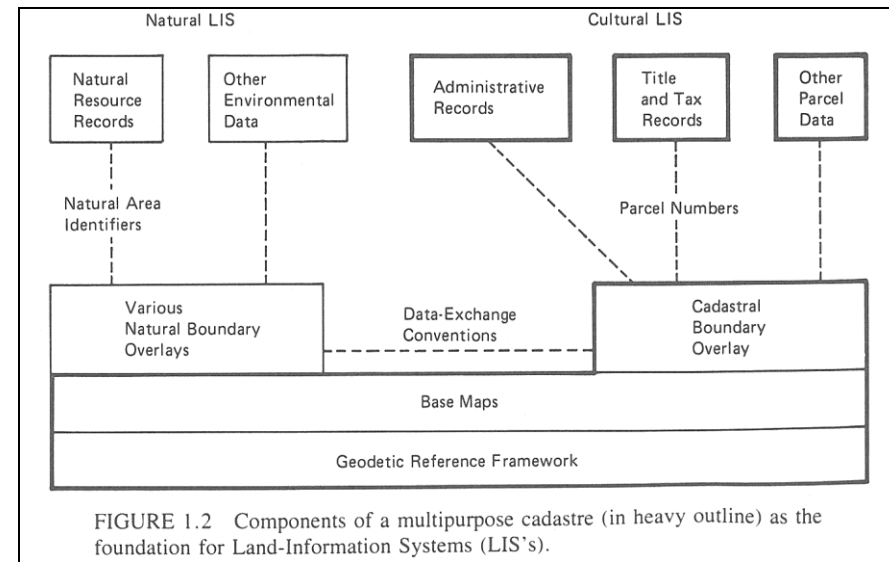
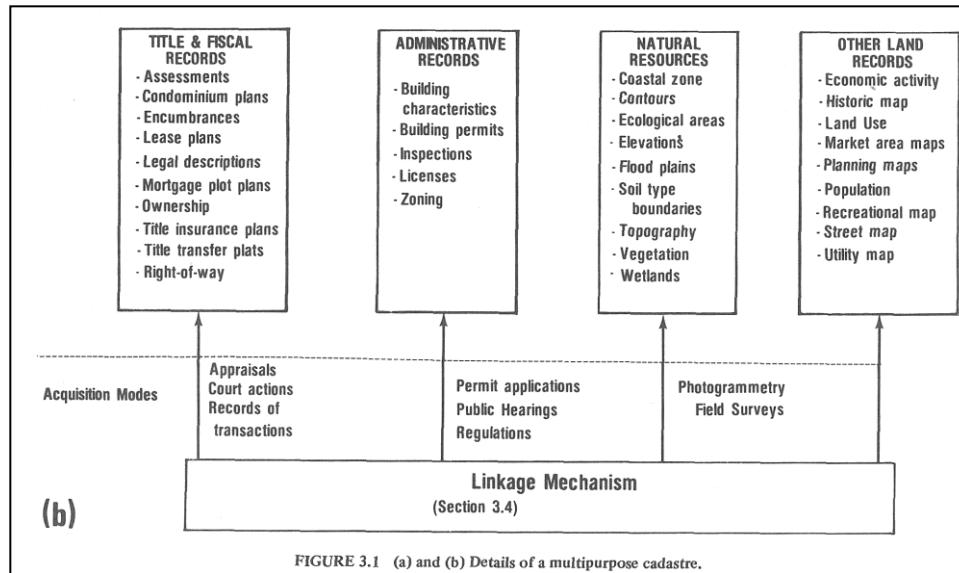
- Parcels are a critical part of a modern GIS



Data Collection and Management

❖ Cadastral systems

- Parcels are linked to many operations of government



Data Collection and Management

❖ Cadastral systems

Potential Benefits to Local Government

Assures that the best available data are used in each public transaction

Avoids conflicts among land records of different public offices

Improves accuracy of real-property assessments

Provides base maps for local planning and preliminary engineering studies

Provides a standardized data base for neighborhood, municipal, county. or regional development plans

Avoids costs of maintaining separate map systems and land – data files

Encourages coordination among separate map systems and land –data files

Improves public attitudes toward administration of local government programs

Potential Benefits to provincial & national governments

Provides accurate inventories of natural assets

Provides accurate locational references for administration of state regulations such as pollution controls

Accurately locate state ownership s of other interest in land

Provides a standardize data base for management of public lands

Provides large-scale base maps for siting studies

Simplifies coordination among province and local offices

Provides a data base for monitoring objects of national concern e.g. agricultural land use and foreign ownership of real estate

Provides standardized records for managing provincial/national assistance to local programs such as housing, community development and historic preservation

Potential Benefits to private firms and individuals

Data Collection and Management

Property Ownership Land Records Information System (POLARIS), Charlotte, North Carolina

Mecklenburg County, North Carolina
POLARIS Property Ownership Land Records Information System

LIVING WORKING GOVERNING VISITING GIS HOME SEARCH Charmeck

Parcel Information

Print Ownership and GIS Summary

Parcel Ownership Summary

NOTE: ADDITIONAL OWNERS, LEASEHOLDS, CONDO COMPLEX AREAS MAY BE PRESENT ON THIS SELECTED TAX PARCEL.
CLICK HERE TO SEE OTHER OWNERS TIED TO THIS PARCEL

Parcel ID#: 00107145A GIS ID#: 00107145
Owner Name: JOSEPH E KAYLOR AND ROBIN S KAYLOR
Mailing Address: 17304 JETTON RD CORNELIUS, NC 28031

Property Characteristics

Legal Desc.: L117 SEC2 M17-543
Land Area: 1 WF
Fire District: 09-CORNELIUS / LEMLEY
Special District: FIRE SERVICE B
Account Type: INDIVIDUAL
Municipality: 3-CORNELIUS
Property Use: VACANT

Situs Addresses Tied to This Parcel

16714 GREEN DOLPHIN LN

Choose an address from the list above and click on the links below for more information
Where to Go Vote | School Districts
Parks Within 3 Miles | Get Directions

Links to More Information

FEMA, Zoning, Etc., Adjoining Owners
Tax Values & Building Info, Tax Bill Info.

Map: 1425759.9, 630427.05 -- Image: 844, 599 -- ScaleFactor: 1.9237045203969642

100% INVESTOR REBATE PLAN Become a Sponsor

Data Collection and Management

Charlotte-Mecklenburg Co – Property Records

The screenshot shows a web browser window displaying the 'Real Estate Lookup' page for parcel 00107145A. The page includes a search sidebar, a navigation menu, and several data tables.

Search By: Property Value, Address, Owner Name, Parcel ID. **Filtered By:** No Filter, Max. Value: 500000.

Parcel List:

Parcel	Value	Location
00107145A	300000	16714 GREEN DOLPHIN LN CORNELIUS
02910399	210900	2429 EARLY FLIGHT DR UNINC
19922109	203600	7010 ROCK ISLAND RD CHARLOTTE
19922110	238400	7006 ROCK ISLAND RD CHARLOTTE
23125779	200900	5117 SURREYHILL CT CHARLOTTE
23125788	204000	3532 MANOR HOUSE DR CHARLOTTE
10950120	251900	6801 KERSFIELD PL MINT HILL
10950130	214000	6914 KERSFIELD PL MINT HILL
10950138	206400	6814 FENNING DR MINT HILL
11101853	226700	6003 CATTAIL CT UNINC

61124 records

Parcel Information:

Parcel ID	Account	Parent	Previous
00107145A	INDIVIDUAL		

Owner(s): January 1st Owner

Owner Name	Mailing Address	City/State
KAYLOR JOSEPH E HUSBAND	17304 JETTON RD	CORNELIUS NC 28031
KAYLOR ROBIN S WIFE	17304 JETTON RD	CORNELIUS NC 28031

Legal Information:

Legal	Municipality	Date Annexed	Special District	Fire District	Acreeage
L117 SEC2 M17-543	CORNELIUS	6/30/2000 12:00:00 AM	FIRE SERVICE B	CORNELIUS / LEMLEY	0

Total Parcel Assessment:

Building	Land	Features	Total	Exemptions
0	300000	0	300000	Exemption Year Approved Review Date Amount

Sales Information:

Land Use:

Use	Units	Type	Neighborhood	Assessment
R122	1	WF	A101	300000

Building Information:

Bldg	Description	Type	Year Built	Property Location
				16714 GREEN DOLPHIN LN CORNELIUS

Building Details:

Bldg	Story	Units	Total SqFt	Heated SqFt	Foundation	Ext. Wall	Grade	Value

Building Features:

Bldg	Heat	Fuel	FirePlace	AC	Fixtures	Bedrooms	Full Baths	3/4 Baths	1/2 Baths

Sub Area:

Bldg	Description	Size

Depreciation:

Bldg	Physical	Functional	Economic	Special	Override

Data Collection and Management

POLARIS – Great Search

POLARIS Market Analysis

PLEASE FILL OUT THE FOLLOWING

1. Choose a Primary Search Type Below:

- Properties Within a Particular Political Jurisdiction
- Selected Parcel's Appraisal Neighborhood Code:
Code will be filled in when a parcel is selected on the map within POLARIS.
- Properties Located on a Particular Street
Examples: Hawthorne Ln, N Tryon St, or Dilworth Rd W
Dir. Street Name Street Type Dir.

2. Choose a Political Jurisdiction: CHARLOTTE

3. Parcels With Acreage:
Not all parcels are assessed by acres. From to Acres

4. Parcels Without Acreage: Any Lots Only (No Acreage)
 Waterfront Lots

5. Total Market Value Range:
Leave market value ranges set to "0" to disregard range. \$ to \$

6. Total Sales Price Range:
Leave sales price ranges set to "0" to disregard range. \$ to \$

7. Sales Date Range: Start Date: MO. YEAR
End Date: MO. YEAR

8. Property Use Type: Single-Family
If property use type is "not" vacant land, you can apply the additional filters below if needed.

Year Built Range: to Sq. Ft. Range: to
Leave year built ranges set to "0" to disregard range. Leave square footage ranges set to "0" to disregard range.

Number of Bedrooms: ANY Number of Full Baths: ANY
Exterior Frame Type: ANY Story Type: ANY

9. Sort Results by: Descending Market Value Order

Show Building Photos? Yes No
Display 9 Comparables Per Page

Find Properties Reset Default Search Criteria

Data Collection and Management

Economic Development

The screenshot displays the 'Economic Development GIS' web application interface. The browser address bar shows 'Google' and the URL 'Charlotte-Mecklenburg, North Carolina'. The application header includes the title 'Economic Development GIS' and the tagline 'Helping Businesses make the right decision.' Below the header, there are navigation tabs: 'Welcome', 'Search/Analysis', 'Results', 'Themes', 'Legend', and 'Print Map'. The 'Results' tab is active, showing a 'Parcel Search Results' panel. The map on the left shows a parcel outlined in cyan, with surrounding streets labeled: 'Hambright Rd', 'Monaco Dr', 'Covert Dr', 'Milan Dr', and 'Montecarlo Dr'. The parcel number '28076' is visible on the map. The search results panel on the right contains the following information:

Parcel Search Results

Location:
PID: 01519111 [Link to POLARIS](#) [Link to RE Lookup](#)
Owner Name(s): LAKE NORMAN PAVILION LLC
Situs Address: HAMBRIGHT RD HUNTERSVILLE
Mailing Address: PO BOX 1496 CORNELIUS, NC 28031
Building/Property Characteristics:
Total Tax Value: \$355,000.00
Total Heated Square Feet: 0
Year Built: 0
Building Type:
Story Height:
Property Use Type:
Zoning: SINGLE FAMILY RESIDENTIAL - RURAL ACREAGE
Total Acreage: 40
Land Units: 40
Land Unit Type: AC
Account Type: NC CORP
Fire District: HUNTERSVILLE / CRAIGHEAD
Special District: FIRE SERVICE D

Below the search results, there is a placeholder box that says 'Photo Not Available'.



Official Charlotte Chamber of Commerce and Mecklenburg County Government Web Site
By using this site, you acknowledge and agree to [our disclaimer](#). For more information, please email gis@charlottechamber.com.

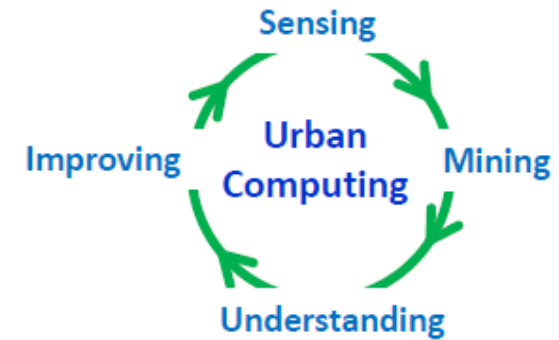
Data Analysis & Modeling

❖ Urban computing

- Emerging concept where every **sensor**, device, person, vehicle, building, and street in the urban areas can be used as a component to sense **city dynamics** to enable **city-wide computing** to tackle the challenges of urban areas (urban planning) so as to serve people and cities
- Using crowd-sourcing, volunteered geographic information to better understand use and function of cities

❖ Questions

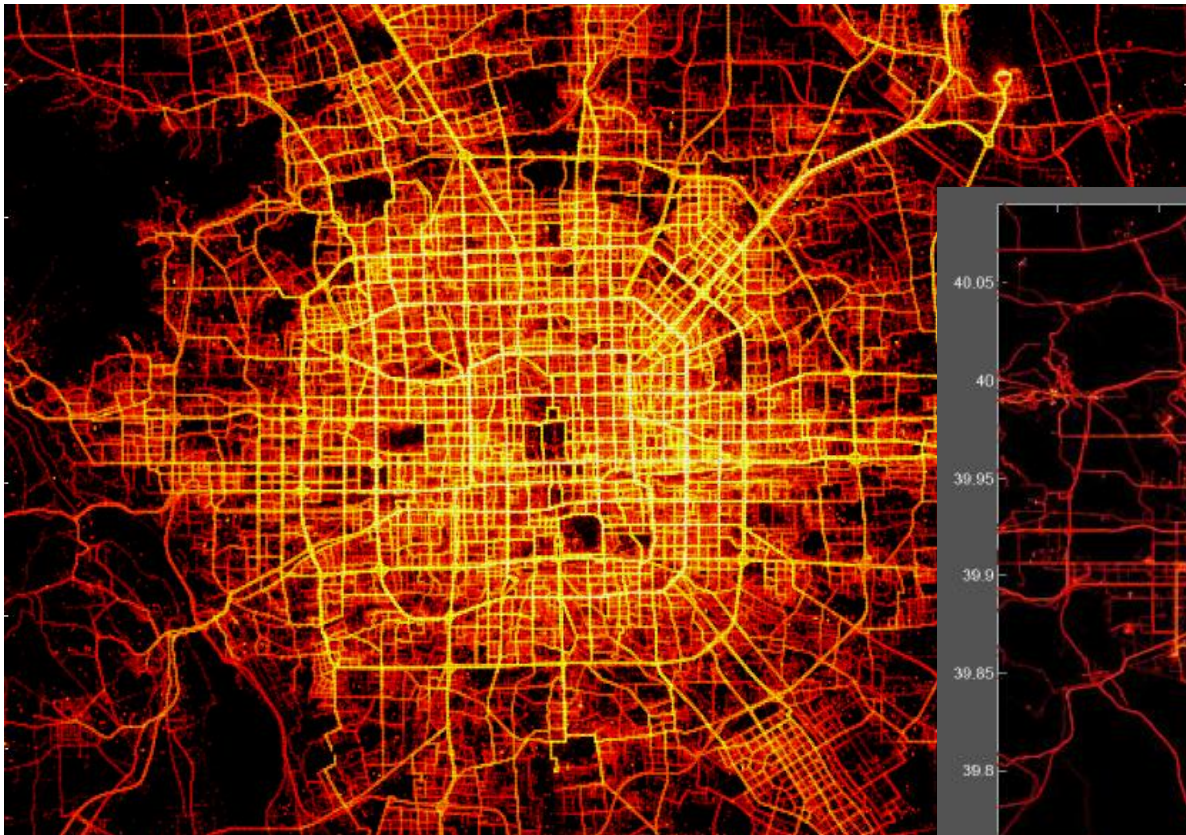
- What's wrong with the city configuration?
- Does a carried out urban plan really work?



Data Analysis & Modeling

❖ Urban Computing

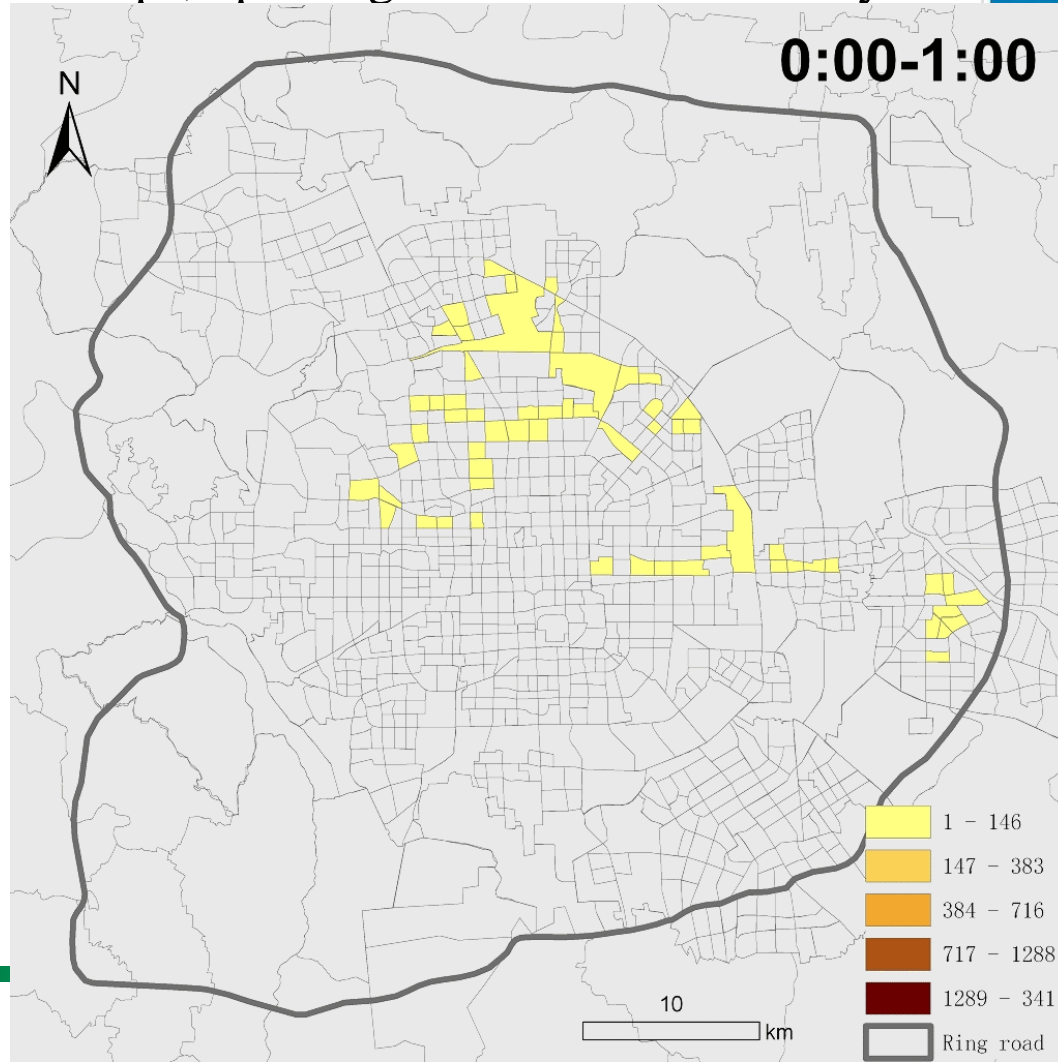
- Taxi trajectories in Beijing (67,000)
- Detection of traffic anomalies, functional regions, travel itinerary suggestions



Data Analysis & Modeling

❖ Urban Computing

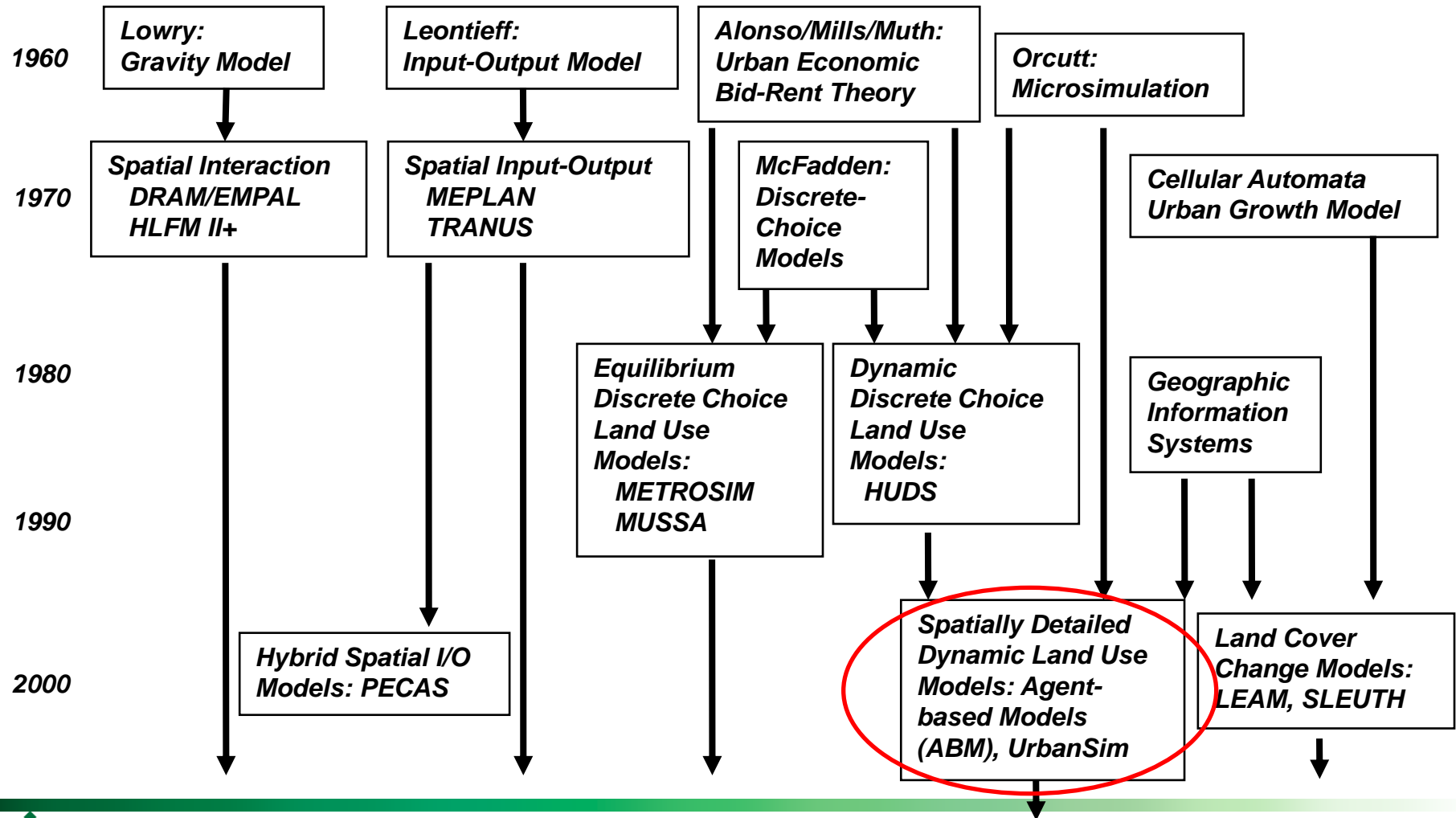
- Bus Smart Card, Beijing
- Commuter trips, updating travel behavior surveys



Data Analysis & Visualization

❖ Models of Urban Dynamics

- Evolution of Urban Models

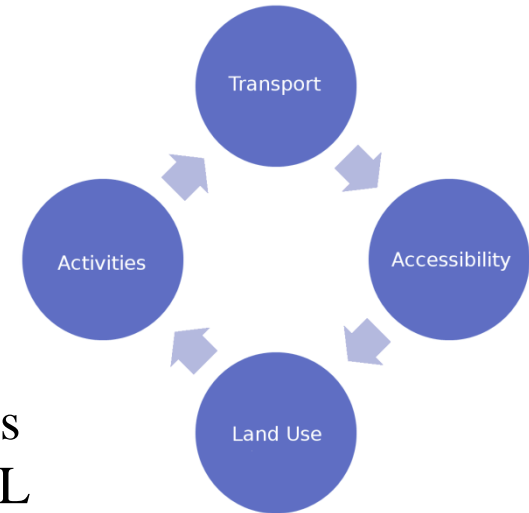


Data Analysis & Visualization: Urban Dynamics

❖ Land use & Transportation

❖ How is ABM/CLUES different...

- Than Spatial I/O and Spatial Interaction Models
 - E.g. TRANUS, MEPLAN, DRAM/EMPAL
 - Dynamic, not cross-sectional equilibrium
 - Microsimulates agents and spaces, not aggregate
- Than Cellular Automata Models
 - Land Cover or Land Use Change Models
 - Agents and behaviors not based on cell transitions
 - Clearer accounting of agents, real estate, location
- Better for policy assessment and analysis



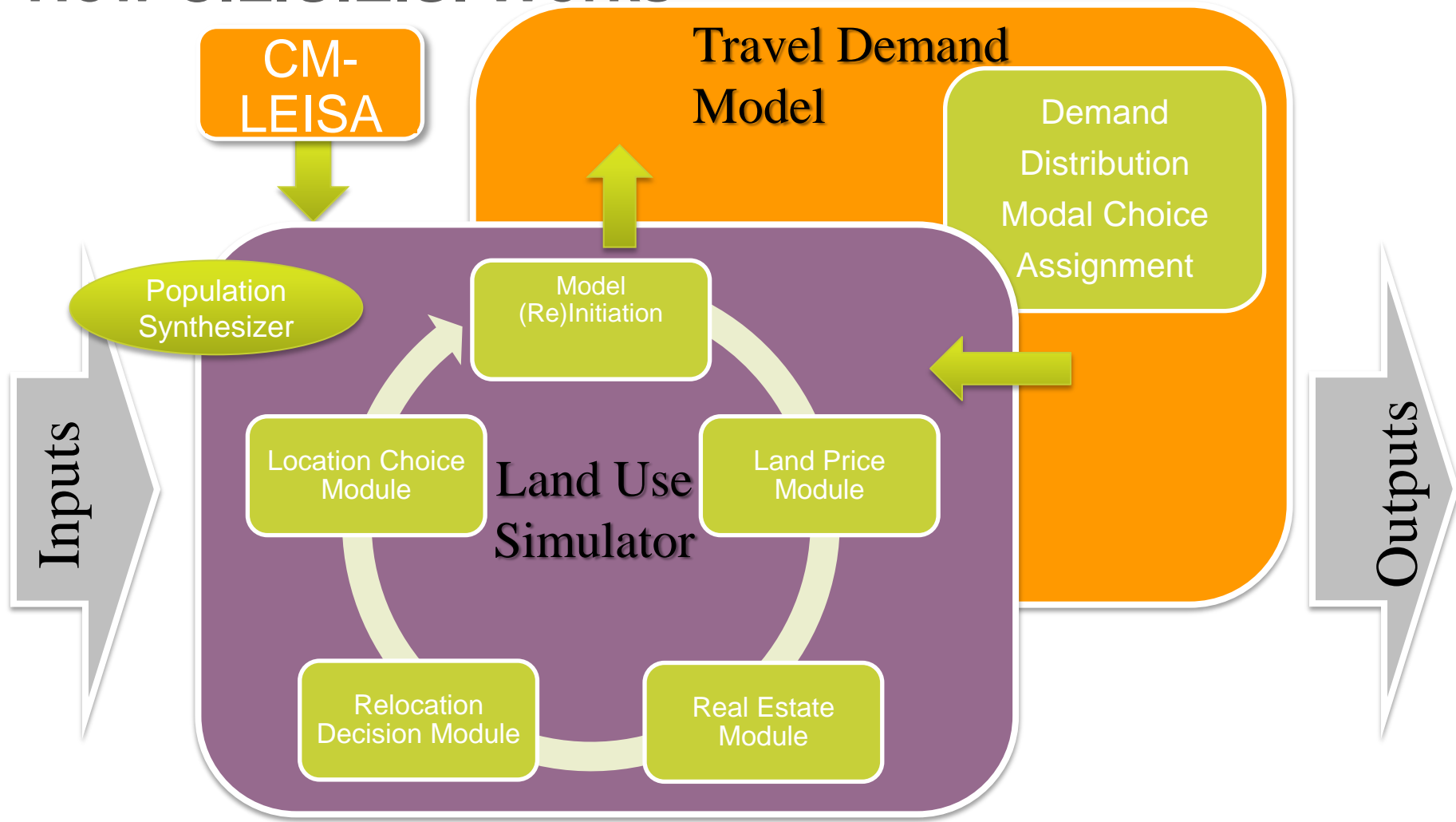
❖ How C.L.U.E.S. Works

- Process-based approach
- Behavioral simulations of individual agents
- Parcel level - allows for fine-grained analyses
- Integrates transportation and land use
- Models market interactions
- Dynamically simulates annual time steps
- Portable and open-source
- Customized version of UrbanSim

Data Analysis & Visualization: Urban Dynamics

How C.L.U.E.S. Works

System Architecture



❖ How C.L.U.E.S. Works

- Process-based approach
- Behavioral simulations of individual agents
- Parcel level - allows for fine-grained analyses
- Integrates transportation and land use
- Models market interactions
- Dynamically simulates annual time steps
- Portable and open-source
- Customized version of UrbanSim

Data Analysis & Visualization: Urban Dynamics

C.L.U.E.S. Inputs

Raw Data	Data Source	Derived Input Data
Parcel & Tax Data (2001-2009)	Mapping and Project Services in Mecklenburg County	Parcels & Buildings Development templates
PUMS (2008) STF3 (2000)	Census Bureau	Households Persons
Jobs & Businesses (2006, 2008, 2010)	Employment Security Commission ReferenceUSA Charlotte-Mecklenburg Planning Dept.	Jobs at place of work by NAICS code
Zoning ordinances	Charlotte-Mecklenburg Planning Dept. Planning Dept. of all the towns	Development constraints
Protected land	North Carolina Gap Analysis Project	Development constraints
FEMA	Mecklenburg County	Development constraints
Preliminary plans	Mecklenburg County	Development templates
Transport network	Metrolina/CDOT	Travel data



Data Analysis & Visualization: Urban Dynamics

Inputs

Businesses in Parcels, Mecklenburg County, 2008

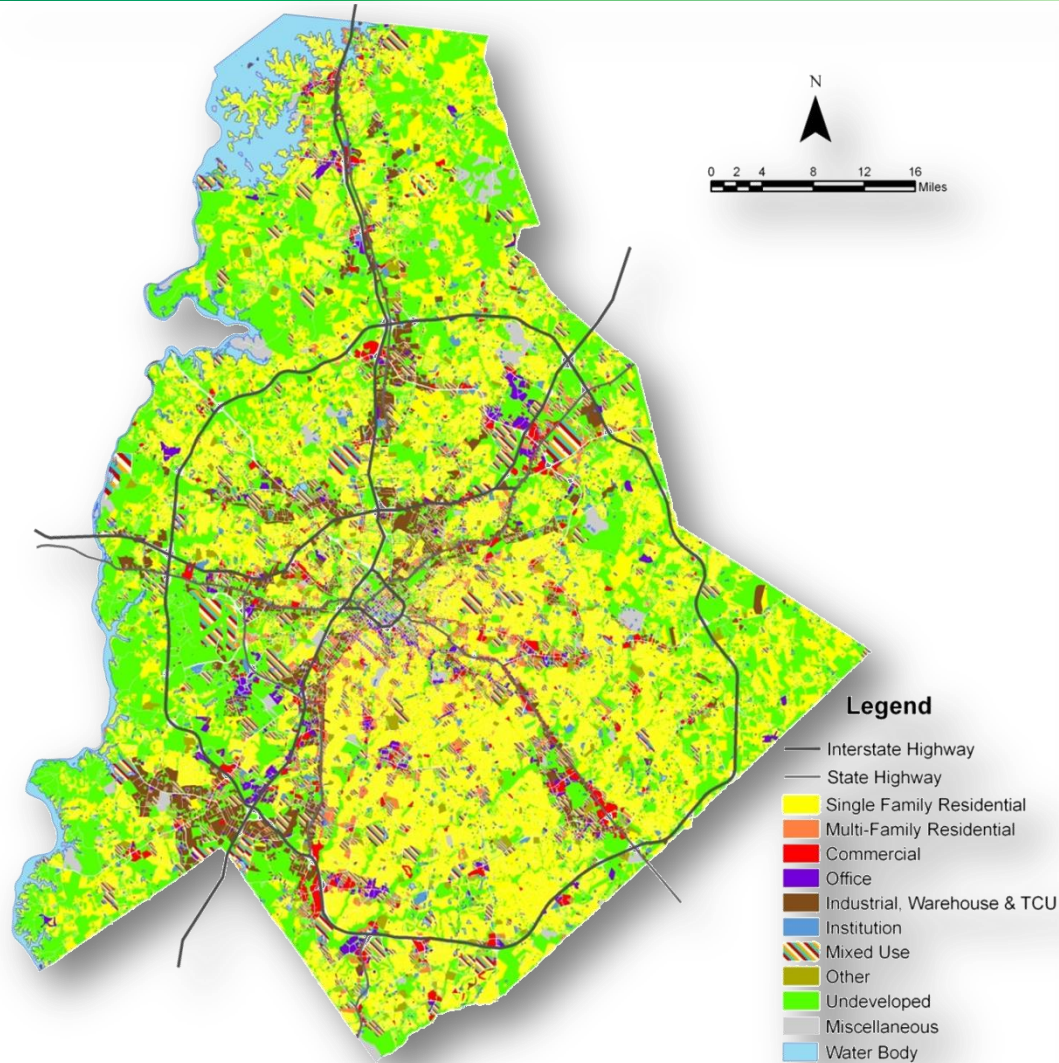


Economic Sectors

- | | |
|---|------------------------------------|
| ● Construction, Natural resources, Mining | ● Professional & Business Services |
| ● Manufacturing | ● Education & Health Service |
| ● Transportation, Trade, Utilities | ● Leisure & Hospitality |
| ● Information | ● Other services |
| ● Financial activities | ● Government |

Data Analysis & Visualization: Urban Dynamics

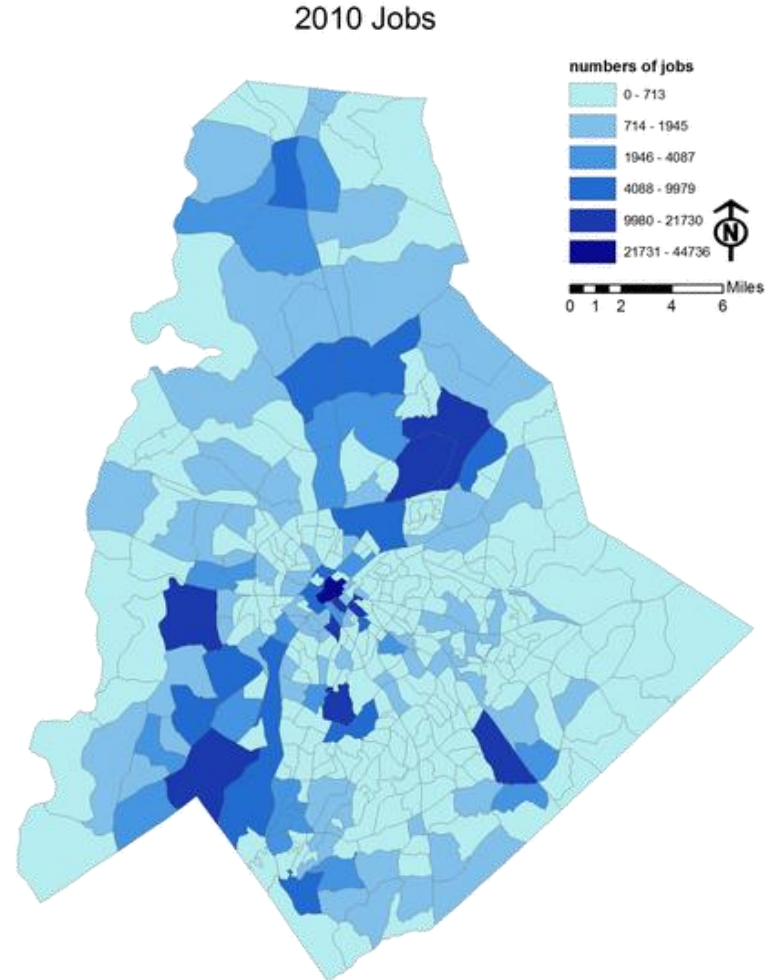
Inputs



Land Use Map, Mecklenburg County, 2008

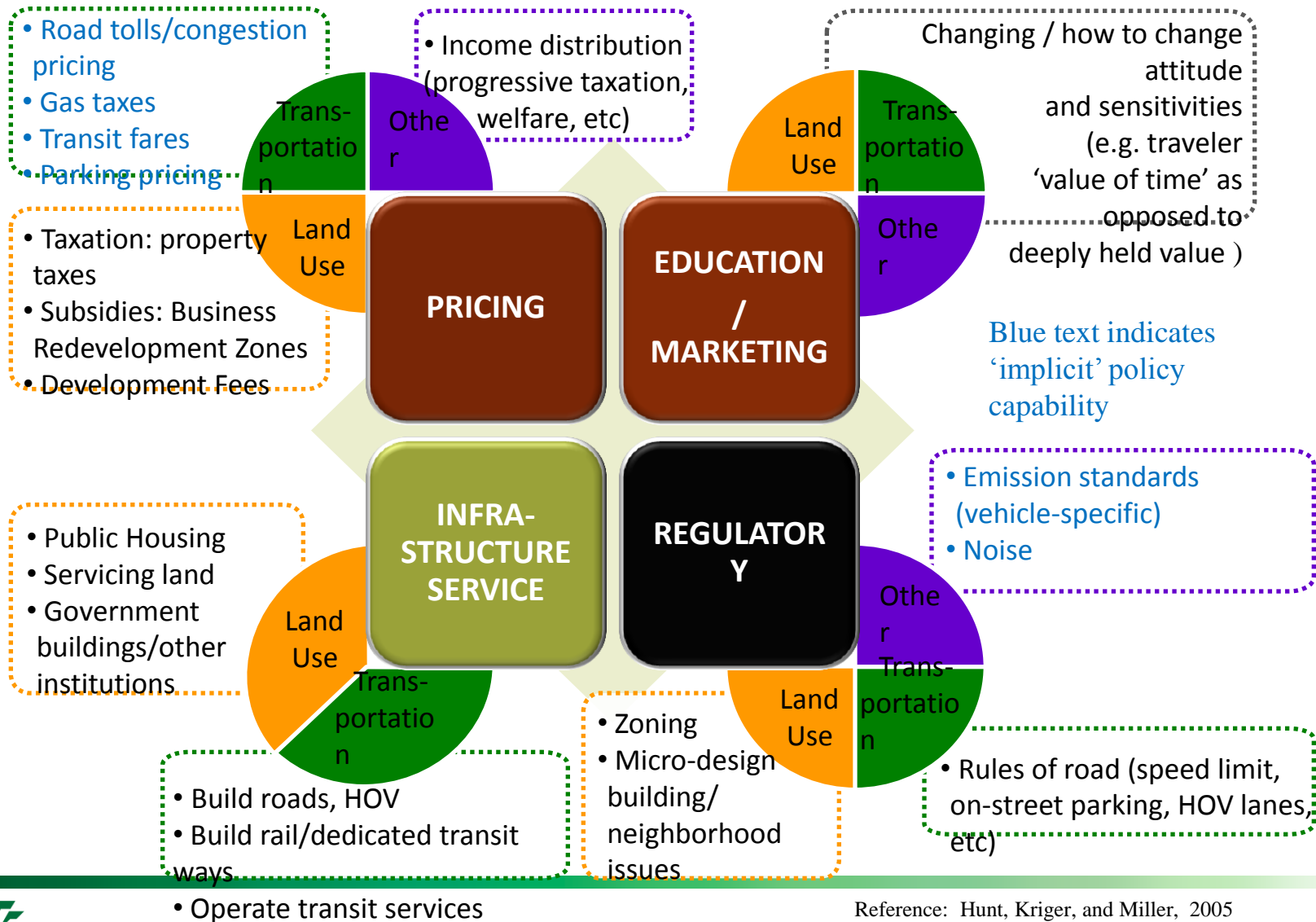
Outputs

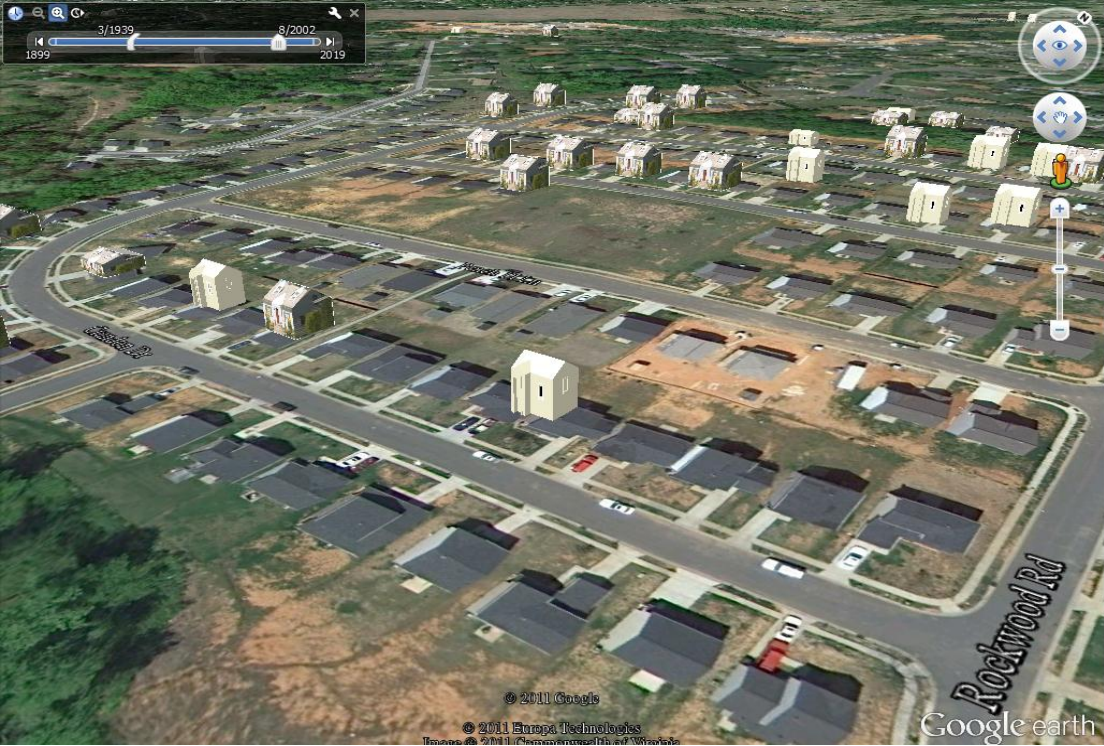
Jobs Projections Sample



Data Analysis & Visualization: Urban Dynamics

Policy Evaluation (what is testable?)





Under Development:
Google Earth platform
to better communicate
with the public on
urban form



Data Analysis & Visualization: Facility Location Models

- ❖ Rapidly expanding urban areas are dynamic environments
 - Need to expand existing network of public facilities to meet anticipated increase or decrease in demand
 - **schools**, libraries, emergency services
- ❖ Closing existing facilities in areas characterized by population decline
- ❖ Location models are tools for regional and urban planners and decision makers
 - Each student must be assigned to a school
 - Budget determines number of schools (p -median)
 - School deemed essential can be kept in the system
- ❖ Public facility location models
 - Minimize total travel distance to the facility j
 - p -median - Hakimi (1964)

Formulation

❖ Objective Function

$$\min \quad Z = \sum_{i \in I} \sum_{j \in J} a_i d_{ij} X_{ij}$$

Where Z is the total impedance

i is a demand node, I is the set of all demand nodes

j is a school site location, J is the collection of all school sites

a_i is the demand at location i

d_{ij} is the impedance between locations i and j

X_{ij} means the allocation between demand i and site j

Formulation

❖ Subject to (constraints)

$$\sum_{j \in J} X_{ij} = 1 \quad \forall i \in I$$
$$X_{ij} \leq Y_j \quad \forall i \in I, \forall j \in J$$
$$\sum_{j \in J} Y_j = p$$
$$C_j^- \leq \sum_{i \in I} a_i X_{ij} \quad \forall j \in J$$
$$C_j^+ \geq \sum_{i \in I} a_i X_{ij} \quad \forall j \in J$$
$$X_{ij} \in \{0,1\} \quad \forall i \in I$$
$$Y_j \in \{0,1\} \quad \forall j \in J$$

p is the total number of schools to open

C_j^- is minimum capacity of school site j

C_j^+ is maximum capacity of school site j

Y_j is the location decision variable

❖ iGLASS – a Planning Support System

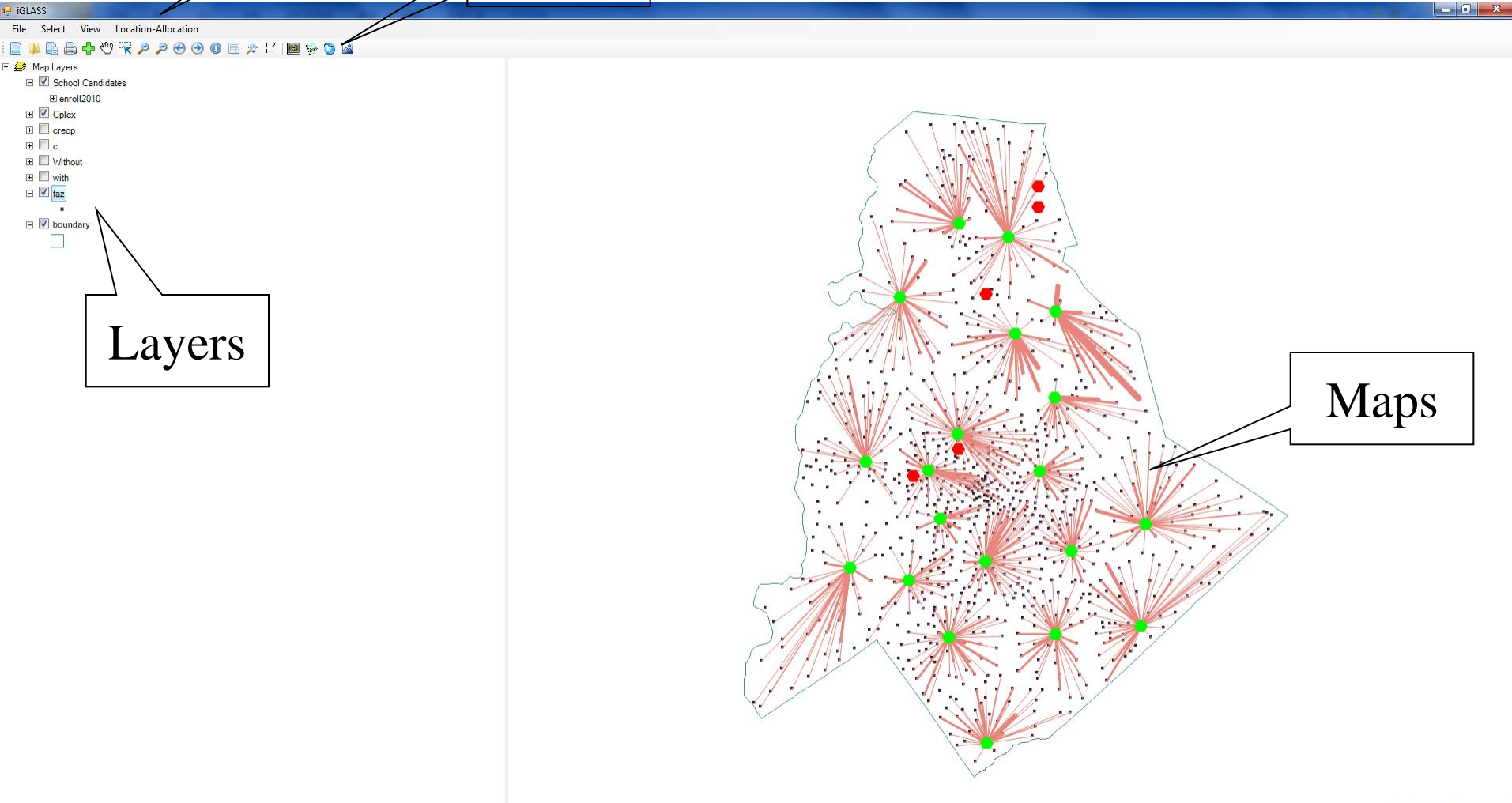
- Portable
- Interactive
- Scalable open source GIS platform
 - DotSpatial 1.3
 - C#
- The model parameters and input data can be altered on the fly through the GUI (such as addition of school locations and modification of their capacities)
- Visualization components pertain to children assignment to school and school utilization
- Highlights demand allocated to a given school
- The model allows for sensitivity analysis on capacity constraints and the fractional allocation of nodal demand to multiple schools
- Complex computational algorithm (Tabu search and genetic algorithm)

Data Analysis & Visualization: Facility Location Models

Menu

Toolbox

iGLASS



Layers

Maps

Conclusions

- ❖ Urban studies have made major progress thanks to computers and information technologies, and so have urban planning and urban management
- ❖ Recent trends are from model-intensive to data-intensive
- ❖ The integration and coupling of data, modeling, and visualization leverage the strength of each component
- ❖ Spatial information technologies present great opportunities for spatial urban and regional planning in fast developing countries

THE END

Thank you!

Jean-Claude Thill

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Editable attribute tables

Attribute Table Editor

Edit View Selection Tools

TAZID	stu2010	SchoolID	nearOrder	closestDis	travelTime	re
10001	78	9	2	3217.014017530...	4437.564868733...	12
10002	85	10	0	2396.434762300...	2396.434762300...	0
10003	114	10	0	2921.568854750...	2921.568854750...	0
10004	0	10	0	2121.970733909...	2121.970733909...	0
10005	27	9	2	3209.620843288...	4469.656469609...	12
10006	5	10	0	3082.404979559...	3082.404979559...	0
10007	0	10	0	3314.508899725...	3314.508899725...	0
10008	52	9	1	2674.057590811...	3969.590467334...	12
10009	15	7	1	3501.273866147...	4026.121403976...	52
10010	66	9	2	3400.773503580...	4596.283013481...	11
10011	3	10	0	3702.450762144...	3702.450762144...	0
10012	25	9	2	3614.567578268...	4804.097092613...	11
10013	0	10	0	3948.933704961...	3948.933704961...	0
10014	0	10	0	3955.954218009...	3955.954218009...	0
10015	12	9	1	3569.616554227...	4690.680659814...	11
10016	5	10	0	3360.685981228	3360.685981228	0

In Memory 1 row selected.

Close

Location-Allocation parameters configuration

Define the number of schools to open

Define the type of distance

Open-Close constraints on schools

Define tabu search parameters

Location-Allocation Configuration

Layer

Demand Layer: TAZ Demands

Site Layer: School Candid

Constraints on Sites

Algorithm

Based on Index

Based on Population

Based on Priority

Adaptive Priority

P-Median

Distance

Split by:

Power (D):

Power (P):

Percentage: 100

Max Distance:

Cost

Euclidean Distance

Travel Time

P-Value: 20

Neighbor: 20

TabuLen: 10

OK CANCEL

School Constraints

Number of Periods: Period 1

Increase Capacity by:

Number of Schools:

School remains open if it's built after: 1950

Closed School

Schools

Open Schools

MARIE G. D
ARDREY KE
BUTLER HK
HOPEWELL
INDEPENDE
MALLARD C
MYERS PAF
New School
New School
New School

BERRY ACADE
E.E. WADDELL
EAST MECKLEI
GARINGER HIG
HARDING HIGH
OLYMPIC HIGH
PROVIDENCE H
VANCE HIGH
WEST CHARLC

OK Cancel