NCFMTC- Modeling Your Campus

Basic GIS Modeling: Improving Campus Maintenance, Management, and Planning
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Abstract

- Basic GIS Modeling: Improving Campus Maintenance, Management, and Planning
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- Data models, workflow and geoprocessing models, 3D and time series models are all basic GIS building blocks. When combined these capabilities add new dimensions to how decisions are being made in day to day operations as well as planning for the future. This presentation will explore some of the many uses and benefits that can be realized by providing broad access to basic GIS capabilities in a campus environment.
Topics

• What is GIS
• How is GIS being used
• GIS models
  – Data models
  – 3D models
  – Geoprocessing models
  – Integration of Time
  – Making them work together
• ESRI’s vision
• Q&A
What is GIS?
Geographic Information System

• An information system based on geographic location
• A complete system to
  – Visualize results via maps and reports distributed in softcopy or hardcopy form
  – Perform spatial and relational queries and analysis
  – Create, update, and maintain spatial data

...an integrating technology
...promotes sharing and coordination
Geographic Information Systems

5 parts of a GIS

GIS

People

Information

Hardware

Software

Business Rules and Procedures
What is a Geographic Information System?

A GIS links spatial data (geography) with tabular data (attribute data).

Features (on map) 
Attributes (in table)

Managed As Layers

GIS database (set of layers for a geographic area)

...all data is mapped to a location on the earth
Visualization & Communication

- Thematic analysis
- Authoring
- 2D/3D viewers

- Visual interrogation
- Animation and graphing
- Spatial selection

- Symbolization
- Labeling
- Publishing

ArcGIS Desktop

Visualization

Iteration & Learning

Mapping
How many people live within a 300 yd cordon of the road?

Complex Spatial Analysis

- Proximity
- Overlay
- Network

...all data is self aware...
Geodatabase: Object-relational information model responsible for managing all geographic data types and their associative rules and behaviors.

**Geodatabase Management**

- Organization and management of spatial information
  - Persistence
  - Access
  - Replication
  - Versioning
  - Check in/out
A GIS works with thematic layers of spatial data to model the natural and built environment providing a common picture.

**Transportation**
- Roadways & Paths
- Railways
- Bus Routes
- Waterways

**Utilities**
- Electric
- Gas
- Water
- Phone
- Steam

**Boundary Data**
- Town
- Campus
- Police Precincts
- Land Parcels
- Buildings

...a framework for performing “what if” scenarios
How is GIS Being Used in Facility/Campus Management

• GIS is being used for:
  – Planning
  – Space Management
  – Real-estate/portfolio management
  – Asset management
  – Safety/Security
  – Environmental health
  – Transportation planning
  – Emergency planning and response
  – Work order management
  – Way finding (routing across campus and thru buildings)
  – IT infrastructure management

…Just some of the business functions
Where is this happening?

**Who Are the Early Adopters?**

- Universities
- Federal Gov’t
  - DoD all services
  - NASA, GSA, etc…
- Large private companies
- State, County & large City
- Airports

...Organizations managing large campus environments
GIS Models

...GIS “Abstracts” Geography
Data Models

• GIS data sets are more than database management system (DBMS) tables
  – They incorporate advanced behavior and integrity like other information systems.
  – The schema, behavior, and integrity rules of geographic data sets play a critical role in GIS.

...more closely represent real world objects
Data Modeling

*Basics to get started*

- GIS design involves organizing geographic information into data themes that can be integrated using geographic location.
- Design begins by identifying the data themes to be used, then specifying the contents and representations of each thematic layer.

…data modeling cycle
11 Steps to GIS database modeling

Basics to get started

1. Identify the information products that you will create and manage with your GIS
2. Identify the key data themes based on your information requirements
3. Specify the scale ranges and spatial representations of each data theme at each scale
4. Decompose each representation into one or more geographic datasets
5. Define the tabular database structure and behavior for descriptive attributes
6. Define the spatial behavior and integrity rules for your datasets
11 Steps to GIS database modeling cont.

7. Propose a geodatabase design
8. Design editing workflows and map display properties
9. Assign responsibilities for building and maintaining each data layer
10. Build a working prototype and review and refine your design
11. Document your geodatabase design
The Geodatabase

Contains Datasets

- Datasets represent integral collections of information with a meaningful real-world interpretation.

- Types of geographic dataset:
  - Tables
  - Object classes, feature classes, relationship classes
  - Feature datasets
  - Networks, Topologies, Raster and Survey datasets

- Datasets have associated information to help manage integrity, behavior, and interpretation
  - Domains
  - Relational integrity
  - Topology
  - Metadata

…the data model defines the schema of the Geodatabase
Validation Rules

• Store attribute, connectivity, and relationship rules on objects as part of the geodatabase.
• Predefined, parameter driven
  – Attribute range rule
  – Attribute set rule
  – Connectivity rule
• Perform custom validation by writing code.
Domains

• Describe the legal values of a field type.
  – Used to ensure attribute integrity
• Can be shared among classes
• Transfer with the geodatabase
• Types of domains:
  – Range
    • A tree can have a height between 0 and 300 feet.
    • A road can have between one and eight lanes.
  – Coded value (e.g., a set)
    • A tree can be of type oak, redwood, or palm.
    • A road can be made of dirt, asphalt, or concrete.
Subtypes

- Partition the objects in a class into like groups.
- Defined by the value of a subtype field.
  - Have the same attribute schema
  - Have the same behavior schema
  - Can have different default values and domains for each field
  - Can define topology rules between subtypes
A topology manages a set of simple feature classes that share geometry.

- Integrate feature geometry
- Validate features
- Control editing tools
- Define relationships between features
- Ensure the quality of your data
Geodatabase Data Models

*Standardized Templates for Many Fields*

- Address
- Agricultural
- Atmospheric
- Base Map
- Biodiversity
- Census-Admin
- Boundaries
- Defense-Intel
- Energy Utilities
- Environmental
- Forestry
- Geology
- Groundwater
- Health
- Historic Preservation & Archaeology
- Homeland Security
- Hydro
- IHO
- Land Parcels
- Local Government
- Marine
- National Cadastre
- Petroleum
- Pipeline
- Telecommunications
- Transportation
- Water Utilities

... Help Users Get Started
... Provide Consistent Standards
Geodatabase Model for Building Interiors
3D Models

Providing new perspectives

• A means to visualize “reality”
• Another dimension for thematic mapping & reporting
• Basis for 3D analysis

...a powerful way to visualize your campus
City & Campus Planning
Economic Development

Green Mountain Geographics, Ltd.
Simple Campus Visualization
Hospital Visualization – Patient Rooms by Department
Developing a 3D Model

Demo

- Extruded Vectors
- Draped Vectors
- Imagery
- Elevation
Geoprocessing Models

- Geoprocessing is a language consisting of operators, or tools, that operate on the data (tables, feature classes, rasters, TINs, and so on), and perform tasks that are necessary for manipulating and analyzing geographic information across a wide range of disciplines.

- Geoprocessing models are how you automate your work.
  - When you create a model, you are preserving a set of tasks, or a workflow, that you can execute multiple times.
  - There are an infinite number of workflows you can automate using models.
  - Models can range from very simple to as complex as you can imagine.
  - Models are a way of documenting & sharing your knowledge about a workflow with others.
A Simple and a Complex Model
Geoprocessing Demonstration
Iterative Modeling

- ModelBuilder now supports looping
- Use...
  - Lists
  - Series
  - Boolean conditions
  - Count
  - Feedback

Iterative Modeling

- ModelBuilder now supports looping
- Use...
  - Lists
  - Series
  - Boolean conditions
  - Count
  - Feedback
Monitoring the built environment

...interpolated surface from field readings
Integration of Time

*New Ways to Manage, Analyze, & Visualize Geography*

- **Tools for Manipulation**
  - Query
  - Change analysis
  - Iterative processing
  - Visualization
    - Animation
    - Charting
  - Tracking analysis
  - NetCDF data supported
- **Tools to Manage Historical State**

**Multidimensional Data Sets (NetCDF)**

- **Real Time Sensor Network**
- **Mobile**
- **Stationary**

**View**

**Control Room**

**Modeling Simulation**

**Files**

... New Opportunities
Animation in All Applications
Visualizing Change Over Space & Time

- Maps
- Graphs
- 3D Scenes
- Globes

... Communicating Patterns, Relationships, & Processes
Example: Office Vacancy Animation
Making Them Work Together

More complex scenarios can be modeled by combining basic capabilities from each area discussed

– Data Models
  • Representation and Behavior
– 2D & 3D Visualization
– Geoprocessing
– Time

...The whole is more than the sum of the parts
Planning & Analysis - Parking
Compact 2D display of large amounts of information

Abstract representation for the real features

Features scaled to represent any quantity

All ESRI GIS tools applicable

Modeled in ArcGIS ArcMap
Current Space Allocation

- Organizations Split Across Floors
- Inefficient Use of Space
Early Random/Greedy Solution

- Good Intra-Organizational Synergy
- Efficient Use Of Space
Current Condition
Emergency Preparedness and Response planning
ESRI’s Vision
Our Customers Use GIS as a Framework for Managing Their Business

Connects Disciplines, Departments, Organizations
GIS is Providing a New Medium For Understanding
Modeling the Physical and Cultural Knowledge of our World
Breaking Down the Earth into Components and Systems . . .

Providing
• Systematic Knowledge
• An Integrative Framework
• Analytic Methods
• Intuitive Visualization

. . . Creating Order and Meaning
. . . Defining Interconnections and Interdependence
. . . Providing a Broad Understanding of Natural and Human Ecology
GIS Is Influencing How We See and Do Things

Building a Common Understanding

Creating a Sense of Engagement

Providing More
- Science
- Accuracy/Detail
- Realism
- Logic & Analysis
- Immediacy

... Changing How We Communicate
GIS Should Work as a Complete System
A New Way to Manage and Disseminate Geographic Knowledge

Author/Serve/Use

- Maps
- Data
- Models
- Globes
- Metadata

Making GIS Knowledge Available To Anyone . . .
. . . Integrates With Other Systems Via Standards
GIS is the Perfect Platform for **Integration**

*To Author, Serve, and Use Geographic Knowledge*

**Managing Complexity** . . .

. . . And Making It All Accessible
Managing Governments, Businesses, & Campuses

...Increasing Efficiency And Collaboration
Visualizing & Reporting Space Utilization

NASA LaRC

Inside Buildings

Across Facilities/Real Property Portfolios
Managing IT Infrastructures
Web-based Facility Management Reporting

US Navy Atlantic Fleet
Shore Installation Management Systems
Bed Capacity Management

Community Memorial Hospital
Building an ESRI Common Operating Picture

Employee Locator

- Tracking Server
- Legacy Systems
- Business Systems
- Geospatial Analysis & Map Publishing
  - ArcGIS Server
Where To Go From Here?
Session to Attend to Learn More:

• W2A - Jim Nelson - Building a Campus Model from Scratch
• W4A – Mike Parkin – Inside Out: Performing GIS Analysis on interior spaces
• W4C – Katherine O’Brien – A Campus-Wide Geodatabase: bricks and Mortar of a University's GIS
• TG1 – Panel moderated by Jeannie Rice – Implementing GIS: How Do I Know If I Was Successful?
• T2A – Paul Cote – Integrating BIM and GIS: The Road Ahead
• T4B – Stuart Rich – Developing a GIS Data Model Standard for Interior Spaces
• F2A – Gary Smith – Using SketchUp and ArcGIS to Map and Manage Buildings
• F3A – Birds of a Feather Session - Assessment and Implementation Planning for GIS Systems
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Questions?
Thank You
Please Come See Us at Our Booth

... More Rational Approach That Considers & Integrates All the Factors ... 
... A Geographic Science Approach