Geographic Information (GIS) Data Collection and Storage

Chuck Roberts
Tosia Shall
GIS Data Collection and Storage

- Request: The use of GIS in data collection
  - Several Ways to interpret the request
    - Mobile GIS: Field Data Collection and Editing
    - Desktop GIS: Scanning, digitizing, feature creation
    - Managing and Building a Database
      - Well-structured data
      - Relationships well-defined between “layers”
    - Data creation, management, and display can be achieved via several methods
GIS Data Collection and Storage

• Presentation will give an overview of:
  – Methods of Data Collection
  – Storing GIS Data in a Database
    • What attributes differentiate GIS data from other data
    • Best ways to format data
  – Displaying GIS Data
    • Visual Analysis
    • Increasing the value of your GIS data by integrating with other sources/types of data
Agenda

• What is GIS Data

• Methods of Collecting GIS Data

• Storing GIS Data

• Visualizing GIS Data
Points represent anything that can be described as an x, y location on the face of the earth, such as shopping centers, customers, utility poles, hospitals, or cellular towers.

Lines represent anything having a length, such as streets, highways, and rivers.

Polygons describe anything having boundaries, whether natural, political or administrative, such as the boundaries of countries, states, cities, census tracts, postal zones, and market areas.

Raster Data –
Addresses –
Measures –
GIS Data

Datasets represent collections of information with a real-world interpretation

- Social Factors
- Bio-Diversity
- Engineering
- Land Use
- Environmental Considerations

Abstract reality into layers, each layer having the same type of features. Can overlay them for analysis purposes.
You can extend the geodatabase with more advanced capabilities (such as by adding topologies, networks, or subtypes) to model GIS behavior, maintain data integrity, and work with an important set of spatial relationships.
GIS Data

Every feature in the map is connected to a corresponding row in the attribute table.

This connection/link gives us the ability to access the information behind the feature for use in analysis – it’s not just a picture of a feature.
When a feature ‘knows’ where it is located on the surface of the earth, it can be studied in relation to other features on the earth.
Geographic — uses lat long to define locations on the surface of a sphere or spheroid. GCS definition includes datum, prime meridian, and angular unit.

Projected — origin (0,0) is located at the center of the grid. Projected Coordinate systems are still based on a geographic system that is based on a sphere or spheroid.
Getting information from a curved surface to a flat one involves a mathematical formula called a map projection, or simply a projection.

No projection can preserve all these properties; as a result, all flat maps are distorted to some degree. Fortunately, you can choose from many different map projections. Each is distinguished by its suitability for representing a particular portion and amount of the earth's surface and by its ability to preserve distance, area, shape, or direction. Some map projections minimize distortion in one property at the expense of another, while others strive to balance the overall distortion. As a mapmaker, you can decide which properties are most important and choose a projection that suits your needs.

Conformal (preserve Shape), Equal Area, Equidistant, True Direction
Without knowledge of data accuracy, provenance, and age, you can't have a high level of confidence in decisions based on that data.

Federal Geographic Data Committee's (FGDC) Content Standard for Digital Geospatial Metadata (CSDGM) aims to provide a complete description of a data source.
Methods of Collecting GIS Data

• Creation or capture from digital sources
• Mobile Collection
• Geocoding
• Add X,Y coordinate data as a layer
• Import and Convert
Check metadata of images or image services to know what spatial reference or projection you’ll use when creating your features. Look at scale when you capture features, note it in the metadata.
Better to have drawing georeferenced than to try to do it afterwards.
• A mobile GIS synchronizes the office and the field
• Field workers can operate in a connected or disconnected environment. If disconnected, they have an extra step to connect in the office to upload new data or updates.
• Mobile GIS can increase the accuracy of your data by using integrated GPS.
What is the workflow for ArcGIS Mobile?
Leverage ArcGIS throughout...

1. Define data model
   Design mobile map

2. Provision devices
   • Mobile data
   • Applications
   • Projects

3. Field
   • Collect
   • Modify

4. Field Sync
   • Post
   • Refresh

This slide fades in on each click…
Trim your map down to the essential data.
Choose symbology appropriate to the device, to the resolution, and to the environment you’ll be in.

Where are the Satellites? Your Body is an obstruction!
Is accuracy crucial? consider offsets in/near canopy or buildings
Geocoding

Takes a table of addresses and turns the addresses into point locations
Address locator: translates nonspatial descriptions of places, such as street addresses, into spatial data that can be displayed as features on a map. An address locator contains a snapshot of the reference data used for geocoding, and parameters for standardizing addresses, searching for match locations, and creating output. Address locator files have a .loc file extension.
Geocoding: Things to Remember

- When points are geocoded, the coordinates they are given will have the same coordinate system (projection) as the data frame.

Data frame projection: WGS 84
New points’ projection: WGS 84

...Change the projection of the data frame to the desired spatial reference BEFORE geocoding points.
Add X,Y Coordinate Data as a Layer

Table of X,Y coordinates

Use Add XY Data Tool to create points from table

Could be output from GPS device
Import and Convert

- Shapefile
- Coverage
- CAD
- Raster
DEMO: Data Creation
Storing GIS Data
Rich model for storing geographic information
Data can be stored in files, in relational databases, and in XML schemas, as we saw in the previous section.
Inside the Geodatabase

- A geodatabase contains datasets – simple features plus logic

- Datasets represent collections of information with a real-world interpretation

- Types of geographic datasets:
  - Simple Features: Feature Classes, Tables, Rasters
  - Complex Data Structures: Feature Datasets, Relationship Classes, Networks, Measures, Dimensions

- Datasets have associated information (business logic) to help manage integrity, behavior, and interpretation
  - Domains, Relational integrity, Topology

Simple features plus business logic

World is abstracted into layers, each layer containing one type of feature

Simple and complex feature types – complex data is built from simple features, and add value or an additional dimension like measures – are built on linear features like roads, but use an alternate measurement scheme to give attributes to sections of the roads (like sections that need paving).

Business logic can also be built into a geodatabase to help manage data integrity and relationships between feature classes or between features in the same feature class.
- One parcel in a parcel feature class is an instance of the parcel feature class.
- There is a link between the feature you see on the map, and the associated attribute table – feature coordinates are not displayed in the
Features

Every feature in the map is connected to a corresponding row in the attribute table.

...so when you select a feature, the associated row in the attribute table is also selected.
Multipart features, annotation, and additional dimensions such as heights and measures.
Looking at the geodatabase in ArcCatalog, it looks like a cylinder and inside you will find individual feature classes, or feature classes grouped together into a feature dataset for a logical purpose. You can also find tables not attached to feature classes but may hold additional information about those features……. and raster datasets.
• Create feature data sets for: grouping layers to apply business logic or to create complex data structures from them.
Importing a schema from a geodatabase XML workspace document

The resulting XML workspace document that contains the geodatabase schema can then be shared with other ArcGIS users who can import it into their own geodatabases using ArcCatalog as follows:

If one does not already exist, create a new geodatabase into which you will import the schema.
Right-click the geodatabase, point to Import, and click XML Workspace Document to run the import tool.
Use the browser to locate the XML workspace document to import. If you are sure it is schema only, you can check Schema Only before executing the import operation.
Geodatabase Raster Data

- Support for many formats
  - tiff, bmp, GRID, among others...

- Attribute field in a table

- Raster dataset
  - individual rasters

- Raster catalog
  - A collection of raster datasets
  - Accessed as one entity
  - Each can be accessed as a raster dataset
  - Each member can have its own storage properties
Strategies for effective geodatabase design

Data Model Principle: GIS needs a framework, not just an ad hoc list of layers

• Examples of integrated data compilation:
  – Terrain framework: Topographic maps, elevation, drainage network, transportation network, map features, cross country movement, etc.
  – Urban framework: Buildings, critical infrastructure, etc.
  – Imagery framework: Satellite and aerial, local, regional, and national assets, etc.
  – Human framework: Demographics (population characteristics), Cultural centers, Citizens, Administrative districts and zones etc.
  – Workforce framework: Mobile workforce tracking, service centers, traffic conditions, warehouses, etc.
  – Sensor framework: Camera locations, Devices, etc.
  – Operations and plane framework: Zones of control, planned movements, response, etc.
  – Topo maps: Even topographic map products are compiled in unison – not as a series of independent layers
You take the time to create a good geodatabase design, you gather current and accurate data, then the next step is to USE it. There are many different clients in which you can visualize data.

Web Applications
Desktop Applications
Globe Applications – mash up with other data
Mobile Applications
Desksots are thick clients, that tend to do the heavy duty analysis, data maintenance, and cartography. You can build models or workflows in a desktop in order to make it easier to repeat processes. Models can be shared, making knowledge transfer easier.
Web applications are becoming more prevalent, for many reasons. Web apps are generally easier to use than thicker clients like desktops. More focused applications, used in certain situations, like the VIPER application from the Virginia Emergency Operations Center. Let’s see of video of VIPER in action.
Tend to me mostly visualization, very little analysis. But they are perfect for presentations, for illustrating a point.
And finally, you can make your data even more valuable by integrating or overlaying it with other data. You can download data or add services to your applications.

Share your data within your organization, through data.gov or through ArcGIS Online. VIPER was a good example of data is brought together from different departments to form a common operational picture. Basemap data services were also integrated – the EOC uses the data, but is not responsible for its maintenance.
This brings us to the end of our GIS Collection, Storage, and Visualization presentation, and now I’d like to invite Rick Mueller to the podium.