Making Maps With GIS

Getting Started with GIS

Chapter 7

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Objective of this chapter is;

Good maps made by GIS follow the accepted rules of cartographic representation and symbolization. Maps terminology is given, the different map types covered, and some of the design rules introduced.

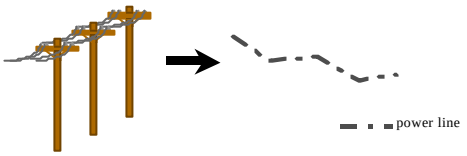
Making Maps With GIS

7.1 The Parts of a Map
7.2 Choosing a Map Type
7.3 Designing the Map

7.3.1. Basics of Design
7.3.2. Pattern and Color

What is a map?

- "A graphic depiction of all or part of a geographic realm in which the real-world features have been replaced by symbols in their correct spatial location at a reduced scale."



What is a map?

- "Map is the communication tool for the organisation, presentation, communication and utilisation of geo-information in graphic, digital or tactile form (ICA-1991)."
- …a representation or abstaction of geographic reality.

Maps as …… for GIS

- sources of data
- the final stage

a map has to follow its own visual grammar

Cartographic Elements

- Medium Paper, window, computer screen
- Figure is the body of the map data itself and is the part of the map referenced in ground coordinates.
- Ground
- Reference information defining locations on the map

Cartographic Elements (2)

- Border is the part of the display medium
- Neatline is the visual frame for the map
- Insets is either an enlarged or a reduced map designed to place the map into geographic context or to enlarge an area of interest whose level of detail is too specific for the main map scale (the inse t should be clearly distinguishable from the figure and ground).
- Metadata e.g. index

The Parts of a Map: Map Elements

Cartographic Elements (3)

- Page coordinates defining locations on the map itself
- Graticule/Grid

the reference link between the two coordinate systems on the final map

- North arrow

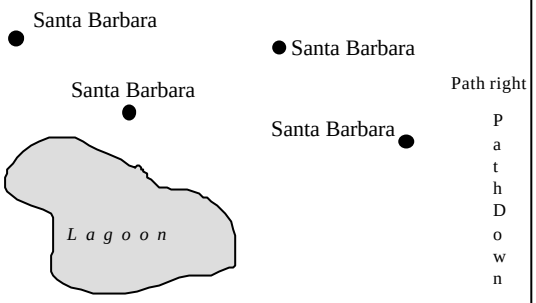
Cartographic Elements (4)

- Figure is the body of the map data itself and is the part of the map referenced in ground coordinates.
- Point/Line/Area symbols with visual variables
- Text information is an integral part of a map, and no map is complete without it
- Place Names and Labelling

Cartographic Elements (5)

- Title located in visually prominent position with largest/boldest text.
- Scale is a visual expression of the relationship between the ground coordinate space and that of the map page space (a graphic scale is preferred)
- Projection(s) and datum
- Sources obtained the data used to compile map:atlas,private or governmental agency, web site,etc.

Text placement



Text: Selection and Placement

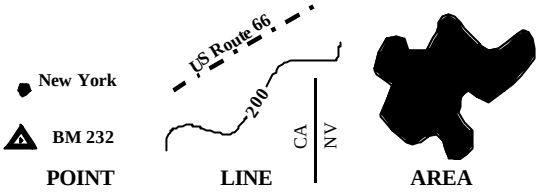
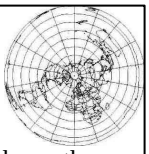


Figure : Some cartographic label placement conventions. Points: right and above preferred with no overlap. Lines: Following the direction of the line, curved if a river. Text should read up on the left of the map and down on the right. Areas: On a gently curved line following the shape of the figure and upright.

Map types

- *General purpose maps:* many maps show some or all of the types of features at the same time.
- *Thematic maps* show just one or two themes or layers of information, often coded, coloured, or grouped for convenience.

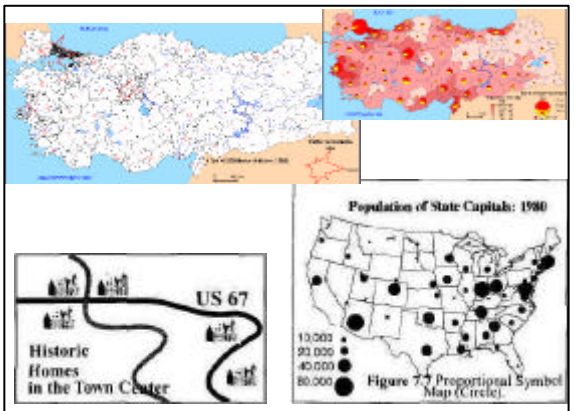
Map types



- *Reference map* or a basic outline shows the simplest properties of the map data (world outline map, with named continents and oceans).
  - A general reference map, usually showing a suite of features including terrain, streams, boundaries, roads, and towns, is called a *topographic map*, is often used as reference information behind GIS map layers.

Map types

- A *dot map* uses dots to show the location of features and may show a distribution such as population against a base map.
- A *picture symbol* map uses a symbol, to locate point features such as ski resorts.
- The *graduated symbol map* is the same, except that the symbol size is varied with the value of the feature. Typically, geometric symbols such as circles, squares, triangles, or shaded "spheres" are used.



Map types

- The *network map* shows connected lines with similar attributes. A subway map, an airline route map, and a map of streams and rivers are examples.
- The *flow map* is the same, but it uses the width of the line to show value, for example, to show the air traffic volume or the amount of water flow in a stream system.

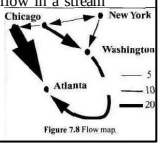
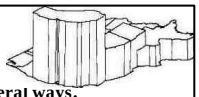


Figure 7.8 Flow map.

Map types

- A *choropleth map* is the familiar shaded map where data are classed and areas such as states or countries are shaded or coloured more or less densely according to their value. A variation on this, the unclassed choropleth, uses a continuous variation in tone or colour rather than the steps that result from classes.
- An *area qualitative map* simply gives a colour or pattern to an area, for example the colours of rocks on a geological map, or the land-use classes derived from image classification in remote sensing.

Map types



- **Volumetric data can be shown in several ways.**
  - Discontinuous data are often shown as a *stepped statistical surface*, a block-type diagram viewed in perspective.
  - The standard *isoline map* is a map with lines joining points of equal value. Surface continuity is assumed, meaning that sharp breaks are usually smoothed. The terrain equivalent is the contour map, with its characteristic *datum* and *contour interval*.
  - A variant is the *hypsometric map* in which the space between contour lines is filled with colour using a sequence designed to illustrate variation. Image maps and schoolroom topographic maps use this type.

Map types

- Three-dimensional views of surfaces rendered in perspective can be either a *gridded fishnet*, where a grid is distorted to give the impression of three dimensions, or
- a *realistic perspective*, when an image or shaded map is draped over the surface rather than a grid.
- *simulated hill shading* where illumination of shadowing is simulated by the computer and a gray scale or a colored map is used to show the surface.

Map types

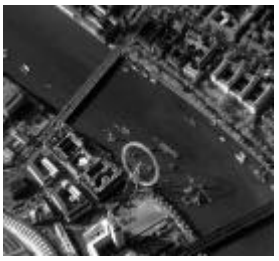
- Gridded fishnet
- Realistic perspective
- Hill-shaded
- Image map

Map types

- image map or ortophoto map

(!) landsat

(!) Ikonos



Map Types: Point Data

- Reference
- Topographic
- Dot
- Picture Symbol
- Graduated Symbol

Map Types: Line Data

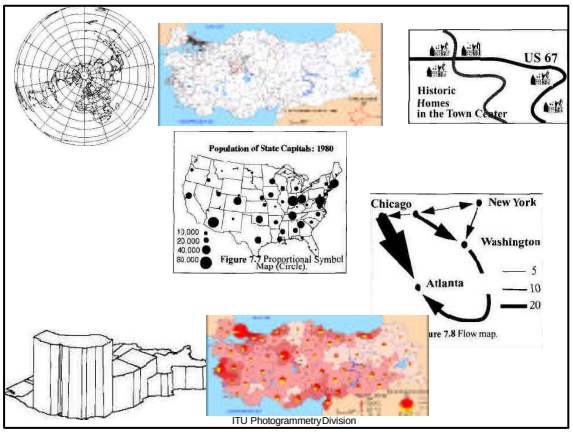
- Network
- Flow
- Isopleth
- Reference

Map Types: Area Data

- Choropleth
- Area qualitative
- Stepped surface
- Hypsometric
- Dasymetric
- Reference

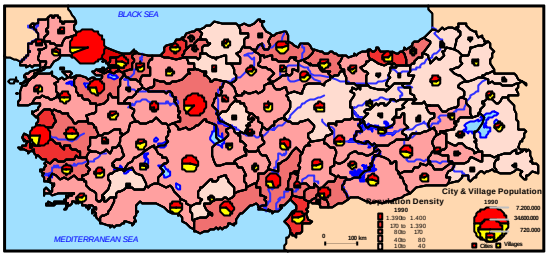
Map Types: Volume Data

- Isopleth, Stepped Surface, Hypsometric
- Gridded fishnet
- Realistic perspective
- Hill-shaded
- Image map



Choosing a Map Type

- Cartographers have designed hundreds of map types: methods of cartographic representation.
- Not all GISs allow all types.
- Most have a set of basic types
- Depends heavily on the dimension of the data to be shown in the map figure.



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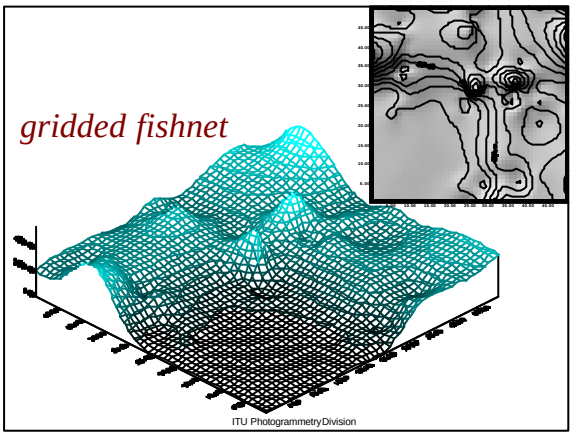
gridded fishnet



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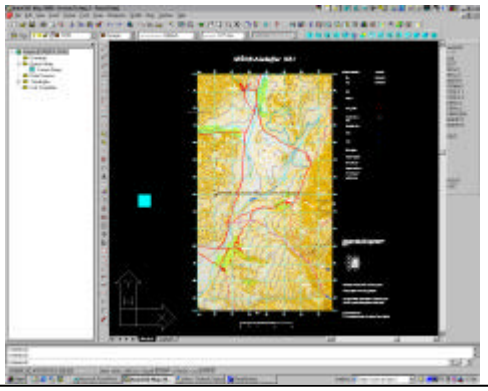

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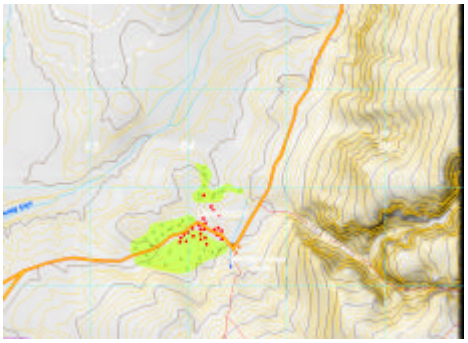

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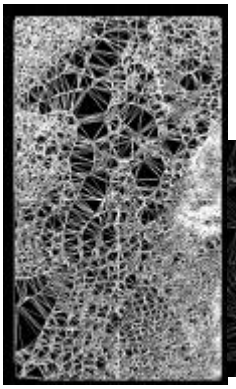

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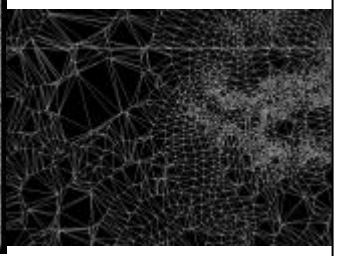

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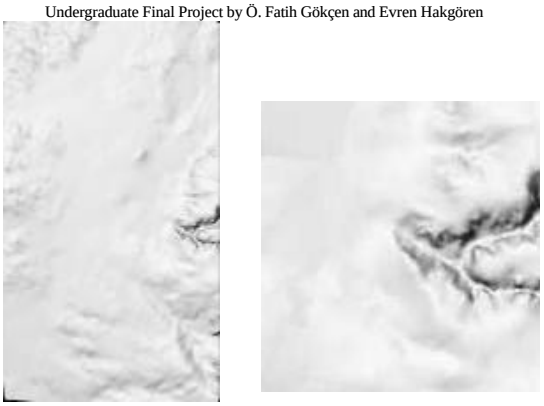

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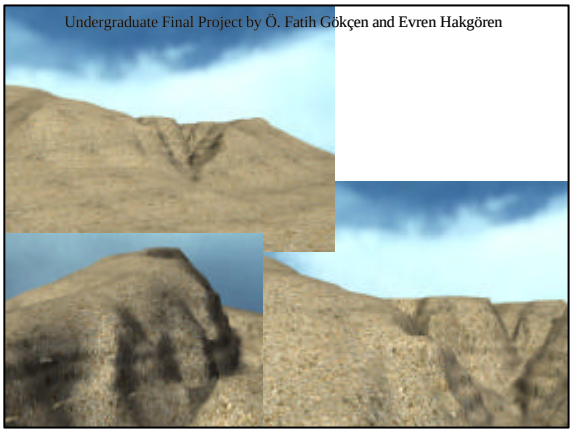

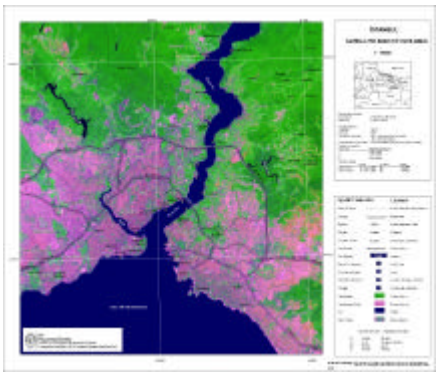

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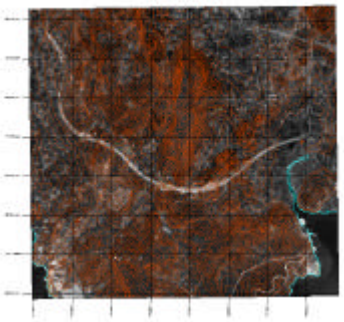

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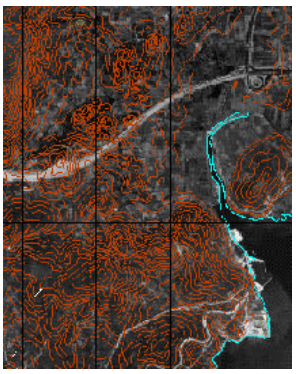

Orthophoto - map

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Choosing the Wrong Type

- Fairly common GIS error.
- Due to lack of knowledge about cartographic options.
- Can still have perfect symbolization.
- Possibility of misinformation
- Definite reduction in communication effectiveness.

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Map Types: Point Data

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- Topographic
- Dot
- Picture Symbol
- Graduated Symbol

Map Types: Line Data

- Network
- Flow
- Isopleth
- Reference

Map Types: Area Data

- Choropleth
- Area qualitative
- Stepped surface
- Hypsometric
- Dasymetric
- Reference

Map Types: Volume Data

- Gridded fishnet
- Realistic perspective
- Hill-shaded
- Image map

Map Types: Time

- Multiple views
- Animation
  - Moving map
  - Fly thru
  - Fly by

Choosing Types

- Check the data
  - Continuous
  - Discrete
  - Accuracy & Precision
  - Reliability
- Dimension (Point, Line, Area, Volume)
- Scale of Measurment (Nominal etc.)
- GIS capability
- May need to supplement GIS software

Data Scaling (Stevens)

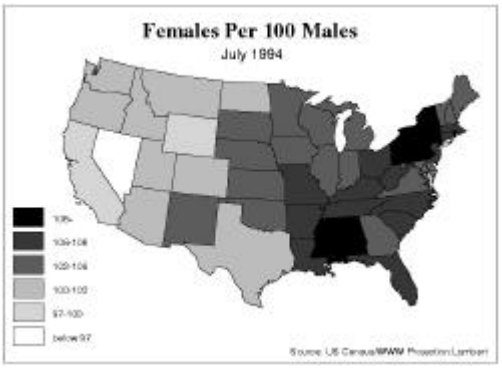
- Nominal (Name of a place)
- Ordinal (Small, med., large town)
- Interval (Arbitrary zero e.g. Sea Level)
- Ratio (Absolute zero e.g. dollars, densities)

Example: Choropleth Mapping

- Data should be AREA (e.g. States)
- Data should not suffer from area effect.
- Population?
- Per capita Income?
- Elevation? Temperature?
- Boundaries unambiguous.
- Areas non-overlapping.

Classification

- Equal Interval
- Natural groups
- N-tiles
- Equal or unequal?
- Logarithmic? Linear? Discontinuous?
- How many classes?
- Non-overlapping, distinctive groups.



The Need for Design

- To appear professional and avoid errors, GIS maps should reflect cartographic knowledge about map design.
- A map has a visual grammar or structure that must be understood and used if the best map design is desired.
- Cartographic convention (e.g. forests should be green).

Map Design

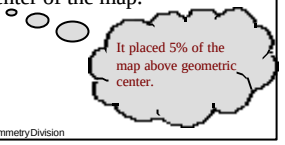
- A GIS map is designed in a process called the design loop.
  - Create map layout as macro
  - Draw on screen (proof plot)
  - Look
  - Edit macro
  - Repeat until happy
  - Make final plot
- Good map design requires that map elements be placed in a balanced arrangement within the neat line.

Map Design

- A GIS map is designed in a process called the design loop.
- Good map design requires that map elements be placed in a balanced arrangement within the neat line.

Map Design (2)

- Visual balance is affected by:
  - the "weight" of the symbols
  - the visual hierarchy of the symbols and elements
  - the location of the elements with respect to each other and the visual center of the map.



The Design Loop

- Create map layout as macro
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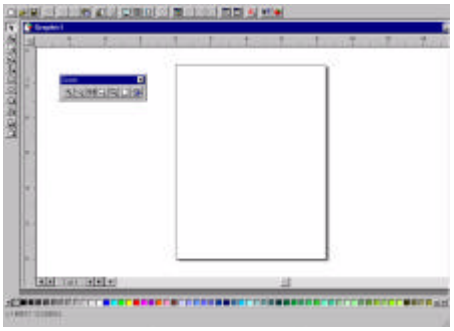
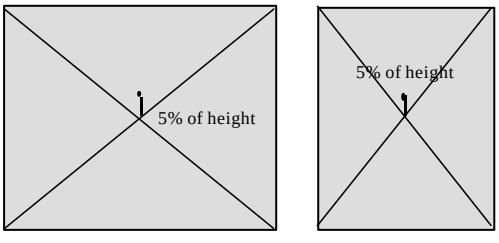
Graphic Editors



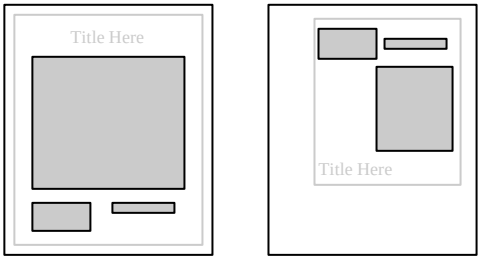
Visual center



Landscape

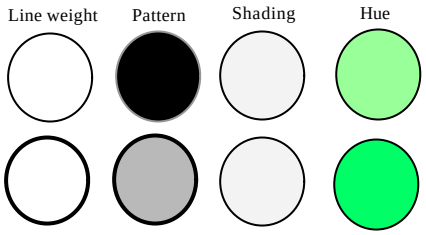
Portrait

Visual Layout



Eye expects (1) balance and (2) allignment

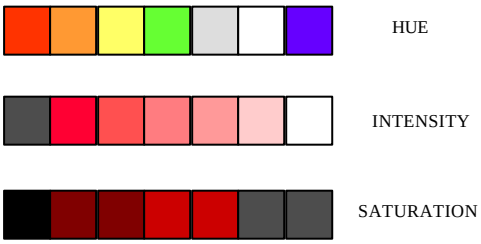
Symbol “weight”



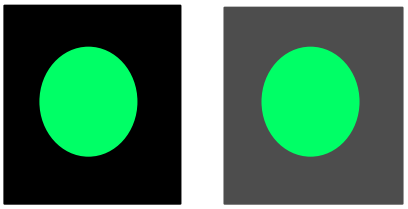
Color and Map Design

- Color is a complex visual variable and in a GIS is specified by RGB or HSI values.
- Red, Green, Blue are additive primaries.
- Magenta, Cyan and Yellow are subtractive primaries.
- Saturation and Intensity map better onto values than hue.

Dimensions of Color

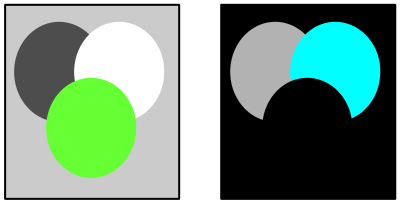


Simultaneous Contrast



When several hues appear in juxtaposition on a map, the colours are perceptually altered by the eye, a phenomenon known as *simultaneous contrast*.

Color Primaries



Subtractive color

Additive color

Graphic Editor Software

- Vector
  - Adobe Illustrator
  - CorelDraw
  - Freehand
- Raster
  - Photoshop
  - CorelPaint
  - Fractal Paint

Scale and Generalization

- Smaller scale means fewer features.
- Smaller scale means smoother features.
- Smaller scale means combining features.
- Smaller scale means displacing features.
- Often scales are mixed or overgeneralized.

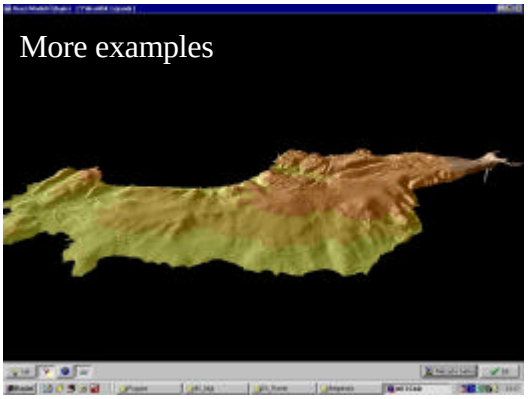
Map Design and GIS

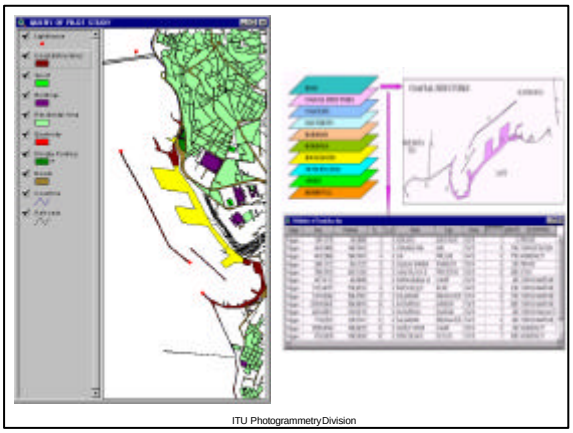
- When a GIS map is the result of a complex analytical or modeling process, good design is essential for understanding.
- The map is what distinguishes GIS as a different approach to the management of information, so extra care should be taken to improve the final maps that a GIS generates in a GIS task.

… as conclusion

- **The last stage in the mapping process is the conversion of the GIS data into a map design.**
- **… almost infinite number of choices or symbols, fonts, colours, line thicknesses, and so on. Selecting the "best" design can make an enormous difference in the effectiveness of the map.**
- **If a map has taken a large amount of work to generate, it is well worth the GIS user's effort to make doubly sure that the design is good.**

More examples





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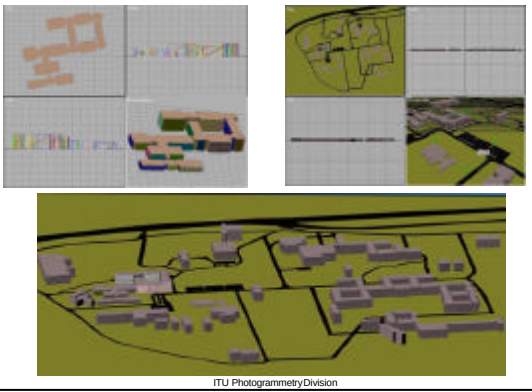

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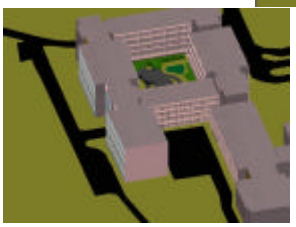

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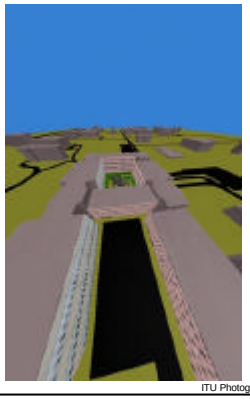

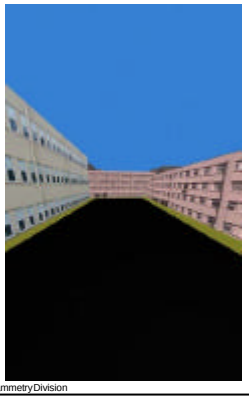

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Coming next…

How to Pick a GIS.

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