

An Introduction to

Geographic Information Systems and Remote Sensing

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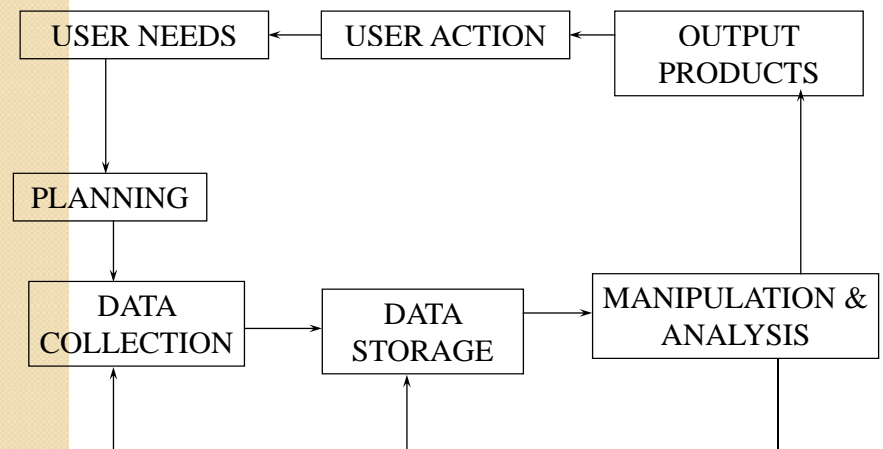
Geographic Information Systems

1. It is an information system that is designed to work with data referenced by spatial or geographic co-ordinates
2. A database system with specific capabilities for spatially-referenced data, as well as a set of operations for working with the data

Conclusion : Map & computer

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SIMPLIFIED INFORMATION SYSTEM OVERVIEW



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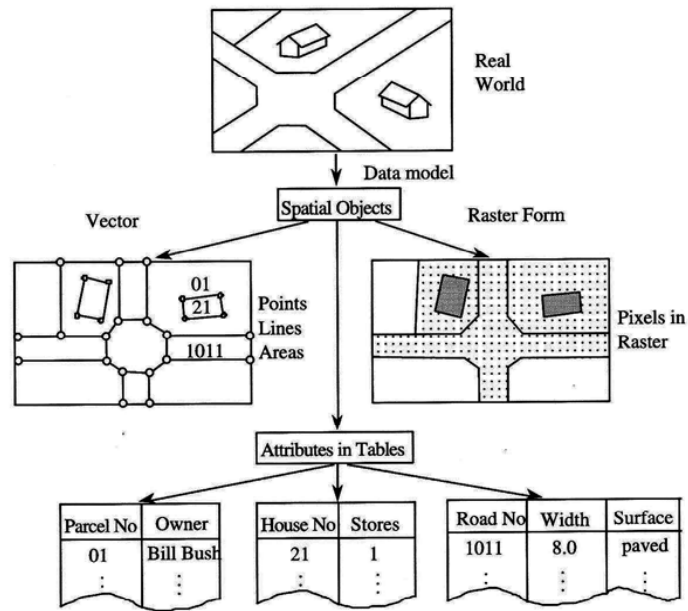


Figure 1.2 Concept of Geospatial data

Do we need GIS?

Reasons to have a GIS:

- geospatial data are poorly maintained
- maps and statistics are out of date
- data and information are inaccurate
- there is no data retrieval service
- there is no data sharing

Benefits from a GIS :

- geospatial data are better maintained in a standard format
- revision and updating are easier
- geospatial data and information are easier to search, analyze and represent
- more value added product
- geospatial data can be shared and exchanged freely
- productivity of the staff is improved and more efficient
- time and money are saved
- better decisions can be made

Table 1.1 GIS Versus Manual Works

Maps	GIS	Manual Works
Storage	Standardized and Integrated	Different Scales on different Standards
Retrieval	Digital Data Base	Paper Maps, Census, Tables
Updating	Search by Computer	Manual Check
Overlay	Systematically Done	Expensiv eand Time Consuming
Spatial Analysis	Very Fast	Time & Energy Consuming
Display	Easy Cheap and Fast	Complicated Expensive

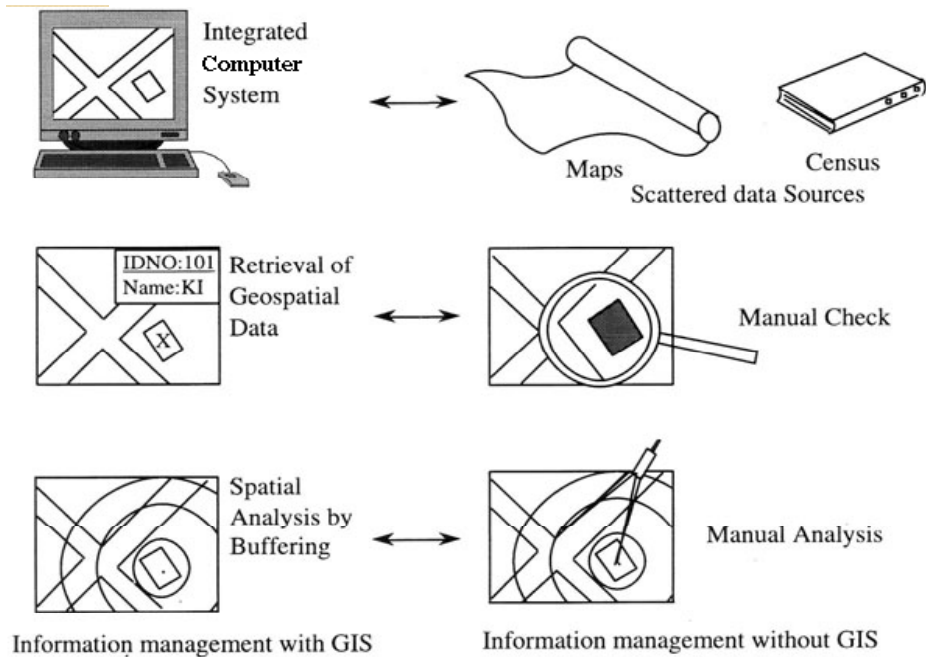


Figure 1.3 Comparison of Geospatial Information Management

What are the functions of a GIS?

The questions that a GIS is required to answer :

What is at.....? (Locational question ; what exists at a particular location)

Where is it.....? (Conditional question ; which locations satisfy certain conditions)

How has it changed.....?

(Trendy question ; identifies geographic occurrence or trends that have changed or in the process of changing)

Which data are related

(Relational question : analyzes the spatial relationship between objects of geographic features)

What if.....?

(Model based question ; computers and displays an optimum path, a suitable land, risky area against disasters etc. based on model)

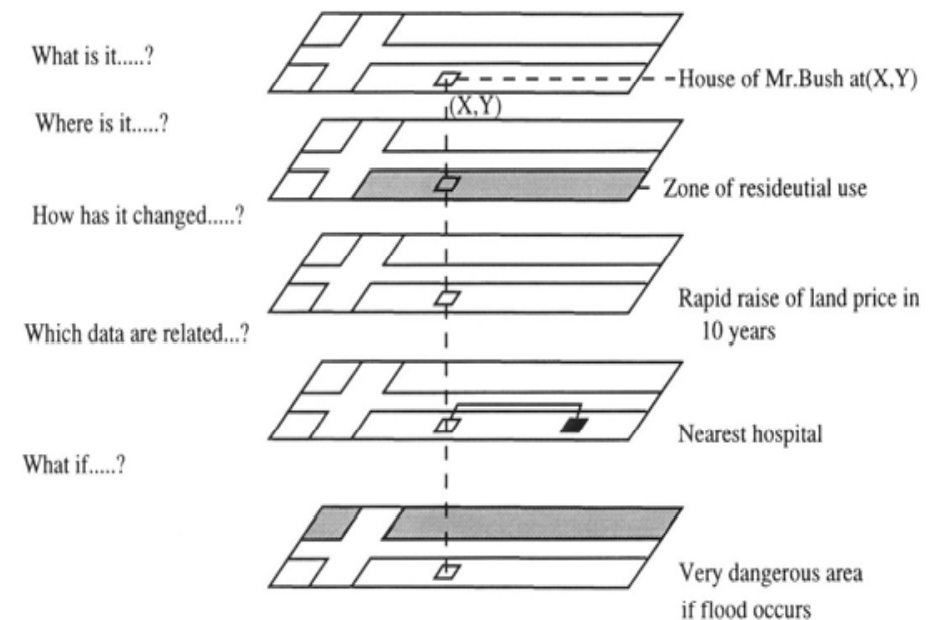


Figure 1.4 Required Functions of GIS

Table 1.2 Basic Functions of GIS

Functions	Sub-functions
Data Aquisition and preprocessing	Digitizing Editing Topology Building Projection Transformation Format Conversion Attribute Assignment etc.
Database Management and Retrieval	Data Archival Hierachical Modeling Network Modeling Relational Modeling Attribute Query Object-oriented Database etc.
Spatial Measurement and Analysis	Measurement Operations Buffering Overlay Operations Connectivity Operations etc.
Graphic Output and Visualization	Scale Transformation Generalization Topographic Map Statistical Map 3D Birdis Eye View etc.

Component of GIS

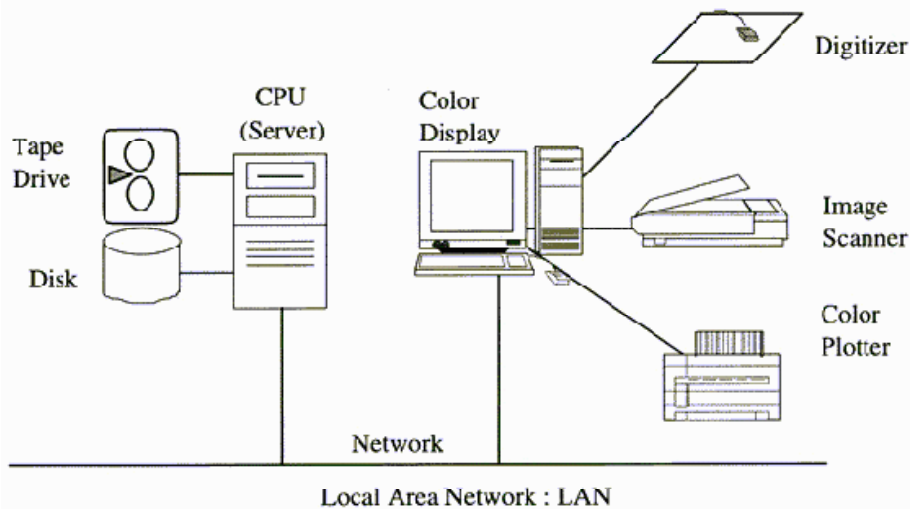
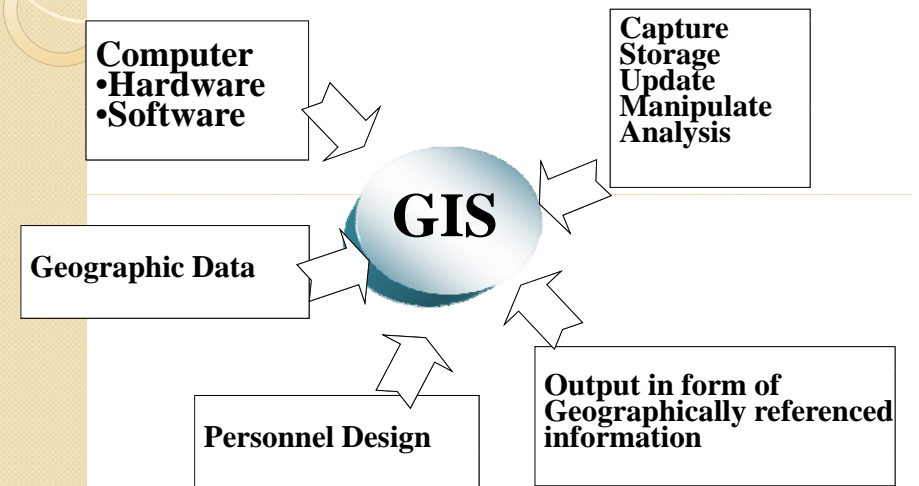
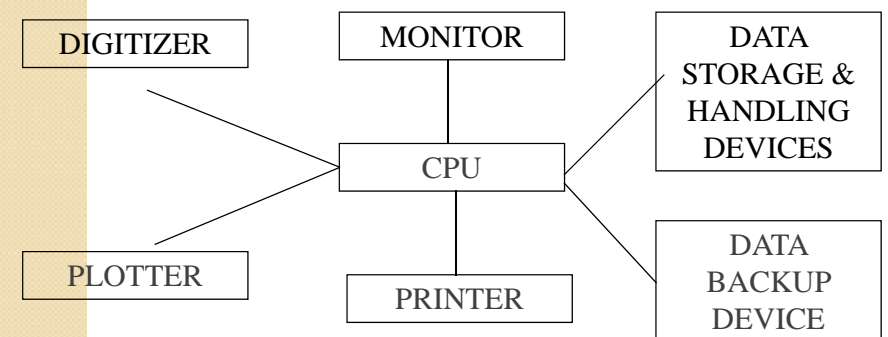
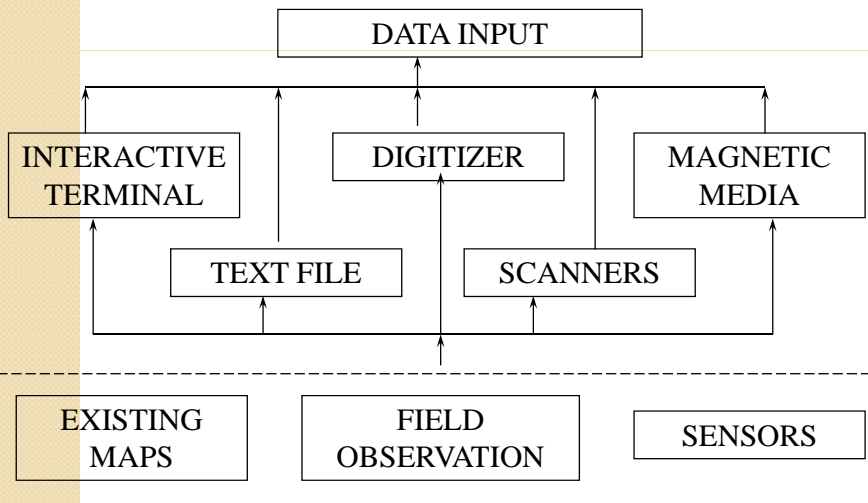
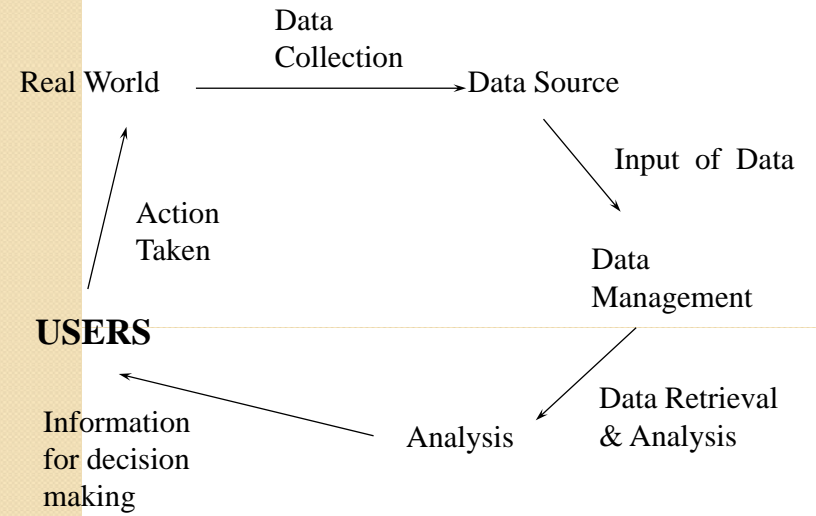
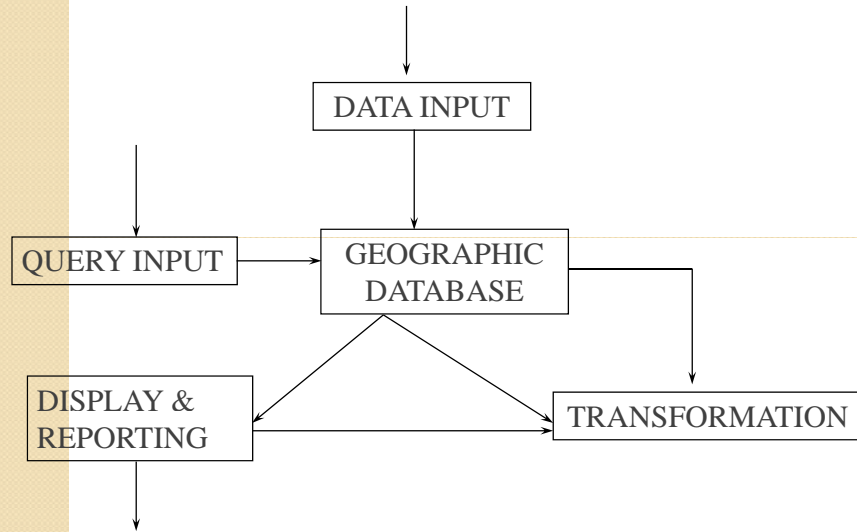


Figure 1.5 Components of GIS Hardward System

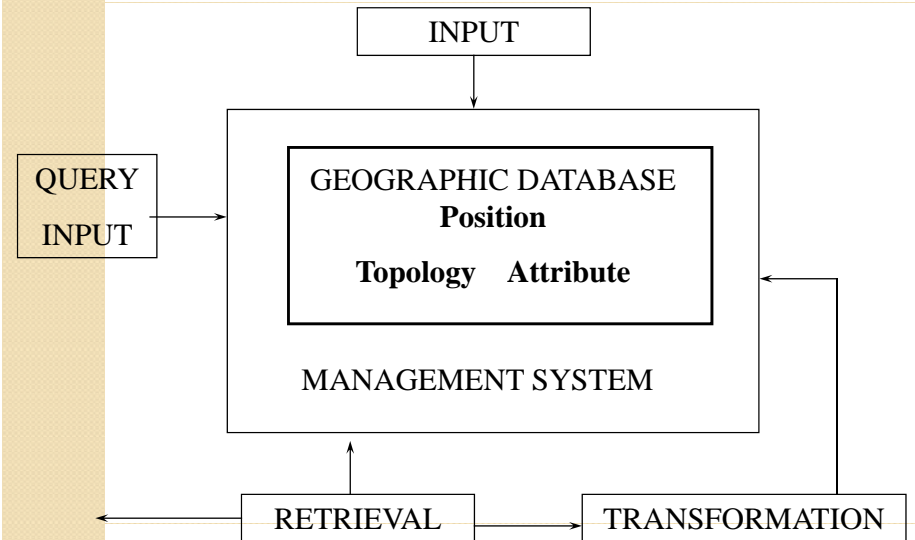
Major Hardware Components

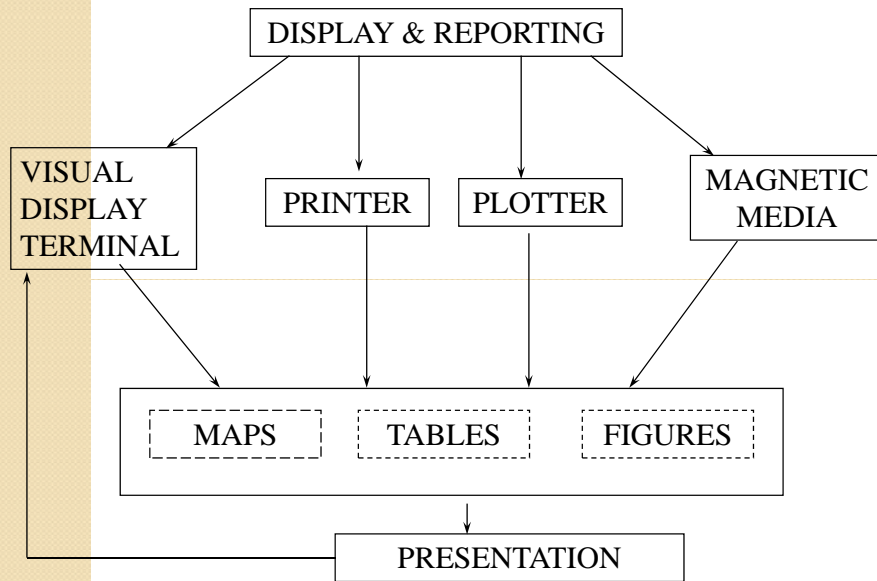


Major Software Components



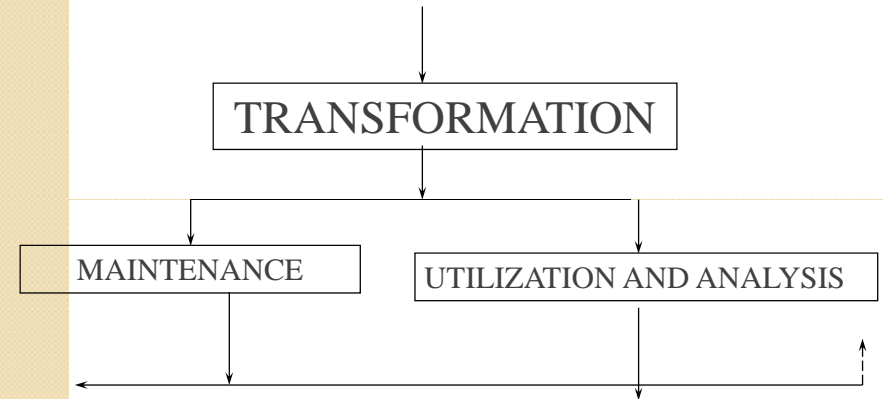
COMPONENTS OF A GIS





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DATA TRANSFORMATION



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Geographical Concepts

- Spatial Objects - geographic area with associated attributes and characteristics
- Point - a spatial object with no area
 - key attributes : geodetic location other data based on application
- Line - spatial object made of connected sequence of points
 - no width
 - spatial location on either side of the line
- Nodes - intersection of line or end of line segment

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- Polygon
 - A Closed Area
 - simple polygon undivided area
 - complex polygon divided area of different characteristics
- Chains
 - special kind of line segment which corresponds to a position of the boundary edge of a polygon
- Scale
 - ratios of distances represented on a map to their true length on the earth's surface
 - dimensionless
 - small scale map (Ex. 1:1,000,000 large area)
 - large scale map (Ex. 1:10,000 large area)

- Resolution : distinguishing individual parts
 - Spatial resolution for geographic data as the content of the geometric domain divided by the number of observations, normalized by spatial dimension
 - (Ex. 2D-dataset $Res = \sqrt{\text{area}/\text{inform}^2}$)
 - (Ex. 3D-dataset $Res = ?$)
 - Size of the resolution element (Resel) => related to size of objects we can distinguish in a dataset
- Spatial Domain
 - Area covered by the observation
 - ☑ More information => mean resolution gets smaller
 - ☑ Less information => mean resolution gets larger
 - ☑ If information increase and mean resolution element gets smaller => Higher resolution

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GIS Functional Elements

- Data Acquisition
- Data Processing
- Data Management
- Data Manipulation and Analysis
- Data Product Generation

Data Acquisition

Process of identifying and gathering the data required for the application.

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Data Preprocessing

- Manipulating data in several ways to be able to prepare it for further modeling.
- Converting Format
 - Georeferencing
 - Geometric Correction
 - Resampling
- Establishing a consistent system for recording – Data model

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Data Management

- Helps in creating and assessing the database.
- Consistent method for data entry, update, deletion and retrieval.

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Data Manipulation and Analysis

- Working within database to derive new information.
- Statistical tool.
- Modeling.
- Logical and Boolean tools.
- Specialized model.

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Product Generation

- Soft Copy
- Hard Copy
- Cartographic principles built-in Computer Aided Drafting Tool

Product Presentation

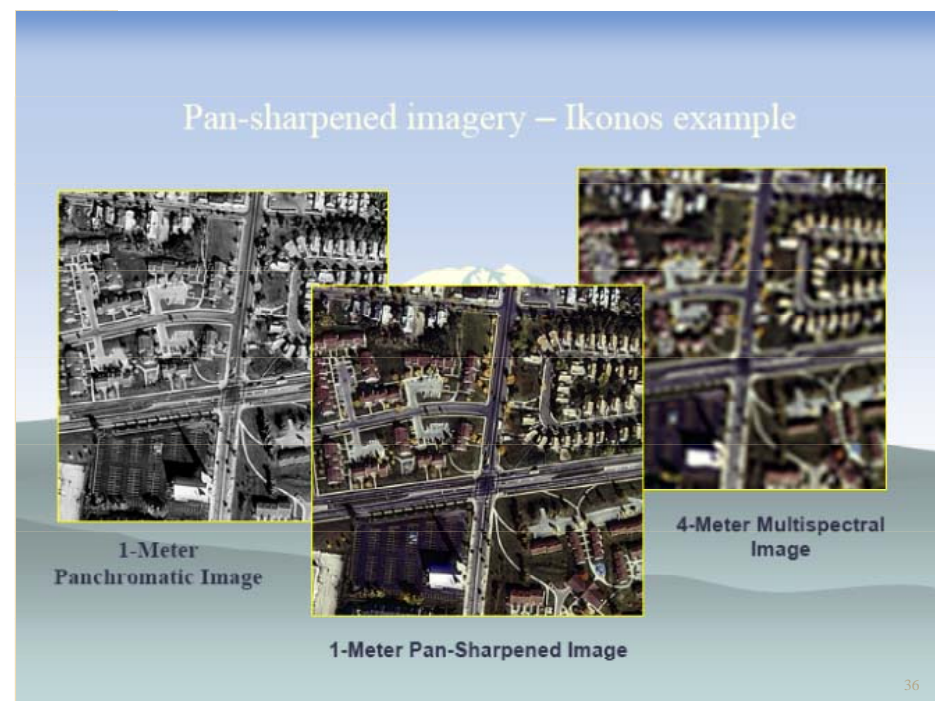
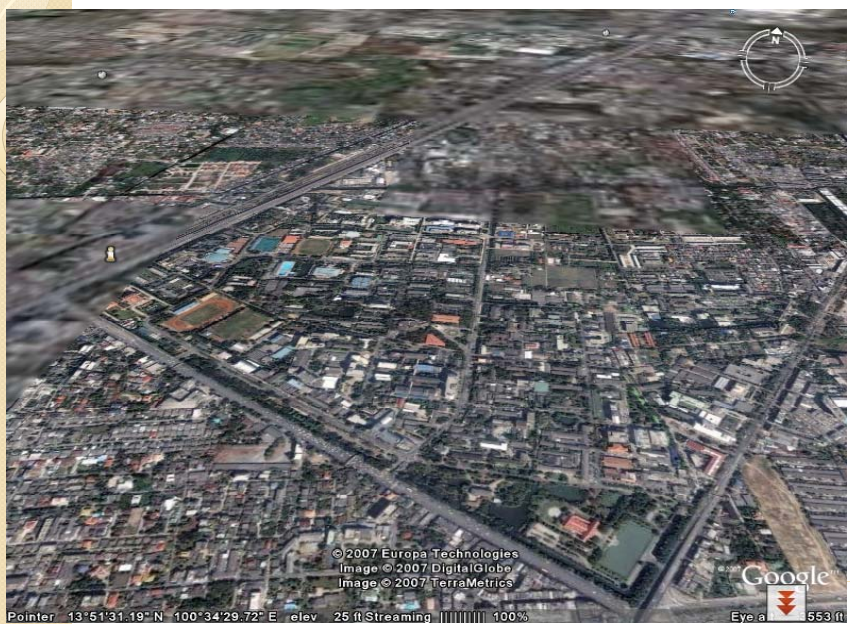
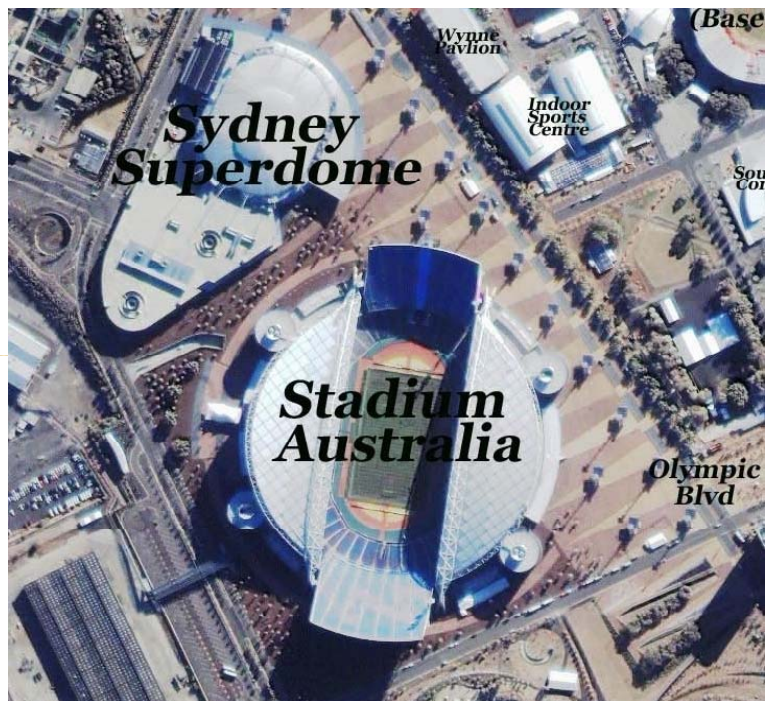
- Report - (Table, Map, Write-up)
- Multimedia

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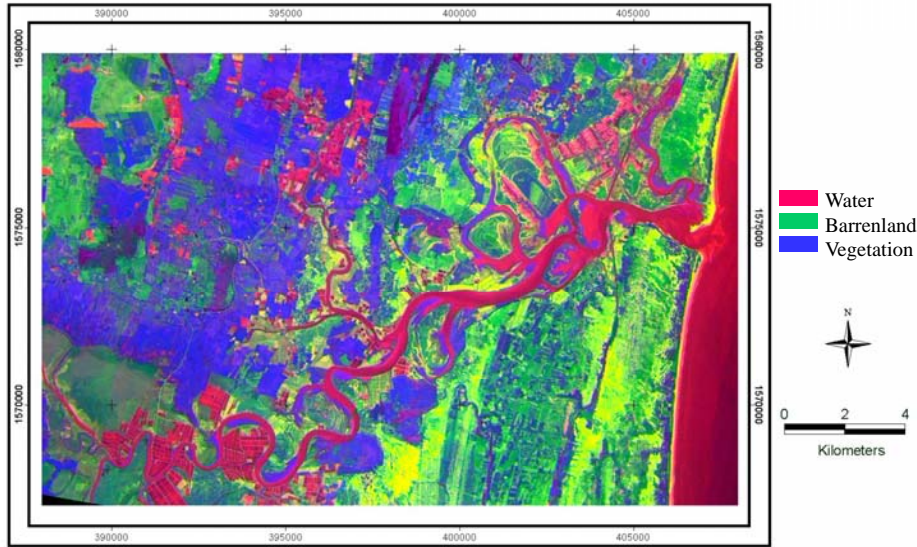
GIS - an integrated multidisciplinary science

Geography	Statistics
Cartography	Operations Research
Remote Sensing	Computer Science
Photogrammetry	Mathematics
Surveying	Civil Engineering
Geodesy	Urban Planning etc.

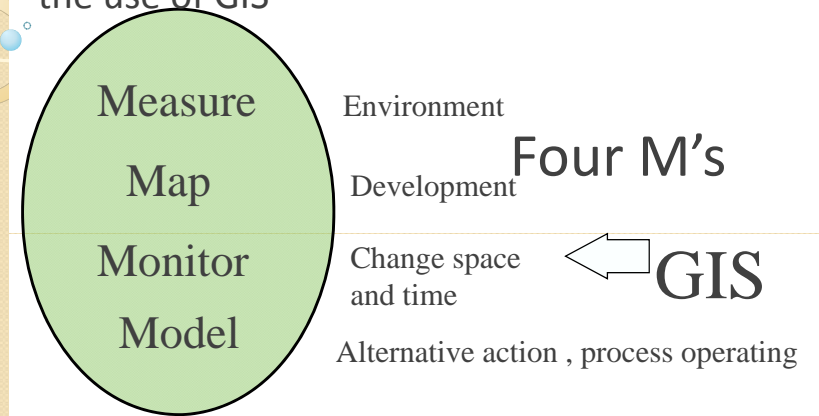
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Kandleru Creek, AP, India: Data Fusion Image of IRS LISS-3 (23.5 m.) and PAN (5.8m.) (PCA)

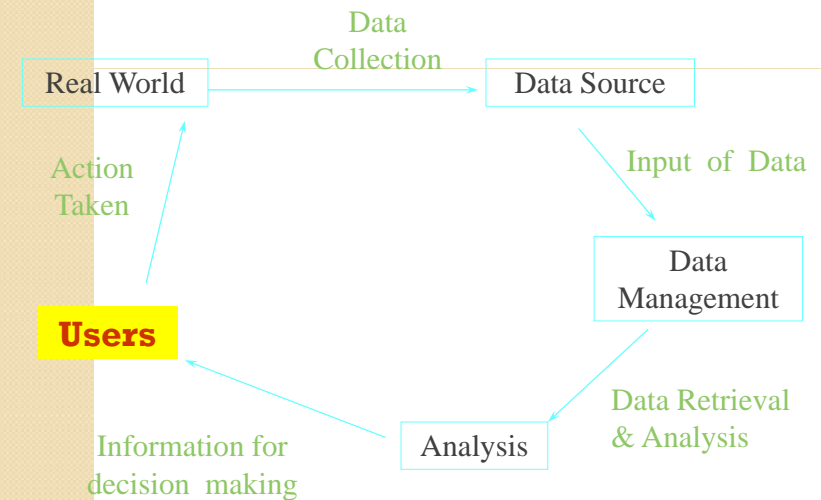
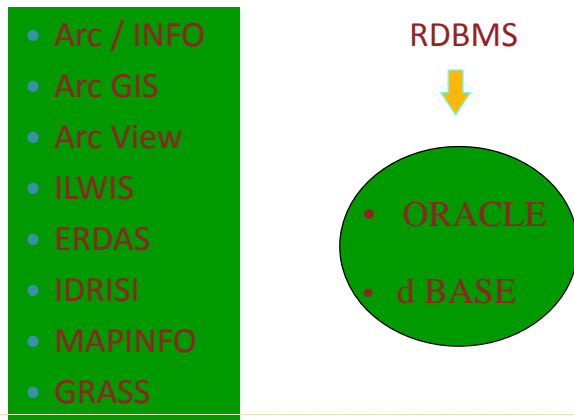


Key activities (4M) can be enhanced through the use of GIS



GIS are a means of integrating spatial data acquired at different Scale, times and different format

Professional Packages



Major Areas of GIS Applications

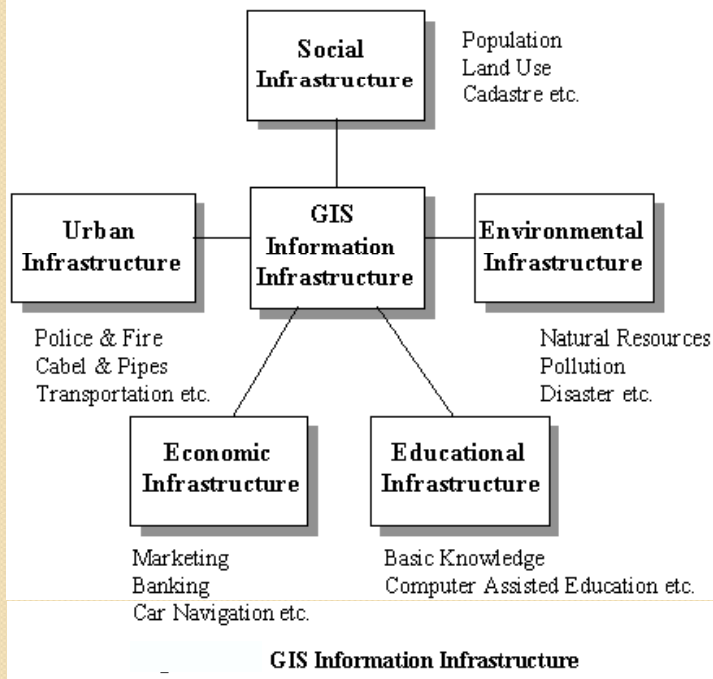
Area	GIS Applications
Facilities Management	locating underground pipes & cables planning facility maintenance telecommunication network services energy use tracking & planning
Environment and Natural Resources Management	suitable study for agricultural cropping management of forests, agricultural lands, water resources, wetlands etc. environmental impact analysis disaster management and mitigation waste facility site location
Street Network	car navigation (routing & scheduling) locating houses and streets site selection ambulance services transportation planning
Planning and Engineering	urban planning regional planning route location of highways development of public facilities
Land Information System	cadastre administration taxation zoning of land use land acquisition

GIS as an Information Infrastructure

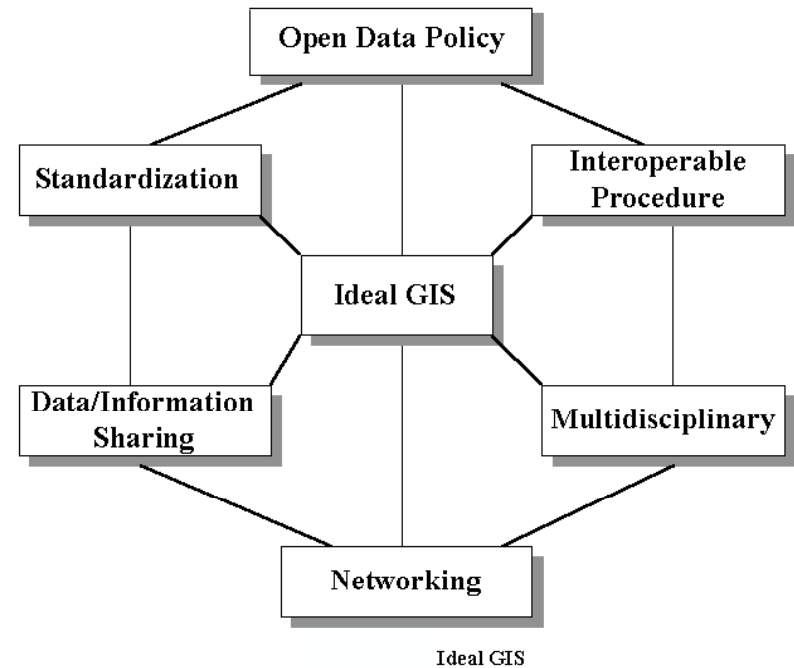
Information has become a key issue in the age of computer, space technology and multimedia, because the information infrastructure contributes to the quality of life as in the followings Infrastructure.

Social infrastructure...	better society
Environmental infrastructure...	better management
Urban infrastructure....	better life
Economic infrastructure.....	better business
Educational infrastructure.....	better knowledge

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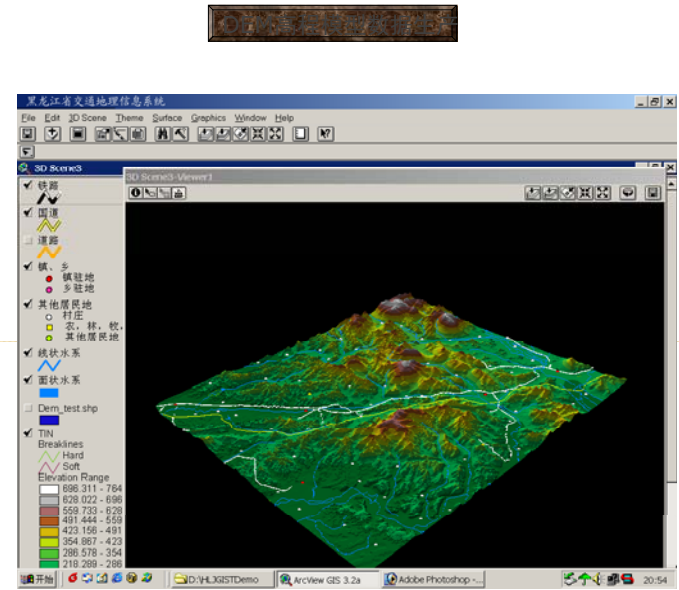


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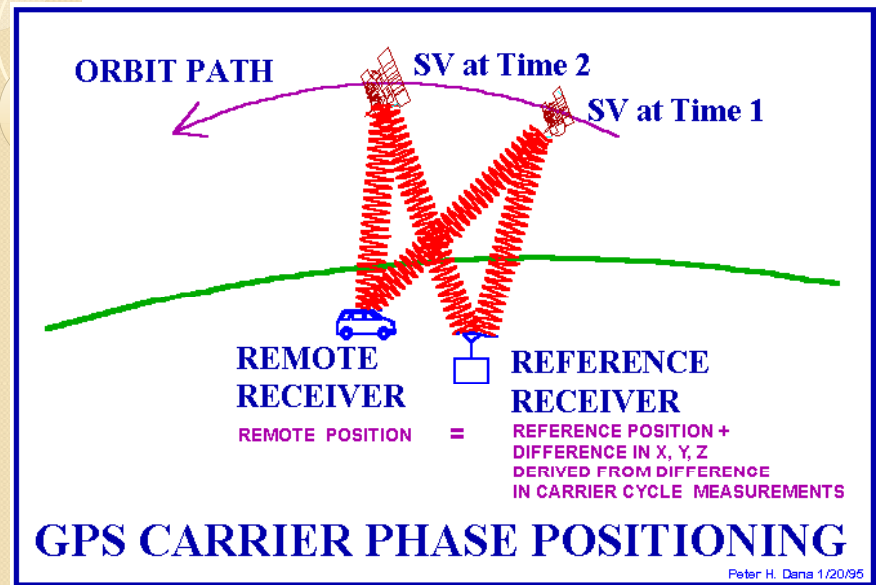
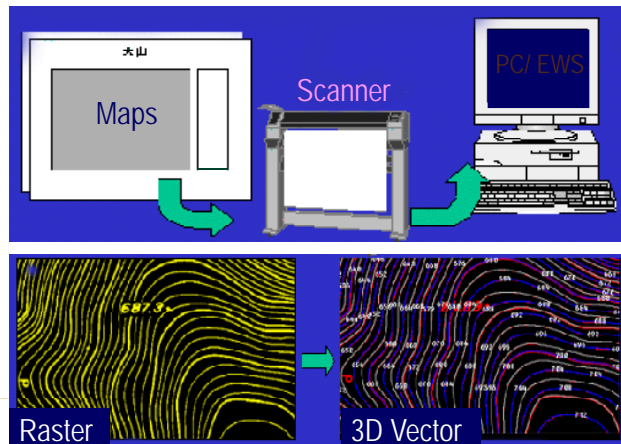
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GIS APPLICATION

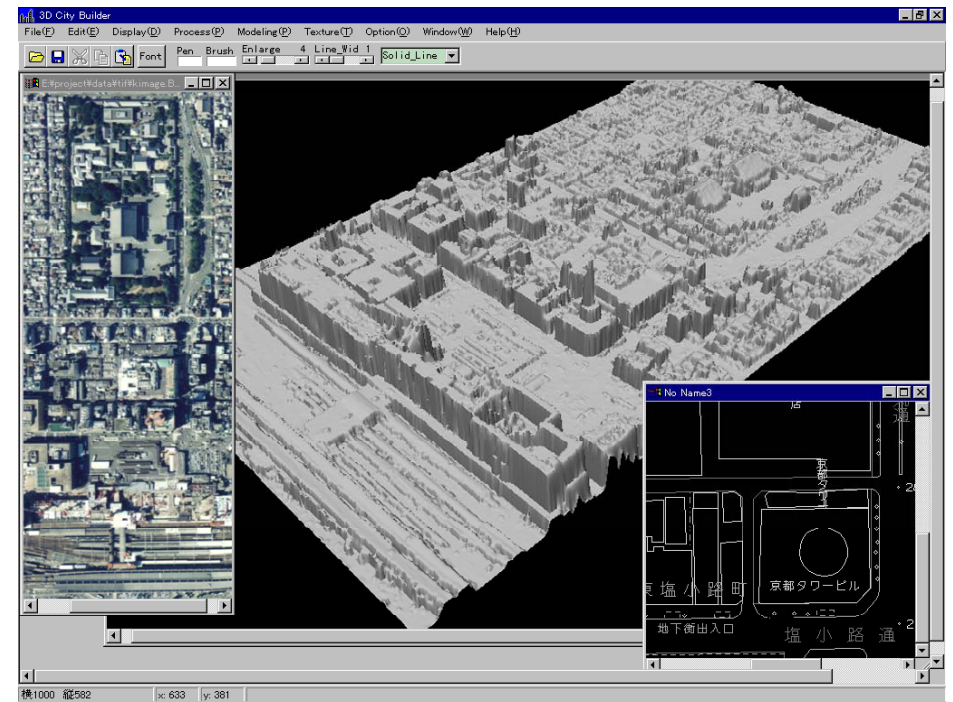
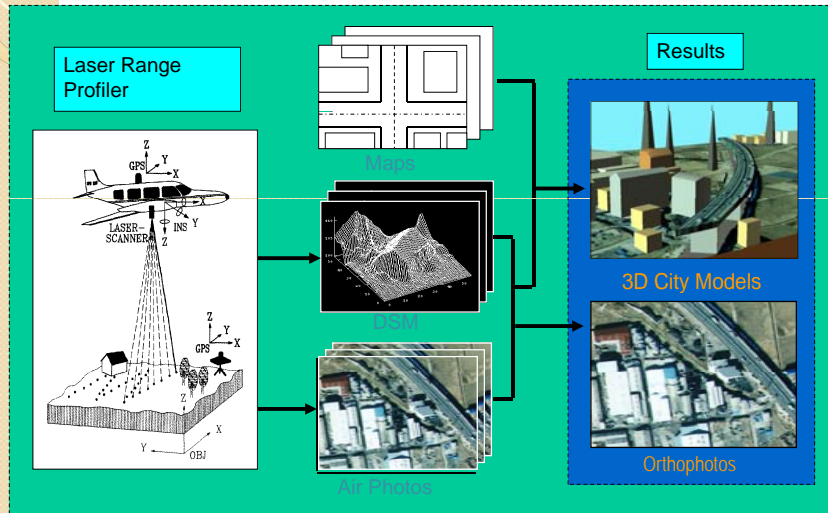


INTRODUCTION

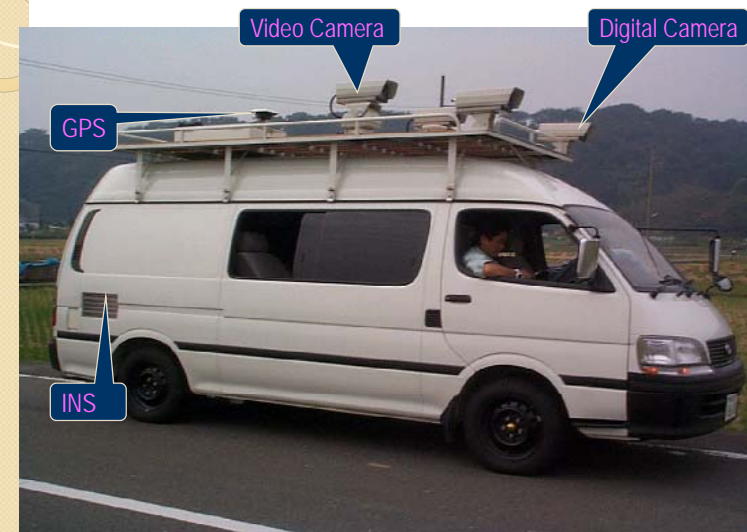
- Our Goal → Automated Understanding Raster Maps

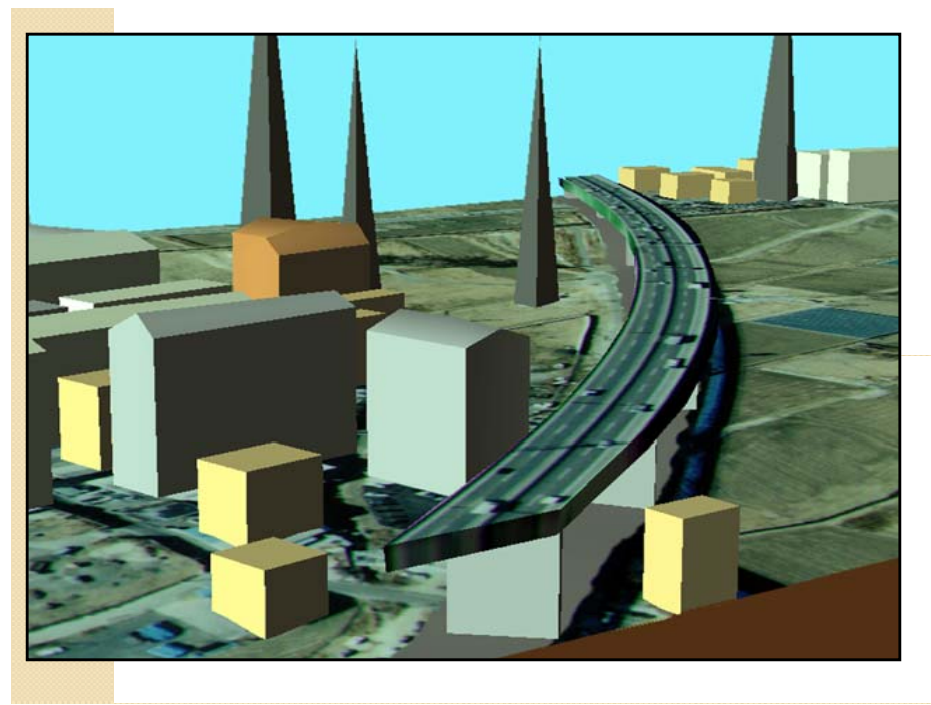


System Outline

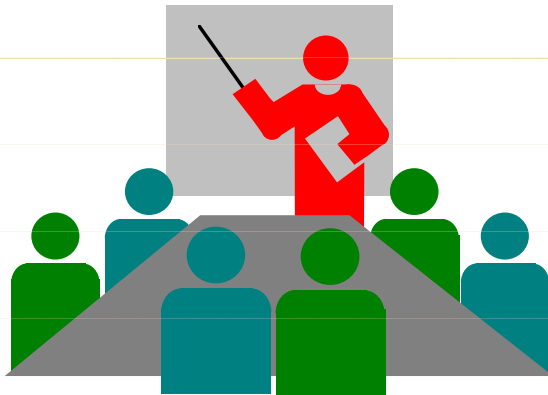


Mobile based Laser Range Scanning





Thus we finish the introduction to GIS.



Let's think about the potential of GIS.....

GIS ONLINE:

1. <http://www.innovativegis.com/basis/primer/concepts.html>
2. <http://www.sli.unimelb.edu.au/gisweb/menu.html>