GEOGRAPHIC INFORMATION SYSTEM

INTRODUCTION TO GEOGRAPHIC INFORMATION SYSTEM

A geographic information system (GIS) is a computer system for capturing, storing, checking, and displaying data related to positions on Earth's surface. By relating seemingly unrelated data, GIS can help individuals and organizations better understand spatial patterns and relationships.

GIS technology is a crucial part of spatial data infrastructure, which the White House defines as "the technology, policies, standards, human resources, and related activities necessary to acquire, process, distribute, use, maintain, and preserve spatial data."

GIS can use any information that includes location. The location can be expressed in many different ways, such as latitude and longitude, address, or ZIP code.

Data Capture

Data Formats

GIS applications include both hardware and software systems. These applications may include cartographic data, photographic data, digital data, or data in spreadsheets.

Cartographic data are already in map form, and may include such information as the location of rivers, roads, hills, and valleys. Cartographic data may also include survey data and mapping information that can be directly entered into a GIS.

Photographic interpretation is a major part of GIS. Photo interpretation involves analyzing aerial photographs and assessing the features that appear.

Digital data can also be entered into GIS. An example of this kind of information is computer data collected by satellites that show land use—the location of farms, towns, and forests.

Remote sensing provides another tool that can be integrated into a GIS. Remote sensing includes imagery and other data collected from satellites, balloons, and drones.

Finally, GIS can also include data in table or spreadsheet form, such as population demographics. Demographics can range from age, income, and ethnicity to recent purchases and internet browsing preferences.

Spatial Relationships

GIS technology can be used to display spatial relationships and linear networks. Spatial relationships may display topography, such as agricultural fields and streams. They may also display land-use patterns, such as the location of parks and housing complexes.

GIS must make the information from all the various maps and sources align, so they fit together on the same scale. A scale is the relationship between the distance on a map and the actual distance on Earth.

GIS Maps

Once all the desired data have been entered into a GIS system, they can be combined to produce a wide variety of individual maps, depending on which data layers are included. One of the most common uses of GIS technology involves comparing natural features with human activity.

GIS systems are often used to produce three-dimensional images. This is useful, for example, to geologists studying earthquake faults.

GIS technology makes updating maps much easier than updating maps created manually. Updated data can simply be added to the existing GIS program. A new map can then be printed or displayed on screen. This skips the traditional process of drawing a map, which can be time-consuming and expensive.

GIS Jobs

People working in many different fields use GIS technology. GIS technology can be used for scientific investigations, resource management, and development planning.

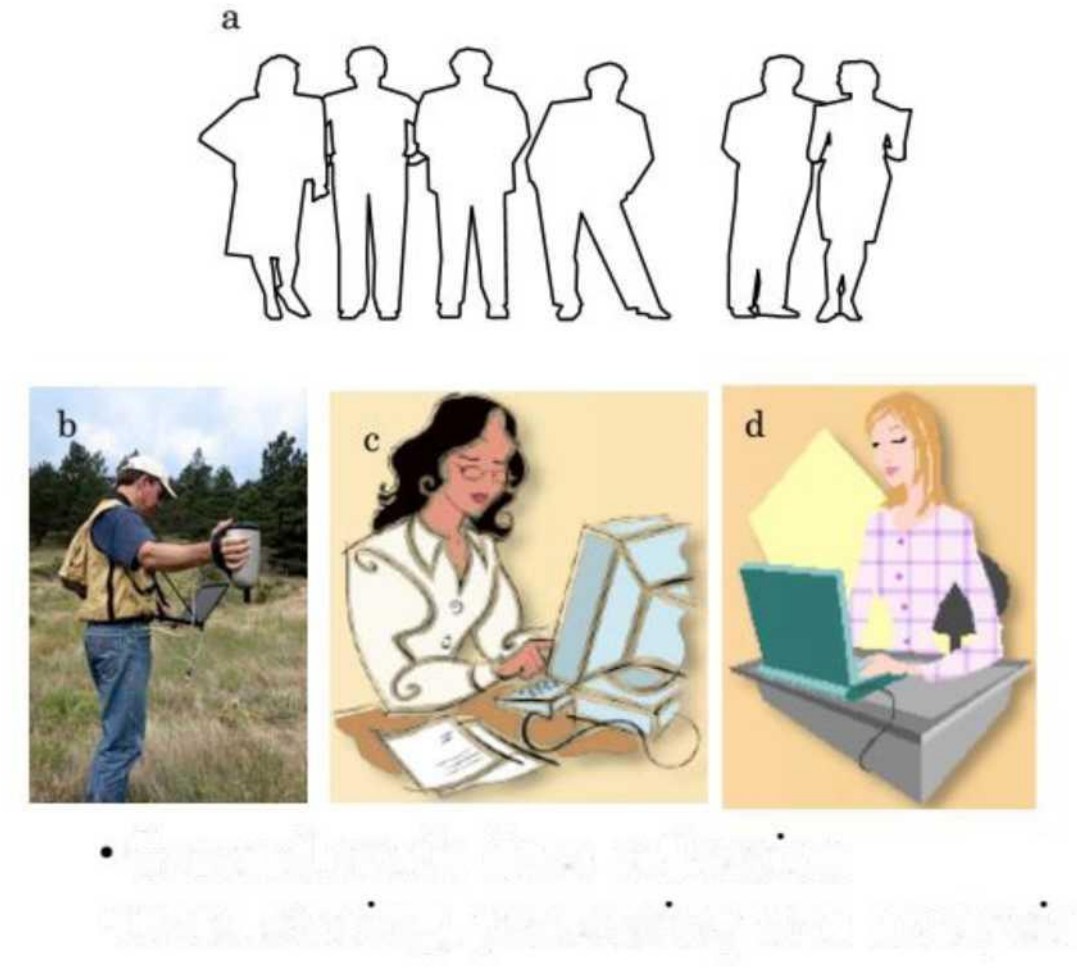
Many retail businesses use GIS to help them determine where to locate a new store. Marketing companies use GIS to decide to whom to market stores and restaurants, and where that marketing should be.

GIS COMPONENTS

1. People

are the most important part of a GIS -define and develop the procedures used by a GIS

-can overcome shortcoming of the other 4 elements (data, software, hardware, procedure), but not vice-versa



2.DATA

- **Data is the information used within a GIS**
- **Since a GIS often incorporates data from multiple sources, its accuracy defines the quality of the GIS.**
- **GIS quality determines the types of questions and problems that may be asked of the GIS**

Remote Sensing and topographic data

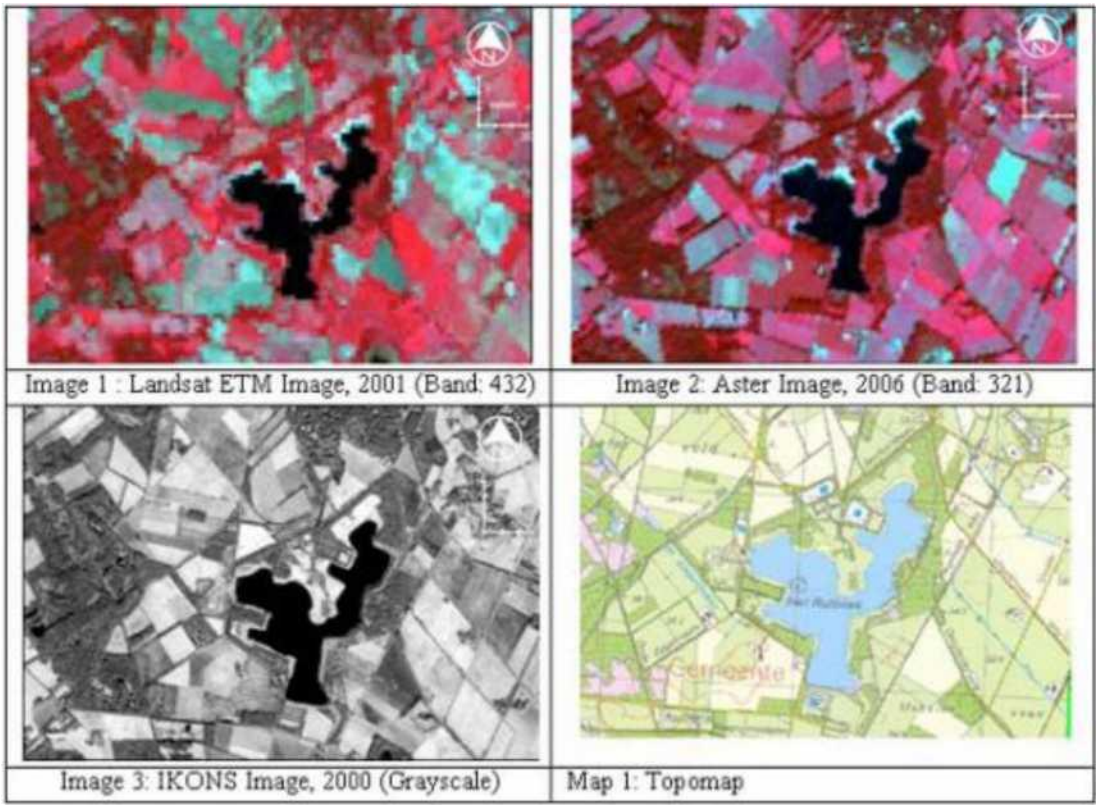


Image 1 : Landsat ETM Image, 2001 (Band: 432)

Image 2: Aster Image, 2006 (Band: 321)

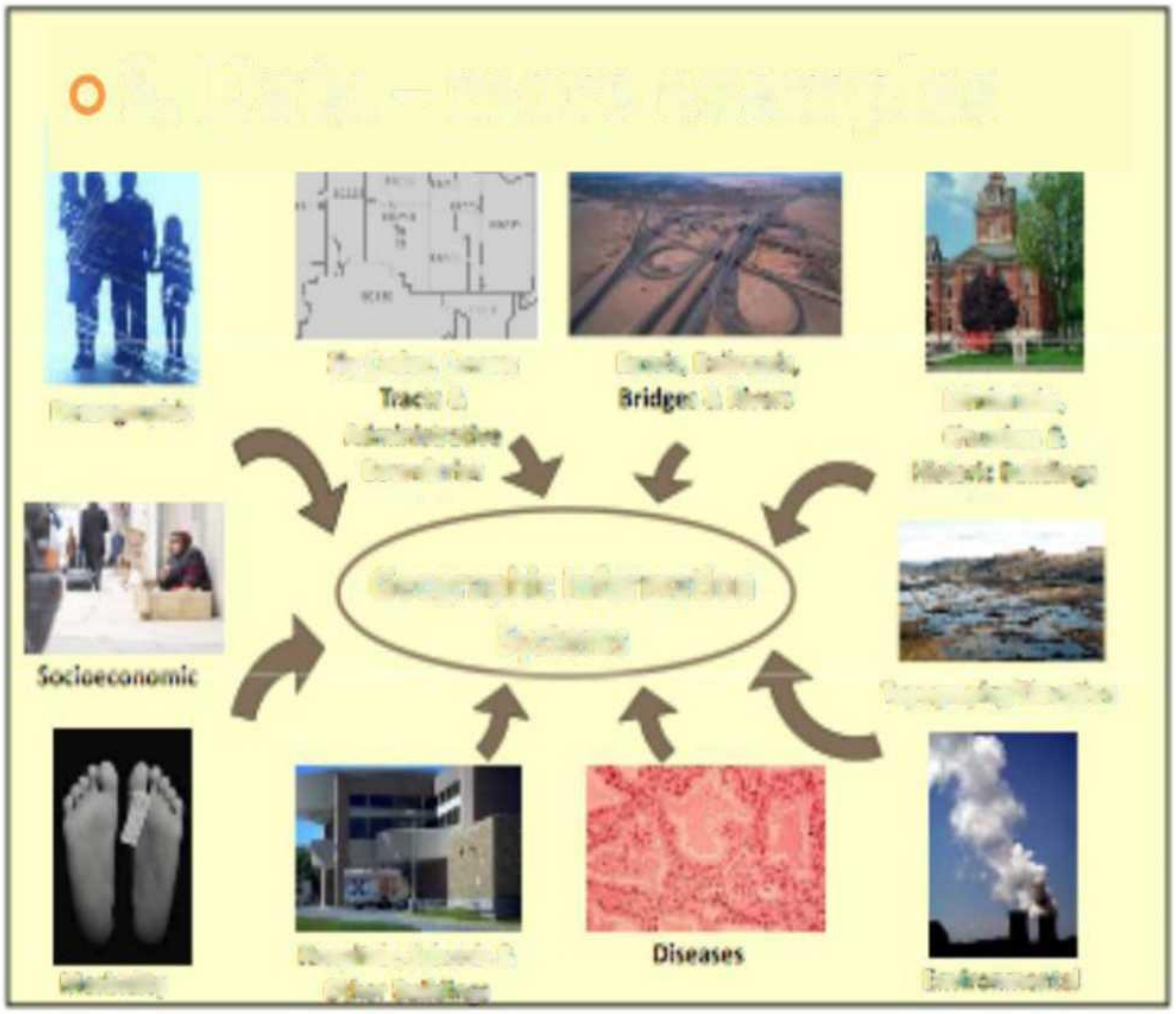
Image 3: IKONS Image, 2000 (Grayscale)

Map 1: Topomap

Ground truth data

Qbs. Point	GPS Reading		Present Landusej	ETM image 2001	IKQNOS	Topographic Map
	X	Y		Class Maine		Legend Class
1	351642	5783025	Forest	Forest	Forest	Forest
IS	*mm*	5783163	Bare Land	Grassland	Grassland	Grassland
17	351000	5732900	Arable Land	Grassland	“Grassland	Grassland
20	350700	57S3200	Forest	Forest	Forest	Forest
23	351100	5783000	Grassland	Arable Land	Arable Land	Arable Land

MORE EXAMPLE.



what does it mean to be "doing GIS"?

- **using the tools of Geographic Information Systems to solve a problem**

such as those in the previous examples

a GIS project might have the following stages:

1. **define the problem**
2. **acquire the software (and the hardware?)**

3. **acquire the data**

4. **clean the database**

5. **perform the analysis**

6. **interpret and present the results**

3. GIS software

- **It encompasses not only to the GIS package, but all the software used for databases, drawings, statistics, and imaging.**
- **The functionality of the software used to manage the GIS determines the type of problems that the GIS may be used to solve.**
- **The software used must match the needs and skills of the end user.**

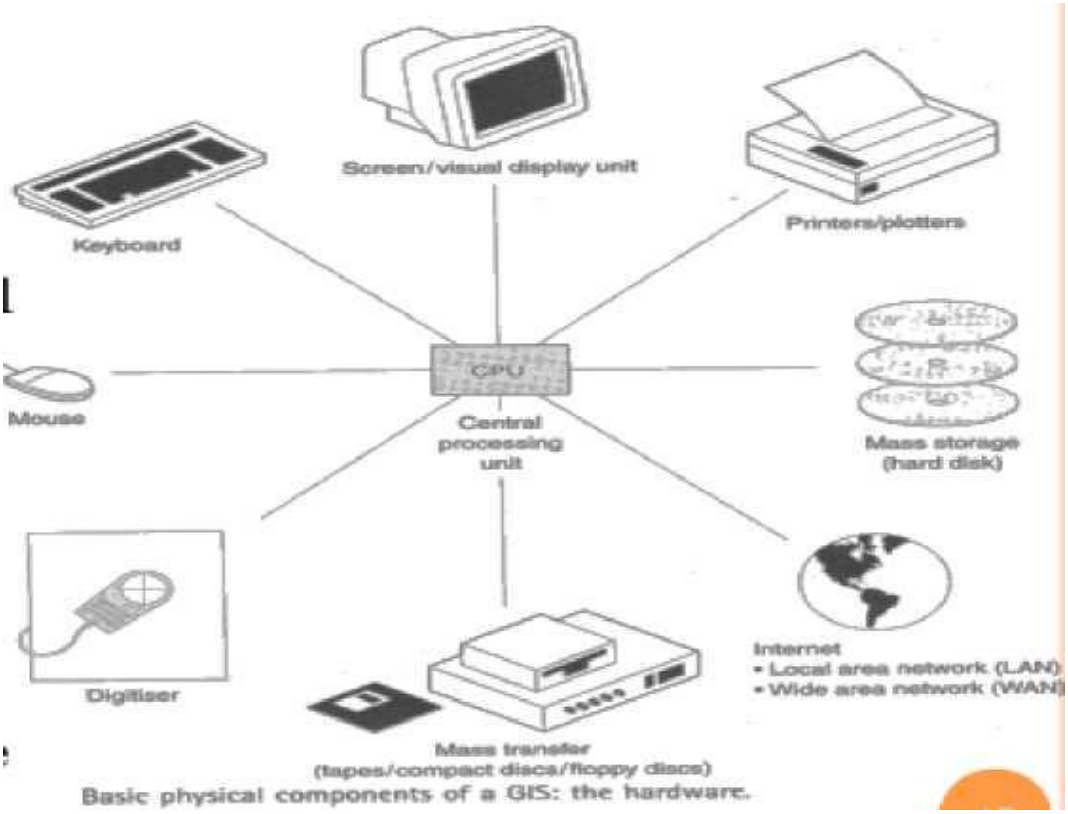
3.1 Popular GIS Software

- **Vector-based GIS**
  - **ArcGIS(ESRI)**
  - **ArcView**
  - **MapInfo**
- **Raster-based GIS**
  - **ErdasImagine (Leica)**
  - **ENVI (RSI)**
  - **ILWIS (ITC)**
  - **IDRISI (Clark Univ.)**

4. Hardware

The type of hardware determines, to an extent, the speed at which a GIS will operate.

- Additionally, it may influence the type of software used.
- To a small degree, it may influence the types/personalities of the people working with the GIS.

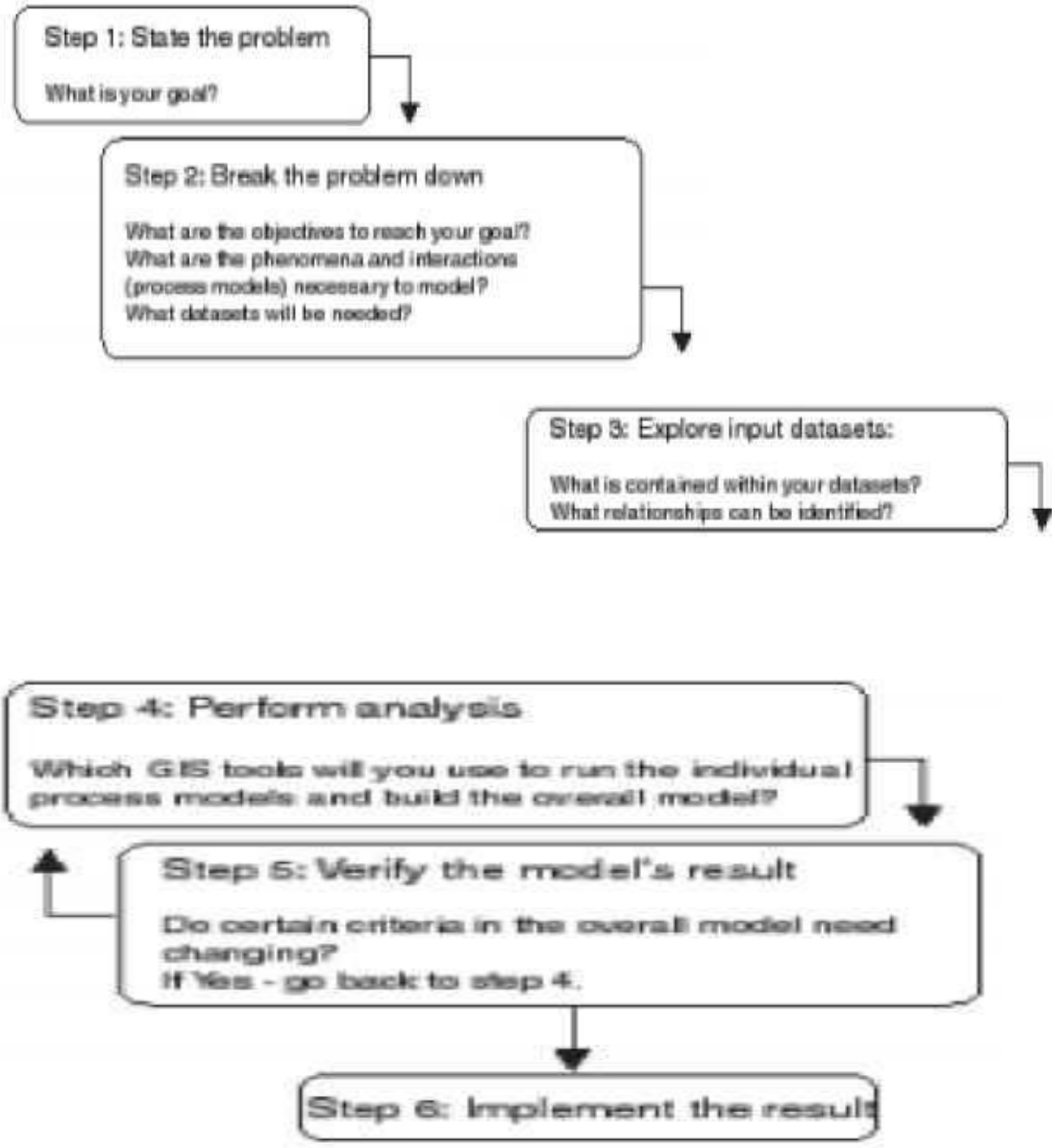


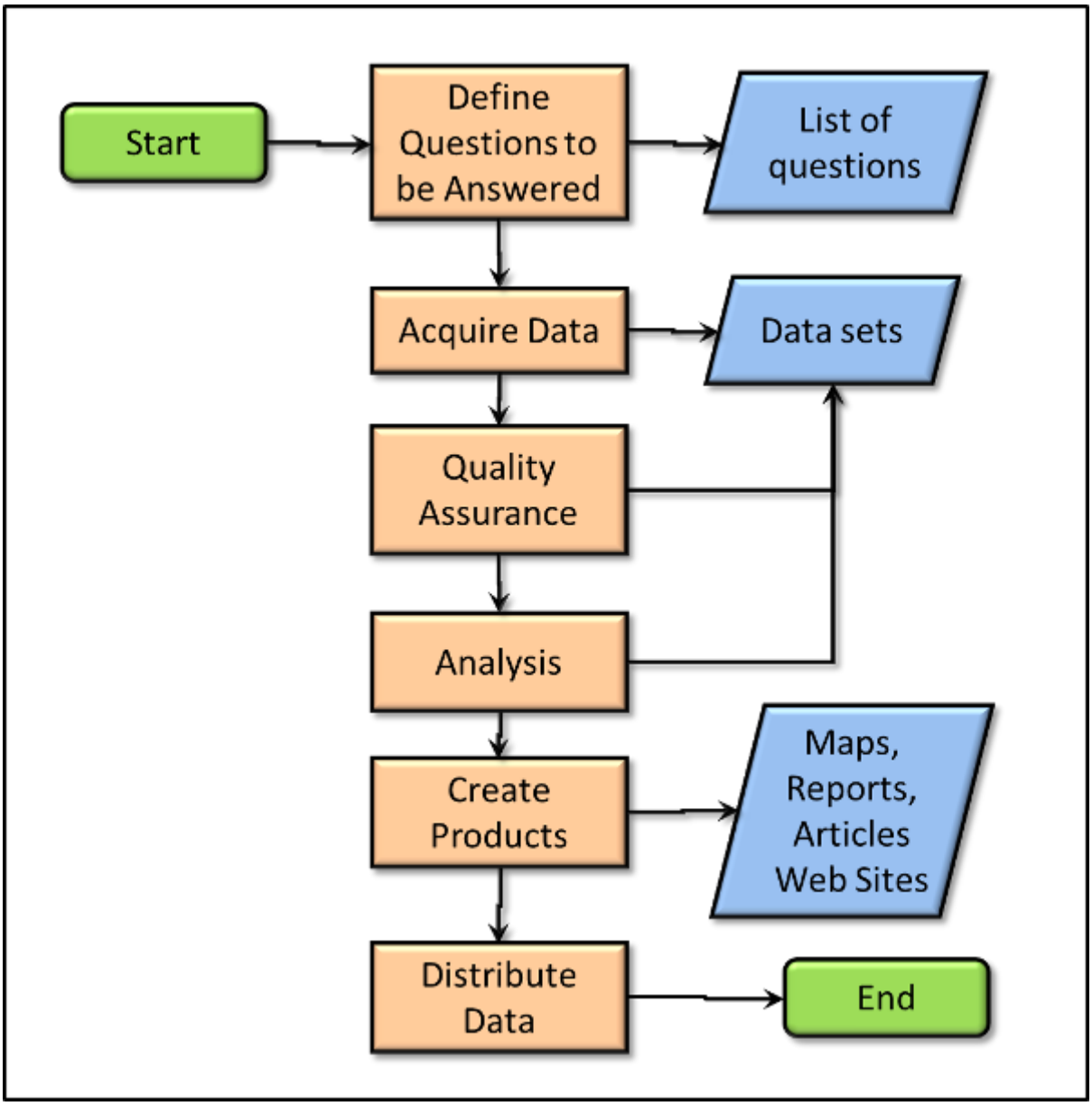
Basic physical components of a GIS: the hardware.

5. Procedures/ Methods

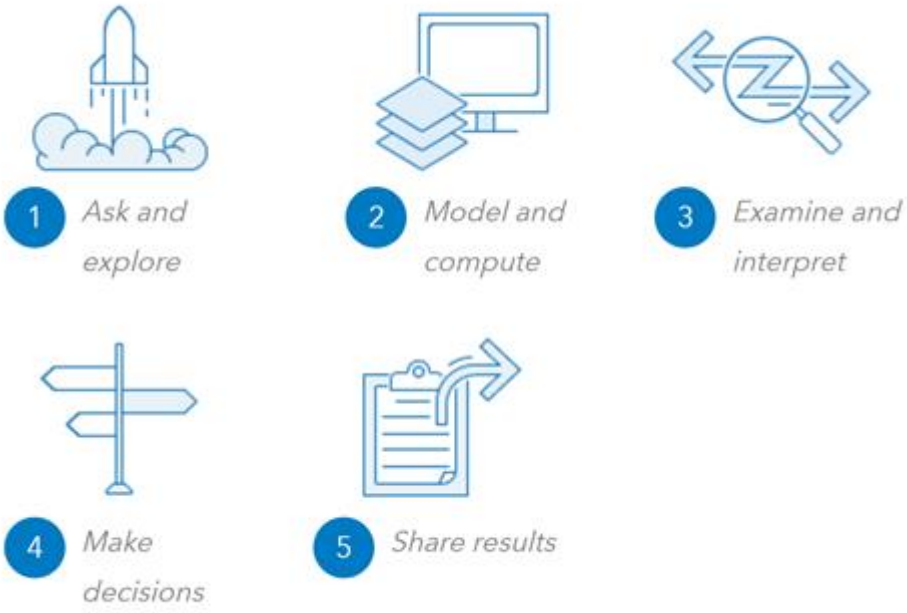
The procedures used are simple the steps taken in a well defined and consistent method to produce correct and reproducible results from the GIS system. The procedures used to input, analyze, and query data determine the quality and validity of the final product.

5.1 Spatial problem solving approach


Step 1: State the problem
What is your goal?
Step 2: Break the problem down
What are the objectives to reach your goal?
What are the phenomena and interactions (process models) necessary to model?
What datasets will be needed?
Step 3: Explore input datasets:
What is contained within your datasets?
What relationships can be identified?
Step 4: Perform analysis
Which GIS tools will you use to run the individual process models and build the overall model?
Step 5: Verify the model's result
Do certain criteria in the overall model need changing?
If Yes - go back to step 4.
Step 6: Implement the result



Many problems in the world today can be solved using the spatial problem solving approach.



1. Ask and explore

- Set the goals for your analysis. Begin with a well-framed question based on your understanding of the problem. Getting the question right is key to deriving meaningful results. Questions that can be answered using spatial analysis include:
    - How many are in an area?
    - Which sites meet my criteria?
    - What are the characteristics of an area?
    - How is it distributed?
    - What is near what?
    - What is on top of what?
    - How is it related?
- Explore and visualize your data to refine and scope the question that you want to address. Exploring your data will shed light on aspects of the question that you may not have considered, prompting you to further refine your question.

2. Model and compute

- Choose an analysis tool to transform your data into new results or build a model of multiple tools to feed the results of one tool into the next.
- Process the data analytically to derive essential information that helps you answer your question.

3. Examine and interpret

- Manipulate and display the results of your analysis as information products, such as maps, reports, charts, graphs, and information pop-ups.
- Seek explanations for the patterns you see and speculate about what they might mean from a spatial or temporal perspective.
- Assess whether the results of the analysis provide an adequate answer to the question you asked. If not, you may need to adjust your approach. Is your question too broad or too narrow? Do you require more or different data? Should you use more or different analysis tools?
- Determine whether assumptions about the data, analysis methods, and mapping methods would alter the results. Also consider what artifacts of the data, analysis, and mapping processes deserve special attention.

4. Make decisions

- Document your interpretation of the analysis results and decide how to respond.
- In some cases, you can take action based on your interpretation of the results. Implement a solution, correct a situation, create an opportunity, or mitigate circumstances.
- In other cases, no action is required because your goal was to build knowledge and gain a deeper understanding.
- Often new questions arise that need to be addressed. These new questions will often lead to further analysis.

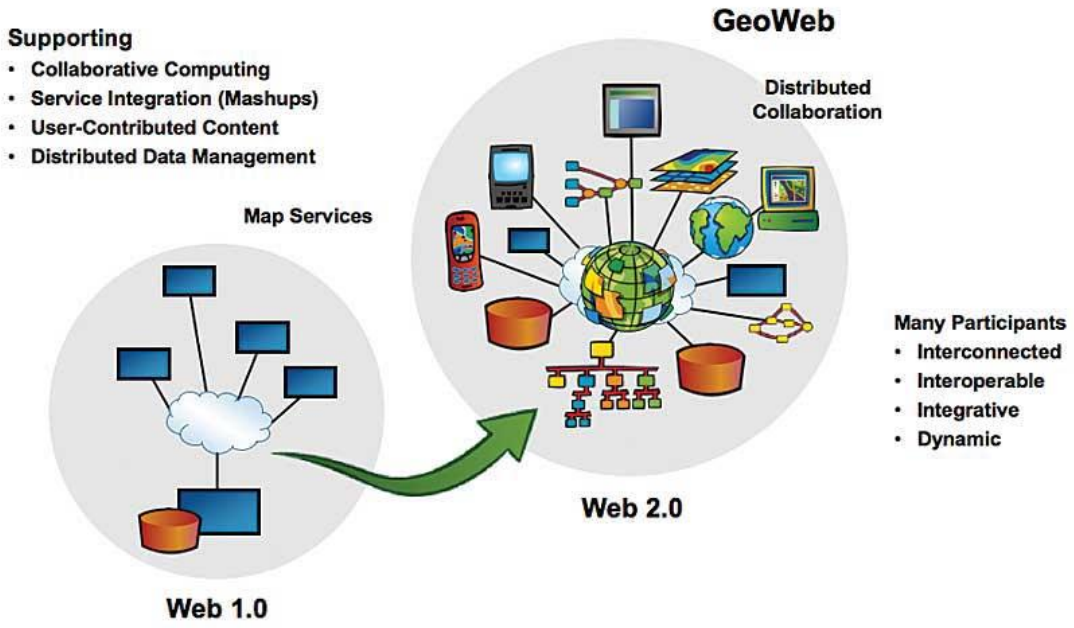
5. Share your results

- Identify the audience that will benefit from your findings and determine who you want to influence. Then use maps, pop-ups, graphs, and charts that communicate your results efficiently and effectively.
- Share those results with others through web maps and apps that are geoenriched to provide deeper explanation and support further inquiry.

This description of the spatial problem solving approach is a simplification, in large part because problem solving isn't linear.

The Web Provides a New Pattern for Implementing GIS

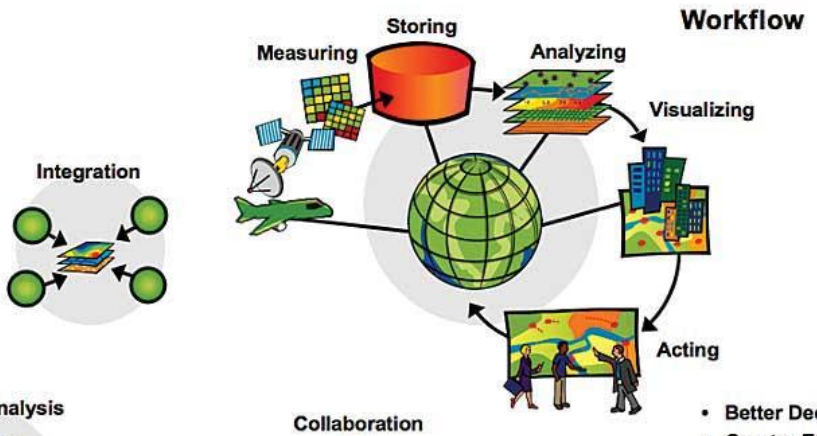
Becoming a New Platform



An Agile Framework for Collaboration and Integration of Systems

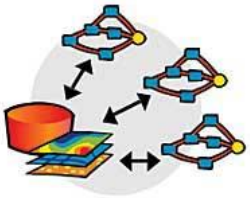
GIS Applies the Geographic Approach

Providing Tools, Methods, and Workflows That Support Collaboration and Action



Spatial Analysis

Collaboration

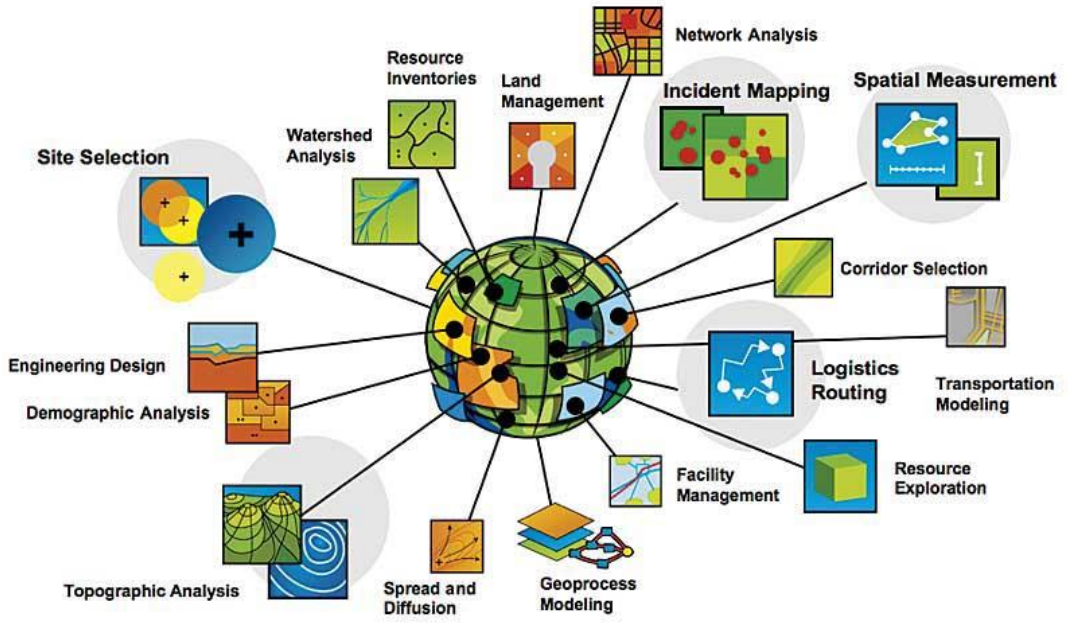


- Better Decisions
- Greater Efficiency (Money/Time/Resources)
- More Effective Communication

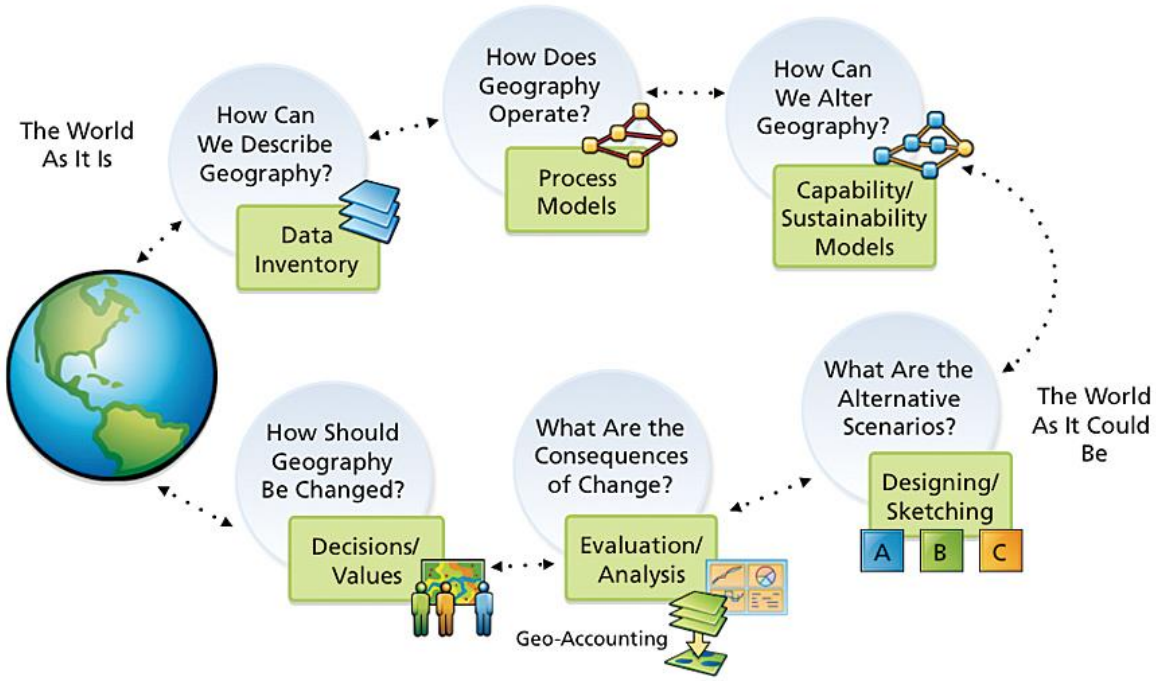
Improving the Way We Do Things

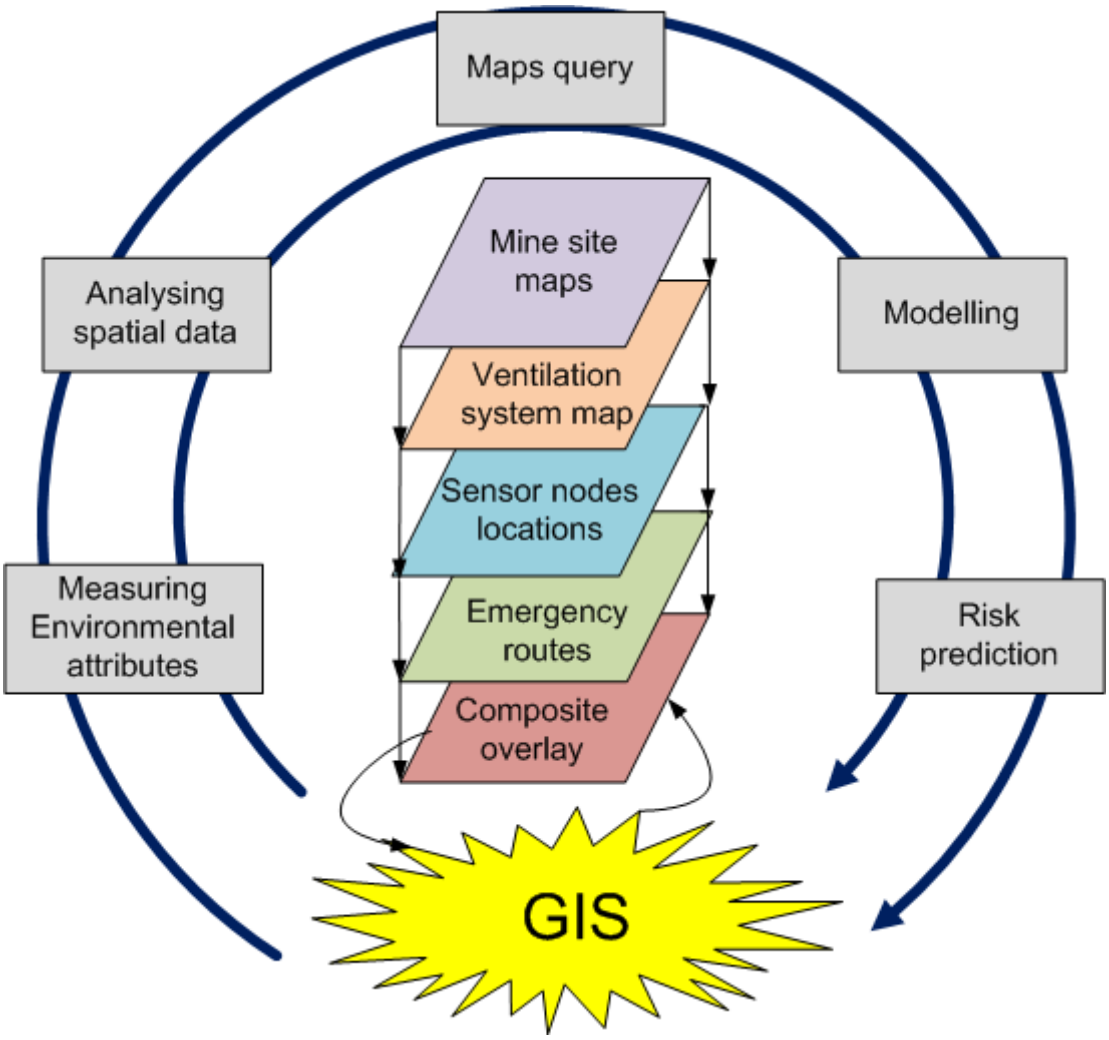
GIS Is Being Applied Around the World

Across Many Disciplines, Professions, and Organizations



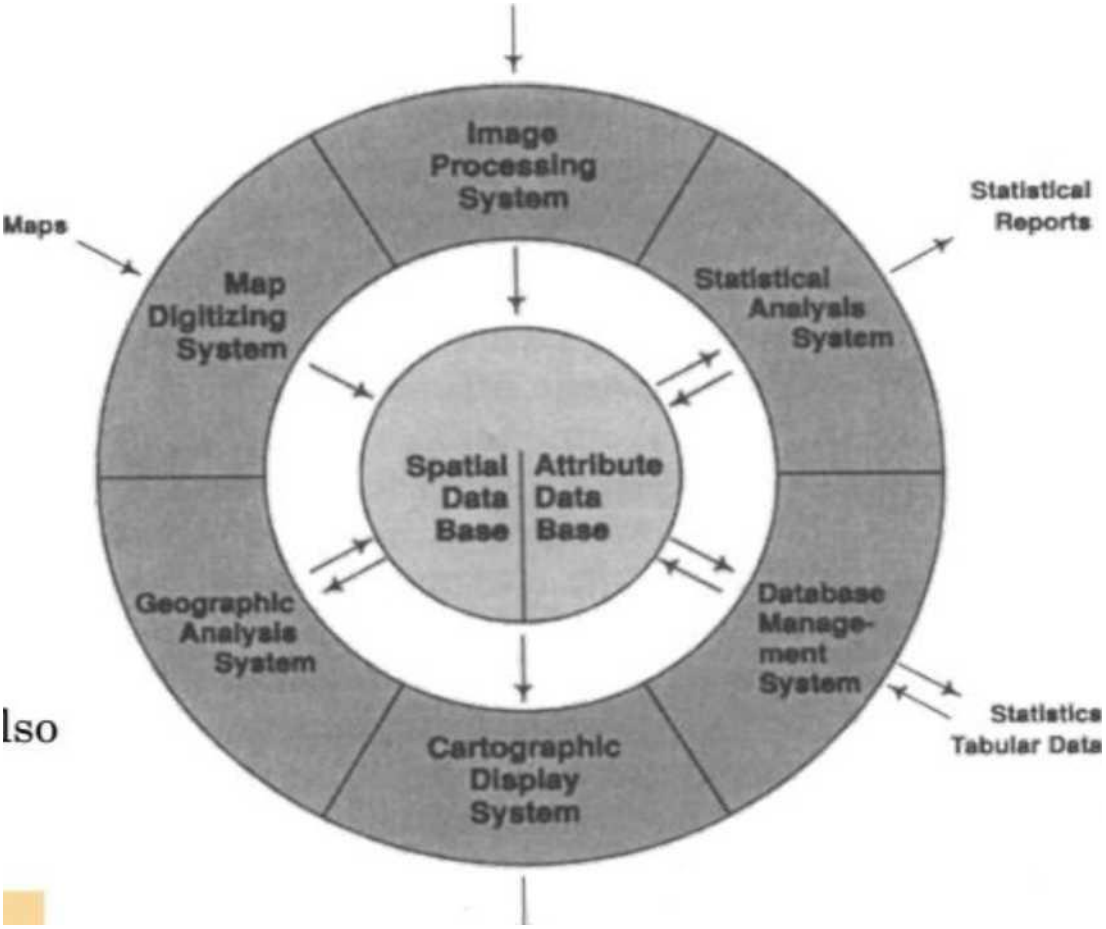
Becoming an Instrument of Evolution


The World As It Is
How Can We Describe Geography?
Data Inventory
How Does Geography Operate?
Process Models
How Can We Alter Geography?
Capability/ Sustainability Models
What Are the Alternative Scenarios?
Designing/ Sketching
A
B
C
The World As It Could Be
What Are the Consequences of Change?
Evaluation/ Analysis
Geo-Accounting
How Should Geography Be Changed?
Decisions/ Values



II-COMPONENTS AND FUNCTIONS OF GIS

a)Components



b) FUNCTIONS OF GIS

Data collection

- Capture data

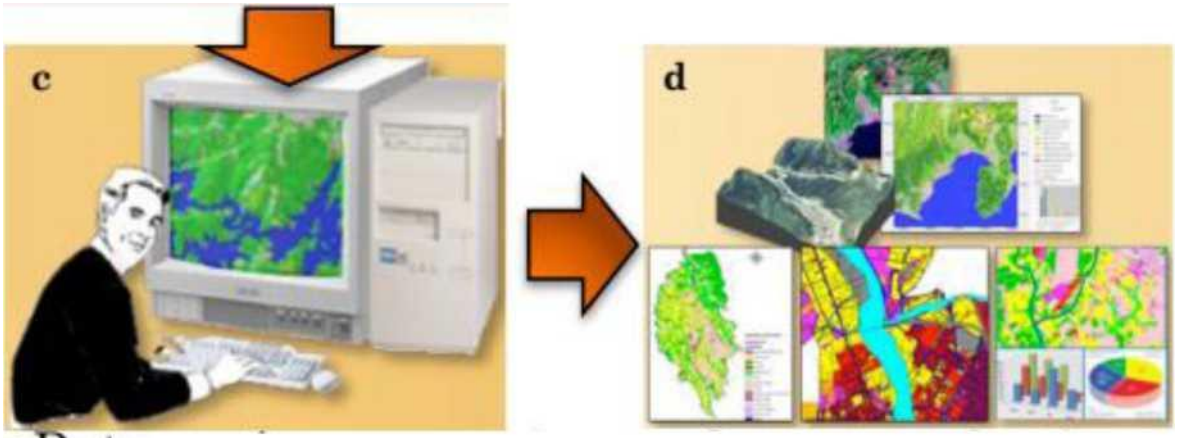
Data storing, processing & analysis

- Store data
- Query data
- Analyze data

Output production

Display data

Produce output



Data collection using GPS & RS

- paper maps are also sources of data storing, processing • Output production & analysis
- statistical report, maps