

INTRODUCTION

The idea of using map layers is an old one. Layered information from traditional maps had been used for practical purposes for a long time. But computers made the application of this concept much more practical.

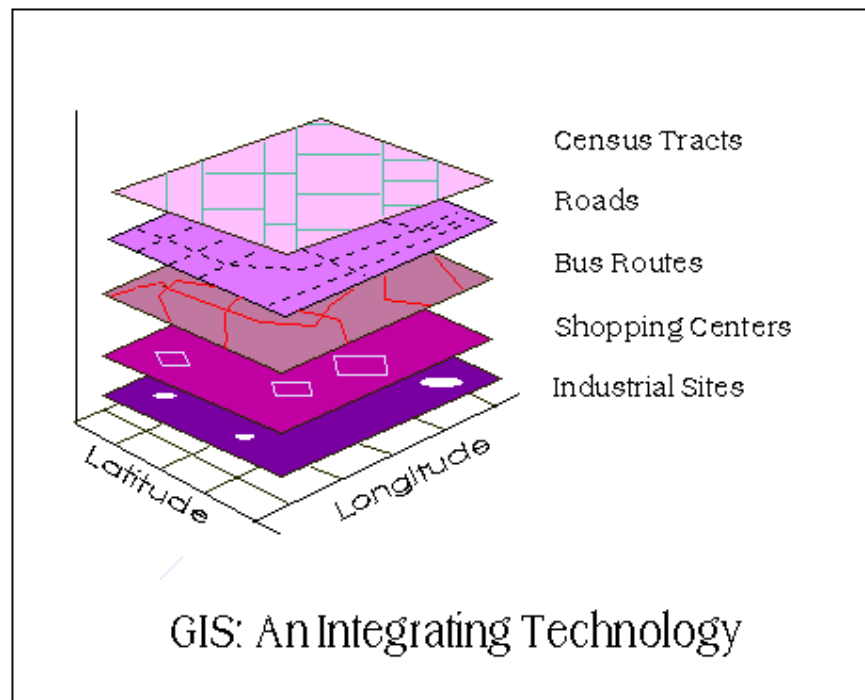
GIS was a welcome change from the era of hand cartography when maps had to be painstakingly created by hand, even small changes required the creation of a new map. The earliest version of a GIS was known as computer cartography and involved simple line work to represent land features on the top of each other to determine patterns and causes of spatial phenomenon.

The capabilities of GIS are a far cry from the simple beginnings of computer cartography. at the simplest level, GIS can be thought of as a high-tech equivalent of a map. However, not only can paper maps be produced far quicker and more efficiently, the storage of data in an easily accessible digital format enables complex analysis and modeling not previously possible. The reach of GIS expands into all disciplines and has been used for such widely ranged problems such as prioritizing sensitive species habitat to determining optimal real estate locations for new businesses.

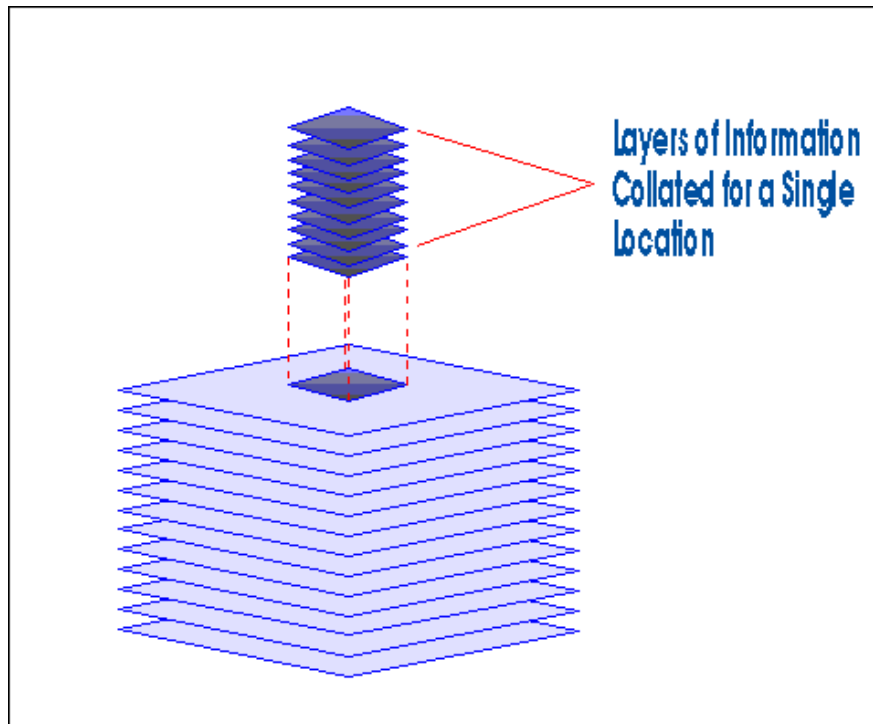
The keyword to this technology is geography, this usually means that the data is spatial, in other words, data that is in some way referenced to locations on the earth. Coupled with this is usually data known as attribute data. Attribute data generally defined as additional information, which can be tied to spatial data. An example of this would be schools. The location of the schools is the spatial data. Additional data such as the school's name, level of education taught, school capacity would make up the

attribute data. It is the partnership of these two data that enables GIS to be such an effective problem solving tool.

GIS operates on many levels. On the most basic level , GIS is used as computer cartography , i.e. mapping. The real power in GIS is through using spatial and statistical methods to analyze attribute and geographic information. The end result of the analysis can be derivative information , interpolated information.



GIS uses layers ,called “themes” to overlay different types of information . Each theme represents a category of information,such as roads or bus routes . The layers which are underneath remain visible while additional themes are placed above .



The Canadian government created and used the first computerized GIS in the 1960's . Other governments and university laboratories soon built similar systems. However ,GIS systems were not widely used until the late 1970's,when technological improvements and lower costs made computers widely available . GIS sales boomed during the 1980's, as governments and businesses found more uses for the systems. A number of companies began producing new GIS software to program computer systems to increase their functions . Currently more than 100,000 GIS systems are in operation. The global market for GIS has been estimated at over \$7 billion.

DEFINITION OF GEOGRAPHIC INFORMATION SYSTEMS

The organized activity by which people

- Measure aspects of geographic phenomena and processes.
- Represent these measurements ,usually in the form of computer database , to emphasize spatial themes,entities and relationships.
- Operate upon these representations to produce more measurements and to discover new relationships by integrating disparate sources.
- Transform these representations to conform to other frameworks of entities and relationships.

FACTORS AIDING THE RISE OF GIS

- Revolution in information technology .
- Communication technology
- Rapidly declining cost of computer hardware, and at the same time ,exponential growth of operational speed of computers.
- Enhanced functionality of software and their user-friendliness.
- Visualizing impact of GIS .
- Geographical feature and data describing it are part of our everyday decisions are influenced by some facet of geography.

COMPONENTS OF GIS

- 1. HARDWARE**
- 2. SOFTWARE**
- 3. DATA**
- 4. PEOPLE**
- 5. TRAINING**

The next step in understanding GIS is to look at each component of GIS and how they work together. These components are:

HARDWARE:

Hardware comprises the equipment needed to support the many activities of GIS ranging from data collection to data analysis. The central piece of equipment is the workstation, which runs the GIS software and is the attachment point for ancillary equipment. Data collection efforts can also require the use of a digitizer for conversion of hard copy data to digital data and a GPS data logger to collect data in the field. The use of handheld field technology is also becoming an important data collection tool in GIS. With the advent of web-enabled GIS, web servers have also become an important piece of equipment for GIS.

SOFTWARE:

Different software packages are important for GIS. Central to this is the GIS application package. Such software is essential for creating, editing and analyzing spatial and attribute data, therefore these packages contain a myriad of GIS functions inherent to them. Extensions or add-ons are software that extends the capabilities of the GIS software package. For example, Xtools is an ArcView extension that adds more editing capabilities to ArcView 3.x. Component GIS software is the opposite of application software. Component GIS seeks to build software applications that meet a specific purpose and thus are limited in their spatial analysis capabilities. Utilities are stand-alone programs that perform a specific function. For example, a file format utility that converts from one type of GIS file to another. There is also web-GIS software that helps serve data through Internet browsers.

DATA:

Data is the core of any GIS. There are two primary types of data that are used in GIS. A geodatabase is a database that is in some way referenced to locations on the earth. Geodatabases are grouped into two different types: vector and raster. Coupled with this data is usually data known as attribute data. Attribute data generally defined as additional information, which can then be tied to spatial data. Documentation of GIS datasets is known as metadata.

People

Well-trained people knowledgeable in spatial analysis and skilled in using GIS software are essential to the GIS process. There are three factors to the people component: education, career path, and networking. The right education is key; taking the right combination of classes. Selecting the right type of GIS job is important. A person highly skilled in GIS analysis should not seek a job as a GIS developer if they haven't taken the

necessary programming classes. Finally, continuous networking with other GIS professionals is essential for the exchange of ideas as well as a support community.

TRAINING:

People working with GIS software must be well trained how to use them.

WORKING OF GIS

1.RELATING INFORMATION FROM DIFFERENT SOURCES:

A GIS, which can use information from many different sources, in many different forms can help with such analyses. The primary requirement for the source data is that the locations for the variables are known. Location may be annotated by x,y, and z coordinates of longitude, latitude, and elevation, or by such systems as ZIP codes or highway mile markers. Any variable that can be located spatially can be fed into a GIS. Several computer data bases that can be directly entered into a GIS are being produced by Federal agencies and private firms. Different kinds of data in map form can be entered into a GIS. A GIS can also convert existing digital information, which may not yet be in map form, into forms it can recognize and use. For example, digital satellite images can be analyzed to produce a map like layer of digital information about vegetative covers. Likewise, census or hydrologic tabular data can be converted to map-like form, serving as layers of thematic information in a GIS.

2. DATA CAPTURE

If the data to be used are not already in digital form, that is, in a form the computer can recognize, various techniques can capture the information. Maps can be digitized, or hand-traced with a computer mouse, to collect the coordinates of features. Electronic scanning devices will also convert map lines and points to digits.

A GIS can be used to emphasize the spatial relationships among the objects being mapped. While a computer-aided mapping system may represent a road simply as a line, a GIS may also recognize that road as the border between wetland and urban development, or as the link between Main Street and Blueberry Lane.

Data capture - putting the information into the system - is the time-consuming component of GIS work. Identities of the objects on the map must be specified, as well as their spatial relationships. Editing of information that is automatically captured can also be difficult. Electronic scanners record blemishes on a map just as faithfully as they record the map features. For example, a fleck of dirt might connect two lines that should not be connected. Extraneous data must be edited, or removed from the digital data file.

3.DATA INTEGRATION:

A GIS makes it possible to link, or integrate, information that is difficult to associate through any other means. Thus, a GIS can use combinations of mapped variables to build and analyze new variables.

Using GIS technology and water company billing information, it is possible to simulate the discharge of materials in the septic systems in a neighborhood upstream from a wetland. The bills show how much water is used at each address. The amount of

water a customer uses will roughly predict the amount of material that will be discharged into the septic systems, so that areas of heavy septic discharge can be located using a GIS.

4.PROJECTION AND REGISTRATION:

A property ownership map might be at a different scale from a soils map. Map information in a GIS must be manipulated so that it registers, or fits, with information gathered from other maps. Before the digital data can be analyzed, they may have to undergo other manipulations - projection conversions, for example - that integrate them into a GIS.

Projection is a fundamental component of mapmaking. A projection is a mathematical means of transferring information from the Earth's three-dimensional curved surface to a two-dimensional medium - paper or a computer screen.

Different projections are used for different types of maps because each projection is particularly appropriate to certain uses. For example, a projection that accurately represents the shapes of the continents will distort their relative sizes.

Since much of the information in a GIS comes from existing maps, a GIS uses the processing power of the computer to transform digital information, gathered from sources with different projections to a common projection.

5.DATA STRUCTURES:

GIS must be able to convert data from one structure to another.

Image data from a satellite that has been interpreted by a computer to produce a land use map can be “read into” the GIS in raster format.

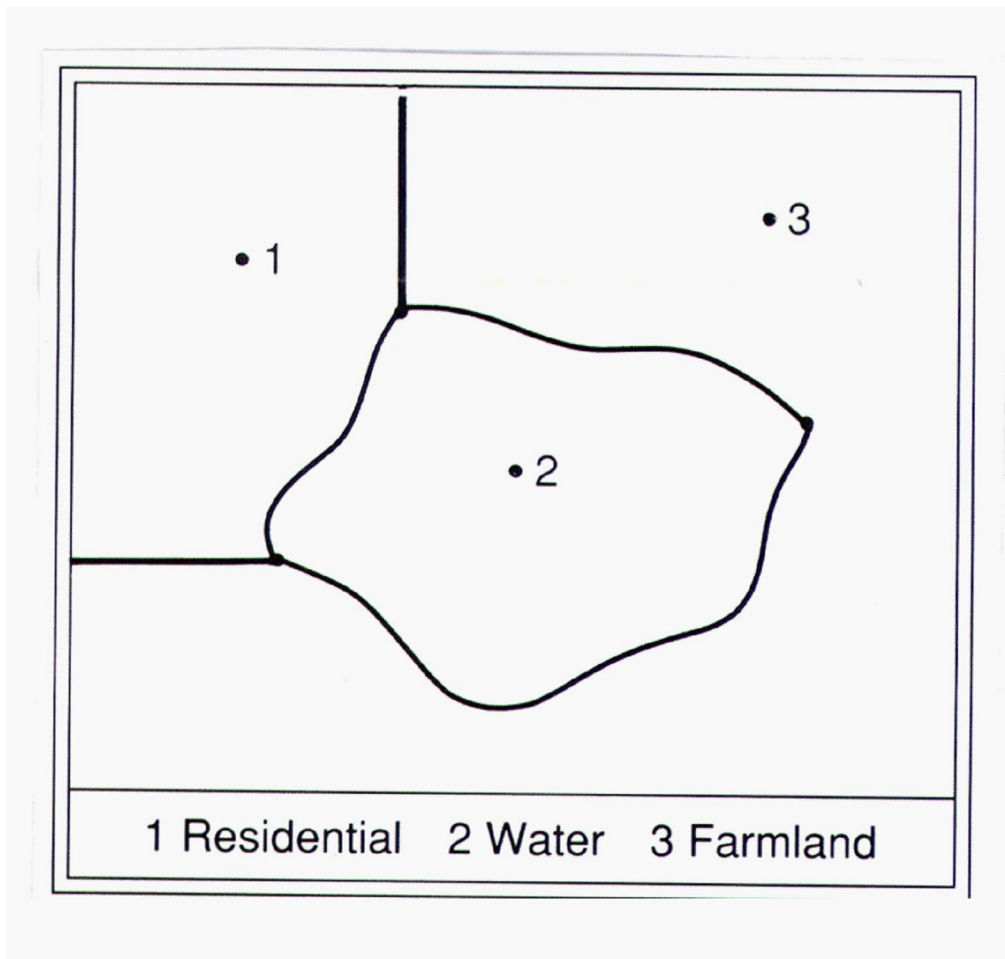
Raster data files consist of rows of uniform cells coded according to data values. An example would be land cover classification.

1	1	1	3	3	3	3	3	3
1	1	1	3	3	3	3	3	3
1	1	2	2	2	2	3	3	3
1	1	2	2	2	2	2	3	3
1	2	2	2	2	2	3	3	3
3	3	3	2	2	2	3	3	3
3	3	3	3	2	3	3	3	3
3	3	3	3	3	3	3	3	3
1 Residential 2 Water 3 Farmland								

Raster data files can be manipulated quickly by the computer, but they are often less detailed and may be less visually appealing than vector data files, which can approximate the appearance of more traditional hand-drafted maps. Vector digital data have been captured as points, lines (a series of point coordinates), or areas (shapes bounded by lines).

An example of data typically held in a vector file would be the property boundaries for a housing subdivision.

Data restructuring can be performed by a GIS to convert data into different formats. For example, a GIS may be used to convert a satellite image map to a vector structure by generating lines around all cells with the same classification, while determining the cell spatial relationships, such as adjacency or inclusion.



Thus a GIS can be used to analyze land use information in conjunction with property ownership information.

6.DATA MODELING:

It is difficult to relate wetlands maps to rainfall amounts recorded at different points such as airports, television stations, and high schools. A GIS, however, can be used to depict two- and three-dimensional characteristics of the Earth's surface, subsurface, and atmosphere from information points. For example, a GIS can quickly generate a map with lines that indicate rainfall amounts. Such a map can be thought of as a rainfall contour map.

Many sophisticated methods can estimate the characteristics of surfaces from a limited number of point measurements. A two-dimensional contour map created from the surface modeling of rainfall point measurements may be overlain and analyzed with any other map in a GIS covering the same area.

ADVANTAGES OF GIS

- 1. POWER OF MAPS.**
- 2. MAKING BETTER DECISIONS.**
- 3. PLANNING OF PROJECTS.**
- 4. IMPROVING ORGANIZATIONAL INTEGRATION.**

POWER OF MAPS:

For simplicity's sake we often call GIS "mapping software." We most often associate maps with physical geography, but the map to the right demonstrates that GIS is flexible enough to map any kind of terrain, even the human body. GIS can map any data you wish. Making maps with GIS is much more flexible than traditional manual or automated cartography approaches. A GIS creates maps from data pulled from databases. Existing paper maps can be digitized and translated into the GIS as well.

The GIS-based cartographic database can be both continuous and scale free. Map products can then be created centered on

any location, at any scale, and showing selected information symbolized effectively to highlight specific characteristics. A map can be created anytime to any scale for anyone, as long as you have the data. This is important because often we say “I see” to mean “I understand.” Pattern recognition is something human beings excel at. There is a vast difference between seeing data in a table of rows and columns and seeing it presented in the form of a map. The difference is not simply aesthetic, it is conceptual—it turns out that the way you see your data has a profound effect on the connections you make and the conclusions you draw from it. GIS gives you the layout and drawing tools that help present facts with clear, compelling documents.

MAKE BETTER DECISIONS:

The old adage “better information leads to better decisions” is true for GIS. A GIS is not just an automated decision making system but a tool to query, analyze, and map data in support of the decision making process. For example, GIS can be used to help reach a decision about the location of a new housing development that has minimal environmental impact, is located in a low-risk area, and is close to a population center. The information can be presented succinctly and clearly in the form of a map and accompanying report, allowing decision makers to focus on the real issues rather than trying to understand the data. Because GIS products can be produced quickly, multiple scenarios can be evaluated efficiently and effectively.

PLANNING OF PROJECTS:

Advantage of GIS is often found in detailed planning of project having a large spatial component, where analysis of the problem is a pre requisite at the start of the project.

Thematic maps generation is possible on one or more than one base maps, example: the generation of a land use map on the basis of a soil composition, vegetation and topography. The unique combination of certain feature facilitate the creation of such thematic maps. With the various modules within GIS it is possible to calculate surface,length,width and distance.

IMPROVING ORGANIZATIONAL INTEGRATION:

Many organizations that have implemented a GIS have found that one of its main benefits is improved management of their own organization and resources. Because GIS has the ability to link data sets together by geography, it facilitates interdepartmental information sharing and communication. By creating a shared database one department can benefit from the work of another—data can be collected once and many times.

As communication increases among individuals and departments, redundancy is reduced, productivity is enhanced, and overall organization efficiency is improved. Thus in a utility company the customer and infrastructure databases can be integrated so that when there is planned maintenance, affected people can be informed by computer-generated letters.

CONCLUSION

Many disciplines can benefit from GIS techniques. An active GIS market has resulted in lower costs and continual improvements in the hardware and software components of GIS. These developments will, in turn, result in a much wider application of the technology throughout government, business, and industry. Maps have traditionally been used to explore the Earth and to exploit its resources. GIS technology, as an expansion of cartographic science, has enhanced the efficiency and analytic power of traditional mapping. Now, as the scientific community recognizes the environmental consequences of human activity, GIS technology is becoming an essential tool in the effort to understand the process of global change. Various map and satellite information sources can be combined in modes that simulate the interactions of complex natural systems. Through a function known as visualization, a GIS can be used to produce images - not just maps, but drawings, animations, and other cartographic products. These images allow researchers to view their subjects in ways that literally never have been seen before. The images often are equally helpful in conveying the technical concepts of GIS study subjects to non-scientists.