

Cadcorp Introductory Paper I

An introduction to Geographic Information and Geographic Information Systems



Keywords: computer, data, digital, geographic information systems (GIS), geographic information (GI), mapping, software.

Geographic Information Systems or GIS are being used in a multitude of application areas. This brief paper outlines firstly what geographic information is, and secondly what GIS encompasses. It is not intended to be an extensive narrative on GIS although a reference section including a further reading and useful web sites is attached.

Geographic Information

Many organisations hold information that contains a spatial reference i.e. they contain information that associates the data to places or locations. These locations could include;

- an address: 25 High Street, Watton, Hertfordshire
- A building: Buckingham Palace
- a County or Local Authority area: Cheshire or South Beds
- a grid reference: 567000, 232670
- Latitude or Longitude: 51.562 , -3.792
- A place name: Berlin
- A country: Spain

All of the above refer to a location in the physical world and as such are deemed to be Geographical Information. One way of representing Geographical Information is to present it visually – on a map. The map therefore acts as a visual representation of objects in the real world. For example, on an Ordnance Survey map, different symbols are used to represent discrete objects. This is one form of Geographic Information. By making this information **digital** (stored in a computer) we can begin to query and process the information more efficiently. Imagine trying to measure the length of all the motorways in a country using a paper map. Within a GIS this can be a simple process.

We can develop the richness of our GI further, by bringing data from various sources together within GIS. We may have a map which shows roads but we could improve it by differentiating between the types of roads e.g. Motorways, A, B, Minor roads. This will help in journey planning or in illustrating how well served a new superstore site may be. Another example may be of county boundaries, whilst it is useful to show where the boundaries exist, it may be even more useful to plot how many people live inside the boundary or how many houses are available to let or what the employment rate is and so on (**Figure 1**).

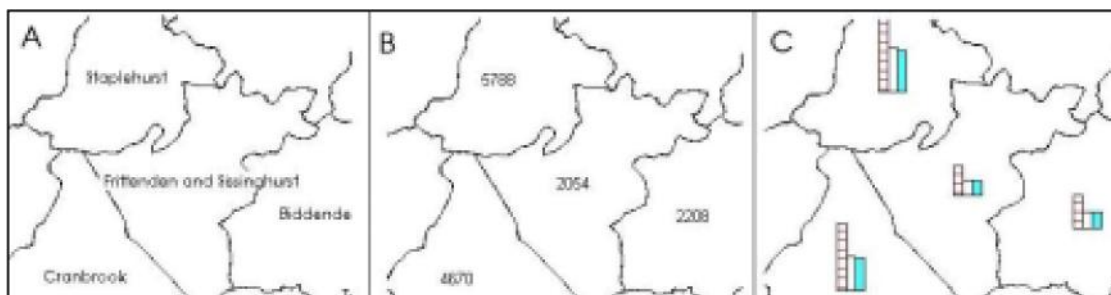


Figure 1a-c. a) Administrative boundaries, b) number of people within each one, c) bar graphs of total number of people, number of males and number of females within each area.

In the previous example the demographic information is linked to the physical world by the administrative boundaries. These are the geographic places to which our information relates. This information is an **attribute** of the location.

A location can have more than one attribute, for example, a building may have attributes such as the number of storeys or the number and type of people living in it, the landlord's details and so on. All of

this information is brought together because it refers to geographic locations. Because we can bring data together or **integrate** it, we can then begin to ask questions of the data using a **Geographic Information System** or **GIS** as it is more commonly known. **Figure 2.** shows three physical areas and example of the types of **attributes** which can be linked to them.

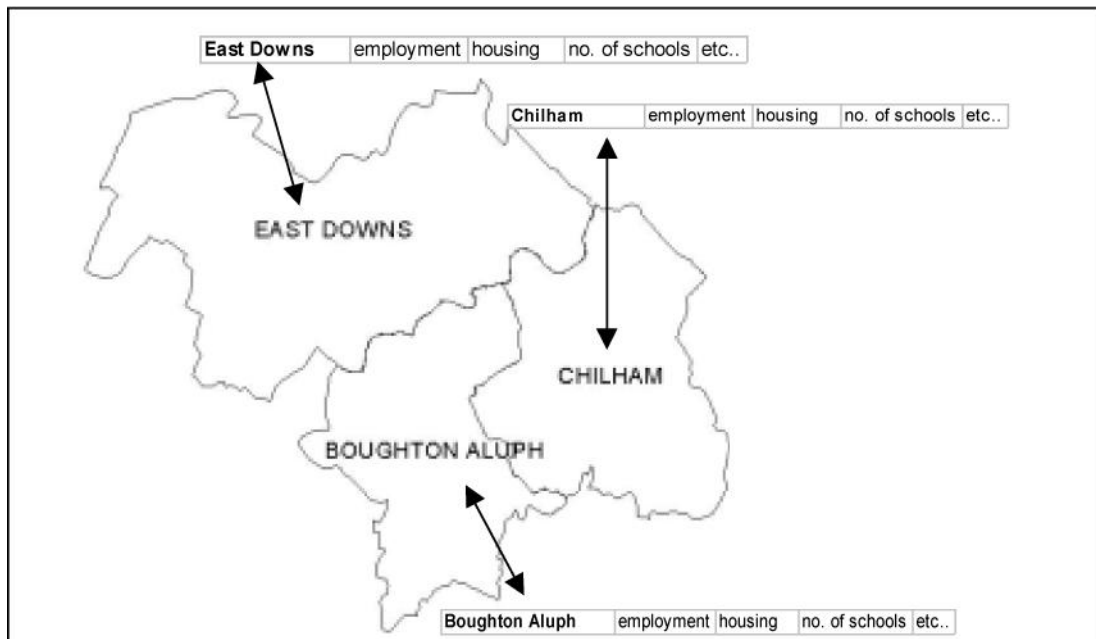


Figure 2. Information being linked to three discrete places.

Geographic Information within Geographic Information Systems (GIS)

To utilise the raft of spatial information that is available, a GIS can be employed. **A GIS is a suite of computer technologies which, to varying degrees, allows an end user the opportunity to capture, edit, manipulate, display, analyse and export information.** There are a multitude of different systems and different system users in existence. Today's GIS grew out of the development of computer technology in the USA in the 1960's. Today the global GIS market is a multi-billion dollar concern. Users of GIS (and GI) include Local and Central Government, business, planners, retailers, marketing agencies, telecommunication companies, mapping agencies, conservation groups and many more.

GIS themselves range in functionality and complexity. Simple systems may have three or four functions which may be as simple as displaying topographic (base mapping) data and allowing the user to print out a map, whilst more sophisticated or 'high end' GIS, will allow extremely complex calculations and processes to be performed. Such processes may include locating the optimal site for a new building or analysis of satellite imagery.

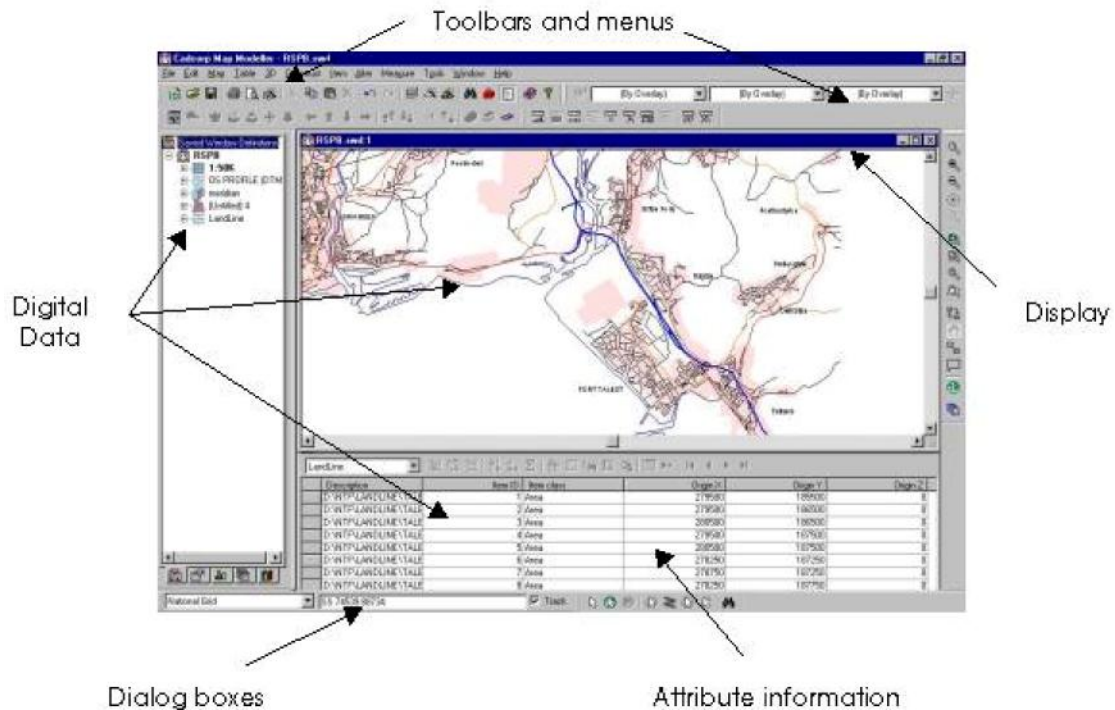


Figure 3. Cadcorp SIS – a ‘high end’ GIS being used to analyse data relating to South Wales.

As mentioned above, a GIS presents us with the opportunity to manipulate and analyse geographic information. There are many ways of getting data into a system, perhaps by purchasing ‘off the shelf’ data or through the user creating or obtaining their own datasets. There are many vendors of digital spatial information and there are also many agencies that concentrate solely on converting paper or textual records into a digital format. The format the data needs to be in for use in the GIS often depends upon the system in question. In broad terms though GIS data is stored in one of two formats, **Vector** or **Raster**.

Vector data is a means of storing real world objects as points, lines and polygons. For example, a road network may be represented as lines, housing plots may be represented as areas and accident locations may be represented as points. There are no hard and fast rules about how a real world object can be represented, though users should give some consideration to which is the most appropriate representation. In all cases attribute (qualitative or quantitative) information can be linked to these points, lines and polygons.

For example, points, lines and polygons may be used to represent an urban area in the UK. Points representing the locations of local shops in the area, lines representing the road network and areas are the various types of land use e.g. urban areas or farmland or greenbelt.

Raster data is different to vector data in that information is stored in a regular grid or raster. The grid will consist of regular shapes (normally squares) and each cell in the grid will have a value depending on what is represented. Each cell in the raster will be the same size. Raster data can include aerial photography, satellite images, base mapping or user defined data.

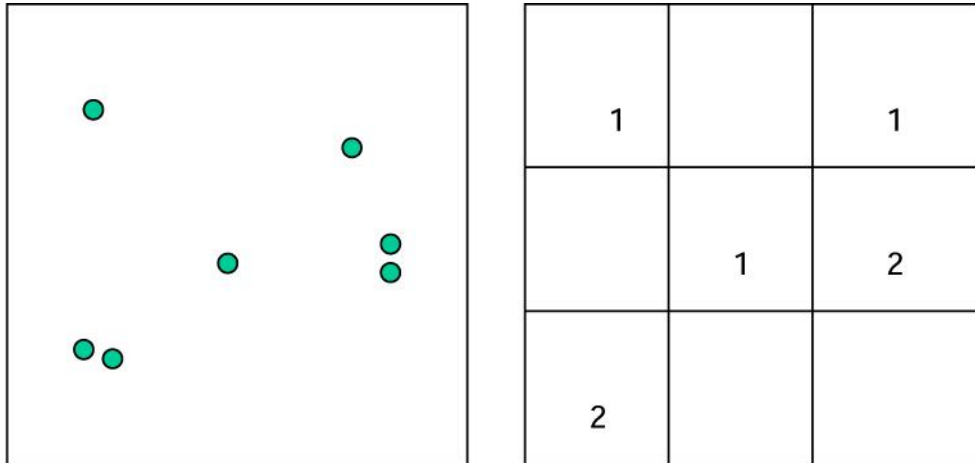


Figure 4. A vector representation of an area compared to a raster representation of the same area. Note how the point data is converted into blocks.

Raster and vector data have their strengths and weaknesses. Vector data usually requires less storage space but raster data is sometime easier to capture (by scanning). The types of analytical operations that can be applied on data are also affected if the data is raster or vector. Indeed, some systems may only handle either vector or raster data.

Data Layers

Within a GIS, regardless of whether it is a raster or vector system, data is usually segregated into **layers**. These layers may be 'roads', 'countries', 'county boundaries' and so on. Obviously they will be represented slightly differently in raster or vector formats. In general terms though, a GIS realises its potential by 'overlying' each of these layers. This allows the user to concentrate on objects of interest or relevance to their analysis or study.

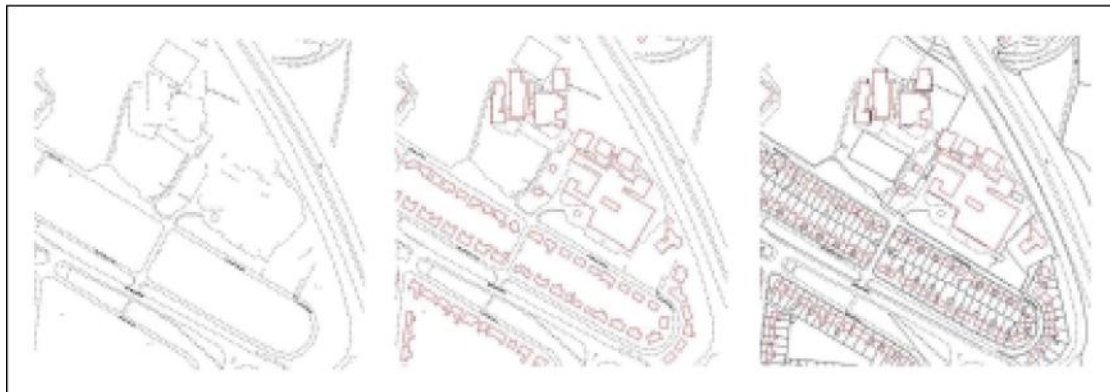


Figure 5. Three data layers. Roads, buildings and property lines (Ordnance Survey Landline data).

By breaking data down into these layers we can use GIS to analyse the inter-relation of objects. In many GIS it is a routine task to identify 'how many objects are within the area' or 'which is the nearest'. This kind of analysis is called a **spatial query**. The ability of a system to perform such tests allows users to perform a variety of tasks from analysing where a business' best customers are to finding the optimal place to site a telecom aerial, which has least visual impact on the environment.

There are a series of analytical functions which are resident within GIS. The major functions are discussed in **Cadcorp Introductory Paper II**. GIS and GI when coupled appropriately offer huge savings in cost and time in many business and analytical functions. For more in depth coverage please feel free to delve into the following texts and web resources.

Further Reading

Introductory Texts

- *Exploring Geographic Information Systems*
Nicholas Chrisman
Paperback - 314 pages (March 1996)
John Wiley and Sons (WIE); ISBN: 0471108421
- *Principles of Geographical Information Systems*
Peter A. Burrough, Rachael A. McDonnell
Paperback - 346 pages (February 1998)
Clarendon Press; ISBN: 0198233655

Reference

- *Geographical Information Systems*
Paul A. Longley (Editor), Michael Goodchild (Editor), David Maguire (Editor),
David W. Rhind (Editor)
Hardcover - 1296 pages (12 February, 1999)
John Wiley and Sons; ISBN: 0471321826
- *Fundamentals of Spatial Information Systems*
Robert Laurini (Editor), Derek Thompson (Editor)
Hardcover - 484 pages (October 1991)
Academic Press Inc; ISBN: 0124383807

Technical Introduction

- *GIS: a computing perspective*
M.F. Worboys
Paperback - 300 pages (October 1995)
Taylor & Francis; ISBN: 0748400656

Web Resources

- **Association for Geographic Information**
The Association for Geographic Information (AGI) is the national centre for geographic information. It represents the broad interests of the geographic information community in the United Kingdom. Includes a GIS dictionary.
<http://www.agi.org.uk>
- **Ordnance Survey**
UK National Mapping Agency. Includes information on GIS useable data for the UK.
<http://www.ordsvy.gov.uk>
- **United States Geological Survey**
US Government agency, some useful guides to GIS use.
<http://www.usgs.gov/>
<http://info.er.usgs.gov/research/gis/title.html>
- **Cadcorp**
Cadcorp is a leading developer of Geographic Information Systems (GIS). Based in Stevenage and London, the Cadcorp distribution and VAR network stretches worldwide.
<http://www.Cadcorp.com>