

## CHAPTER 13

# Information Systems

### 13.1 INFORMATION SYSTEMS

Significant amounts of data that are collected through digital aerial mapping, remote sensing, and image analysis are stored in databases for information systems. There are several types of information systems, including Geographic Information Systems (GIS), Land Information Systems (LIS), and Automated Mapping/Facilities Management (AM/FM). Not all information systems serve exactly the same purpose, but most have similar functions.

This chapter will touch briefly upon GIS. According to ASPRS, a GIS “is an information system able to encode, store, transform, analyze, and display spatial data.”

The concept of GIS is over 100 years old. Originally, information layers were represented by individual transparent or translucent maps that were overlain one atop another to form a physical composite of data layers. Early linear structured computers, along with rudimentary peripheral input and output devices, were unsupportive of the demands of GIS functions. Beginning in the late 1960s, computer-based GIS became a working reality. Current working environments for a GIS would be CADD/CAM/CAD or softcopy.

#### 13.1.1 Value of Geographic Information Systems

The primary advantage of a GIS is the capability of the system to reach into the database and select particular portions of information necessary to formulate alternative solutions to given scenarios.

#### 13.1.2 Demands of a Geographic Information System

A GIS is a very demanding information collection and manipulation environment incorporating a number of characteristics:

- The user must be permitted to constantly interact, issuing instructions and receiving responses, with the computer system.
- Output from GIS systems must be graphic. Such output devices would include high-resolution color graphic screens and data plotters.

- Geographic information sets are large and complex, requiring huge amounts of digital storage to be readily available.
- Hardware engines must be capable of processing large volumes of layered information quickly and providing timely solutions to queries.
- Computer hardware configurations and software packages are necessarily complex to accommodate the multidimensional (XY, XYZ, attribute) nature of geographic data. Therefore, the database management systems (DBMS) must be comprehensive and sophisticated.
- Benefits derived from the application of GIS must exceed the cost of these environments. Fortunately, the cost of increasingly more powerful hardware and efficient software continues to lessen. Hence, these facilities are available to a varied market.
- Information from a multitude of diverse sources can be integrated into a database. Information systems must be capable of comparing blocks of dissimilar data and presenting the viewer with a composite scenario based on given situation parameters. This allows the manager to manipulate variable parameters to compare multiple solutions with a limited expenditure of time and manual effort.

## 13.2 COMPUTER-AIDED MAPPING

Map compilation and analysis are accomplished today through the use of specialized computer software algorithms designed to perform engineering drafting and design (CADD) and GIS functions. CADD software is usually designed to be more robust in the compilation of feature detail, while GIS software usually provides more spatial analysis tools. It is rare today for a mapping project to only demand two-dimensional mapping data sets without real spatial ties. Therefore, current demands for spatial data compilations and analysis usually require that map compilation systems include both CADD and GIS capability used in tandem.

Software vendors such as Intergraph, AutoCAD, and ARC/INFO are major developers of map compilation and spatial analysis tools. Software packages supplied by these and other vendors provide a suite of software tools that are capable of map feature compilation and GIS analysis. Another critical tool in these packages is digital image viewing and scaling tools which allow the mapping scientist to compile feature detail, annotate features, geographically locate features, and store the information in databases for ease of analysis.

## 13.3 THEMES

A theme encompasses an area of similar characteristics. Collected data for various themes are placed in specific data layers for convenience in evaluating the database. Individual layers must be georeferenced to the ground using a common grid system, such as the state plane, UTM, or latitude/longitude. This assures that the data from various layers geographically matches when composited.

## **13.4 DATA COLLECTION FOR INFORMATION SYSTEMS**

A GIS database is integrated with information from diverse sources to propagate information system solutions and products. Data from these sources can be mixed and matched in analyses ventures. Data derived from remote sensors other than aerial cameras are incorporated into databases. As a consequence, photogrammetrists, especially those who operate softcopy systems, should have some knowledge of remote sensors, image analysis, and GIS to correctly apply these technologies.

Except for the most uncomplicated GIS studies, the expertise of several technicians proficient in various fields of discipline may be required to affect a reliable solution.

## **13.5 U.S. GEOLOGICAL SURVEY INFORMATION SOURCES**

The USGS is a source of information which GIS project managers may wish to look into.

### **13.5.1 Tutorial**

The USGS furnishes an illuminating tutorial describing the concept of a GIS at the web site <http://www.usgs.gov/research/gis/title.html>, explaining what a GIS is and how it works. Its step-by-step progression with easily understood text and complementary illustrations delves into the following:

- Relating information from different sources
- Data capture
- Data integration
- Projection and registration
- Data structure
- Data modeling
- Information retrieval
- Topological modeling
- Networks
- Overlays
- Data output
- Applications

### **13.5.2 Geospatial Information**

The USGS is also a source of obtainable geospatial information that a project manager may want to examine as a source of digital mapping products, which may be especially useful for GIS/LIS projects on large areas. Log on to the web site <http://mapping.usgs.gov/www/products/status.html> to learn, by state, the status of such geospatial data products as:

DEM (digital elevation models)  
DOQ (digital orthophoto quads)  
DLG (digital line graphs) with specific overlays  
DRG (digital raster graphs)  
NAPP (national aerial photographic program)

A list of USGS National Mapping Program geospatial data and products that are available can be found on the web site <http://mapping.usgs.gov/www/products/1product.html>.

The USGS web site [http://rmmcweb.cr.usgs.gov/elevation/dpi\\_dem.html](http://rmmcweb.cr.usgs.gov/elevation/dpi_dem.html) describes DEMs and how to order this data media which can be employed to create contours and orthophotos.

Technicians who are planning to interject USGS layered data into GIS projects may want to access the web site <http://rmmcweb.cr.usgs.gov/nmpstds/dlgstds.html> for information regarding the National Mapping Program Standards for 1:24,000 scale DLG data layers involving hydrography, transportation, boundaries, public land survey system, built-up areas, hypsography, vegetative surface cover, and named landforms.

A listing of available individual 1:100,000 scale DLGs that are available within the confines of various states can be located by logging on to <http://edcwww.cr.usgs.gov/glis/hyper/guide/100kdigfig/states.html>. To access a particular state, substitute the two-letter state code for ?? in the web address.

A DRG is a scanned image of a standard series topographic map referenced to a UTM grid. The web site <http://mcmcweb.er.usgs.gov/drg/> cites information about the availability of this raster data.

Information regarding multidisciplinary GIS projects specific to the sciences of biology, geology, mapping, and hydrology can be acquired through the auspices of the USGS. A search of the web site <http://ask.usgs.gov/sources.html> will lead to authorities throughout the United States, specialists located in field offices, facilities specializing in pertinent sciences, and partnerships with other organizations. This source furnishes lists for:

- Earth information centers
- State water resources representatives
- Libraries for biology, geology, mapping, water
- USGS libraries
- Scientific partnerships
- USGS offices

### 13.5.3 Areas of Specialty

Information paths can also be traced to areas of specialties, such as:

- Earth Observation System Data Center
- National Earthquake Information Center
- National Landslide Information Center
- National Geomagnetic Information Center

- Coastal and marine geology
- Energy sources
- Minerals information
- Biology and ecology centers
- Volcano observatories