Environmental Data Management Best Practices

Geospatial Data Management
Software

This fact sheet addresses the planning and selection of the correct software solution(s) for implementing a GIS solution. The GIS professional and information technology (IT) administrator should review this document when identifying the correct GIS software for a project or program.



Overview

Geographic information systems (GIS) are built from software components that manage large data sets with geospatial geometries, provide visualizations of the data, perform geospatial analyses on the data, and respond to requests from users through desktop software and web-based interfaces for the data. The main characteristics of a GIS software package are its analytical functions that provide means for deriving new geoinformation from existing spatial and attribute data (Huisman and de By, 2009). There is not one single GIS solution that addresses all possible project or organization needs. Each organization or project team should evaluate currently available GIS software solutions for applicability to a specific project. This document highlights key considerations that should be used in determining the correct GIS software for a project, as well as available secondary software packages that may be helpful in performing specific geospatial analyses.

Planning

Each organization needs to determine which GIS software will best meet their needs. There are many aspects to the organization's proposed geographic software that need to be considered. This is not an all-inclusive list, but is intended to be a guide to assist the organization with their software purchase and deployment.

- Do a comprehensive geospatial needs analysis of the organization's geographic data management needs.
- Determine software solutions currently available to the organization. Organizations may have policies, grants, or systems in place that limit the types of software solutions possible.
- Determine if data and analysis operations will be provided to users inside and/or outside of the organization via web interfaces.
- Determine the available budget for initial purchase of the software and any annual maintenance costs.
- Research the geographic software available, both open-source and commercial off-the-shelf solutions.
    - The costs for open-source software are generally in the development, maintenance, and administration of the software.
    - Commercial off-the-shelf (COTS) GIS software has licensing fees with a more robust software environment that reduces a user's need to incur costs in development and maintenance.

- Research the organization employees' use and knowledge of the available software.
    - Also consider training needs for existing staff and when onboarding future staff.

- Determine the analysis capacity needed in the organization to understand what version, extensions, or level of a software package will best meet the organization's needs.
- Work with the organization's IT purchasing group to purchase the software that meets the organization's needs.
- Examples of GIS software include:
    - ArcGIS
    - Global Mapper
    - GRASS GIS
    - Hexagon Geomedia
    - OpenStreetMap
    - QGIS

Acquisition

The deployment of GIS often involves multiple components that may be installed across several machines. Commercial off-the-shelf GIS software may utilize a licensing system that specifies the number of users that can use the software at any one time. The license server administration tool that manages and controls multiple licenses should be installed on a single machine that all other devices are able to communicate with. Desktop software or mobile applications could be installed on multiple devices, or the software could be accessed through a network server. Alternatively, some deployments can leverage named user accounts and an online portal for checking out licenses, which eliminates the need for a license server machine. Once software has been procured, a test environment should be developed to allow for future software releases to be evaluated prior to distribution to all users. The test environment should include all established workflows, tools, custom developments, and registrations necessary to ensure that software updates do not disrupt GIS users' workflow.

When deploying an enterprise GIS software, additional software may be required to handle web services, web map interfaces, load balancers to manage web requests, and data stores to manage GIS data sets. Each of these components may be installed on one or more machines based on deployment architecture and system redundancies. As with the desktop software, a test environment should also be established to allow administrators to evaluate system upgrades or workflow adjustments prior to deploying into production environments.

Data Processing and Evaluation

GIS software can often support data management or exporting of records for use in other software packages. If other software tools outside of GIS are necessary for a specific project, then GIS may be evaluated as a data source for those tools. If the intended software tool does not have a direct interface with the GIS software, determine the correct process for exporting GIS data in an appropriate format. Pay special attention to the software tool's ability to open and read the GIS data and coordinate system data. Some software tools are coordinate system agnostic, while others have more stringent requirements. The accuracy of the coordinate location may be lost if the coordinate information is compromised in the data transfer. Examples of additional software tools include:

- EQuIS
- EVS/MVS
- GWSDAT
- PostGIS extension for PostgreSQL
- Rockworks
- Surfer

USGS Model Scalability and Deployment Considerations

GIS software scalability is primarily the focus of user license seats for use of desktop software or named user accounts for enterprise GIS software. Each of these systems can grow with the number of users that require access to GIS data for collection or analysis. During the initial needs assessment, the planned general roles and number of users should be identified. As project needs dictate, the number of users can be adjusted and additional licenses or software instances can be procured.

Resources

- For more information about useful geospatial analysis tools and software, go to https://gro-1.itrcweb.org/.