

An Enterprise Approach to GIS System Management and Implementation

A case study of Adams County, Colorado

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Abstract

The right mix of software components combined with a flexible development environment and organizational framework go a long way to implement a successful enterprise GIS for Adams County. This paper provides a look at enterprise GIS from both a software design and system implementation perspective. It contains a proven approach to successfully managing, integrating, and delivering ESRI software to a diverse user base.

Overview

Adams County, Colorado is located in the northeast quadrant of the Denver metropolitan area. Traditionally, its extensive farms and ranches characterize it, however, recent growth of the Denver metropolitan area has redefined Adams County as one of the fastest growing urban areas in Colorado. As this trend continues over the next decade, Adams County will need to adapt to increasing demand for services and rising costs of doing business. One way to offset the demand for services is through a coordinated effort to share and develop the County's information infrastructure. Through more comprehensive and integrated database management systems, the County is increasing its level of service by providing distributed information resources.

Exhibit 1 - Adams County Growth Statistics

Year	1990	1998	1999	2000	2001	2002	2003	2010**
Total Population*	265,038	N/A	N/A	363,857	N/A	N/A	N/A	449,200
Population Increase	N/A	N/A	N/A	+98,819	N/A	N/A	N/A	+85,343
Total Parcels	N/A	112,017	116,441	122,869	131128	132191** *	138,256	N/A
Parcel Increase	N/A	N/A	+4,462	+6428	+8259	+1063***	+6,065	N/A

* Source: US Census Bureau Statistics

** Estimated by State of Colorado

*** The City and County of Broomfield annexed approximately 7,162 parcels in 2001

As part of the IT development and integration effort, the Adams County GIS team has taken a leading role at demonstrating how enterprise-wide software implementations go a long way to save staff time, reduce redundancy, provide support via centralized information access, and enhance customer service.

Problem Statement

GIS, at the enterprise level, is complicated by a number of organizational and technical factors. The ability of GIS to serve a diverse user base, integrate with various systems, replace (certain) information resources, and alter long standing business processes all contribute to the complexity of GIS implementation and management. Some of the issues and problems that most organizations face in terms of implementing GIS are identified as follows:

- Supporting information management systems are typically designed to meet very specific user needs and often present integration challenges ranging from software compatibility to database design and integration issues.
- GIS is often difficult to distribute due to network limitations and central data processing needs.
- Business processes and related information flow are difficult to alter and replace, especially, when management and staff prefer “business as usual”.
- System and data resources take time to develop and mature before they are of an acceptable level of accuracy and dependability. GIS is one of the few systems that cannot “go live” until all data is appropriately developed.
- Existing staff is difficult to retrain and new staff is difficult to integrate into the existing business cycle.
- Cooperation and system ownership can be difficult to establish. Some departments or user groups may not feel obligated to support needs of the enterprise in the same way as others. Departments also like to retain ownership of their resources and share only under their own terms and conditions.
- Increasing demand for GIS resources, tools, and functionality are difficult to keep up with. As organization begins to distribute GIS capability many departments and users come looking for more resources and support. This increase in demand for GIS services is hard to accommodate.

By formulating a consistent approach to GIS implementation, some of the problems can be circumvented or at least addressed more cohesively. The following sections examine Adams County’s approach to GIS management and implementation from an organizational and technical perspective.

Understanding the Organization

Understanding the organization is a critical component of building an enterprise GIS. Without a basic understanding of how a organization operates it is difficult (if not impossible) to find and capture key information resources, understand the business needs of your customers, alter or replace processes that may be inefficient, and develop relationships that will grow and unify the direction of your enterprise. The following sections provide an overview of Adams County’s organizational framework and key business functions for GIS support.

Administration, Schools, Social Services, Sheriff

Adams County Government is organized into three main service agencies: Administration, Schools, and Sheriff. Each organization operates independently with the exception that all they are subject to available property tax, collected and managed by the County Administration. Cities and Special Districts are also key business constituents of Adams County as they too are entitled to property tax revenue and provide critical services within the County. All agencies at this level in the organization framework need GIS to understand their existing business environment, support existing service providers, and anticipate or forecast the future need for services. Coordination within and among these groups is critical to growing and maintaining GIS

as a shared resource. Currently, Adams County Administration is the only organization that is actively developing GIS as an enterprise resource.

Administration

Adams County Administration supplies a range of mission critical services that both support and/or depend heavily on GIS capabilities. In many ways the Administration is the first “line of defense” in the local government business cycle. The primary GIS support divisions include: Social Services, Finance, Planning, Public Works, Assessor/Treasurer, Clerk and Recorder/Elections, and Parks. Elected officials direct the Assessor, Treasurer, and Clerk and Recorders offices. All other directors answer to the appointed County Administrator and the (three) elected Commissioners. At the Administration level, GIS implementation is coordinated via the Information Technology (IT) division of the Finance department.

GIS Work Groups

Multiple GIS work groups are embedded within the Administration’s departments. Traditionally, these departments have either maintained or consumed map-based information. Currently, GIS working groups exist in the Information Technology, Planning, Public Works, and Assessor departments. These working groups specialize in GIS data or application development and are the lead GIS support resource for the County. As the county system continues to expand, additional work groups may be needed to support the system full time. Parks and Community development for example have begun to develop GIS data and may decide that they need full time GIS staff in order to keep up with system data maintenance.

GIS Management Schema

Management Structure

Adams County operates a decentralized IT and GIS program. The Information Technology department, operating under direction of the Finance Department, provides coordination, project management, and daily support to most County information infrastructures. Data and system ownership lies primarily in the hands of individual departments and their various user groups. Data and system level sharing is coordinated via IT and the County’s IT Governance Committee. The IT Governance Committee is chaired by the Finance Department and requires participation by various department directors and/or high-level managers. Specialized sub-committees are established to coordinate specific systems such as GIS. The GIS Sub-committee is composed of GIS technical users and managers. The committee meets regularly to discuss system development, data sharing, and other GIS specific issues. Any recommendations or changes to direction by the GIS Sub-committee are sent up to the IT Governance committee for higher-level input and/or final approval. This IT governance is a critical component effecting enterprise system development and implementation.

User Environment

Understanding the user environment is another critical piece to managing and administering enterprise GIS. Knowing the user base will help streamline technology selection, level of customization, and user training efforts. For analysis purposes, most GIS or spatial data consumers can be classified as one of the following user types:

Technical Developer or Specialist – This user type typically has GIS in their professional title, has specialized GIS software training, and can efficiently implement or even customize GIS with little or no regular support. This group of users directly supports application or database development.

Technical Consumer or Analyst – This user type also may have specialized training, and can use GIS software out of the box but requires support to efficiently access database resources for analysis and customization purposes.

Non-Technical Consumer – This user type is strictly a geographic or map level data consumer. They likely do not have technical expertise or training to use GIS software, might not know how to read maps well, look for a quick answer or decision support, and are not interested in formal GIS training.

GIS Components and Resources

In order to manage and implement enterprise level GIS, it is useful to categorize system resources and implementation projects. Adams County developed the following classification of system resources to help manage and organize system components and implementation efforts:

- **GIS Data** – This management category contains spatial database resources that are distributed via GIS. Adams County currently maintains and distributes data in all available ESRI formats. Additional Sub-class of GIS data are identified below.
- **GIS Tables** – These resources include non-spatial data resources in the form of standalone tables or external relational database management systems (DBMS) that are distributed via GIS. While most stand-alone support tables are actually part of their appropriate spatial dataset (above), any table that relates to a spatial dataset is managed here. The GIS integrates directly with several data management systems including the Assessor's Computer Aided Mass Appraisal (CAMA) System, the (building) Permit Management System, and the Elections Voter Registration System.
- **GIS Reports** – This management component includes distributed reports that are accessed via GIS. Most reports are developed and distributed with Crystal Reports. Lately, we've been developing a web-based standard that generates HTML reports via ASP requests and does not require any client side software aside from a internet browser.
- **GIS Programs** – This component contains distributed application extensions and scripts. Any programming used to extend base functionality of GIS software is managed here.
- **GIS Maps** – This category accounts for hard copy outputs that are reproduced regularly for distribution. The county currently distributes a range of large and small scale maps both internally and to the public. Map atlas of zoning and property data are generated regularly and PDF is currently the distribution standard for the County.
- **GIS Documentation** – This component includes user based GIS documents designed to communicate system level use, metadata, and organizational

information. Adams County is beginning the process of incorporating all system documentation in one comprehensive GIS User Manual. The User Manual is generated in HTML help file format and distributed online for access to updated information by all.

- **GIS Training** – GIS User training is conducted at multiple user levels. GIS Web Service training is provided during 1-2 hour training demonstrations. Technical user training is currently provided in partnership with a local community college. The community college uses off the shelf GIS training manuals and custom Adams County training exercises to provide a 5-day technical training course to County employees. Advanced GIS developer and/or specialist training are typically purchased from ESRI or other software vendors.
- **GIS Administration** – System hardware and software require constant maintenance and upgrades. Administration is primarily a function of the IT department but technical system users can also access this resource to conduct their own upgrades.
- **GIS Projects** – This category is designed to accommodate user department based projects that are not distributed to the enterprise but require a central repository for data and system level access. GIS project types vary widely and are typically organized by user or department.

GIS Database Sub-Classes

Since database resources tend to be extensive and highly variable from one organization to the next, sub classifying this data provides a useful mechanism to organize and distribute databases. Adams County uses the following categories of data when working with or developing various databases:

GIS Data Management Sub-Classes

Aerials	Store and manage digital aerial photography
Control	Survey control monuments and Public Land Survey System (PLSS)
Districts	Taxable and non-taxable administrative and regulatory districts
Environmental	Natural and manmade features that can be identified on the ground
External	Various data from external data providers
Jurisdictions	City, county, state, and federal jurisdictional boundaries
Land Records	Property and subdivision records
Transportation	Transportation network infrastructure and related services

GIS Application Services

GIS “application services” is a concept designed to package and distribute GIS data to County staff and the public. For purposes of development, GIS user types (above) are delivered GIS data and functionality via a series of customized GIS applications, referred to as GIS Application (or Map) Services. Non-technical user needs are addressed using web-based GIS solutions with ArcIMS. Technical user needs are addressed with desktop applications in the ArcView or ArcGIS environments. As a general concept, map services are designed around specific needs of a user group (or Department) or a specific set of data such as US Census Bureau statistics. Map services package customized search, report, and analysis tools, with an appropriate set of spatial and non-spatial data resources. These services enable GIS users to identify data as part of a service rather than go directly to a file management system or DBMS repository to search for particular sets of data. Additionally, the map services package common SQL queries so that system users can pass requests to the system without having to know the details associated with their request.

Building Application Services

There are some basic concepts that make application service effective at the enterprise level. First, application services must deliver a standard user interface (UI) template to all users in the organization. The UI template delivers a consistent look and feel for the whole organization. Search, report and analysis tools are found in the same locations no matter which application service is activated. Second, application services are named, customized, and, extended to reflect the user needs or data resource that defines the service. While some services may offer redundant capabilities, they all have some level of customization that make them unique. It is very important that customizations and extensions do not compromise the look and feel of the overall UI in order to reduce the learning curve associated with different services.

Web Application Services

Adams County operates Web-based application services for standard Internet or intranet client access. These services are designed for non-technical users who primarily need point and click GIS functionality. The application service is closely linked with the most commonly requested information by staff and the public. Each service also serves as portal with hyperlinks to many internal and external information resources such as City Internet sites, online documents, the Assessor’s property data, and the County’s Permit System data. Each web-based service uses custom Active Server Pages (ASP) and HTML programming to deliver specialized search, display, and analysis functionality to its users.

ArcView Desktop Application Services

Currently, Adams County operates an application service referred to the GIS Query Application. The query application is built on the ArcView 3.x environment and acts as a standardized portal to available data and DBMS integration programming. By accessing an ArcView project file over the County network, staff can quickly search and query the GIS database and view available layers and resources. Similar to the web

based application service, this service acts as a central portal for accessing other system via the desktop. Currently, the desktop application portal is integrated directly with the Assessor's CAMA System, the Permit Management System, the Voter Registration System, and the County Internet. This system resource is customized with ArcView extensions and delivered on centralized GIS servers. Due to decentralized use of the application by some departments, application code has also been adapted to run independently using a client configuration with MS Access database support.

Accomplishments and Challenges

Organizational Framework

The Adams County GIS experience demonstrates that a decentralized management and user environment can be effectively integrated and shared if the appropriate IT management infrastructure is in place. The IT Governance Committee and GIS Subcommittee are key components to consensus building and channeling resources to and from the appropriate work groups. By providing a central IT group the power to control and develop centralized system resources can be accessed, protected, and distributed efficiently. At the same time, there is much work to be done to improve County level communication and development. Many of the top tier organizations have little to no GIS infrastructure and a limited number of users.

GIS Management Schema

Adams County's GIS management schema has developed and evolved over time. It has proven to be an effective means to manage and organize GIS resources and communicate ideas and project needs among GIS staff and work groups. However, the schema is large and difficult to understand from a non-technical level. It is difficult to get management and non-technical staff to understand all the components that are involved with system management and implementation.

Application Service Architecture

The application service architecture is a key component to delivering GIS and database resources. The broad range of GIS data resources are difficult to communicate to a diverse user base. Therefore, a consistent mechanism like application services helps to package and deliver GIS, and circumvents the need to explain various data formats, system resources, and detailed SQL query statements.

Conclusions

Only recently has Adams County Administration begun to operate GIS truly at the enterprise level. By using this management structure and the application services approach, the County will continue to develop and adapt enterprise resources. With most of the technical components in place, Adams County has entered an on-going management phase of the system implementation. Departments and the public are now accustomed to accessing and presenting data quickly and independently. New demands for functionality and service arrive daily and the system support levels are maximized.

While no quantifiable analysis of system level effectiveness have been conducted, it is obvious by system performance and monitoring that the information is heavily utilized and that application services are an effective delivery mechanism. One of the most notable issues is that the system architecture has out paced the ability for the GIS developers to communicate and train system users. As the application services concept continues to grow in both the PC and Web-base architectures, this will continue to be an issue. With the integration of databases and system level architecture in place, changes and customizations are easier than ever to implement and GIS has taken on overwhelming acceptance as an organizational asset.

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