Title: United States Air Force Academy GeoBase Program

Author: Timothy Beermann

Abstract:

The United States Air Force Academy (USAFA) in Colorado Springs, Colorado, has been using GIS technologies for over 10 years. While the GIS program has seen many successes, the use of a file based system led to several problems that were difficult to overcome. The Air Force GeoBase Initiative provided guidance in implementing an enterprise GIS that is geared towards meeting Air Force mission requirements. With this guidance in hand, the USAFA has started the process of replacing their file based system with an enterprise system to meet the needs of the entire installation.

Introduction

The United States Air Force Academy (USAFA) in Colorado Springs, Colorado, is tasked with training the future leaders of the Air Force. Their mission is to "Inspire and develop outstanding young men and women to become Air Force officers with knowledge, character and discipline; motivated to lead the world's greatest aerospace-force in service to the nation." The student body consists of approximately 4000 men and women representing every state and several foreign countries.

The 10th Civil Engineer Squadron (10CES) supports the mission of the USAFA by maintaining an installation that covers an area in excess of 18,000 acres, holds over 1000 buildings, and has one of the most active runways in the Air Force. The 10CES has been using Geographic Information System (GIS) technologies for over 10 years to help them manage the installation.

While early GIS implementation efforts saw limited success, they lead towards the development of a robust, ESRI based, mapping capability that has proven to be an invaluable tool for the 10CES and the rest of the Academy. Significant improvements have been incorporated over the last several years due to software enhancements made by ESRI, as well as unparalleled Air Force GIS guidance brought about by the GeoBase Initiative.

Early GIS at the USAFA

In an effort to more effectively manage the many natural and human-made assets on the USAFA, the 10CES started investigating the use of geographic information system technologies in the early 1990s, starting with a GIS hardware and software study conducted in 1991. This GIS study led to the development in 1992 of the USAF Academy Information Management System (AIMS). AIMS was an Application Development System (ADS) add-on to AutoCAD that used GeoSQL, and was able to tie into the Air Force Work Information Management System (WIMS).

The first AIMS application was an Excavation Permit Generation module that used existing base map and utilities data displayed on the USAFA's 1"=400' and 1"=100' map sets. A needs assessment for four additional modules (Family Housing Projects, Housing Community Planning, Utilities Planning, and Pavements) was conducted in 1994, and an AIMS user's manual was delivered in 1995. Unfortunately, by 1998, AIMS was no longer in use.

When interviewed as to why they thought the initial GIS efforts had failed, 10CES personnel described a system that was complicated to use, difficult to access (the system ran on a single PC), and hard to maintain (it was dependant upon its own, separate, dataset). AIMS was completely abandoned when the last person who still knew how to use it left the Academy.

The United States Air Force GeoBase Initiative

These GIS implementation problems were not unique to the USAFA, and were common at other DoD installations. One of the fundamental problem in the Air Force was the way in which GIS was being

introduced. The technology was typically brought to an Air Force installation by an individual who was trying to solve a specific problem related to their mission. This individual then became responsible for all of the data that the system need. In many cases, the data for this system could only be used in that system. It was not uncommon to have two (or more) people at the same base start developing GIS systems independent (and unaware) of one another. This lead to a situation in which mapping efforts, both in terms of time and money spent, would be spread across multiple, redundant, and often conflicting data sets and systems. Eventually, funding for data development and maintenance would be cut off, or people would simply give up due to the unanticipated investment of extra time and money that became necessary to keep their systems operational.

Even installations that had developed successful GIS systems had to contend with the fact that they often could not share their success with other Air Force units due to a lack of commonality. They also were faced with far higher development costs, since they had to start and maintain their programs with no overall guidance or ability to leverage larger Air Force efforts.

The founders of the United States Air Force GeoBase Initiative realized that GIS would never succeed at installations as long as these issues persisted. They also understood that GIS covered a far more wide-spread and crucial role than was being realized at most bases. The use of GIS across the Air Force could fundamentally change the way in which geospatial data and mapping were being conducted and managed, providing a level of information superiority at the installation level that had not been previously possible.

Changing the way in which the entire Air Force uses geospatial data across the globe was no small task. Years of dedicated effort led to a solid GeoBase program, framed by the vision of "One Base … One Map." The result of this effort for installations like the USAFA was a road map on how to implement a GIS system that would most benefit the entire Academy, which in turn would benefit the entire Air Force.

Early USAFA GeoBase Efforts

The first step in implementing GeoBase at the USAFA was the development of a Strategic Plan. This Strategic Plan helped to identify the issues which had led to the demise of previous GIS attempts in the 10CES, and laid out a strategy for developing a system that would be of greatest use to the whole Academy.

In conjunction with the strategic planning process was a remapping effort undertaken in partnership with the local community. The Academy made an important and decisive decision when they insisted that the vector data extracted from the orthophotography be delivered using the GeoBase recommended Tri-Service GIS standards (now known as the Spatial Data Standards for Facilities, Infrastructure, and Environment [SDSFIE]). It was not an easy thing to convince the other partners (and the vendor) that the data should be delivered in this format. The success of the Academy to receive their ArcInfo Coverage data using this schema greatly aided in future development.

The Academy's new GIS was based on ESRI Coverage data stored on 10CES file servers that were accessible via the USAFA NET. GIS users who had ArcView 3.x loaded on their machines could access GIS data to support their day to day mission support activities. Installation maps and custom maps were created and maintained by the 10CES GIS and CADD section. By late 2000, there were about 50 or 60 GIS users at the Academy, mostly in the 10CES.

While this GIS system was an unquestionable success, the use of a file based system led to a number of issues that were difficult to resolve. People were able to copy version of the data as they saw fit, making it impossible to ensure that people were always referencing an authoritative, up to date copy.   Many people would add additional attribute data that assisted them with their mission, but were unable to effectively share their work with others who could make good use of it for their own mission. Applications that were developed to work with file based data had a greater tendency to become dependant on specific data sets which were reference by that single application (leading to increased redundancy). The maintainers of the GIS data could never hope to be able to update all of these data sets, and were often not even aware of them.

Enter the GeoBase Architecture

Two developments came together to set the stage for the USAFA's next round of GIS development. The first of these was the creation of the HQ Air Force Geo Integration Office (HAF GIO), which was tasked to lead the development of GeoBase standardization and architectural design efforts across the Air Force. Second was the development progress of ESRI's ArcGIS 8.x line of GIS software.

The HAF GIO set forth a vision in which each Air Force installation would deploy a single, authoritative, high fidelity, digital base map that could be accessed as a map service by all functional elements. This base map would serve as a Common Installation Picture (CIP), and would be accessed as an installation GeoBase map service for any and all IT solutions that required a mapping component. The CIP would be defined and made accessible using open standards. Organizations with geospatial data directly related to their own mission could spatially reference their data (termed Mission Data Sets, or MDS) on top of the CIP.

The concept of a comprehensive installation CIP and MDS would go a long way to alleviate the tendency of installations to peruse independent mapping efforts for independent information solutions. It would provide the fundamental framework for tying all of these independent solutions into a coherent entity. It is not the intention of GeoBase to replace legacy systems, but rather to offer a common mapping platform that can be readily accessed by these legacy systems, and in many cases, bring systems together in a way that was not possible before.

The idea of being able to offer the CIP as an easily accessible map service using open standards made ESRI an ideal choice for GeoBase implementation. An ArcSDE Geodatabase would provide the GeoBase mapping service that could be quickly accessed using ArcMap, ArcIMS, or any of a number of Open GIS Consortium (OGC) compliant applications.

GeoBase Implemented Using ESRI's ArcGIS

At the USAFA, as at most other Air Force Installations, the choice was made to move their file base, service oriented, GIS system into an enterprise GIS model using GeoBase guidelines and ESRI technology.

A large effort went into looking through all of the data that was housed across the many file servers maintained by the 10CES. Selected data was loaded into an SDSFIE schema on an Oracle 9i database using ArcSDE 8.3, and maintained using ArcGIS 8.3 with an ArcInfo license. The GIS staff at the Academy was now able to focus their attention on managing the single source of data housed in the new geodatabase.

In addition to this, an ArcIMS based GeoConsole application was developed to allow USAFA personnel to quickly access maps via the USAFA NET using the web browsers found on their machines. The GeoConsole used ArcIMS 4.0.1 and Microsoft's .NET technology, running on an IIS web server, to allow for direct access to the USAFA CIP and MDS's. People who previously had to physically walk to the GIS section in the 10CES were now able to directly access the maps that they needed on a day to day basis. Not only did this save them time and effort, but it also helped to re-orient the GIS technicians from being service based map makers and printers to geodatabase maintainers and editors. Over time, this re-orientation should go a long way towards making the CIP and many MDS's much more up-to-date and accurate.

The ArcIMS system development also included a number of applications designed to enhance specific workflows that offered a significant savings in time and effort. Among these was a dig permit application that significantly streamlined the process necessary to allow digging on the Academy. This also helped to free up the time of a GIS technician, who used to have to make and print maps for every single dig permit application submitted. The time saved through automation can now be used to help maintain the central geodatabase.

Because the USAFA is using the same standards that are being used at all other Air Force Installations, they were also able to take advantage of development work that other commands were undertaking. These customized applications were all created using ESRI's ArcObjects, and were designed to work on data defined using the SDSFIE, ensuring that they could be deployed at the Academy with little or no need for additional development. These applications also helped to automate the tasks of the Academy's GIS technicians, further freeing their time to be spent on editing and maintaining the many feature classes held in the Academy's geodatabase.

Enterprise GIS Makes an Impact

Providing a mechanism for directly accessing USAFA maps made an immediate impact on the mission of the 10th Security Forces Squadron (10 SFS). The Academy's graduating class of 2004 had the distinct honor of having President Bush attend their graduation ceremony. In preparation for the President's visit to the Academy, the 10 SFS used the new geodatabase to make all of their plans to protect the President. These maps were imbedded in a presentation given the Secret Service, who commented that it was the "best (they) had seen to date."

This provides a powerful example of what can happen when you put the tools directly in the hand of the people who need them.

Conclusions

From its beginnings as a stand-alone application used to automate a dig permit system, to its current incarnation as an enterprise mapping system that forms the basis of multiple applications and capabilities, the USAFA GIS has shown itself to be a microcosm of the issues that led to the Air Force GeoBase Initiative. It also aptly demonstrates how GeoBase concepts, implemented with ESRI technology, can provide a robust, mission centric, geospatial information backbone that will continue to enhance the capabilities of Air Force organizations to perform their mission.

Author Information:
>Timothy Beermann
>GeoBase Manager
>HQ USAFA/CEPD
>8120 Edgerton Drive, Suite 40
>USAF Academy, CO 80840
>Phone: 719-333-1606
>Email: timothy.beermann@usafa.af.mil