

Campus GIS: Facility Management using ArcSDE and ArcGIS Server

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Abstract:

City College of San Francisco (CCSF) uses 300 facilities to accommodate over 100,000 students annually. In 2007, CCSF administration awarded funding for the use of GIS as a facility management and services tool by utilizing ArcGIS Server. The college had no previous existing GIS system; this paper will talk about, the challenges for migrating disjointed resources into a central ArcSDE repository, where it could be accessed through a single web-based solution. ArcGIS Server was chosen as the foundation and using ASP .NET allowed an application with flexible framework. The application provides a secure intranet browser for administration while allowing individual departments to customize maps for their needs. The public version serves the student population providing individual maps for each campus and the ability to query by building, room, and services.

Background:

This paper gives some insight on how to build a GIS-based Facilities Management (FM) system within a college environment. City College of San Francisco (CCSF) was in need of a system to help organize and deliver facility information considering no system previously existed. In addition, CCSF was given the task of identifying spaces and certain exterior features for ADA purposes as well as inspections by 2008. All this information will need to be made publicly available online. To accomplish this required the cooperation and collaboration of data from several departments; therefore the system is designed to:

- Store data in a central repository for several departments
- Collect, manage, and display facility and grounds data
- Access information through a simple interface for secure and public websites

The college needed a simple solution to first gather all top priority data and then be able to share it over a web interface. CCSF chose the ESRI platform as a solution to start the FM system. The decision to use ESRI was mostly due to costs and familiarity with the software - the college purchases an annual ESRI Site License which includes the necessary applications.

Building Support

The CCSF GIS Mapping Project team realized to build a GIS-based FM from scratch would require building a strong case for a department, committee or top administrator to champion the idea. To discover how GIS could help the college meetings were held with some of the entities thought could really benefit from a GIS.

Initial presentations and meetings were held with Facilities Planning, Buildings and Grounds, as well as shared governance committees. We needed to gauge their reactions, discover holes in our proposal, and understand their work-flows. It was determined that most people favored the idea, though cautious about how much the college really needed a GIS-based FM. Common critiques were voiced about training and budget. We determined the support from Facilities Planning and Buildings & Grounds were not enough to justify spending thousands of dollars to only catalogue maps/drawings and build an interactive campus map – after all, Google Earth is available.

The team began to look at how GIS could augment or enhance the colleges marketing and recruiting efforts. Meetings with the Research, Planning, and Grants and Marketing departments were encouraging and revealed that spatial data had never been considered in their approaches to market the college or recruit students. At the time of the meeting, no one knew the spatial distribution of our students and college catalogues were sent to every house in San Francisco. The team and both departments felt GIS could at least offer a new way of looking at their data.

Campus Police was an obvious candidate to support GIS for crime mapping. However, the events at Virginia Tech brought to light further uses of GIS. In meetings with the Police Chief, it was voiced how important emergency planning and response was to the department. GIS was an easy sell for crime mapping but it became a solid choice for enhancing the colleges Emergency Response Action Plan. Campus Police viewed GIS as an important tool for their success and became a major supporter for the proposal.

The college was also responsible for updating and maintaining ADA features across the district. Meetings with the ADA committee and Disabled Students Services and Programs revealed a large need to be able to track inspections, construction changes, and maintenance of accessible sidewalks, entrances, and elevators. In addition, the college needed to publish a website that listed the ADA rating of all classrooms and offices in the district. The ADA committee recognized GIS as a platform to disseminate this information to the community and became a major supporter of the GIS proposal.

Understanding the college operations and having support of seven departments and a few governance committees we sat down with top administrators. The top administrators were pleased with the proposal, recognized the need for GIS, and were able to justify the cost of implementing the first phase of the project.

To build a GIS based FM from the ground up required careful maneuvering in an organization as large as CCSF. Like any large entity politics play a role in changing

policy. The team garnered support for such an ambitious project while tapping the ear of top administrators for ideas and overall college needs.

Early Challenges

The college facilities are managed by two departments: Facilities Planning and Buildings & Grounds, which are under the Office of Finance and Administration. Traditionally, these departments have relied on its senior engineers and personnel to maintain facility information. This information was handled or shared through paper plots or word of mouth; a turn towards electronic drawings has occurred in the past decade. However, neither department sponsored a method to manage their data. As a result, each department faces a challenge when gathering or sharing information. Staff waste time searching for and then determine if it's up to date. Another concern is loss of valuable information when personnel leave; consequently, new hires require more time to learn the facilities.

The first challenge relied on department heads to recognize the need for such a system to improve existing conditions. Both heads recognized the importance of developing a centralized space to manage and share information. Next, we conducted a survey of data to determine what spatial and non-spatial data these departments were maintaining. This survey allowed us to first index many of the drawing files but also gain insight on how to organize the data.

The next challenge was to determine how best to create the basemap data for the district. Hours were spent reviewing CAD drawings for I-Ten to georeference and translate to GIS. The college had a masterplan but it was outdated and the remaining CAD drawings only covered parts of the campuses. After the translation we discovered some areas were out-of-date or just didn't align with the orthophoto. Some hands-on digitizing was necessary to resolve the inaccuracies.

Utility data were gathered from existing CAD drawings and scanned plots, then georeferenced to the orthophoto. No drawing existed to show all the utilities for the entire campus. Instead, several drawings had to be pieced together to create a composite of the utilities. Again, the translation revealed many of the utilities to be incomplete. A meeting with the Buildings & Grounds also revealed many of the utilities to have been moved or long gone – they had no up-to-date drawings of the campuses to check against the submitted files. To correct the utility data the college invested in a sub-foot GPS unit and walked the campuses with engineers to gather accurate locations of nodes. Utilities were then adjusted to the nodes and attributed correctly.

Another challenge faced was how to utilizing Banner data to locate employees. The top administrators were weary of allowing another system to access Banner data. To gather a log of employee office locations the Banner group will export a file to the GIS server that will be consumed and update the employee table weekly. Likewise, Campus Police was concerned with another system accessing highly private victim and suspect data. Campus Police also exports a filtered database to the GIS server to be consumed and updated

weekly. In addition, the police required further work to describe incident locations. Incidents in the interior of buildings could be located by the Master-ID of spaces but incidents outside lacked a location system. To solve the exterior location for incidents the team created a grid to cover the campuses. Now, all incidents can be located on the all campus property.

The challenges faced by the CCSF GIS Mapping Project team show how difficult migrating disjointed data can be into a common place. The challenge also revealed the typical departmental silos that can exist in large institutions. However, looking forward the college can now function more efficiently and maintain better records.

Design and Implementation:

Before deciding on a geodatabase design CCSF staff and the team at I-Ten sought an established FM model but were unsuccessful. Ultimately we discussed what datasets would participate and how to relate them. Recognizing the amount collaboration we determined certain data would be prioritized for immediate use while other department data would follow. The team decided on seven tables of priority:

Room: contains all interior and building spaces

ADA: ADA access information

Student Services: Services such as Financial Aid, Registrars Office etc.

Employee: All faculty and staff office or department assignments

Documents: Documents, photos, drawings etc.

Building: Building information, square footage, number of rooms etc.

Utilities: All underground utilities and some surface features

It was clear from the start the Room table would be most important because it delivered the floorplan graphics but also because the Employee, ADA, Building, Student Services, and Document table could easily be related once a unique id was assigned to all spaces.

The unique id was created by assigning each campus, building, floor level, and floorplan space an id. Combining those four pieces of information would form the “master-id”. For example, room 101 in Batmale Hall on Ocean Campus has the master-id of 0-2-1-101; the logic is described below:

Location:	Ocean	Batmale Hall	1 st	101
Logic:	Campus	Building	Floor/Level	Space #
Master-ID:	0	2	1	101

The Room table contains all spaces with their unique id. Using the Room table as the control, the next task was assigning the master-id to the other tables who could directly relate to the spaces. This included the employee, ADA, Student Services, and Document tables. Now that a relation was created it made locating the majority of staff and faculty on campus who are assigned a room or department, ADA information surveyed at the room level is linked; Student services which are typically located in rooms can be

located and documents can be assigned to rooms, floors, or buildings. The Building table only has a relation to the Room table in that all interior spaces must be part of a building. The Utility table, at this point, will only have a relation to the Document table. Buildings & Grounds staff found it important to view drawings, photos and reports on the utilities in question. Overall, the model we developed has been successful and efficient. However, ESRI is in the process of delivering a FM model which we hope to utilize in the future.

Looking at the larger picture, the college wanted to consolidate datasets and streamline editing by taking advantage of enterprise GIS. The college chose to use ArcSDE with Oracle as the engine to store, edit, and display their spatial data. The benefits of using an enterprise GIS are: connection to Oracle, real-time editing, eliminate duplication and redundancy, and a centralized database.

ArcGIS Server Application:

In the design phase, the team was faced with several different solutions to create the web based application for the college. The team reviewed ArcGIS Server, Mapguide, Google Earth but ultimately settled for ESRI ArcGIS Server for the following reasons:

- Functionality and ease of programming with API
- Scalable
- Performance and stability
- Enterprise solution works nicely with ArcSDE
- Inbuilt AJAX enabled
- Easy to manage and deploy

Applications

The first application is for ADA Access at all campuses in the district. The application is designed to display features necessary for persons with mobility issues to navigate a campus. These features include items like path of travel, handicap parking, elevators etc. More importantly, the application offers several queries for users to find buildings, rooms, student services, and staff on campus. The result is a map with helpful features for navigation and a report on the room with a picture and link to Google Earth.

Another application developed is for the utilities of the campus using a secure intranet site. All underground and some surface utilities have been, for the first time, combined. Group and individual meeting with staff from the Facilities Planning and Buildings & Grounds expressed large interest in being able to view campus wide the utilities and then being able to identify individual features.

Further Development:

ArcGIS Server Java API

The team is proud to be part of the ArcGIS Server 9.3 Beta Team. We are currently testing and implementing 9.3 on a test server. In addition, we are in process of developing

an intranet application with limited functionality using ArcGIS server Javascript API. This application will mainly augment searching and enhance tool tips.

3D Buildings and Facilities

With the ability to utilize 3D in ArcGIS Server we will model one building from the main campus to demonstrate the 3D technology. The model will not only include the building and surrounding basemap data but also the interior floorplans of the building. We hope to show the use of:

- Globe and 3D services
- Authoring content for a globe service using ArcGlobe
- Publishing a KML service
- Building a globe service cache
- Consuming globe services using ArcGIS Explorer

Routing within Buildings

Another goal is to develop routing functionality for the campus. This will allow a routing service to direct users from building to building. Though the routing centerlines and nodes have been created we still face challenge of developing a good model for routing for interior spaces. We hope with help from ESRI we can achieve this goal.

Conclusion:

CCSF needed a simple solution to manage their facility data and solve the task of updating floorplans, basemaps, and utilities. ESRI's ArcSDE and ArcGIS Server have helped manage and share data along with the ability to track and update assets. In addition, this data can now be served to end-users via web applications. The FM system now allows:

- Data to be centrally stored for more efficient management and sharing
- Staff and administrators to view and query facility data at any time
- Departments can now tailor a map service to their needs
- Data can be updated and served to staff or public in a timely manner

Though the use of GIS for FM in this case is a small step towards a larger FM system, it has proven successful in that it accomplishes the goals set forth by the college. It is hoped GIS and FM will become a bigger part of how the college operates, manages its assets, and serves the community.