Paper Title
Building and Maintaining a GIS and Utility Integrated System

Primary Author
Ms. Jennifer Reek
GIS Coordinator
City of Brookfield

Paper Abstract

The City of Brookfield, Wisconsin migrated closer to a City enterprise GIS system by integrating the utility based GIS data with the public works databases. In 2006, the City implemented a GIS and utility integrated system with the use of ArcSDE and a public works software application. This presentation describes migrating data to build the system, integrating the public works system with geodatabases, maintaining the data throughout several city departments, benefits from using an integrated system, and future additions to the system. In addition, the presentation will show how software integration can provide benefits by maintaining water utility assets primarily within GIS verses highway sign data within a public works software application.

Background

The City of Brookfield is a community located in Waukesha County, Wisconsin, approximately 15 miles west of downtown Milwaukee and has a population of 39,607. Since beginning its GIS program in 2000, the City has made major strides toward improving access to geographic data and the quality of that data. The GIS program has developed and is maintaining over 100 feature classes. To coordinate and maintain GIS data, the GIS program is structured in a decentralized program with the GIS Coordinator in the Information Technology department, 2 editors in the Engineering department, and 1 editor in Community Development department. Editors and users have 4 concurrent ArcInfo, 4 concurrent ArcView, and 6 Stand-alone ArcView licenses available. City staff has the ability to view, query and map all of this information through the City’s internal ArcIMS site. Even with all of this data and activity, there was a lack of enterprise vision within the City.

Prior to 2006, the GIS program had over seven production personal geodatabase resulting in many issues for administrating and editing. The databases frequently locked out users, no multi-editing, several publication databases to update, unreliable backups,
users using dated information, corrupted databases, problems accessing data to remote buildings and limited integration with other applications.

Asset management of utilities existed in both ESRI GIS and CarteGraph Systems (an ESRI Business Partner) asset management software within the Highway, Water and Sewer departments but the systems were not integrated. Prior to GIS integration, these departments had utilized the asset management software for payroll and work orders with the exception of Highway department sign, light and signal inventories. The asset management database for these inventories was completed and had fields containing the x and y coordinates to map in GIS. The water, sanitary and storm sewer inventory data existed only in ESRI geodatabases.

**Project Overview**

Public Works departments repeatedly requested the ability to integrate GIS with asset management software to view and report on assets. In addition, the Water Utility needed to maintain electronic data of its assets as required by Public Service Commission (PSC) through the Formulation of a Continuous Property Records Procedure. As previously mentioned, the water, sanitary sewer and storm sewer digital inventories were available in ESRI geodatabase format since early 2000 and maintained in the Engineering department. Also since early 2000, the Water and Highway departments have been using an asset management, CarteGraph Systems, for work orders and payroll. Two attempts to gather proposals for solutions failed during the budget process. The results being very expensive or the asset management software “at the time” did not truly integrate with ESRI GIS software.

**Pre-project Planning**

How should a project be planned after two attempts to gather proposals and the project fails during the budget process? Pre-project planning was a key component for this project. The following outlines our pre-project planning:

- **Needs Assessment**: Met with staff from Engineering, Water, Sewer and Highway departments to assess needs and requirements. Needs and requirements were documented.
- **Software Application Assessment**: Researched and assessed CarteGraph Systems software which all the departments were using for payroll. In addition, Highway had a complete sign inventory. Determined new software was able to integrate with ESRI GIS using its new GeoConnect and GIS Director modules. Unlike other
asset management applications with GIS, the GIS and asset management databases remain separate and are associated on specific features/tables information through a replication process in SQLServer. GeoConnect administrates the development of the associations and maintains the replication/integrity of both databases. (See example of the module later in the paper)

- Software and Data Conversion Costs - Received a quote from CarteGraph Systems for software and data conversion costs
- Assessed ESRI and CarteGraph platforms - Determined upgrading ESRI and CarteGraph to SQLServer solved current issues related to performance, accuracy, and reliability was a beneficial solution. Costs were determined for all upgrades
- Implemented new City procedure which addressed budget issues by developing “Concept Plans” for review:
  - Departments submit Concept Plans to the IT Director for consultation
  - Projects are reviewed and approved through the IT Steering Committee – Committee consists of six department heads
  - Approved projects are then submitted through the budget approval process

Concept Plans consist of:

- Project Name
- Project requestor
- Project owner
- Project description
- Strategic goals project satisfies
- Other Dept. involved or affected by the project
- Required completion date
- Expected system life
- System/Project dependencies
- Implementation strategy
- Estimated monetary benefits
- Non-monetary benefits
- Estimated costs

**Asset Management/GIS Integration Concept Plans**

This project required two concept plans to fully integrate systems

1. “ArcSDE Concept Plan”
2. “Upgrading Existing CarteGraph Programs to SQL Server and Implement WATERview Software Concept Plan”
Question: What would happen if the 2nd concept plan would succeed and not the 1st?

- Both concept plans were very thorough and crossed-referenced each to assure that both would be approved
- IT Director was fully informed of consequences to explain to committee members

Project Development and Budget Process for this Project

As part of the project development, the Information Technology staff researched database needs and determined that an enterprise solution was required. The City chose SQLServer since it was implemented for several other application and was robust enough to handle the requirements.

In June 2005, “ArcSDE Concept Plan” and “Upgrading Existing CarteGraph Programs to SQL Server and Implement WATERview Software Concept Plan” were submitted through the IT Steering Committee. They were both approved and the projects were submitted for budgetary approval. The projects were approved and the planning process began. Without the documentation that was required for concept plans and the review of the IT Steering Committee, these projects would have most likely failed in the budgetary approval stage. Aldermen were able to have confidence that the projects were thoroughly analyzed and reviewed by staff to benefit the City as a whole.

Project Planning and Implementation for an Enterprise Solution

I. Upgrading GIS to SQLServer with ArcSDE-

To successfully implement the enterprise solution, a project plan was developed in early 2006 to upgrade GIS to ArcSDE/SQLServer. All project plans incorporate a timeline with tasks and personnel to perform each task.

Among the initial tasks, training classes were identified for staff and consulting time with ESRI was scheduled. A key strategy that worked was sending both the SQLServer Administrator and GIS Coordinator to ArcSDE training. Then, within a month of training and before knowledge was lost, an ESRI consultant was on-site to assist with installing, configuring and implementing ArcSDE and work with staff to build three ArcSDE databases. These tasks were performed on time and successfully.

Once GIS was upgraded, the GIS Coordinator had the task of loading several existing personal geodatabases into the three GIS ArcSDE geodatabase. This effort included
organizing the data, setting permissions for editors and viewers, creating a multi-version environment and establishing routines to reconcile/post and compress the database.

The final task was to re-point existing map projects and the ArcIMS project to the new ArcSDE geodatabases. This task continued for several months as projects were accessed.

By following the project plan and its timelines, the upgrade to SQLServer/ArcSDE was successful. Since this project, the City’s GIS has functional ArcSDE geodatabases in which we are multi-editing and eliminated the locking issues. The geodatabases have nightly backup routines through SQLServer. Accessing the data, even through a T1 to remote City buildings was not only possible but, fast. Finally, the City could start working toward an enterprise solution by integrating with other software applications.

II. Integrating GIS and Asset Management Software Applications-

Once GIS was up and running with ArcSDE in a multi-versioned environment, the project plan to integrate GIS with an asset management application was developed. The City received the upgraded licenses for CarteGraph Systems software in March of 2006. The GIS/asset management software integration started in the summer with organizing the Public Works departments work flows and determining where data resided. One major concern was how to organize the asset management data in SQLServer. Another concern was organizing the GIS utility data in ArcSDE. Several major decisions were made throughout the project and are described in the following section.

The data within the asset management software was organized by department within four separate Microsoft Access databases. Highway department had two databases for work orders, payroll and the sign/light/signal inventories. Water and Sewer departments had one database each to keep track of work orders and payroll. The GIS coordinator met with staff to discuss the options and what were the benefits and cost of each data conversion option. One option was to combine all the data into one database which would have a major conversion effort and added (unbudgeted) cost. The other was to separate Highway department from Water and Sewer departments into two databases. This would require less conversion effort and remain within budget. The decision was to separate the data into two databases, Signs and Utility.
With this decision finalized, the project plan was revised. Tasks included:

- Research and develop the Utility geodatabase – Database includes water, sanitary sewer, storm sewer and sign/light/signal data
- Load and administer the new Utility geodatabase
- Schedule and contract with CarteGraph Systems to assist in creating and implementing the databases
- Schedule on-line sessions for training and changes to the database
- Convert Sign inventory, work orders and payroll to SIGNview database
- Convert existing asset management work order/payroll data and add asset tables in CarteGraph’s WATERview database
- Administer permissions and backup routines
- Populate Utility/sign geodatabase features using SIGNview x and y coordinates
- Associate Utility/sign geodatabase features using GeoConnect
- Associate Utility/water geodatabase features with WATERview data using GeoConnect
- Add tables in WATERview to track hydrant pressure data
- Train in-house staff

The description of tasks was revised more as the project progressed. As databases were developed and users started viewing and entering data, it became apparent that the structure of the data needed to change. Fortunately, CarteGraph is very versatile with utilities and tools to help create new fields to new parent/child record sets, develop forms to enter data and create custom reports. In addition, the GeoConnect and GIS Director modules turned out to be an essential part of integrating GIS and CarteGraph data and to modify the databases to meet the City’s needs.

Since the water geodatabase was created years prior to integration with asset management, the structure of data did not match for hydrants and valves in CarteGraph’s WATERview module. In addition, being created with a “Cad” mindset, annotation was created for all mains, hydrants, and valves. In order to associate the features with counterparts in WATERview, the hydrant valves needed to be separated from the hydrant nozzles. In turn, the annotation for both features needed to be re-associated to the feature linked annotation in GIS. Also, additional record sets were required to be made in WATERview to associate with separate main valve, service valve and curb stop valve in GIS. Through the GeoConnect and GIS Director, the record sets were created and associated.

Within the sign/light/signal data, the Highway department originally organized the data with the signs separate from the lights and signals. Through the conversion, these
dataset were combined to save creating new record sets. As the users worked with the data, they found the need to filter the lights and signals data from the signs which proved to be time consuming. The GIS Coordinator was able to filter and export to a geodatabase feature class of the lights and signal data then use GeoConnect in CarteGraph to build the new record set in SIGNview module.

GeoConnect module example:
Needless to say, the project has produced a successful integration between the GIS and asset management applications in which both the Highway and Water departments are starting to see the benefits. The Highway inventories are being completely maintained by their staff with occasional assistance from the GIS Coordinator. The Water department’s assets are placed in the geodatabase by the Engineering staff. Specific asset information (hydrant number, type of hydrant and pumps), work orders, and associated card images are maintained by the Water department staff.

**Viewing and Editing with the Integrated System**

With the integration, the user can now view the asset management data and geodatabase data together. Shown below are sign assets in SIGNview:

![SIGNview Image](image)

Associated fields with the geodatabase data are in ID, MUTCD Code, and the x,y fields.
Users have the ability to send the entire or portions of the record set to an ArcMap project. Below is an example of the sign information in ArcMap:

In addition, within ArcMap using CarteGraph’s GIS Directors add data function, the user can specify the features to view and any or all of the CarteGraph fields to query on in the attribute table.
Before integrating the database, static maps of the sign inventory were created using export routines which were time consuming. Now, the maps are shown live on the City’s ArcIMS site and are up-to-date when re-plotted from the ArcMap projects. Below is an example of the City’s traffic control regulatory map using the MUTCD Codes:

Another tool that is valuable is the ability to zoom and flash in ArcMap that a user is viewing or editing in CarteGraph. Shown below is an example of the two applications working together.
Editing routines have been enhanced through the integration. The following shows editing hydrant information with an ArcMap project with a WATERview form that was created in CarteGraph:

The City will be completing this project this year. To complete the project plan, more robust record sets will be added within the WATERview database. Currently, the newly created record sets for the separate valve data has limited functionality in the inspection and event child record sets. The GIS Coordinator will be interviewing the Water department staff to add required fields for these functions.

Future Development

Future development will enhance the enterprise system. The City will be exploring the following:

- Provide viewers “live” data for all features to the City’s internal ArcIMS site
- Enhance the ability to track hydrant pressure data
- Take the information to the field - asset inspections via system mapping in an ArcReader project and Microsoft Access database of exported/imported inspection data
- Explore wireless data entry and viewing in the field as technology is enhanced with the City
- Assess sanitary sewer integration GIS with SEWERview – cost/benefit analysis required
- Integrate with City’s financial system – not current accessible
Acknowledgements

CarteGraph Systems

Contact Information
Primary Author
Ms. Jennifer Reek
GIS Coordinator
City of Brookfield
2000 N. Calhoun Rd.
Brookfield, WI 53005
US
262-796-6709
reek@ci.brookfield.wi.us