

Butler County, Ohio Saves Thousands Using Prisoners to Convert Data

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Abstract

Butler County, Ohio recently saved several hundred thousand dollars using inmates of the Ohio Prison System to convert 8,000 infrastructure record drawings of water, wastewater, and storm assets into the ESRI based enterprise GIS. In addition to the significant budget savings, the project demonstrated commitment to their community by training inmates in ESRI software.

The County also benefited from implementing simple, low cost, and highly effective ESRI extension software. ArcReader was deployed throughout the entire County for enterprise map printing with direct hyperlinks to raster scans of record drawings. ArcPad and ArcReader were deployed in the field on a tablet PC with similar functionality. In the near future, the County plans to deploy ArcSchematics for water and sewer networks.

With this asset register foundation investment in place, the County is prepared to move forward in business focused application development and system integration to support enhanced utility Asset Management.

Background

Butler County is located in the southwestern section of Ohio, approximately 25 miles north of Cincinnati and 35 miles southwest of Dayton. Butler County provides water distribution and sewage collection/treatment services to its customers in and around the county. The present County limit covers approximately 470 square miles with an estimated population of 334,000 people.

The Butler County Department of Environmental Services (BCDES) service area includes approximately:

- 80 square mile water distribution system
- 542 miles of water main
- 13,550 water valves
- 6,500 fire hydrants (auxiliary valves are included)
- 108 square mile sewer system
- 628 miles of sewer main
- 14,410 manholes.

In the summer of 1999, BCDES embarked on the implementation of a GIS. BCDES's approach to the GIS implementation was to:

- Work with the Ohio Prison System to convert all record drawings into the GIS.
- Implement simple ESRI-based applications and extensions that have well documented business value.

Vision

The vision for the GIS is to embed institutional knowledge of water and sewer network assets into the GIS to support long-term management. The GIS implementation will facilitate the timely and accurate capture, documentation, and distribution of network asset information to the entire workforce. This will enable BCDES to improve customer service, meet competitive challenges, and achieve the performance targets established by key utility and community based stakeholders.

The GIS will achieve BCDES' data management and performance objectives by:

- Reducing the time and effort currently required to manage network asset information
- Improving the quality and completeness of asset information
- Supporting long transaction planning and optimizing asset renewal and creation activities
- Minimizing the need for paper records
- Minimizing the time to locate maps and information
- Eliminating duplication in map storage and updates.

Data Conversion

Data conversion typically accounts for 60-75% of the cost for a utility to develop and implement a functioning, enterprise GIS. Many small to mid sized utilities have difficulty in both acquiring funding and providing internal staff to manage the entire conversion effort. In a 1999 Technology Master Plan, BCDES committed to implementing a full GIS for long-term management of asset information. All asset information was in hard copy. The County surveyed the industry and discovered that the Ohio Penal Industries (OPI) could accomplish the conversion at a third of the cost of traditional firms. Ohio Penal Industries (OPI) is a part of the Department of Rehabilitation and Corrections. OPI Inmates are trained in Computer Aided Drafting and Design and receive on the job experience under direct supervision.

OPI's services included providing the County with a proposed work plan and bid options. Legal counsel for the County reviewed the prospective work plan and contract. Once both parties agreed to the terms of the contract, the work plan was finalized and the project began.

Therefore, in August of 2001, OPI began converting data according to the following. OPI received digital files of the scanned maps from the client. The maps were then organized into the appropriate sections and assigned to operators to capture data using Microstation. In-house QC personnel checked the Microstation design files for accuracy of data and feature placement.

The corrected design files were imported into an ArcMap personal geo database and the features separated into the correct layers. The resulting personal geo database was checked

for connectivity using the system network wizard, and then sent to the client for final quality control.

The overall process took approximately 31 months and converted 8000 paper as-built drawings. Throughout the project, several benefits and challenges were discovered, as follows:

Benefits

- Investing in the community
- Significant cost savings to tax payers
- Prison inmates learn a valuable trade to assist in becoming productive members of society upon release

Challenges

- Communication and project team structure. Access to staff performing conversion
- Update of core technology in prisons to support the volume in data to be converted

Technology Implementation

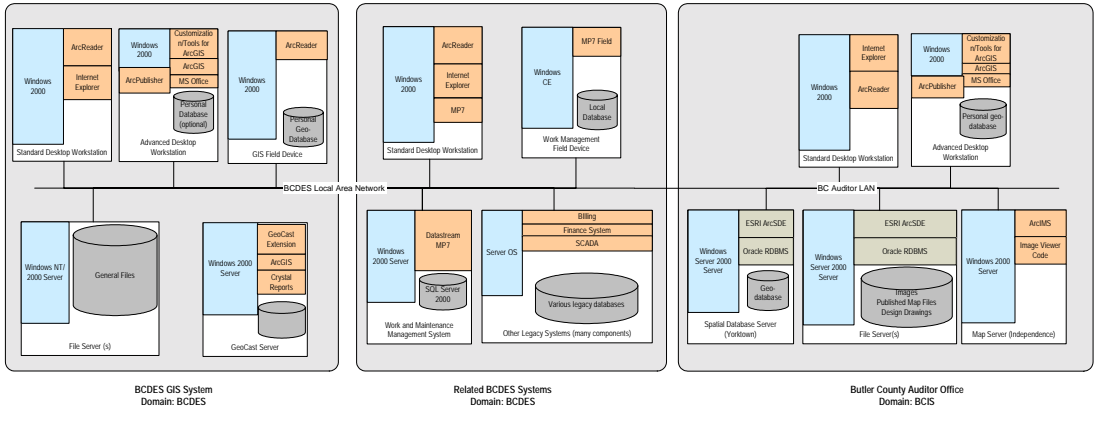
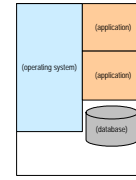
The project team used a structured approach, adapted from the Rational Unified Process (RUP) for software development, to produce an appropriate implementation plan for the GIS and associated organizational changes. The first step in this process was to establish the core Initial Conceptual Architecture (ICA) of the system. The purpose of establishing an ICA is to clearly define the target environment in which all development work will be deployed.

Evolution of the ICA was expected during application design and implementation, but core assumptions should remain constant. Figure 1 below shows the primary logical ICA components and their relationships. Where possible, specific applications and components have been named. For example, the ESRI ArcGIS application for desktop analysis was a known component.

BCDES established a business standard to use off-the-shelf ESRI software, configured to BCDES functional requirements, rather than deploying custom solutions. This reasoning behind this standard is that there is a need to coordinate with surrounding counties and utilities that are using ESRI software and BCDES did not plan to acquire staff to support custom development.

Figure 1 BCDES Initial Conceptual Architecture

BCDES Initial Conceptual Architecture



The functional components of the Initial Conceptual Architecture are described in the table below.

Component	Description
Standard Desktop Workstation	The standard desktop workstation services casual users that need view access to GIS data without heavy data processing. This component will be deployed with minimal client software cost (e.g. ArcReader). The standard desktop workstation has read-only access to data that is maintained by an advanced desktop workstation.
Advanced Desktop Workstation	The advanced desktop workstation is for users needing more complex data maintenance and processing capability. This environment supports several applications such as tracing and advanced geospatial analysis. This component was built on ESRI's ArcGIS Product Suite. This suite is a modular suite of GIS applications that includes ArcView, ArcEditor, ArcInfo and ArcGIS Extensions.
Field Device	The field device will be used by field staff needing map-driven data access while disconnected from the BCDES network. Two applications were evaluated—ArcPad with Windows CE tablet computer and ArcReader with Windows 2000 tablet computer. In the end, the ArcReader configuration was selected for field use. ArcReader enables field operations staff to have current infrastructure maps in a free reader application. Hard drive requirements are driven by the need for large numbers of scanned documents in the field. These 8,000 scanned documents are hyperlinked to the assets and available in the field.
Spatial Database Server	The spatial database server uses ESRI's Spatial Database Engine (SDE) to provide enterprise level spatial data access. The spatial database server supports data transactions including read and write operations, and works with DBMS replication services and backup utilities for spatial and tabular data resources. Indexing and caching algorithms provide high performance access to all GIS data sources.
Map Server	The map server component uses ESRI's ArcIMS to publish map products over the web. ArcIMS includes administrative and authoring tools to support a majority of GIS information product publishing requirements out-of-the-box. This software serves as the main information portal to GIS data stored in ArcSDE.
License Manager	This administrative service component is configured for license management of network-managed applications (typically floating licenses of ArcGIS).
RDBMS Server	A relational database management server (RDBMS) provides efficient, reliable, secure data management for high-end applications such as high volume on-line transaction processing (OLTP) environments, query-intensive data warehouses, and demanding internet applications. It includes a common set of application development features including SQL object-relational capabilities and programmatic interfaces for writing stored procedures and triggers. This system will be used to store information related to GIS features in the geodatabase Asset Register.

Applications and Procedures

The following four applications and procedures were developed as core components in the implementation:

- **ArcGIS - Facility Placement and Record Management**

This application manages the update and entry of water, sewer and storm water related features and attributes to the GIS. This is the primary maintenance tool for ongoing management of GIS information. This application includes the administrative components of posting changes to the production environment.

- **ArcReader - Enterprise Portal**

This application acts as the main point of entry for the GIS for most users. It includes functionality that allows query and view of features, thematic mapping, viewing facility schematics and printing of structured mapping.

- **ArcReader - Mobile Computer**

This application provides a portal that can be used by field personnel in either network connected or disconnected state to:

- View files related to a feature
- View and query features
- View facility schematics and related files.

- **Tools And Procedures To Import Contract Drawing To GIS Network**

The project team developed a standard document for layer naming and block attribution for engineering drawing submittals. This was primarily driven by the need to standardize and automate updates to the asset register in the GIS. Several options were investigated to convert/import developers' AutoCAD drawings into the ArcMap network. Following are the three solutions considered:

- **ESRI's CAD drawing import functionality.** ArcMap has the ability to seamlessly integrated AutoCAD drawing into ArcMap's existing network. It also allows user to display and query CAD data sets without first having to convert drawing files to the ESRI format. The limitation of this tool is that users can only convert/import one layer at a time. This is a very time consuming, thus it is not favorable for drawings that have more than one layer.
- **SAFE FME objects.** SAFE FME has significantly more functionality and associated license cost than what is required for BCDES for daily operations and was therefore not recommended for implementation.
- **Haested Methods GISConnect Software (Recommended).** This tool is very cost effective and has full functionality required for BCDES. Tools and procedures were written around out-of-the-box functionality.

With the asset register and associated application foundation investment in place, BCDES is prepared to move forward in business focused application development and system integration to support enhanced utility Asset Management.

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