Cloud Nine: Developing an Entirely Cloud Based GIS, Asset Management and Work Order System

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ABSTRACT

The Fort Bend County Levee Improvement District No. 2 (the District) tasked Freese and Nichols, Inc. (FNI) with the development of an asset management program for District facilities in May 2013. The first step was developing an asset management implementation plan with a GIS and work order system gap analysis. The second step was developing an asset inventory and geo-database, level of service targets and key performance indicators. The third step was implementing a new work order system.

The District employs a management consultant and primarily relies on cloud technologies for data management. The use of cloud technologies for data management is rapidly gaining momentum at progressive utilities like the District. FNI successfully migrated the District to entirely cloud-based technologies for GIS, asset management and work order systems.

KEYWORDS: Asset Management, Work Order System, Cloud Technologies, ArcGIS Online, Cityworks Online
INTRODUCTION

The Fort Bend County Levee Improvement District No. 2 (the District) tasked FNI with the development of an asset management program for District facilities in May 2013.

The District maintains an 11.2 mile raised earthwork levee (Figure 1) that serves as protection for over $4 billion in property and assets. As a levee district, it is vitally important to have a clear understanding of what assets the District owns, where exactly those assets are located, what condition those assets are in and what assets owned by other entities affect District assets. The District is progressive amongst levee districts in its desire to apply asset management principles to its facilities.

![Figure 1. ArcGIS Online map of District assets](Image)

The first step in the asset management program was developing an asset management implementation plan with a GIS and work order system gap analysis. The second step was developing an asset inventory and geodatabase, level of service targets and key performance indicators. The third step was implementing a new work order system.
The District is unique in that it does not have a physical office or dedicated staff. Instead, it employs a management consultant and relies on cloud technologies for data management. Typically, an organization’s server acts as the gateway between cloud technologies and an organization’s internal assets such as desktops and laptops (Figure 2). Because the District does not have its own server, all elements were developed solely for cloud environment technologies. A cloud-based GIS was developed on ArcGIS Online, a cloud-based document storage system was developed on FileCloud and a cloud-based work order system with mobile field device capability was developed on Cityworks Online.

![Figure 2. Interaction between Cloud and Server Technologies](image)

Through the efficient use of cloud technologies, the District is able to eliminate the cost of expensive software and hardware purchases while remaining on the cutting edge of technology. The final product is an entirely cloud-based, fully-integrated GIS, asset management and work order system. Use of the work order system will allow the District to function more efficiently and increase productivity.
METHODOLOGY

FNI performed a gap analysis of existing asset data, business practices and the work order system to identify enhancements required to facilitate implementation of the asset management program. The analysis identified the need to develop GIS of District assets and implement a new work order system to support their asset management program.

ArcGIS Online

FNI initially recommended the development of an Enterprise geo-database that would organize the data into base, water, sanitary, drainage and District datasets. However, the District envisioned strongly that the safest place to store their data was in the cloud where it could be accessed by any one at any time, especially during emergency operations. As a result, an entirely cloud-based GIS on ArcGIS Online was developed.

As part of the ArcGIS Online development, FNI completed the asset inventory and began field data collection. Using a data model developed by FNI, the Trimble R8 was used to collect field data and condition assessment information. In addition, photo documentation was included for each District asset.

After the District GIS was complete, FNI developed District mapping using ArcGIS. FNI developed District mapbooks to provide the District with a clear understanding of issues such as levee crossings by other entities. The location and utility type was clearly indicated on the mapbook pages (Figure 3). District maintenance crews performed a final review of the mapbooks before the information was uploaded to ArcGIS Online.

![Figure 3. Development of District mapping](image-url)
In addition to storing the physical location of its assets, the District requested to store all of its photos, as-builts and O&M manuals on ArcGIS Online. Because ArcGIS Online charges an annual fee per stored file, it quickly became apparent that storing thousands of photos, as-builts and O&M manuals on ArcGIS Online would have been an expensive storage solution. Instead, the District chose to store all attachments on FileCloud. Each asset in ArcGIS Online contains one or more links to supporting documents (Figure 4). When the user selects a specific item and clicks “More Info” in ArcGIS Online, FileCloud downloads that document. The user can then click on the downloaded data for immediate viewing (Figure 5).

![Image of ArcGIS Online linked to FileCloud](image-url)

**Figure 4.** ArcGIS Online linked to FileCloud
Cityworks Online

FNI proposed improvements to the existing custom work order system to allow the District to access as-built drawings, O & M manuals, warranty information and equipment manuals. The District chose to move to an entirely cloud-based work order system and mobile field devices using Cityworks Online.

Cityworks Online is designed to work with the ESRI local government model. This presented a challenge for the District since levee districts are not included in the ESRI local government model. FNI created a new asset group and feature types, FBCLID2, using the designer module in Cityworks Online. More than two dozen feature types were created in the final Cityworks Online designer module asset group and feature configuration for the District (Figure 6).

Figure 5. Example of picture stored for asset in FileCloud
Because Cityworks Online is designed to work with the ESRI local government model, there were no work order templates for preventative maintenance. FNI customized the software and developed preventative maintenance work order templates specific to each District feature type. Up to two dozen work order templates were developed for each feature type to capture the preventative maintenance activities performed for each asset. In addition, six work order templates were developed for the Flap Gates asset type (Figure 6).

Because the majority of preventative maintenance activities have a repeat cycle, the preventative
maintenance templates were developed incorporating repeat cycles to automatically generate future work orders based on work order completion dates (Figure 7).

RESULTS

Integration of Cloud Technologies

In order to integrate ArcGIS Online and Cityworks Online, FNI created and published a map service feature layer in ArcGIS Online. Cityworks Online uses this feature service to display the same ArcGIS Online map in Cityworks Online (Figure 8).

The assets from ArcGIS Online are each selectable in Cityworks Online so that a one to one relationship can be maintained between the District’s GIS and the work order system. Each work order is assigned to a specific asset using the unique asset identification codes created and stored in ArcGIS Online and referenced in CityWorks Online.

![Integration of ArcGIS Online and Cityworks Online](image)

Figure 8. Integration of ArcGIS Online and Cityworks Online

Creating a Preventative Maintenance Work Order in Cityworks Online

In order to illustrate how a preventative maintenance work order is created in Cityworks Online, the following hypothetical scenario is presented (Figure 9):
• Debris Removal is needed at the two highlighted flap gates indicated by the red circle at right.
• The user selects the two flap gates by clicking on them in the map displayed in Cityworks Online. A results box at top left provides all information that is known for those assets and stored in ArcGIS Online.
• Using the Details tab, the user can set the repeat cycle for the work and attach a “before” photo of the asset. After the work is complete, an “after” photo can be added.

Figure 9. Example of preventative maintenance work order in Cityworks Online

DISCUSSION & CONCLUSIONS
The use of cloud technologies for data management is rapidly gaining momentum at progressive utilities throughout the country. Through the efficient use of cloud technologies, the utilities will be able to eliminate the cost of expensive software and hardware purchases and maintenance while remaining on the cutting edge of technology.

This innovative project involved development of one of the first entirely cloud-based integrations of ArcGIS Online and Cityworks Online software in the nation. The project included business process analysis and optimization, including introductory workshops; development of functional requirements for ArcGIS Online and Cityworks Online systems; design and implementation of geo-database in a development environment; configuration of Cityworks Online in the development environment and integration of these cloud-based software with FileCloud, a cloud-based data storage solution. Mobile apps were configured for ArcGIS Online and Cityworks Online. Conclusion included admin and end user training and a supported technology go-live. The final product is an entirely cloud-based, fully-integrated GIS, asset management and work order system. Use of the work order system will allow the District to function more efficiently and increase productivity.