The Maintenance of Change: Developing Electronic Tools for a Dynamic Sustainable Asset Management System

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Many utilities today are beginning to understand the need for a robust computerized maintenance management system (CMMS) to more effectively manage their assets. Many of these utilities are instituting asset management systems in environments where no existing systems are in place. For those utilities, developing an effective asset management plan becomes two-fold: step one is to capture a snapshot of all the existing assets the utility currently owns, while step two is to ensure that the assets in the system remain updated as the utility changes and grows.

Holtz Consulting Engineers Inc. (HCE) was tasked to prepare an inventory of approximately 35,000 existing assets for Palm Beach County Water Utilities Department (PBCWUD) and a vast network of infrastructure to be added to its asset inventory software, Maximo. The PBCWUD has a network consisting of five water treatment plants, three wastewater treatment plants, several water and wastewater repump stations, rechlorination facilities, and approximately 1,000 wastewater pump stations. In addition to physically capturing the data, the scope of work included establishing the definitions of what would constitute an asset, establishing the data types for data collected on each of the assets, and what specific attributes would be collected for each asset.

To better manage such large-scale quantities of data, a variety of electronic tools were created that would allow users to collect existing data in a user-friendly format for upload to Maximo, in addition to electronic tools used by contractors during the submittal process to ensure that the existing database does not become obsolete over time.

Establishing the Data Structures and Definitions

The data collected on PBCWUD's existing assets needed to be useful and easy to manage; therefore, it was important that the data were given rigid definitions and structure. To ensure that that the data would be of value, a few key factors of an asset were considered:

- What defines an asset?
- How should the assets be structurally organized?
- What types are attributes are important for that asset or family of assets?

Definition of an Asset

Several meetings were held to establish the functional definitions of what would constitute an asset. These definitions are functionally useful for the purposes of PBCWUD, but can be very utility-specific. It was decided that an asset would be defined as follows:

1. Items that costs $1,000 or more.
2. Items that requires routine maintenance or calibration.
3. Items that are difficult to replace due to either long lead times or that require operational shutdown.

These definition criteria exclude spare parts or consumables that dramatically decreased the amount of data needed to be stored and managed and that wouldn't provide much useful information for capital improvements, analysis of day-to-day operations and maintenance, or procurement operations.

Asset Hierarchical Structures

Database structure can vary widely and is ultimately dictated by the purpose of the data collection. For PBCWUD's existing utility networks it was decided that data would be organized via two primary hierarchies: geographically and operationally. Using a two-system approach to database structure hierarchies ensured that data could be easily queried by a variety of different users searching for a variety of very different types of assets. For example, a wastewater plant manager may be interested in locating all assets associated with the replacement of a returned activated sludge transfer pump, while a lift station zone supervisor may be more interested in locating every pump that was ever installed at a specific lift station to see if force main pressures at that location have been causing pump lifetimes to decrease.

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Selection of Asset Attributes

In addition to capturing the assets themselves for input into Maximo, it was equally important that data specific to those assets were captured. This kind of asset-specific data is known as "attributes" and it was important that these attributes were tied to one specific asset via a unique asset identifier and that types of attributes could vary widely from asset to asset.

Attributes could be similar across asset types, such as manufacturer data, model numbers, or serial numbers, or could be very specific, such as size, frame, and horsepower for a motor.

Data Collection

Once a utility has invested in a CMMS and has established the data model of its database management system that establishes the structural hierarchy of how the data is to be stored, managed, and manipulated within the database framework, the next step is to collect the raw data that will be added to the system. This step can often be the most challenging for large-scale utilities that have amassed massive quantities of assets prior to the implementation of any centralized data management system. It's common for these utilities to have very few records of what assets they currently own, and frequently the records they do have are in data formats that are incompatible with each other, or are simply too inconvenient to be useful. For instance, old record drawings may be only available in paper format and are incomplete, missing, or faded over time; existing operation and maintenance manuals that were issued at the end of construction may not have been updated to reflect changes to the system; or larger utilities may have acquired assets from smaller or private systems without proper documentation.

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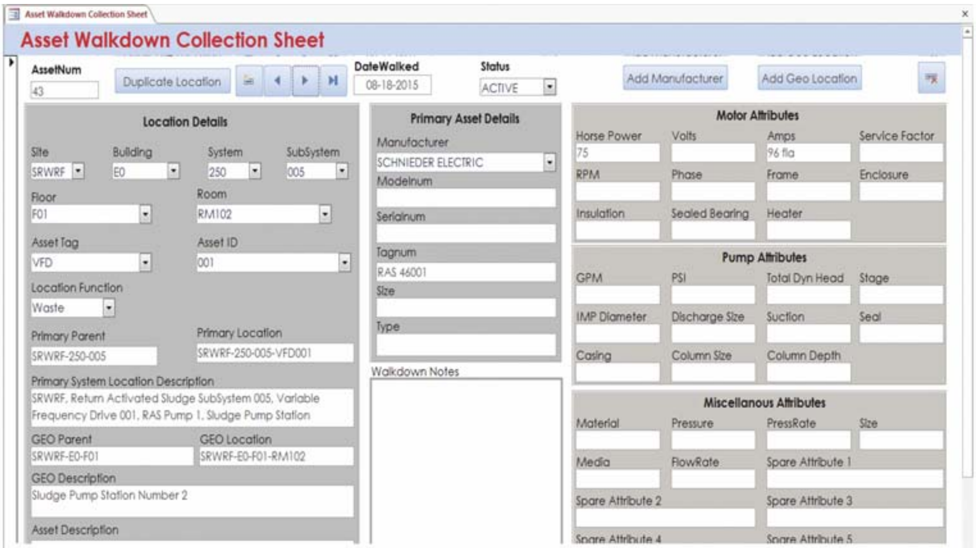

Figure 1. Microsoft Access Walkdown Collection Tool

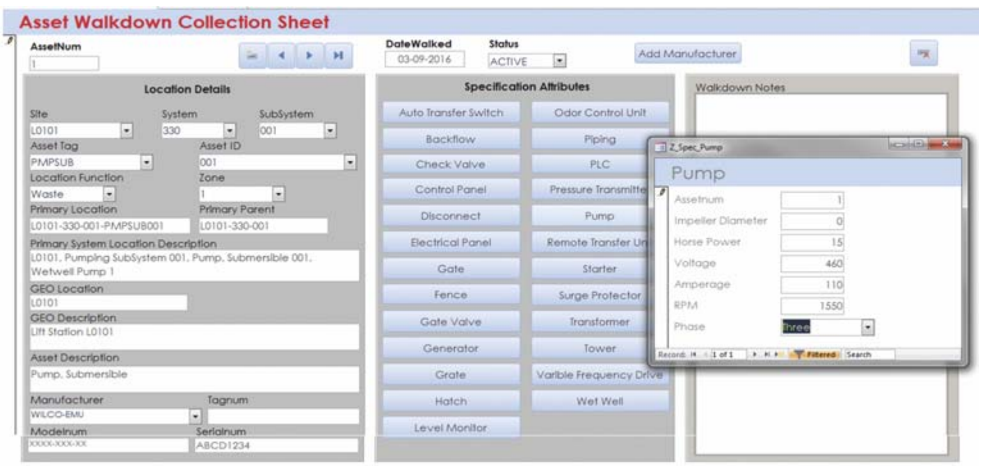

Figure 2. Modified Walkdown Tool for Lift Stations

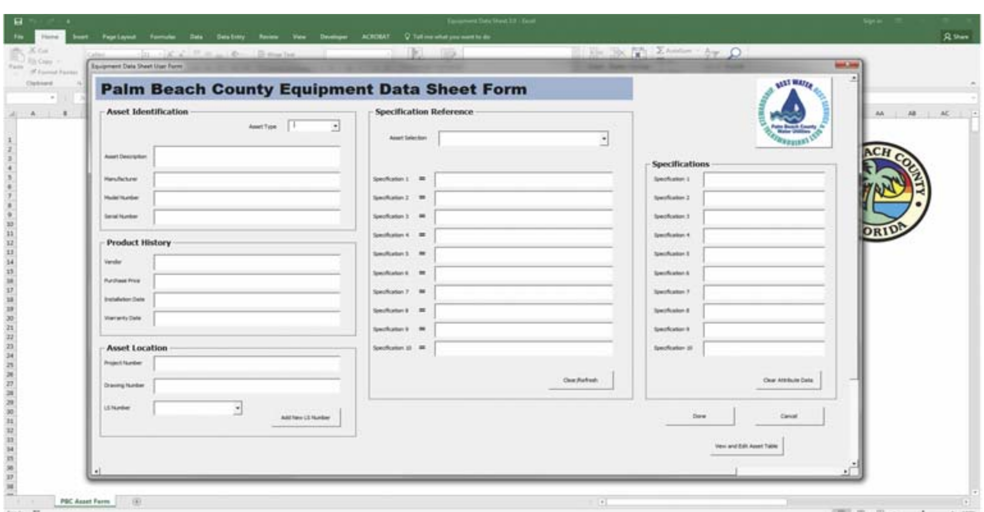

Figure 3. Blank Equipment Data Sheet User Form to be Completed by the Contractor

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Developing the "Walkdown" Tool

At the onset of the project, multiple teams of two (one engineer and one utility staff person) were deployed to "walkdown" each of the facilities, manually fill out asset data on paper, and then transfer that data to an Excel spreadsheet. The data were then sent to PBCWUD where they would need to be modified to fit the data structure that could be uploaded to Maximo. This process was inefficient and each time the data were transferred provided another opportunity to introduce transcription errors.

It was quickly recognized that without a new method of data collection, accurately collecting data on the existing assets in the PBCWUD system simply could not be achieved within a reasonable amount of time and effort. To streamline the data collection process, an electronic walkdown tool was developed, designed on a Microsoft Access platform, and loaded on Microsoft Surface tablets (Figure 1). This tool was designed as middleware that would allow a user to collect field data in a user-friendly format and then automatically "translate" that data into the data structure required for upload to Maximo.

Data collected for each asset includes system, location, asset tag, asset identification number, and various other data fields, depending on the type of asset. A pump's data field may include flow and head conditions, while a motor's data field may include horsepower and speed. Asset function was also categorized as either water, wastewater, or reclaimed water. Finally, the status of the asset was listed as active, inactive, or missing.

The data added into the tool automatically took a Maximo-ready form, meaning that data could be collected in the field, checked for quality assurance, and sent back to PBCWUD quickly and accurately with minimal human error.

Modifying the Walkdown Tool

One of the advantages of using an electronic data collection sheet is that it can be easily tailored to meet different collection types. Data collection at a water or wastewater treatment plant consists of a large variety of assets all located in one centralized area, whereas data collection for wastewater collection lift stations are opposite, with a small subset of asset types all spread out over a large geospatial area. Lift stations typically contain similar types of assets; therefore, a new tool was developed specific to lift stations that could highlight a smaller number of asset types in a much greater level of detail (Figure 2).

Data Maintenance: Electronic Equipment Data Sheets

Asset management systems that dynamically change in tandem with the utility as it grows are considered to be "sustainable," and developing asset management systems that are sustainable are critical to the success of that utility's organizational objectives, particularly for large-scale utilities with rapid growth. One of the biggest challenges to achieving a sustainable asset management system is how the utility will communicate with external influences that are relevant to the assets or asset management system, such as outside contractors, especially if existing procedures were not designed with CMMS in mind. New tools must consider how and when information is to be collected and analyzed, the type and quality of the data, and what specific unique attributes are required to fully describe the asset. Most importantly, the tools must be familiar, simple to use, and widely available.

One of the most common external influences to an asset management system is outside contractors; therefore, HCE's first approach to ensure that Maximo will remain sustainable was to develop an electronic equipment data sheet. This data sheet will be used by contractors performing work for PBCWUD to record new asset data and will be submitted by the contractor at the substantial completion phase of the project. This process will facilitate the transfer of new asset data into the existing asset inventory system.

The software used to develop the new electronic equipment data sheets needed to be familiar, easy to use, and widely available; for these reasons, Microsoft Excel was chosen as the platform for the initial design. The Visual Basic for Applications (VBA) was used to develop "user forms" that allow the contractor to input data on the assets to be added to the PBCWUD system. These data fields defined the assets identity (description, manufacturer, model, and serial number), product history (purchase price and warranty dates), and location (physical location and within the record drawing), as shown in Figure 3. In addition, a dynamic reference table was created so that the contractor can easily locate attributes on the asset that were specific to the asset type and important to PBCWUD. Attributes for a pump may include horsepower, impeller size, amperage draw, total dynamic head, and design flow rate (Figure 4).

As the contractor completes the electronic equipment data sheet, the information is sent to two separate locations: a viewable and editable table within the userform, and a hidden table elsewhere in the spreadsheet. By sending the data to two locations, the contractor can view and edit the assets in a user-friendly interface, while simultaneously, the assets are developing in a Maximo-ready format (Figure 5). This process greatly reduces the time and effort that would otherwise require PBCWUD to use a combination of record drawings and equipment submittal logs to compile information from the project, manually convert the data into a useful form, and upload it to Maximo. Large-scale utilities are constantly updating assets; therefore, the chances that information is missed or wrongly recorded using traditional data collection techniques is magnified greatly and could eventually diminish the usefulness and accuracy of the asset management system.

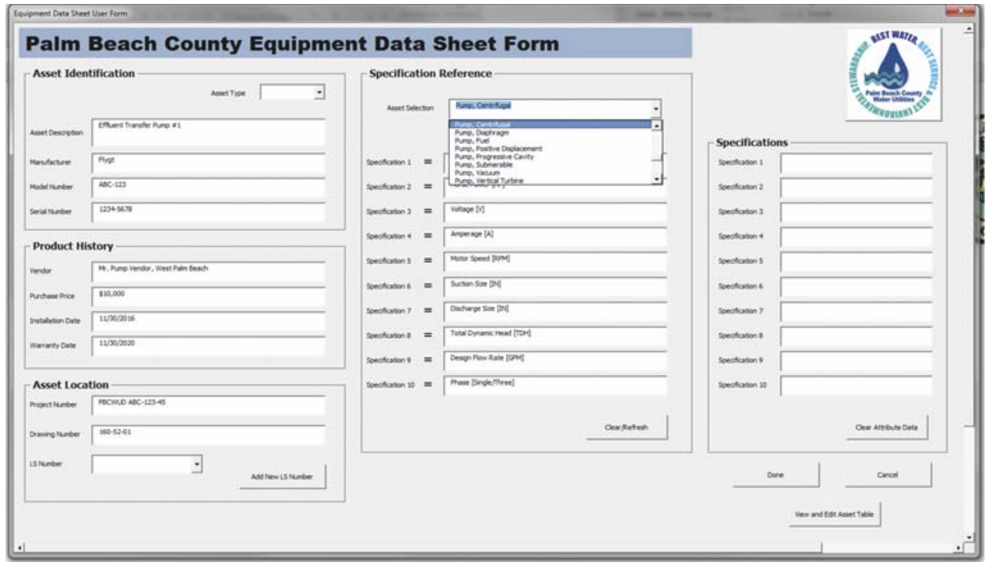

Figure 4. Dynamic Reference Table for Asset Attribute Specification

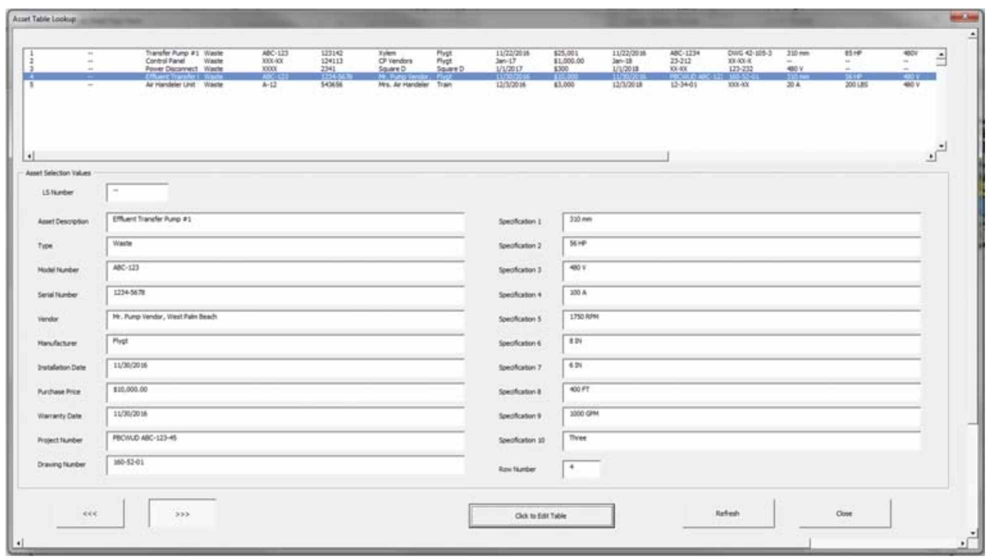

Figure 5. User-Friendly Interface to View and Edit Asset Data Within the User Form

Summary

It is well known in the world of water and wastewater utilities that, to reliably provide water and sewer services, it's imperative to have the right tools; building a successful CMMS program is no different. Electronic tools that aid in the large-scale collection of existing assets and tools that create the bridgework between internal asset management systems and external influences are the first step of many to ensure the sustainability and viability of an effective asset management system.