Selecting & Implementing a Comprehensive Asset Management System

Celine A. Hyer

Hillsborough County Water Resource Services (WRS) provides water, wastewater, and reclaimed water services to approximately 150,000 accounts (about 400,000 customers) in the county. WRS was formed in the 1970s, originally by the county's purchase of many small franchise utilities. In the early 1980s, it began a major construction program to regionalize the system into two service areas, eliminating all franchises.

Since then, the county has been growing from 3 to 4 percent annually, and most of the capital projects have been devoted to expanding capacity to meet demands. Currently, WRS manages over $1.2 billion worth of infrastructure, the majority of which may be approaching the end of useful life in the next 15 to 20 years.

Approximately eight years ago, WRS and its bond engineer identified the need to better plan for the renewal and replacement (R&R) of its assets. At that time, WRS created a 20-year capital program that included significant funding of R&R projects, significant rate increases, and major refinancing plans that allowed us to shift to a pay-as-you-go capital finance plan.

Five years later, WRS recognized the need to implement a new comprehensive asset management system (CAMS) to deal with upcoming aging infrastructure, predominantly reactive maintenance programs, and the wide assortment of software systems that did not communicate with each other. WRS worked with the bond engineer to formulate an advanced asset management strategy that included design and procurement of an enterprise-wide, sophisticated computerized maintenance management system (CMMS) as the heart of a larger CAMS.

This article outlines the strategic planning, design, procurement process, and ongoing implementation process for CAMS at Hillsborough County WRS.

Strategic Planning

Implementing a philosophy of asset management at a utility the size of Hillsborough County can be an overwhelming task. To begin the process, WRS formulated goals for the project that would tie into its mission statement:

"The mission of WRS is to produce, treat, and deliver quality potable water; to collect and treat wastewater and distribute reclaimed water in unincorporated Hillsborough County.

The mission includes providing these services in conformance with state, and federal regulations in an environmentally sensitive, cost-conscious manner utilizing contemporary quality processes to meet customer requirements."

Everyone saw that asset management tied into the cost-effective management of the assets from the existing mission statement, so no changes would be needed in the statement. On the other hand, the processes necessary to carry out this mission, including optimizing maintenance costs and renewal and replacement programs, as well as providing the performance data, would have to be included into the new CAMS. The following goals were also specifically set for the system so that staff had a clear direction as the project progressed:

1) Provide organization-wide systems developed, suited, and used by all sections and teams.
2) Define and inventory all WRS assets.
3) Maintain current asset information, including maintenance data.
4) Report asset information in a useful format for various management needs, including tracking performance.
5) Identify short-term (two to 10 years) and long-term (10 to 50 years) R&R needs and funding strategies.
6) Assist WRS in complying with upcoming CMOM regulations.

Evaluating Current Systems

As a beginning step in determining the Hillsborough County asset management system philosophy and implementation plan, the functionality of WRS's existing IT systems was reviewed. WRS utilizes Enquesta software (formerly Municipal & Utility Package Software, or MUPS) and ESRI GIS software for current asset management functions.

The primary function of the Enquesta (MUPS) software is to manage customer accounts and produce customer bills. Other modules such as accounting and financial, work management, and inventory are also installed and are used to some extent.

The work management module is based on facilities and equipment. About 1,000 facilities are currently set up within the database to track work to. Unfortunately, the system does not address linear or pipe type assets, and none are currently in the database.

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Work orders are generated for key work that is performed, but not for all work activities. The work is typically tied to a facility or area and not to a specific asset. Some standard preventative maintenance work orders are in the system, but they are closed immediately after printing and are transferred to spreadsheets to actually schedule and perform the work.

Compared to a current state-of-the-art CMMS system, the Enquesta (MUPS) system that was analyzed did not perform 23 of the 63 items evaluated and had partial capability on another 20 of the items. The company has plans to upgrade the software capabilities in the future to meet some of the deficiencies, but this upgrade would not be in time for the WRS's CAMS implementation schedule and would not have been tested at any other utility.

The ESRI GIS system is where WRS keeps all its linear asset locations and attributes, such as lines, manholes, valves, and hydrants. The GIS features, however, have not been geographically positioned with exact GPS coordinates, but have been positioned relative to the correct road right-of-way. Also, the GIS system is currently not linked to the Enquesta (MUPS) software.

The overall results of the analysis showed that the Enquesta (MUPS) software functionality would not meet the needs of a CMMS that would fulfill WRS's goals for the asset management program. Also, the GIS software would have to be interfaced with the CMMS system to bring in all the linear assets and attributes.

Workshops to Determine System Philosophy

WRS went through many workshops over a four-month period, led by the bond

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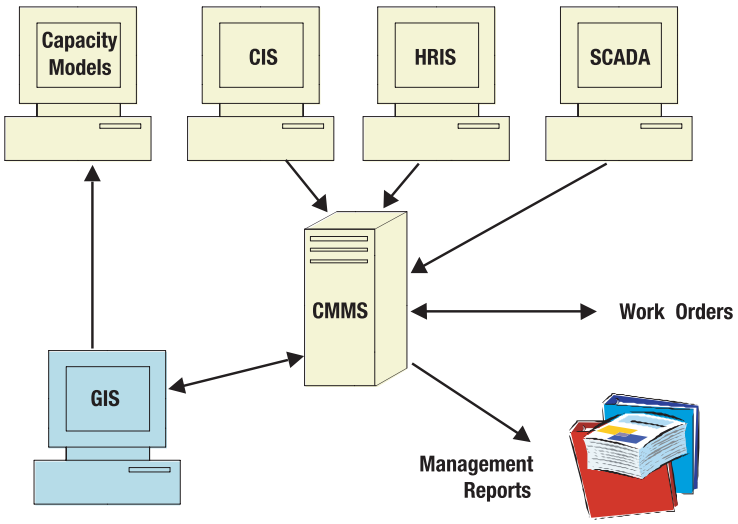

Figure 1 – Comprehensive Asset Management System Diagram Concept

Continued from page 54

engineer. These workshops involved the managers of the different sections to allow them to help shape how the new asset management program would function and how it could meet the needs of all the sections. The following items are important and should be discussed in depth by any utility beginning down the asset management road:

1) Roles and responsibilities should be discussed as to how each section or group would contribute to the maintenance of an accurate asset record and interface with the system.
2) Existing work processes and business practices should be examined and flow charted to determine how things are done currently and how things should be done in the future.
3) Staffing issues should be discussed related to employee skills, job classifications, and any potential union issues that may arise from job duty changes when asset management is implemented.
4) Standardizing processes between sections or teams should be discussed and implemented if possible to make the software implementation easier and less customized in the end.
5) Measures and benchmarks should be discussed to determine what data the asset management system must track to determine the performance of the utility.
6) The definition of an asset must be addressed so the computer program can be loaded with all current assets and so an inventory and condition assessment can be planned.
7) Preventative maintenance programs should be discussed and deficiencies noted.
8) Warehouse management must be addressed in terms of what parts will be assigned to work orders and how maintenance planners can see what parts are in stock for use and check them out.
9) Coordination with existing strategic plans or county policies should be considered so there are no conflicts.

After participating in these workshops, staff found a clear difference between how the plant facilities were doing maintenance work and how the line maintenance section was performing maintenance work. Staffing was also discovered to be different between the sections with different titles performing similar work. Some compromises were made to the work flows in an attempt to standardize processes between sections.

The workshops produced a diagram of what CAMS, the comprehensive asset management system, would look like (Figure 1); what the general asset hierarchy would be (Figure 2); and a starting definition of what would be considered an asset in CAMS.

The concept in Figure 1 is a computer architecture that would use CMMS as the heart of the application, interfacing with other systems and providing comprehensive management reports.

Figure 1 addresses the basic functional elements of the system:

1) Customer Service (CIS) will have a two-way interface to bring service requests into the CMMS program and to transfer meter installation data back to the CIS program.
2) Human Resources (HRIS) will have a one-way interface to bring all employees, classification, and salary information into the CMMS program to facilitate labor costing for work orders and projects.
3) SCADA will have a one-way interface to use run time and flow information to automatically trigger work orders for specific assets.
4) GIS will have a two-way interface to bring the linear assets into the CMMS system and to synchronize the attribute data for each.

A warehouse module within the CMMS system will have all parts stored in the inventory that are used to repair assets. GIS will interface with the existing water and wastewater models to provide the x, y, and z coordinates of the linear assets. Reports will be generated from the CMMS system for management and budgeting purposes, for tracking performance measures, and for benchmarking.

Unfortunately, the CMMS will not be able to interface with the county's financial and procurement systems because of restrictions by the clerk of the county court's office. This fact will cause some double entry and will not allow all WRS costs for operations to be captured in CAMS. In addition to computer architecture shown in Figure 1, WRS will also try a pilot program of mobile computing for field staff to use the CMMS system on handhelds or laptops.

Asset hierarchy is important and will be utilized within the CMMS system to relate assets to each other as parent to child, so that

Continued on page 58

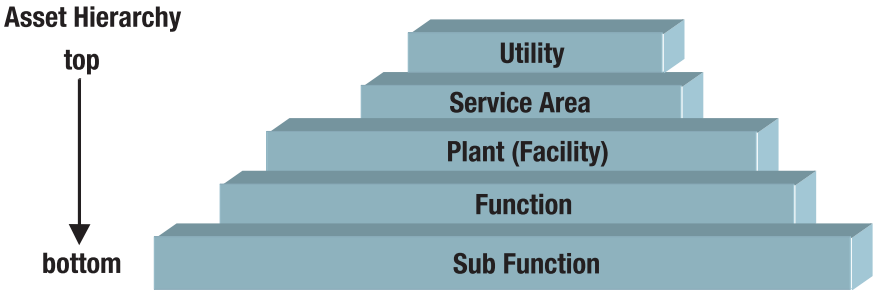

Figure 2 – General Asset Hierarchy Concept

Experience Description	YES?	NO?	Explanation (if needed)
1) Does the proposer have proven knowledge, experience and participation in the water, reclaimed water, wastewater, collection and distribution industry for the past five years?			
2) Does the proposer have verifiable documentation that it has a minimum of five years of fully functional projects providing CAMS solutions for water and wastewater asset management, work management, warehouse inventory management, and GIS integration?			
3) Can the proposed version of the CAMS solution be verified during a product demonstration as having been fully implemented and fully functioning (not beta or pilot installation) for at least six months?			
4) Is the proposer an authorized distributor of any hardware and software items that are being proposed?			
5) Does the project staff proposed to work directly on the project have a minimum of three years of experience in the implementation of information technology?			
6) Does key project staff have a minimum of one year of experience implementing the proposed CAMS solution?			

Table 1 – Minimum Experience Requirements

Continued from page 56

assets can be found easily by drilling down from the high level to the specific. This concept also enhances the reporting capabilities by summarizing data in levels.

Although it sounds fairly straightforward to define an asset, it is confusing because of the different opinions of the managers within the different operating sections. It is critical to create this definition, however, because it will drive the data to be loaded into the system, as well as how work orders will be issued and how inventory and condition data will be gathered.

On the financial side, WRS defines an asset as anything greater than $1,000 in value that will last for more than one year. On the operations side, an asset is seen as any critical item that needs to be tracked. On the engineering side, it is viewed most times as an assembly and not the small individual parts and pieces. On the CMMS side, it is the smallest item you will write a work order to.

For now, WRS has agreed to respect the $1,000 value, to consider items as an assembly (such as a valve, pump, meter, or hydrant assembly), to consider items that are typically warehoused for repairs as components or parts of the assets, and to break down plant equipment into its basic elements: structural, mechanical, electrical, and instrumentation.

Implementation

After determining the general system configuration, it was time to come up with an implementation plan for CAMS. The plan would be executed in three phases: 1) preparation of the RFP documents and vendor selection; 2) installation and configuration of the software, including dedicated staff involvement; and 3) inventory and condition assessment of assets. The second and third phases would overlap to provide accurate asset data as soon as possible for use in the new system.

Preparation of the RFP Document

WRS officials knew how software could be poorly purchased and implemented from previous experiences, so they worked with the bond engineer to prepare a very specific request for proposal (RFP) document that would be based on price and qualifications, instead of price alone, and could be used as the framework for the implementation process. To prepare the detailed RFP, a rigorous process of workshops was set up with internal user groups, including demonstrations of currently available CMMS software systems.

The RFP document carefully defined the exact functional software needs, minimum qualifications for the potential bidders, required interfaces to be built, exact workshops to be performed during implementation, specific plans to submit during implementation, hardware and software to be provided, data conversion from existing systems, specific reports that the system would have to generate, required pilot testing, required training, the desired timeframe for implementation, system acceptance criteria, and finally, how the proposal scoring would be completed. This was outlined in 64 pages of specifications.

Minimum Qualifications

Minimum qualifications included a table of 42 software functional requirements that must be available in the proposer's current software package. It also included required compatibility with existing county standard platforms such as Oracle, Novell Groupwise, Windows XP, Microsoft Office, and ESRI ARC IMS. Table 1 was used to determine the minimum experience requirements.

Proposal Scoring

In addition to the minimum requirement submittals, the proposers also were required to provide specific information on their overall project approach, a project schedule in Primavera or Sure Track, project experience for three past successful projects, qualifications of the key staff members, location of staff members and response times, a checklist of which 188 software functions could be provided out of the box versus customization, and pricing. Once proposers passed the minimum requirements, they would then be graded on the additional sub-

Continued on page 60

Award Criteria	Point Value
1) Software Functions (out of the box)	30
2) Cost	20
3) Project Approach	15
4) Project Staffing Experience/Expertise	10
5) Project Experience (Completed)	10
6) Project Schedule	5
7) Project Staff Location/Response Time (during implementation)	5
8) Software Licensing	5
Total	100

Table 2 – Scoring Criteria

WASTEWATER SYSTEM
MANHOLES

Attribute Name:	Possible Values:	Storage Location: GIS	CAMS
MH ID	Unique ID	X	X
SURVEY_X		X	
SURVEY_Y		X	
SURVEY_Z	Rim Elevation	X	
Barrel Diameter		X	
Barrel Material		X	
Liner	Y, N	X	
Bench		X	
Riser Diameter		X	
Riser Material		X	
Frame/Cover Type	A, B, C, D (to be defined by the COUNTY)	X	
Surface Type	Pavement, Short Vegetation, Trees, Water	X	
Subdivision		X	
Location/Address		X	
Installation Date		X	
Project As-Built Sheet Number	"the 'C' number" to provide link to image	X	
Utility Service Area	Wastewater	X	
Function	Collection	X	
Sub-Function	Gravity Main	X	
Video Filename	Provides link to video and related info.	X	
Environment	ROW, Yard, Easement, Parking Lot, Fenced-Accessible, Fenced-NonAccessible	X	
Rim Height	Height above or below Z grade elevation	X	
Description			X
Equipment Type	Manhole		X
MACP Defect Codes	See draft MACP	X	
Internal Structural Condition Grade	1, 2, 3, 4, 5		X
O&M Condition Grade	1, 2, 3, 4, 5		X
Construction Condition Grade	1, 2, 3, 4, 5		X
External Factors Grade	A through I		X
Structural Grade	1, 2, 3, 4, 5		X
Comments			X

Table 3 – Asset Attributes to be Collected for Manholes

Continued from page 58

mittals according to the criteria listed in table 2.

The overall selection involved a three-step process. Step one included a review of the written proposals. Step two included an oral presentation and a software demonstration. Step three included site visits to working installations. During each of the steps, the scores for the various topics could be adjusted as additional information was learned.

The decision to select the contractor carefully and the three-step selection process took more than six months, but it was well worth the time invested to insure that a CAMS system would be chosen that would best fit WRS's needs. Synergen, now SPL EAM, was the solution selected from the scoring criteria.

Software Installation & Configuration

Beginning the software installation and configuration was easy because of the detailed submittals required in the RFP, the first being the overall project implementation schedule and plan. The plan included all required configuration workshops, interface development, hardware installations, data conversion, training, pilot testing, and full rollout requirements. A listing of the required submittals in the RFP includes the following:

- ☐ Implementation Plan
- ☐ Database Configuration Requirements
- ☐ Mobile Computing Implementation Plan
- ☐ Bar Coding System Implementation Plan
- ☐ Interface Functional Requirements for Each Interface
- ☐ Configuration Workshop Schedule
- ☐ Configuration Testing Procedures
- ☐ Configuration Checklist
- ☐ Pilot Testing Plan
- ☐ Pilot Test Checklist
- ☐ Training Plan
- ☐ Converted Data
- ☐ Facility Installation Checklist
- ☐ Acceptance Checklist

Staffing the team members from WRS's side was the most challenging aspect of participating in the installation and configuration of CAMS. It required dedicated staff for many days from the various sections so that all WRS operations are covered and also buy-in to the finished system.

An implementation team of 12 members participated in workshops about two weeks out of each month for two years. A four-member project management team was established and met monthly to go over the implementation plan progress and address any problems. This is a large investment in staff time, but it will be worthwhile in the long run.

There is also a dedicated CAMS office set up outside WRS's locations so staff members are not disrupted by daily duties during the workshops. Currently they have completed about 99 percent of the software implementation without any major issues.

Surprisingly, one of the biggest issues during the installation and configuration was the existing GIS database, structure, and attributes. WRS personnel went into the project thinking they had a great GIS system but learned that the way technicians entered the data wasn't standardized. Also, data conversion from a previous system has left them with a few problems.

Since all the linear assets need to be created in GIS, the system must be very rigid in defining what an asset is. This had not been an issue in the past. The WRS definition of an asset for pipe includes change in pipe diameter, material, or relative age.

GIS modifications have been completed and assets have been interfaced successfully over to the SPL EAM software. Additional clean-up of the asset attributes is ongoing as the inventory and condition assessments progress.

Asset Inventory & Condition Data Gathering

The third phase of the project includes an inventory and condition assessment of

Continued on page 62

Continued from page 60

assets that will load into the new system. Any system is only as good as the data that resides in it. WRS determined that the data on assets or facilities in the current Enquesta (MUPS) system was questionable and that the data in the GIS system is missing many desired attributes. Because of these deficiencies, approximately $15 million was set aside to perform an inventory and condition assessment on the water, wastewater, and reclaimed-water assets.

Also, in anticipation of CAMS, WRS spent about $200,000 in 2003 on an aboveground inventory and remaining useful life assessment of its plant and lift station assets as a supplement to the annual bond engineer inspection. This inventory and assessment addressed approximately 10,000 assets, while GIS brought over about 150,000 linear assets into the CAMS system.

The inventory and condition assessment has been divided into three pieces, based on the different types of assets and inspection methodologies that exist today. These pieces include 1) an inventory and condition assessment of the manholes and gravity lines, 2) an inventory and remaining useful life assessment of aboveground appurtenances, including all valves, hydrants, and large meter assemblies, and 3) an inventory and remaining useful life assessment of all pressure mains in the system.

For each of the asset types, WRS has created a comprehensive list of attributes that it wishes to collect and store or update in either the GIS or CAMS database. An example of the manhole attributes is shown in Table 3. A similar table has been formulated for gravity pipe, pressure pipe, valves, hydrants, low-pressure pump systems, wastewater cleanouts, and large meter assemblies.

Conclusions

The asset management system design and selection process is working as planned. The project is a multi-year effort with the following main tasks: initial work planning; workshops to familiarize staff to software capabilities; workshops to develop new business processes around the software capabilities; identification, integration, and data migration; software installation and configuration; pilot testing; training; and full rollout, only after the system is approved. An inventory and condition assessment project is running in parallel to load the new system with the best data possible.

This overall process was designed to provide two basic benefits: 1) to allow the contractor to best tailor its CMMS system to the needs of WRS and 2) to train staff in advanced asset management, which is a complete organizational paradigm shift. WRS is very satisfied that it put in the extra time and effort to prepare the strategy and goals for the project, prepare a very detailed RFP, and select the asset management solution based on a combination of price and qualifications.

The configuration and installation has proceeded as planned with no major issues. Some minor issues regarding the database configuration and the definition of an asset in the existing GIS database were encountered and were solved. The most difficult task during the process has been dedicating staff from each section to participate in workshops while maintaining WRS operations.

Because staff has been allowed the time to ask questions and provide input into the creative process, the overall commitment to change has skyrocketed. The workshops became a place where once-isolated sections are could actively work out solutions to problems that have existed in WRS for years. The project has successfully fulfilled its first goal: to provide an organization-wide solution that will be utilized by all sections. WRS is confident that the other goals will also be met as the project heads towards completion.