Designing an Asset Management System

Michael P. Smith, Michael W. Lovett, and John T. Caldwell

Many water and wastewater utilities in Florida are beginning to understand the need to develop a good asset management system (AMS). Fixed-asset management is a requirement in the upcoming U.S. Environmental Protection Agency's capacity, management, operations, and maintenance (CMOM) rule.

Some utilities are recognizing the benefits provided by the enhanced data management and reporting capabilities of computerized asset management systems. The new reporting capabilities meet the reporting requirements of Governmental Accounting Standards Board Statement Number 34 (GASB-34). These software databases can track assets based on either the standard depreciation method or modified approach defined in GASB-34.

There are practical reasons for utilities to invest in computerized asset management systems other than just "meeting the regs." There are benefits that supervisors, managers, directors, and elected officials can realize from a properly designed, comprehensive, integrated AMS. Developing a new AMS provides an opportunity to enhance work processes, integrate various "islands of information," and develop reporting mechanisms that provide timely information for managerial decisions.

What is Asset Management?

Asset management is a general term with many different meanings, depending on which governmental agency is using it. The clerk considers asset management the appropriate recording and reporting of assets in accordance with generally accepted accounting principles. The finance director considers asset management a strategic financial plan. The utility director thinks of his or her job, and maintaining the utility's infrastructure in good working order. The utility supervisor thinks of a work order system that helps plan and control resources and equipment. The information technology (IT) director sees asset management as another enterprise-wide, integrated suite of computer software and hardware requirements.

Obviously these are simplified representations, but they illustrate the difficulty in discussing a topic that is so broad. Since all of these agencies have policy criteria they are responsible to meet, designing an AMS must consider all criteria in order to be useful and successful.

The AMS's primary function is to enable a utility to manage its infrastructure and plant assets based on an asset management plan. This function requires an accurate understanding of the utility's assets, their condition, and their replacement value. It also requires an understanding of which business practices associated with asset management can be continuously improved; what the priorities and risks are; what improvements are needed to optimize the use and extend the life of the assets; and how to most effectively fund the assets' maintenance, refurbishment, and replacement.

The asset-management process includes periodic audits of all process elements to achieve at least the following five objectives:
• Meet utility-wide goals.
• Reduce and anticipate asset-related costs.
• Meet required service levels.
• Conduct asset-related procedures as planned.
• Update and improve asset plans properly.

What is an Asset?

A utility acquires long-lived, fixed assets to provide water and/or wastewater service to its customers. These assets include pipes, treatment facilities, tanks, pumps, buildings, and a variety of other pieces of equipment that have a useful life greater than one year. Agreeing on the definition of an asset will be one of the liveliest discussions utility managers will have as an AMS is designed. Since most currently available asset-management software is designed to handle a wide range of assets, utility managers should not waste much time defining them.

The important thing to remember is that a water and wastewater utility has two basic types of assets: equipment/facilities and piping infrastructure. Piping infrastructure includes water transmission and distribution piping, as well as wastewater collection and conveyance (force) mains. Equipment and facilities are generally all above-ground assets associated with treatment plants or facilities, but can also include below-ground pump stations. On average, the utility's asset value will be one-third equipment/facilities and two-thirds pipe infrastructure.

The average useful life of equipment/facilities ranges from 15 to 30 years, while the average useful life of pipe infrastructure ranges from 80 to 120 years. The strategic infrastructure and financial planning associated with these two categories is significantly different. Operations and maintenance strategies vary for these asset types as well. Further categorizing assets into an asset classification hierarchy is helpful to utility managers for planning and implementing asset management. A utility should establish an asset classification scheme as part of its strategy for implementing a new AMS.

Michael P. Smith, P.E., DEE, is an associate and senior project manager with CDM in Tampa. Michael W. Lovett is a senior project manager of information management services with CDM in Orlando. John T. Caldwell, P.E., is a project manager of enterprise business consulting with CDM in Orlando.

Proactive Planning of Asset Renewal and Replacement

Probably the most important benefit of a properly designed AMS is the ability to plan proactively for the renewal and replacement of utility assets. Many utilities expanded and built new water and wastewater facilities during the late 1970s and early 1980s to meet new regulatory requirements and increased demands. The federal government provided billions of dollars worth of grant funding for these utilities, with additional funding assistance from the state revolving fund program.

Now, some 25 to 30 years later, utilities are beginning to experience the growing pains of replacing their facilities. Estimates by the federal government and other interested parties indicate that funding renewal and replacement (R&R) projects will cost in the hundreds of billions of dollars over the next five years. State and federal governments have no budgets to deal with half the expected capital needs, putting considerable pressure on the utilities to properly plan for R&R projects in the near future.

The utility manager or director who wants to stay ahead of the R&R curve has a number of traditional methods and several new concepts to apply to the problem. A comprehensive, integrated program of structured planning, financing, and delivery of R&R projects will now become a factor critical to the maturing environmental utility's success. Proactive planning allows a utility to use a pay-as-you-go method to finance R&R projects, rather than costly debt-service methods. Over the long run, this approach can mean lower rates for utility customers.

It is important to start the discussion

Continued on page 36

Continued from page 35
about R&R planning with a few simple definitions, since similar terms may have different meanings to people. An ***operations and maintenance (O&M)*** activity or project allows an asset to meet its intended useful life. This may include changing glands and seals, regular lubrication, maintenance of coatings, etc. O&M projects are typically funded and performed by a utility's operations and maintenance division.

A ***renewal and replacement*** project is one that replaces or renews part or all of the asset or facility to keep it in service. Building a new facility to meet growth demands or expanding an existing facility is considered a ***capacity expansion*** project. Projects that are required to meet new, more stringent regulatory requirements are considered ***upgrade*** projects. ***Expansion and upgrade*** projects are easily recognized as capital improvement projects, or part of a utility's capital improvement program (CIP) delivery system, which is typically funded in a CIP budget and delivered by engineering or technical support staff. A capital improvement project improves an asset or system by one or a combination of the following:

1) extending the useful life of the asset or system for more than one year beyond its original design service life,
2) adding to the value of the asset or system, or
3) improving the system by providing better service capability or capacity.

By these definitions, it is clear that R&R projects can be considered CIP projects.

Proactive planning for R&R requires a comprehensive or strategic view of the utility's business. It starts with creating and maintaining an accurate record for each major asset in the system. The asset record should contain an accurate accounting of the installation date and cost, and a good estimate of the asset's useful life at a reasonable level of categorization or detail.

A utility can implement an asset valuation process or program to upgrade asset records if one was not created or maintained. Utility engineers must carefully follow CIP project closeout procedures to capture accurate information into the record. From the asset record, which should be computerized, planners can regularly obtain reports of assets by category that are within the last five years of their useful lives.

Regular inventories and inspections of the utility's facilities should be used to verify the record and observe the actual condition of the assets. Feedback from O&M staff during regular inspections is crucial to prioritizing R&R projects. The planners can then generate a prioritized list of projects that need renewal or replacement in the next two to five years, allowing utility staff time to determine how R&R projects will be funded and delivered.

Financial planning starts with recognizing two basic types of R&R projects: planned and unplanned (emergency) R&R. The utility should also establish user rates so a percentage of the revenues are reserved up to a set amount established for both types of R&R projects (revenue bond covenants typically prescribe the amounts that should be reserved, but these should be viewed as minimum amounts since they may not meet the needs of a maturing utility). Funds for both R&R project types should be replenished until the utility's set amount is achieved.

The planned R&R fund should be gradually increased at the beginning of the life of the utility, generally in relation to the expenditure curve that can be derived from detailed asset information (e.g., install date, historic cost, and useful life). Eventually, the planned R&R fund will reach a steady-state amount equal to the utility's replacement-cost-new divided by its cost-weighted useful life. Several methods of computing this amount are available to the utility manager. Emergency funding should be based on a variety of factors and should include input from various sources, including the utility's risk manager.

A project's size and complexity and a utility's capabilities will determine who will be responsible for delivering the R&R project. A very large or complex R&R project (greater than $200,000 or multi-year projects) would typically be budgeted and delivered by the utility's standard CIP delivery system. Small projects not capitalized for simplicity's sake (less than $5,000 to $10,000) that do not require any engineering evaluation can be budgeted in the O&M division and delivered by the maintenance staff, if possible.

A large percentage of R&R projects will fall within the $5,000-to-$200,000 range. A normal CIP project takes from two to five years to plan, design, and construct, which is too long for most of these types of R&R projects. In addition, the "lean and mean" maintenance staff is probably not capable of providing for this size and number of R&R projects consistently.

A master project concept, which is a CIP project used to set aside money for multiple, simple, and similar projects, can be used to budget for and deliver this project type within one year. The master project team can identify, prioritize, and deliver any of these simple projects during a fiscal year, using the master project's budget if the simple project meets eligibility criteria. This speeds up the delivery of simple R&R projects to less than one year and allows for strategic planning of R&R budgets. When any R&R project is completed, the old asset can be removed from the asset record and replaced with new asset information, restarting the cycle.

Balancing the needs for corrective and preventive maintenance versus asset renewal and replacement is the heart of good asset management. The current state of computer hardware and software makes it possible to track the enormous volume of information needed to allow utility planners to optimize asset management expenditures. Utility management, in the future, will be judged by how well and efficiently it balances and optimizes maintenance versus R&R costs.

Asset Management System Development Strategy

An obvious starting point for designing an asset management system for a water or wastewater utility is to develop a strategy. A project of this nature is comprehensive and involves all of a utility's sections or divisions, as well as other governmental departments. Key elements of an AMS development strategy include:

- identifying project goals and objectives
- developing the AMS scope
- identifying the design groups
- developing the implementation strategy
- developing a change-management strategy
- developing budget costs and schedule

An asset management strategic plan should include the AMS design strategy's development.

Project Goals and Objectives

The project team should be careful to distinguish between AMS project goals and asset management program goals. Most likely, the utility has already identified some general goals for its O&M and capital projects sections. These should be reviewed when identifying the AMS project goals. When designing the AMS, the program goals may change, depending on feedback from the design team about work processes and software capabilities. After the AMS is in place and operating, utility managers can modify other goals related to the utility's performance measures.

Scope of the Asset Management System

A computerized AMS can range in complexity from a set of electronic spreadsheets to a sophisticated suite of integrated software packages, including a geographic information system (GIS), work management, human resources, billing, customer service, supervisory control and data acquisition (SCADA), finance, purchasing, and other software systems. Deciding on the AMS's scope can be difficult and requires an understanding of existing technology available, existing systems in use by the utility, and level of efforts needed to modify the AMS. This is sometimes called a gap analysis, since the utility is analyzing the gaps between its existing and desired system capabilities. At this point, the utility is trying to identify basic system requirements, not a detailed definition of all functional and technical requirements.

Detailed requirements are refined as part of the design process. Some of the basic requirements that will determine scope include:

- How does the utility want to account for its maintenance costs?
- Where will the asset record reside? In what form?
- Will it be an enterprise-wide system? Over the Internet?
- Will it be a stand-alone system or integrated with other software systems? Which ones?
- Will it be GIS-based or an integrated system?

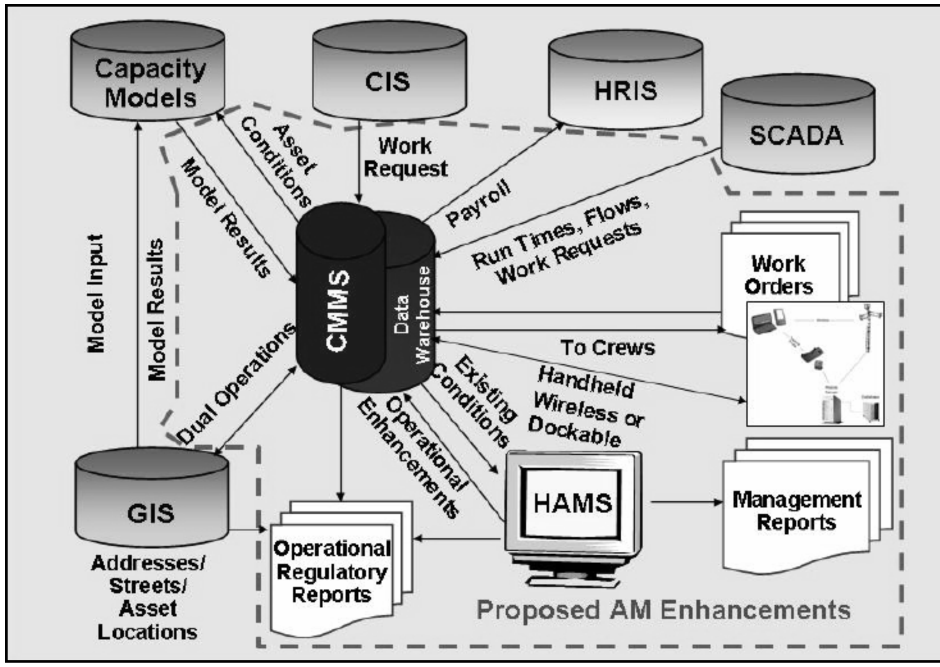


Figure 1
AMS Integration with Current & Proposed Information Management Systems

Figure 1 shows the common integration elements for a utility's AMS. The technology's current state is such that most efficient AMSs are now enterprise-wide capable and use a browser-based technology over the enterprise intranet. High-end AMSs now provide for the integration of GIS data to effectively address the mapping component of CMOM requirements. Once the GIS is integrated, it is easier to include a direct interface to a capacity model, which will directly address the system capacity issues of CMOM.

The integral part of an AMS is the system's ability to allow for the proper maintenance and accounting of maintenance costs associated with the assets. The core products that perform these activities lend themselves for inclusion to the overall AMS and are referred to as computerized maintenance management systems (CMMS). The CMMS, if properly interfaced with the enterprise human resource information system (HRIS) and information from detailed accounting from the parts warehouse or direct purchasing will allow for economical job costing of the maintenance work performed on an asset.

Direct collaboration with the IT department will help better define the enterprise's ability for providing what level of support the IT infrastructure can provide to the overall AMS.

Design Groups

A utility can center the AMS's design on a request for proposal for computer hardware and software systems to implement the desired AMS; however, the computer hardware and software systems alone may not enhance the utility's operations sufficiently to meet the stated asset management program goals. Most utilities may need to modify work processes in coordination with the strengths of the selected asset management software to realize the real benefits of an AMS enhancement.

The design team for the utility's AMS should be divided into three groups: the steering committee, the main design group, and the functional group. At a small utility, these three teams may consist of the same people; at a larger utility, they may be several representatives of different departments. **Figure 2** shows a design team makeup for a medium-sized utility and defines the responsibilities of each group. For the purposes of this article, a medium-sized utility is a water and wastewater utility that serves from 100,000 to 250,000 customers.

Implementation Strategy

An implementation strategy needs to be developed as early in the project as possible. The strategy may be modified as the project progresses through design, but the main elements of the strategy will help the utility decide on the project's overall scope and thus its cost and schedule.

Implementation is the actual process of installing and starting up the new system. It begins in the latter stages of design. Implementation strategy elements include:

- determining how to choose the right solution
- determining how to procure hardware, software, and a system integrator
- defining the role of the system integrator
- determining if there will be a pilot program
- establishing the warranty and startup policies
- determining how to acquire asset inventory and condition assessments
- establishing how to populate the AMS

Change Management

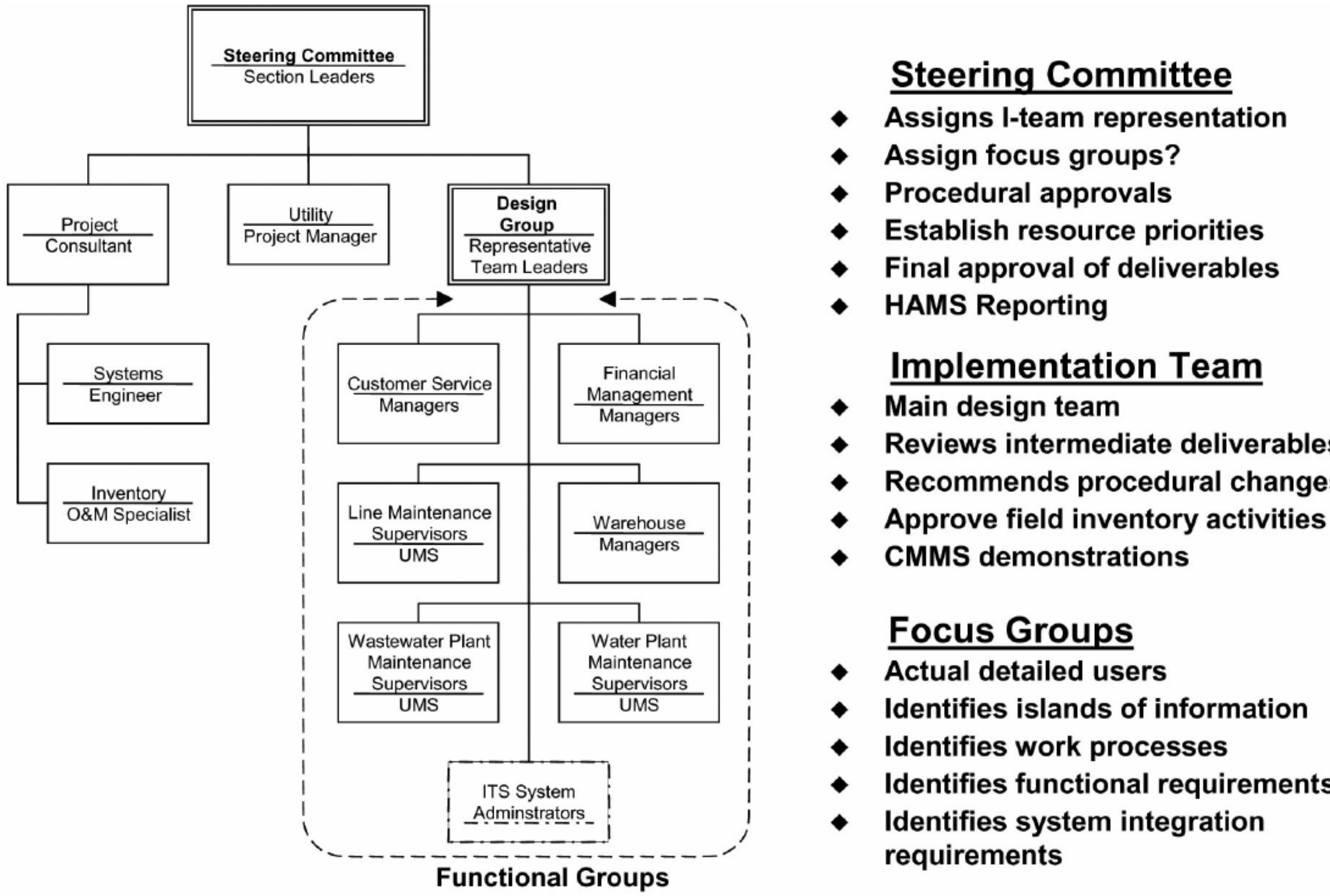
Employees should be informed of any forthcoming changes in their roles as early as possible. A project communiqué should be developed and distributed to all affected employees when implementing the AMS. Those who are directly involved in the AMS's design should talk about the project's progress to their employees. Employees should be solicited for input to be sure that management or mid-level management are informed about what the staff currently likes about how work is being done (if it ain't broke.....) and to provide them an opportunity to create their own wish lists for improvements to help them do their jobs. When producing documents, provide staff an opportunity to review and comment, again to solicit input. This approach is highly effective when managing change, which most people have a hard time accepting.

Budget and Schedule

No good project strategy is complete without a good estimate of cost and schedule. Costs will vary depending on a large number of factors. The budget table shows some of the elements that should be included in the cost estimate:

Continued on page 38

Figure 2
Typical AMS Design Team



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Budget

System Design	$ 300,000
RFDRFP Development	$ 75,000
Vendor Procurement	$ 50,000
Installation & Configuration	
- Hardware/Software..........	$ 1,600,000
- Implementation	$ 1,900,000
Pilot Testing & Acceptance	$ 175,000
Training..............................	$ 125,000
Full Role out	$ 70,000
Maintenance & Support	$ 90,000
AMS System Total	**$ 4,385,000**

It is important to delineate between "project" costs and operational costs. Line items such as training, maintenance support, and customization may extend longer than the project's duration. It is recommended that the design team decide on a time frame for the project and include all costs associated with these line items during the chosen time frame in the project costs. Any costs after the project time frame would be considered operational costs and should be included in the utility's operating budget.

The project schedule can be estimated at the strategic stage into the basic elements shown in **Figure 3**. The time frame for a medium-sized utility to implement an AMS enhancement project will range from two to four years, depending on a number of factors.

Asset Management System Design

The actual AMS design can be divided into the following major elements:

- work process development
- functional requirements development
- system integration requirements development
- implementation requirements development
- request for qualifications/request for proposal development

Work Process Development

Understanding work processes a utility uses to maintain and record asset maintenance is required to design a system that can cost-effectively maintain accurate asset information. Many work processes have to occur in order to install, operate, maintain, rehabilitate, and replace an asset. Some examples of work processes include:

- capital project delivery activities
- equipment/facility maintenance
- piping infrastructure maintenance
- corrective/preventive maintenance
- warehouse inventory
- customer complaints
- meter management activities

There are a series of activities that occur from the time a potential maintenance need is recognized until the work required can be quantified and described through the creation of a work order. Once a work order is issued, there are numerous steps that have to occur in order for it to be acted on—these include obtaining parts, scheduling work, and scheduling and planning other activities. Some of these process activities are similar for different sections of the utility, while others are quite different. Some rely on other processes and must be coordinated. **Figure 4** shows an example work process for preventive maintenance.

The purpose of the work process development task can be subdivided into the following activities:

- identifying existing work processes
- identifying key roles and responsibilities
- developing proposed work process modifications

The design team's functional groups are the key team members in identifying existing work processes. The members of the functional groups are the individuals who should actually accomplish the work. A utility can create workflow diagrams to represent the work processes. These existing workflows can then be reviewed with the design group to iron out any inconsistencies and identify common roles and responsibilities.

Once the existing workflows are identified, the design group can begin to develop the proposed work processes. The steering committee should address and/or approve policy change issues. It is important not to spend too much time at this point on the design. Many changes will still occur when a particular software application is chosen. The primary purpose at this point is to identify what sign-offs should be required and who should do the approvals.

Functional Requirements

Developing functional requirements is the next step when designing AMS enhancements. Functional requirements differ from work processes in that work processes are "what we do or should do" and functional requirements are "how we do it or want to do it." The functional requirements can be broken down into various categories, including:

- IT requirements
- warehouse and inventory requirements
- maintenance requirements
- management requirements
- reporting requirements

The purpose is to identify how a utility wants its AMS to function. A functional requirement example might be: "The AMS must have the ability to allow the prioritizing of maintenance tasks based on critical equipment designation." Functional requirements are used to help define the AMS's operational capability. Some functional requirements can be generalized since most vendors supply the same functions, but others are tailored to the individual needs of a utility.

Functional requirements are intended to judge and quantify how different AMS solutions suit the needs of a utility by comparing vendors' responses when asked if they meet the functional requirements list. Vendors should be judged on whether they completely or partially meet each functional requirement, or if they should identify the level of effort needed to satisfy the requirement. The goal of the procurement process is to select a software application that BEST suits the functional requirements of a utility with the least amount of customization.

System Integration

System integration develops the interface requirements between the new AMS and existing computer applications. This task will vary from utility to utility, depending on the strategy for integration established above. The utility's IT department should provide the major input for this task, since it will most affect the overall operations and maintenance of the utility's IT system.

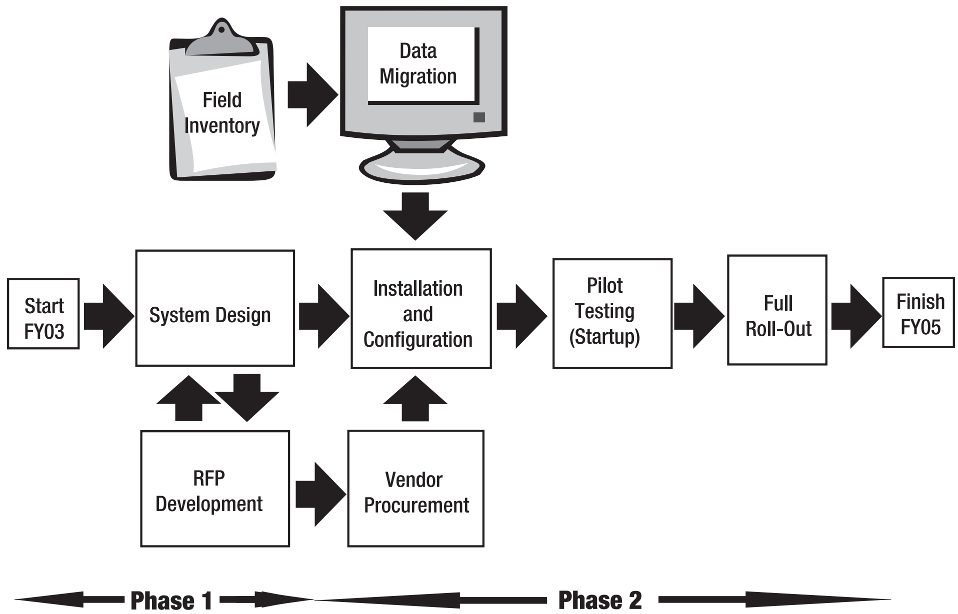


Figure 3
Sample Project Schedule Estimate

Interface requirements must determine how existing and proposed information will feed to and from the new AMS. Database platforms, operating systems, hardware platforms, communication protocols, access and administrative rights, number of seats, and other integration requirements are determined during this part of the project. Other key issues include bandwidth needed for the operation of the AMS, which software programs control what data, and whether it is better to push or pull the interfaced elements to or from the AMS.

Implementation Requirements

As part of the design, the RFP should include implementation requirements. These are similar to special terms and conditions but lay out the specific requirements a vendor must meet when providing software selected by the utility. Obviously, these requirements will include specific instructions for the vendor during the selection process. This part will spell out the procurement process, which will vary for different utilities.

Other aspects of the implementation requirements include the submittal of work plans, configuration process, reporting requirements, pilot testing and acceptance, documentation and training, and startup assistance. The RFQ/RFP is then developed, based on the utility's standard contract terms and conditions, or on whatever procurement method the utility decides is best.

Lessons Learned

When we consider some lessons learned from completed AMS design projects, not surprisingly the biggest element that determines success is the people. When implementing new systems within a utility, there is always a reluctance to change. By nature people will resist changes unless they are informed on and are involved with selecting and implementing these systems. Here are some of the numerous barriers to change and their solutions:

Level of Computer Literacy of Staff

Barrier: Many municipal staff members are not computer literate to a level required to use the new technology.

Solution: Develop a training plan managed by a training coordinator who can track computer literacy levels of future AMS users and apply appropriate training in the areas needed.

Staff Participation in Design and Implementation

Barrier: Sometimes managers may choose software without defining the needs of the staff.

Continued on page 40

Continued from page 39

Solution: The process of initiating staffing changes begins at the conceptual design phase of implementing the new technology. The first step is to involve staff who will be using the technology in the design and decision-making process. This is all part of the change-management process. A utility should hold several workshops for each area where new technology is sought, including specific employees who are planning to use the new systems.

Information Technology Knowledge

Barrier: Management and staff may not know what technology is available to manage data about their operations.

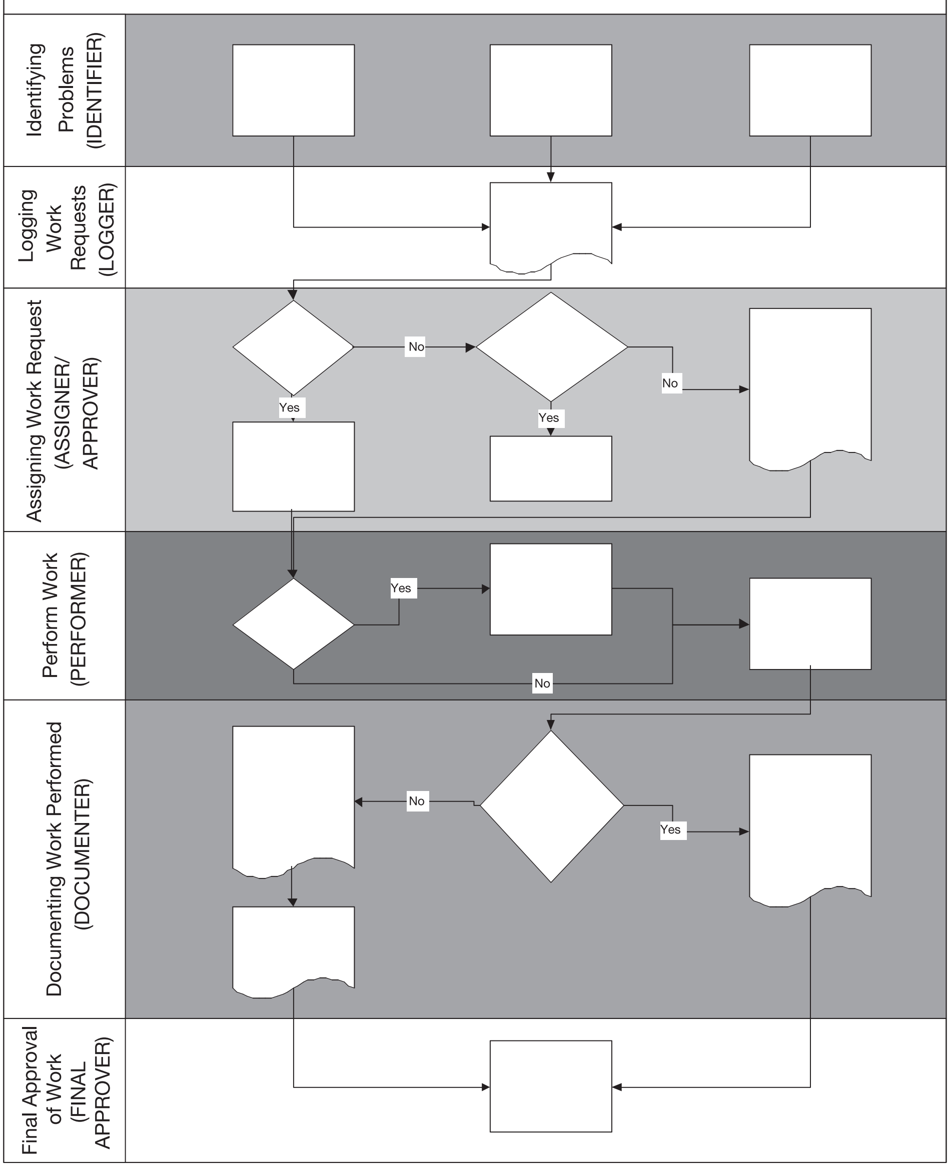
Solution: Establish an information technology steering committee consisting of department managers. This committee should meet and become educated on the latest technology available.

Interdepartmental Politics

Barrier: Some IT departments may want to control all information technology used by the water and sewer utility; however, the utility needs to have priority service if they do. In many cases, IT departments have to service all municipal departments, not just water and sewer.

Solution: Work hard at developing a partnership with the IT department. IT should be in charge of the network and computer standards such as computer operating systems. The water and sewer department should pick and choose their own applications for SCADA, maintenance management, and related systems with input from the IT department. It should also be willing to support IT staff for full-time system administrators to run these systems.

Figure 4 - Proposed Corrective Maintenance Work Process



Interdepartmental Standardization

Barrier: Some plants or departments within a utility may be more aggressive in applying information technology than others, which may be against management's desire to have consistent operations between departments.

Solution: Form a management committee to discuss common strategies for implementing information technology using a common approach. IT managers should be involved in the standardization process to ensure that computer hardware and communications infrastructure standards are followed.

Disconnected Databases

Barrier: Water and wastewater plants and pipeline maintenance groups may have separate databases of equipment and inventory, and lots of paper organized in a non-standardized/centralized fashion. Collection/distribution systems and county GIS may not be integrated or have separate GIS/computer-aided drafting mapping systems.

Solution: Develop a centralized database/data center approach for storing and accessing data. Multiple databases can be developed and used by different applications or departments.

Summary

Municipal utilities are facing increased financial challenges due to increasing demand, diminishing available water resources, some production efficiencies, increasing output restrictions, and aging infrastructure. Utilities are also faced with an increasingly complex environment due to an aging customer base, a diminishing technical labor pool running larger and more sophisticated facilities, an outflow of knowledge with retiring labor base, and growing resistance to rate increases.

A large part of meeting the challenge must come from better techniques for managing assets using an asset management system. A structured approach to developing a fully integrated AMS should strike a balance among technology, process, and people, thus creating ownership of the system through empowerment and use.

Developing an AMS will further engage and involve all employees in day-to-day operations and enhance efficiency and productivity through employee buy-in, increased morale, and streamlined system operations. Additional benefits include maintaining compliance with CMOM and GASB-34 requirements.

As time and budget constraints continue to influence a utility's operations, an integrated asset management system will allow it to maximize the use of its resources.