Columbus DPU's Asset Management Program Achieves Ground Breaking ROI

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ABSTRACT

The water utility industry is facing significant challenges in these uncertain times. Many of these business drivers (Figure 1) have been around for some time but many are new or emerging and now threaten business as usual and even the viability of utilities. Many water and wastewater utilities have started asset management (AM) programs to answer these challenges.

FIGURE 1: Business Drivers Facing the Utility Industry

AM best practices can include a broad range of activities, but key aspects are: Setting Service Levels, Minimizing Life Cycle Costs, and Managing Risk to drive asset related decisions. Organizations that see lasting success find a way to balance all three AM concepts by involving people throughout the organization in the development and implementation of the AM process.

This paper provides a case study, including documented benefits, on the City of Columbus Department of Public Utilities' comprehensive asset management journey and provides useful tips and guidance to other utilities that are considering asset management or have already started their journey.

KEYWORDS
Asset, Business Case, Risk, Levels of Service, Utilities, Continuous Improvement, Cross-functional, Teams, Work Processes, Sustainability

INTRODUCTION

The City of Columbus Department of Public Utilities (DPU) faces similar business drivers as other municipalities including limited funds, aging infrastructure, knowledge loss (baby boomer retirements) and stricter regulations. DPU recently committed to adopting a formal, standardized, and comprehensive asset management (AM) approach to deal with these business drivers and elevate the organization to a new level in meeting their mission:

> "*To enhance the quality of life, now and into the future, for people living, working and raising families in central Ohio through the economic, efficient, and environmentally responsible stewardship of superior public utilities.*"

DPU formally started its AM journey in 2008 with the hiring of the AM Director, and subsequent creation of an Asset Management Office (AMO). Phase 1 early actions, framework, and roadmap activities were completed in 2009, setting the stage for Phase 2, which includes design, development, and beginning implementation of priority AM initiatives. Phase 3 will focus on establishing a culture of continuous improvement to sustain the gains in asset management, anticipate potential business drivers that would affect DPU, and initiate solutions to deal with them.

Led by a cross-departmental AM Steering Team, and guided by AM experts from across the US and around the world (including a "Blue Ribbon Panel" of AM global experts that conducted a 3-day AM workshop in Columbus), DPU has completed Phase 1 of its multi-phase enterprise-wide asset management plan. This development effort involved:

1. Understanding DPU'sAM status using the Water Services Association of Australia (WSAA) Aquamark AM Assessment tool
2. Establishing an overall AM framework to be applied across DPU's utility enterprises (Sewer, Stormwater, Water, and Power) and a practical implementation strategy
3. Development of an overall AM Roadmap that will lead to sustainable operations
4. Piloting the Business Case Evaluation (BCE) process and identification of immediate savings to DPU customers
5. Development of an implementation plan to guide and support Phase 2 activities
6. Validation, mentoring and lessons learned from international expert AM practitioners
7. and provide feedback, to optimize program implementation effectiveness

METHODOLOGY: THE COLUMBUS DPU APPROACH TO AM

For Phase 1, DPU adopted a team based approach (Figure 2) with utility staff, supported by national consultant AM experts, which has been critical to the success to date. This approach was adopted based on the successes from previous AM development efforts in other organizations. Staff from the Director level to frontline team members throughout the organization has been directly engaged in benchmarking DPU's practices, generating enterprise-wide sharing of practices, development of ideas, implementation of improvements, and consensus within work groups and across the organization. This approach ensures that DPU staff can lead subsequent phases of the project.

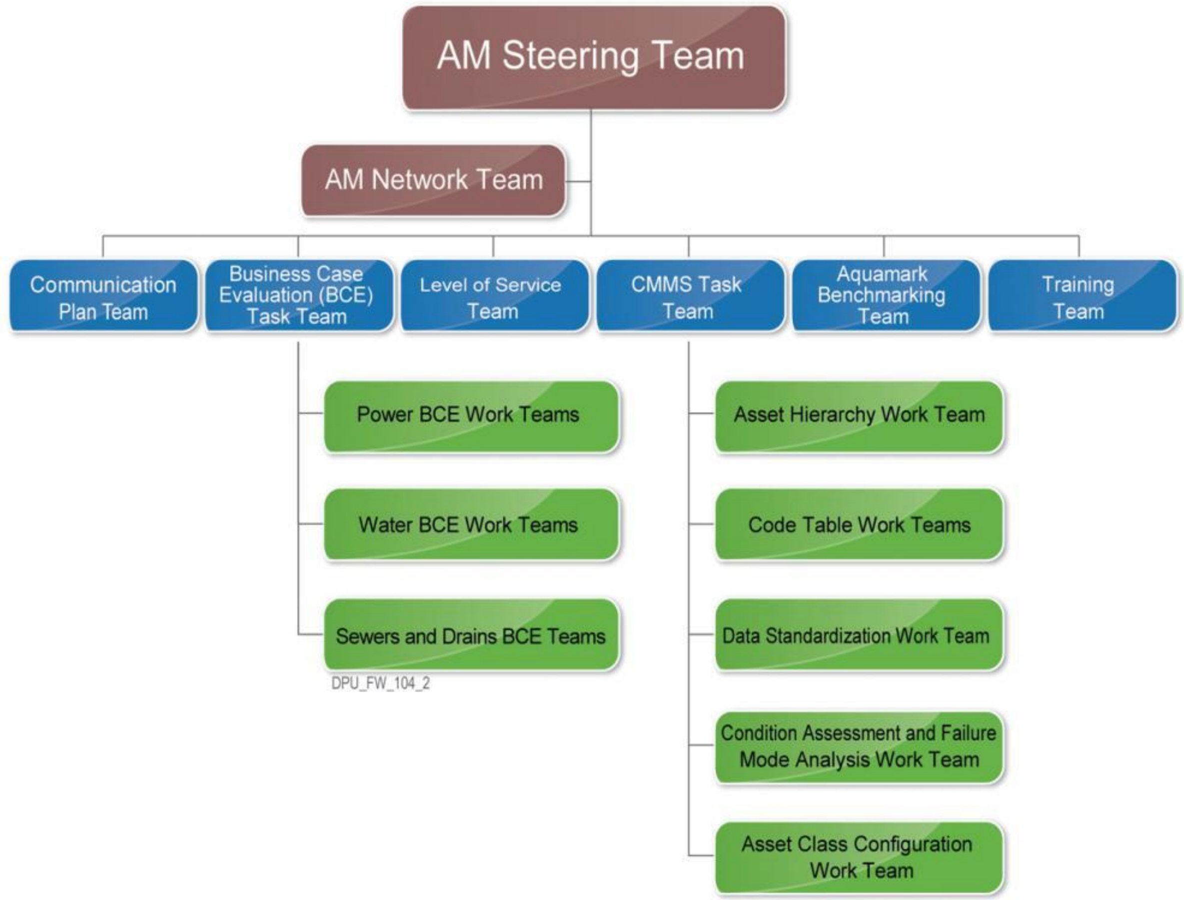

FIGURE 2: Phase 1 Project Team

DPU adopted a six-step implementation methodology (Figure 3) to accomplish its vision for asset management:

Step 1 – Initiate Asset Management	Planning
Step 2 – Immediate Gap Closures Step 3 - AM Assessment Step 4 – Develop EAM Plan	Phase 1
Step 5 – Implement AM Initiatives	Phase 2
Step 6 – Continuous Improvement	Phase 3

FIGURE 3: Asset Management Development

Step 1 - Initiate Asset Management

The DPU executive management team recognized early that asset management could address many of their existing improvement opportunities as well as provide a stable foundation to build a more resilient organization. In this regard, the decision was made to formalize asset management in the organization through the creation of an asset management office to lead asset management development at DPU. An assistant director was hired to lead the program development and eventual integration of asset management into the DPU culture. The AM Steering Team, comprised of the 12 most senior level DPU executives, was created to guide the program. An education process was started targeting all levels of staff through training events, and political stakeholders through one-on-one meetings with elected officials. The general vision for asset management was developed to guide DPUs journey to excellence. A detailed scope of work for phase 1 of a phased implementation approach was developed and used to select a consulting partner for the program.

Step 2 – Immediate Gap Closures

Concurrent with the development of the asset management gap analysis, DPU identified and acted on opportunities to provide a foundation for the AM program, as follows:

1. *People and Team Focus* - All four enterprises at DPU (water, wastewater, drainage, and power) recognize the significant opportunity and benefits of implementing/improving AM practices at DPU through a "people and team focus". Critical benefits include maximizing understanding, ownership, effectiveness, and sustainability of improvements and practices. All significant AM improvement initiatives at DPU are address using a team-based approach, where AM teams involve cross-departmental staff from all organizational levels.

2. *Level of Service (LOS) Framework* – DPU developed Levels of Service for all lines of business and will set targets, assign ownership, and begin performance management in Phase 2

3. *Business Case Evaluations (BCEs)* - DPU has performed a number of "Pilot" BCEs and identified many cost savings opportunities through this robust capital project evaluation process. Savings over the existing capital improvement program from these Pilot BCEs is estimated at $35M. As importantly, an improved process for making major investment decisions at DPU was developed for implementation on a broader scale.

4. *Oracle WAM CMMS* - ongoing development of its computerized maintenance management system (CMMS), Work and Asset Management (WAM) system by Oracle, and related work processes. Phase 1 activities included work with many staff members to develop and execute the existing functionality opportunities in WAM and begin to implement immediate gap closure enhancements that would support Phase 2 requirements and allow for a consistent, unified approach across the organization.

Step 3 - Aquamark Assessment

Developed by Water Services Association of Australia (WSAA), the Aquamark AM benchmarking software focuses on seven functions (Figure 4 below).

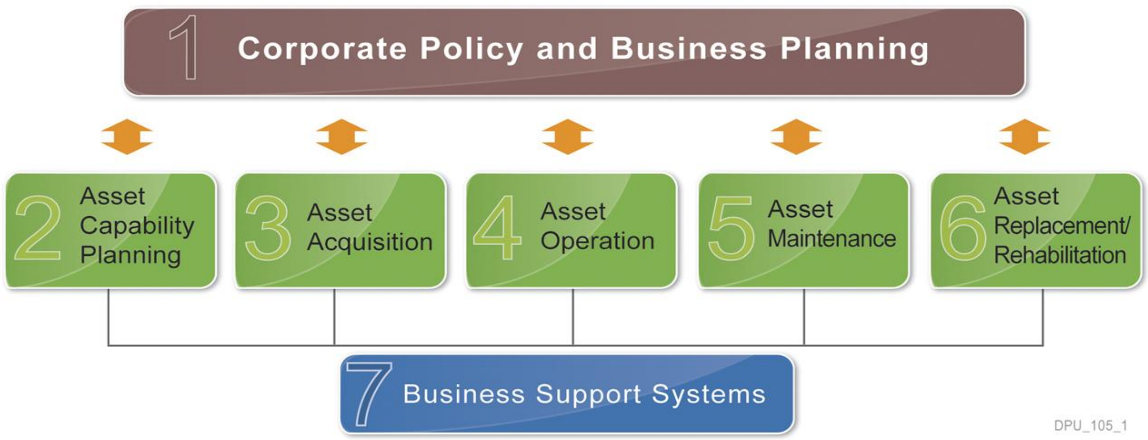

FIGURE 4: Aquamark Seven Functions

Each function is further divided into processes and sub-processes (Figure 5) that allow Utilities to conduct a comprehensive assessment of their asset management practices against best-in-class AM practices.

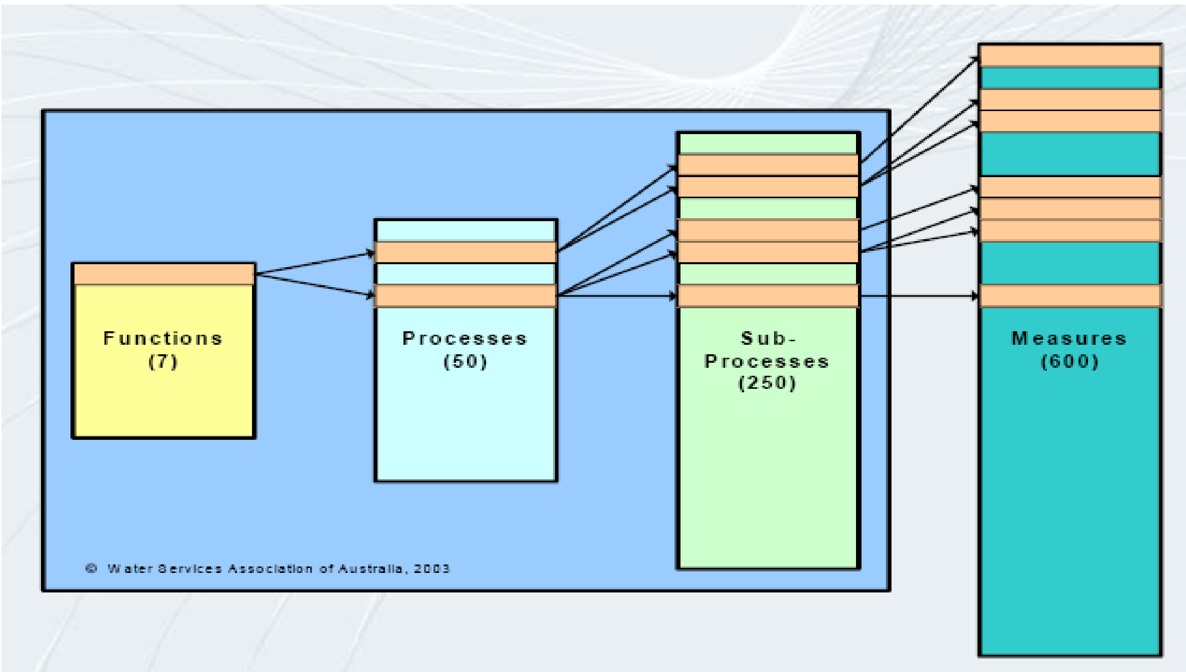

FIGURE 5: Aquamark Processes and Sub-processes

Each sub-process is evaluated for the **Capability** of the organization (how well the process is developed and documented) and their **Execution** (how much coverage and how frequently employees use the practices). This concept is shown in Figure 6 below:

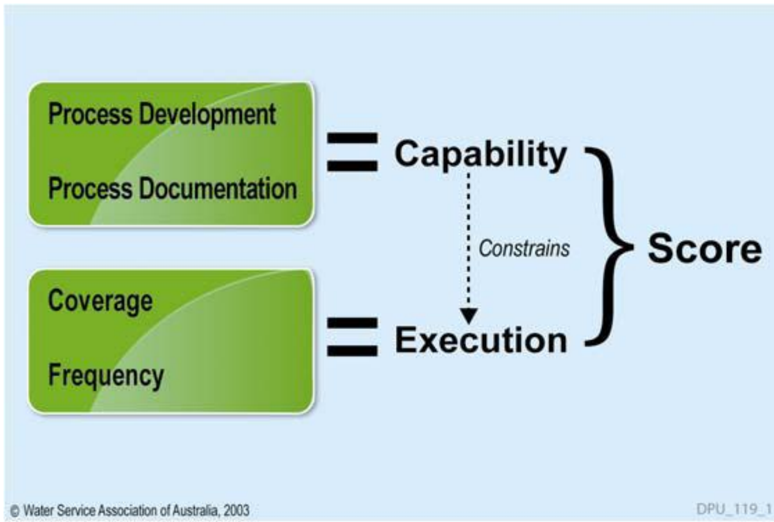

FIGURE 6: Sub-processes Evaluation Criteria

The Aquamark assessment process was conducted at DPU in 15 workshops (targeting each of the seven functions and the four utilities – Power, Water, Sewer, and Stormwater). A wide cross-section of staff was involved to ensure the current situation with respect to AM was reflected in the scores. This also served a purpose of providing education to staff on leading asset management concepts and practices. The overall Aquamark results suggested that DPU was in the development phase of AM and identified a number of opportunity gaps. These gaps were instrumental in developing improvement initiatives for the DPU AM Roadmap. Figure 7 provides a summary of DPU results on each of the seven functions compared to North American utilities (the narrow white bars, with the median shown as a black diamond) that participated in the recent 2008 WSAA International Benchmarking Program.

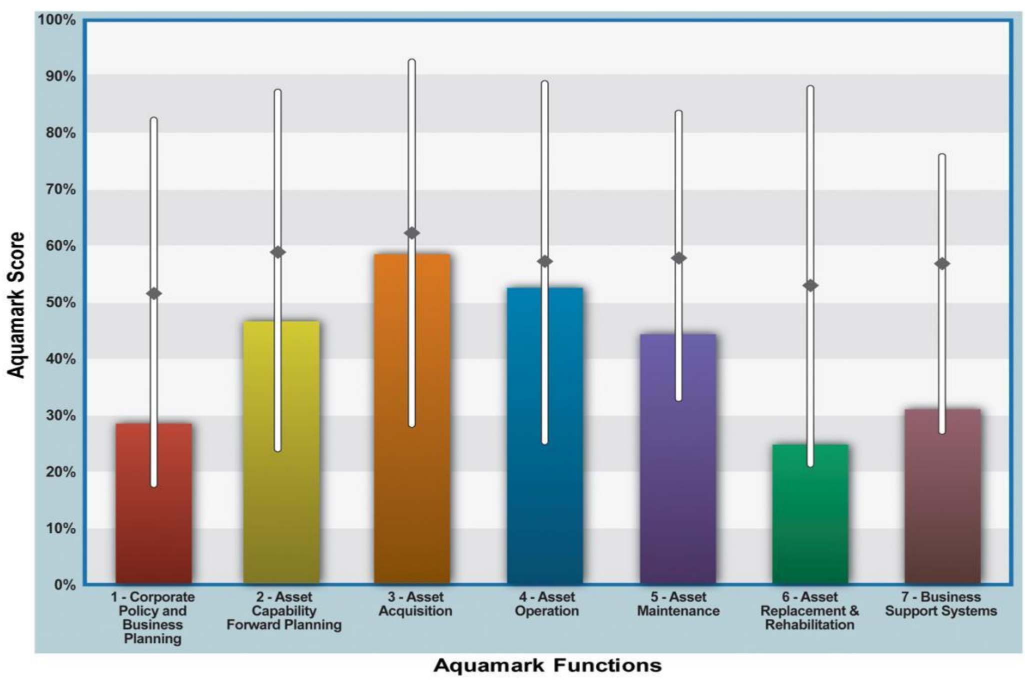

FIGURE 7: Performance Comparison of DPU to North American Utilities

Step 4 – Enterprise Asset Management Plan and Roadmap

The Aquamark gap analysis allowed DPU to develop a vision for leading AM practices together with a number of development opportunities (Table 1) to close opportunity gaps. Many of these initiatives and associated practices were developed in detail in the *Enterprise Asset Management Plan and Roadmap*.

TABLE 1: Columbus DPU's Asset Management Initiatives

No.	Priority	Initiative	Schedule
1	Urgent	Develop a Risk-based Decision Approach to Assets	2010-2012
2	Urgent	Enhance LOS Measures and Targets	2010-2011
3	High	Provide Organizational Development to Support AM	Continuous
4	High	Incorporate AM into DPU's Strategic Plan	2011-2012
5	High	Develop Formalized Project Delivery and Project Management Guidelines, and Implement Business Case Evaluation Process	2011-2014
6	Low	Develop and Implement Strategic Asset Management Plans (SAMPs) by Major Asset Class	2012-2014
7	High	Establish Asset Management Procedures/Standards	Continuous
8	Low	Improve the Procurement Process	2013
9	High	Develop and Implement an Operations Optimization Program	2010-2011
10	High	Develop and Implement a Strategic Maintenance Management Program	2010-2014
11	High	Develop and Implement a Performance Management Program	2011-2013
12	High	Select and Implement Core Technology Systems	2012-2013
13	Low	Develop/Update Strategic Business Plans	2012-2014
14	Low	Implement a Quality Management and Audit System	2014
15	Low	Develop and Implement an Effective Knowledge Management System for Assets	Continuous
16	Low	Focus on Efficiency and Practice Improvements	Continuous

A timeline of 2010 through 2014 is envisioned for DPU to have established all that is needed to achieve its overall vision for asset management, with further efforts characterized by an environment of continuous improvement. This will set DPU on the right track to sustainability and effective utility management practices.

Step 5 –Asset Management Implementation and Early Results

Work has been completed in a number of different areas of AM at DPU. While improvements to the Department's computerized maintenance management system (CMMS) and establishment of

Levels of Service are considered foundational elements of the program, tangible benefits are difficult to document; their benefits tend to be widespread in the form of efficiency.

The initiatives that have resulted in the most easily documented results at DPU are, for the most part, reliant on these foundational elements. For example, the most easily documented AM benefits at DPU have result from conducting business case evaluations, which benefit greatly from the establishment of levels of service. Documentable results from treatment plant operations optimization initiatives and maintenance management initiatives have relied heavily on CMMS data.

The three initiatives that have shown the most significant documented returns on investment at DPU are discussed below.

BUSINESS CASE EVALUATIONS

As mentioned in Step 2 of this paper, the BCE business case evaluation (BCE) process was piloted at DPU early in the program. While the steps in a business case evaluation process can be simple, each agency performing business cases must strike the appropriate balance between the efforts required to complete a BCE with the expected benefit. The pilot phase at DPU was designed to establish the guidelines surrounding the level of detail needed during BCE analysis, documentation, and review.

During the pilot phase, it became clear that a “one size fits all” BCE approach was not appropriate, and the level of detail required should vary depending on the size and complexity of the problem being addressed by the BCE. DPU established a threshold value for each of its four enterprise funds. For BCE’s where the level of risk posed to the enterprise or the proposed solution exceeds the threshold, a full BCE is required. Below the threshold, only a one-page capital project justification form is required for documentation, with review and approval from the appropriate enterprise’s chief engineer and the asset management office.

Taking into account additional lessons learned from the pilot projects and feedback gathered from team members and reviewers on more pilot BCE efforts, the asset management office also created detailed formal procedures on how to complete a BCE. Roles and responsibilities for BCE team members were defined for each BCE step in the form of a swim lane diagram.

Roles range from team leaders responsible for the BCE documentation, subject matter experts, executive sponsors to ensure the BCE analysis is strategically aligned with Department goals, asset management support to guide staff through the process, and Fiscal and executive reviewers. Generally speaking, the steps in the BCE include determination if a BCE will be conducted, a kick-off meeting where a problem statement is defined and preliminary alternatives are identified, an analysis period to flesh out the details of alternatives, triple-bottom line costing of alternatives over a defined life-cycle, documentation of benefit/cost ratios for each alternative compared to status quo, and review.

The AMO’s Asset Management Office’s goal is to fully educate staff on the BCE Business Case Evaluation process and ultimately make it the new way in which DPU conducts business in regards to capital projects. To go from pilot to full-scale implementation, a training program has been created that consists of eight separate online modules representing each of the steps to complete BCE. This training will describe the overall BCE process and expectations, as well as provide information on how to perform all the intermediate steps of completing a successful Business Case and writing a detailed final report. Examples of sections include how to write a problem statement, how to use the financial analysis tool, and how to estimate/monetize social and environmental values of "externalities" that do not have market driven values (e.g. greenhouse gas emissions, traffic delays, power loss, water loss, sewage backups, and overflows). Additionally, in-person training that follows the same format as the on-line training commenced in December, 2011.

Since its inception, the value of the BCE process has been validated by millions of dollars in documented capital savings. This process will only become more efficient and cost effective as staff becomes more acclimated with how to perform BCE tasks efficiently and effectively. Savings realized in the form of capital improvements plan (CAPEX) reductions by performing BCEs have totaled a net of nearly $35 million across the Department. The additional value of social and environmental savings resulting from conducting BCE's increases that benefit by an additional $5 million.

Examples of savings identified in BCE's include the cancellation of a secondary intake and association pumping station to a water treatment plant to provide a supplemental water supply in the event of drought or contamination of the primary water source. Upon examination, it was found that the risk posed was an order of magnitude less than the project cost, particularly given that other projects, such as a new reservoir, dramatically reduced drought risks. Environmental regulations and additional in-system storage also reduced the risk contamination to the plant, allowing it to shut down and flush pollution past the intake without interrupting service to customers.

TREATMENT PLANT / FACILITY OPERATIONS IMPROVEMENTS

In 2010 and 2011, the Department and its prime asset management consulting firm, CH2M Hill, evaluated the operations at both wastewater treatment plants and all three water treatment plants for potential energy and chemical savings. Using a system that CH2M Hill applies to its privately operated systems, including the development of hydraulic and process models, each plant was examined individually aw well as part of a larger treatment system.

Potential opportunities were evaluated for practicality, financial benefit, and the cost of necessary improvements. Ultimately, each opportunity was assessed on its calculated rate-of-return.

For the water plants, four major viable cost savings improvements were identified. Two system-wide opportunities included shifting water production to the lowest cost treatment plant, and increasing the hardness level of finished water to reduce the cost of softening chemical addition.

Changes in hardness did not generate an acceptable rate of return. A reduction in softening, while financially appealing, had an adverse impact on the treatment effectiveness for some primary drinking water standards. The result was that while softening chemical addition would be reduced, other treatment process needed to continue to meet permit violations offset that cost savings. Given the impact on public perception when secondary drinking parameters changes, this options was dismissed.

However, the system-wide hardness discussion led each treatment plant to examine its finished hardness data. Internal policy required plants to produce hardness levels between 120- and 125 mg/L. The plants, despite the fact that they could control hardness on an ongoing basis to a target number plus-or-minus one mg/L, were operating on the low end of that range (121 mg/L, plus-or-minus 1 mg/L). By adjusting the treatment process, lower softening chemical addition to treat to a hardness target higher in that range, an annual savings of $60,000 to $100,000 was realized.

Shifting water production to the low cost treatment plant has proven to be a viable cost reduction opportunity. The amount of production that can be shifted is limited by the physical configuration of the distribution system and reservoir capacity, but it was determined that approximately 2- to 4-percent of water production can be shifted to the low cost water plant in an average year, saving rate payers approximately $190,000 per year.

Other improvements included increasing the cycle-time between filter backwashes and reducing filter backwash duration. A time-based cycle between backwashes tends to be highly efficient for planning purposes. Alternatively, determining backwash frequency based on loading, which can vary seasonally and with major storm events, requires more effort on the part of operators but can be more cost-effective. The backwash process itself was examined and opportunities to reduce wash time were identified. Overall, minor adjustments in the backwash process in 2011 yielded approximately $25,000 to $50,000 in savings, with annual savings expected to rise as operators become more comfortable with adjusting the process without increasing the risk of process failure.

Comparing the cost of the study to the sum of all cost reductions implemented at the water plants results in a 1- to 2-year payback period, and will help keep operating costs low into the future.

In late 2011, the focus shifted to the wastewater treatment plants. Although that study is ongoing, it appears that potential savings opportunities are even greater than those for the water plants.

MAINTENANCE MANAGEMENT IMPROVEMENTS

There are a myriad of activities associated with an advanced maintenance program, ranging from basic preventive maintenance, maintenance job plans, planning and scheduling, maintenance management systems, etc. When considering the labor, services, supplies, and equipment needed to perform these activities, DPU budgets about $65 million for asset maintenance per year. With more complex assets to maintain using a series of more and more sophisticated devices (vibration sensors, infrared sensors, thermal imaging), maintenance represents an opportunity to change and become more efficient while increasing asset reliability, reducing downtime, and ultimately proving more dependable service to customers.

Two recent activities within the maintenance function that have yielded a return on investment for DPU include a reliability-centered maintenance (RCM) initiative and preventive maintenance optimization (PMO) review.

DPU identified two systems for review utilizing the RCM process; one each in wastewater treatment and water treatment. Upon completion of a 3-Day RCM training session, cross-functional teams were identified to complete the RCM review process. RCM is used to preserve system functions through the identification and mitigation of high-risk and costly failures. The

DPU process included reviews of historical failure causes and used a rigorous review and decision tree process to identify and establish mitigation plans that focus on improving safety, environmental impact, and financial performance. The RCM process results in a streamlined preventive maintenance program, including condition based maintenance strategies (i.e., vibration monitoring, oil analysis). For some failure modes, where no maintenance activity can be found to mitigate failure, redesigns, standard operating procedures (SOPs), and design changes may be recommended.

DPU reviewed two systems, the Jackson Pike wastewater screening system and the Hap Cremean water treatment plan sludge pumping system. They were slightly different applications of RCM in that the Jackson Pike system is a functioning system and the Hap Cremean system was newly constructed and not in full operation. Both reviews improved system safety and provided valuable results from new and optimized operation and preventive maintenance (PM) tasks changes.

At Hap Cremean, appropriate and safety related PM tasks were added, pumping design capacities validated and SOPs updated, and lifecycle cost savings and asset life extended from changing from pump equal run time to a duty/standby configuration.

The Jackson Pike review identified that the existing maintenance program was based, for the most part, on original equipment manufacturer (OEM) recommendations. The team’s review concluded that while some of the existing PM tasks added value, some of the equipment was being over maintained. As an example, the lubrication tasks were excessive and these were revised substantially. Some original tasks remained, while others were revised or deleted. New PMs were also created for failure modes not previously identified in the OEM program. The RCM review teams provided feedback to senior management and have validated that RCM is a value-added approach to maintaining safety, reducing maintenance costs, and supporting operational excellence.

In addition to the RCM initiative, a PMO review was also conducted at the Southerly wastewater treatment plant. The process is much more streamlined that a full RCM analysis where PM tasks are pulled from the CMMS and audited by maintenance specialists for current applicability and completeness, as well as estimated times and potential duplications. The pilot review resulted in a reduction in PM tasks and hours and also identified some maintenance process optimization that has resulted in a reduction of paperwork. The PMO review team found this approach to be valuable and DPU is adding this, along with the RCM process to their maintenance management improvements program.

Together, the RCM and PMO efforts at DPU have reduced preventive maintenance tasks by 60-percent for the systems examined, resulting in an annual savings of $110,000. In addition to these financial benefits, implementation of these programs helped DPU improve safety, increase reliability, and optimize operations.

CONCLUSIONS

DPU has embarked on an asset management journey that touches all aspects of the organization and has engaged staff from the top to the bottom of the organization. DPU sees asset management as a key foundation piece in setting the utility on the right track to sustainability and effective utility management practices. The organization has already started to benefit from early implementation from its Business Case Evaluations, WAM CMMS enhancements, and improved team work and coordination, and better understanding of the organization's challenges and strengths from their involvement in many workshops and information sessions.

Overall, DPU has made significant progress in establishing an AM roadmap and is steadily adding the remaining necessary foundation blocks for sustainability through leading asset management practices.

The return on investment is approximately 5 to 1 when considering financial savings to date. Adding in the additional social and environmental savings to date, as well as the anticipated reduction in future costs as asset reliability increases, increases the return on investment significantly.

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