KNOWLEDGE MANAGEMENT FOR ADDRESSING WORKFORCE ISSUES

Prepared by the Knowledge Management Subcommittee of the AWWA Workforce Strategies Committee:

Jeff Oxenford, Oxenford Consulting, LLC (Chair)
Cheryl Davis, San Francisco Public Utilities Commission, (Co-Chair)
Mike Canning
Rhonda Harris, Pro Ops
Linda Jennings, Salt Lake City Department of Public Utilities
Stuart Karasik, City of San Diego Public Works
Gary Visser, Hach Company
Cindy Goodburn, Littleton/Englewood Wastewater
Richard Gerstberger, TAP Resource
Sharon Peters, Metro Vancouver
J. Paul Blake, Seattle Public Utilities

1. INTRODUCTION

This document was developed by the Knowledge Management Subcommittee of the AWWA Workforce Strategies Committee. The goal of the subcommittee is to evaluate and document how knowledge management (KM) can be used to address and support workforce development strategies.

Background

Knowledge retention is rapidly emerging as a major issue for water utilities as the workforce is aging and significant numbers of key employees are nearing retirement age. Workforce issues that are driving the need for improved knowledge management include:

- Baby Boomer retirements;
- Tightening health and safety, environmental, and water quality regulations;
- Changing facilities, technologies, and equipment;
- Competition with other industries for skilled employees;
- Increasing public expectations with regard to customer service, efficiency, and cost; and
- Industry-wide under-investment in the processes required to support staff preparedness (documentation, training, mentoring, and use of knowledge management systems)

Knowledge can be explicit or tacit. Explicit knowledge is knowledge that is written down, codified and stored. Examples of explicit knowledge include reports, documents, diagrams or web content. The challenges with explicit knowledge are keeping it up to date and making sure that it can be found and accessed when needed by employees.

How do you transfer knowledge to new distribution system operators about where critical valves are located in the system, so when a main break occurs it can be repaired in a timely fashion?
Tacit knowledge is the knowledge that resides within the employee and is generally not written down. Tacit knowledge is also referred to as know-how knowledge, experience, or skill. A significant portion of operating information is tacit knowledge that is in danger of being lost when the employee leaves the utility. For existing employees, the challenge is to keep tacit operational knowledge up-to-date, ensure that key operational knowledge is captured, and to make it available when it is needed.

An operator is soon to retire after 35 years of service and is the only employee who has ever performed a complete plant shutdown. Shutdown procedures have never been documented to date. What are some ways that these procedures can be documented?

What is knowledge management?

In simplest terms the goal of knowledge management is to ensure that

“the right people have the right skills at the right time to perform work needed”

Knowledge management focuses on identifying key organizational knowledge, capturing it in a way that can be stored, maintained, and retrieved when needed, and effectively disseminated to the people who need it to do their job.

Knowledge management is a combination of people, processes, and technologies. The people aspect focuses on an organization’s culture (sharing of information, collaboration, and communication). Processes include how knowledge is captured, stored, maintained and disseminated. Technology is properly selected and then implemented to support people and processes. Successful KM programs combine these three elements. In many cases, significant improvements in knowledge management can occur with initiatives focused on low-cost options that target people and processes first, before making large investments in supporting technologies.

The following sections of this document will discuss how to get started with knowledge management, building momentum, and sticking with it; some common knowledge management tools; and case studies of existing KM programs.
2. GETTING STARTED—AND GETTING IT DONE

Since the funding and staff time available to utilities for knowledge management programs is limited, it is critical to define strategies that will optimize return on investment. Before getting started, a few basic questions should be asked:

- What is the knowledge we need to capture?
- What are the consequences if this knowledge is not where it needs to be?
- How should the desired knowledge flow in our organization – from whom and to whom?
- What are the best pathways for this knowledge to flow?

Answering these questions first – specific to your organization and no one else’s – will then allow you to better decide which tools, strategies, and technologies will help you to capture the desired knowledge. (KM Edge, 2010)

Suggested guidelines for development of a program are summarized in the table below.

**TABLE 1: Suggested guidelines for getting started with a KM program**

<table>
<thead>
<tr>
<th>A. Needs Assessment</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Identify mission-critical functions and job categories.</td>
<td></td>
</tr>
<tr>
<td>2. Assess the culture of your organization</td>
<td></td>
</tr>
<tr>
<td>3. Assess the effectiveness of the processes used by your organization to ensure that staff in mission-critical job categories have (or have access to) the information and skills needed to perform quality work.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B. Implementation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Find an approach and suite of staff preparedness tools that fits the needs, culture, and priorities of the organization.</td>
<td></td>
</tr>
<tr>
<td>2. Focus on how employees will access and use information, so that your delivery systems will reflect the need.</td>
<td></td>
</tr>
<tr>
<td>3. Adopt a phased approach</td>
<td></td>
</tr>
<tr>
<td>4. Identify staff who will take the lead in the knowledge management process.</td>
<td></td>
</tr>
<tr>
<td>5. Look for and create learning opportunities.</td>
<td></td>
</tr>
<tr>
<td>6. Look for opportunities to optimize the cost-effectiveness by your efforts by partnering with others.</td>
<td></td>
</tr>
<tr>
<td>7. Create a culture that encourages information-sharing and collaboration</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C. Sticking With It</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Recognize that development and maintenance of staff knowledge is a long-term commitment to changing how you do business.</td>
<td></td>
</tr>
<tr>
<td>2. Reinforce the successes of the organization in knowledge management by acknowledging achievements and mentoring others in the industry when knowledge management efforts prove effective.</td>
<td></td>
</tr>
</tbody>
</table>
The following section describes each of steps as described in Table 1.

A. **Needs Assessment**

It is important to identify the unique issues and needs of your organization. Resist moving into problem-solving mode at the start; take the time necessary to identify key needs and develop a workable, targeted strategy. This assessment should combine the insights of senior management with those of staff from other levels in the organization. Components of the needs assessment could include the following:

1. **Identify mission-critical functions and job categories.**

   Every employee in an organization has an important role to play. However, in a job climate characterized by high turnover and change, it is not feasible (either in terms of cost or staff time) to make an equal investment in every job category and work process. Therefore, it is useful to conduct a workforce development needs assessment to identify the core operational responsibilities of the organization (e.g., water, supply, water quality, and environmental stewardship) and the job categories where deficiencies in staff knowledge or skills could put core functions at most risk. A template used by the San Francisco Public Utilities Commission to identify mission-critical job categories is attached. This type of analysis helps an organization set priorities based on documented business risks.

2. **Assess the culture of your organization**

   An organization’s culture is an organization’s way, identity, and pattern of dynamic relationships, its ‘reality’. It has everything to do with implementation and how success is actually achieved. A management idea such as knowledge management, no matter how good, will not work in practice (implementation) if it does not fit the culture of the organization. An organization can have the most superb strategy, but if its culture is not aligned with and supportive of that strategy, the strategy will either stall or fail. Culture establishes and underpins order, structure, communication patterns, expectations and priorities, decision-making practices, management practices, and other management approaches and systems. It is important to understand the organization’s culture and implement knowledge management in a way that aligns with that culture or implement a cultural change program prior to initiating knowledge management.

   The tools that support information-sharing and collaboration (documentation, staff training, mentoring, and knowledge management) may not be embraced in an organization where knowledge itself is viewed as power, and consequently not shared. Knowledge management tools will gain the most traction in an organizational climate where the capacity and willingness to share information is valued.
3. **Assess the effectiveness of the processes used by your organization to ensure that staff in mission-critical job categories have (or have access to) the information and skills needed to perform quality work.**

Organizations vary in the investments they make in documentation, staff training, and knowledge management. For example, a utility might have a strong program for mentoring apprentices, but limited technical training to keep journey-level staff informed about new facilities, regulations, or technologies. Similarly, a utility might have many documents stored in a computerized knowledge management system, but relatively few staff members who know that the information exists or where to find it. Often utilities have defined in detail the qualifications and credentials needed by candidates in order to obtain a job in the utility, but have not defined the utility-specific knowledge and skills needed to perform the work successfully (e.g., the technologies, equipment, and procedures associated with the utility’s water treatment and distribution processes). Similarly, utilities often have no process for identifying the gap between what employees need to know in order to perform the work, and what they actually do know.

**B. Implementation**

1. **Find an approach and suite of staff preparedness tools that fits the needs, culture, and priorities of the organization.**

Although most organizations in the water industry face similar problems (staff turnover and changing requirements), they have adopted diverse approaches to addressing them. For example, Colorado Springs Utilities has adopted what they call a University Model. Their Workforce and Planning Development Unit includes a training unit for technical skills, a training unit for business skills, and an instructional design unit.

The Santa Clara Valley Water District in San Jose, California, has adopted ISO certification as an approach to documenting and providing training on operational processes. (Fiedler, January 2010) Union Sanitary District, in Union City, California, focuses on identification of critical tasks; documentation of the different types of knowledge needed to perform those tasks; and training and testing to insure staff can perform tasks as required. (McPherson, January 2010) North Coast County Water District in Northern California has maximized the efficiency of its staff by building a learning community. (Weiss, January 2010) San Francisco Public Utilities Commission and the East Bay Municipal Utility Districts have used wiki software technology to support knowledge management. (Smith and Davis, January 2010).

There is no ‘One Right Way’ to build staff preparedness, and mindless mimicking of the specific activities of another organization may be counter-productive. Strategies and programs should be adapted to address the identified needs and priorities of the organization as a whole.
2. **Focus on how employees will access and use information, so that your delivery systems will reflect the need.**

The purpose of knowledge management in the water industry is to meet the information needs of both current and future employees, as well as the managers, public officials, and citizens who need to understand what is occurring and has occurred in order to make responsible decisions at the policy level. Both current and future needs should be taken into account. However, a priority should be placed on making critical information easily available to those who need it, when they need it, in a form that is usable to them.

Employees learn in different ways and may need to access information from a variety of settings. Therefore, consider multiple packaging of important messages. Key information might be reflected in a written procedure; a video procedure; a PowerPoint; workflow diagram; as part of an interactive on-line training tool; in a field guide; as part of a scenario-based training session; or all of the above. For critical tasks, it may be worthwhile to prioritize multiple packaging of key messages over having a hard-copy write-up on all minor procedures. At Littleton/Englewood (CO) Wastewater Treatment Plant, the learning styles of operations staff were analyzed so that Standard Operating Procedures could be written in ways that made them most useful. As a result, Standard Operating Procedures were created with big photographs, arrows, captions, and videos. Written text was minimized. This customization of how the procedures were presented gained staff buy-in, resulted in products that were appealing, and showed staff the commitment of management to meeting their learning needs.

3. **Adopt a phased approach.**

It is rarely feasible to address all of the knowledge management needs of the organization simultaneously. Some activities may be more appropriate for certain parts of the organization (e.g., some types of competency assessment may be more appropriate for some workgroups than others). Some (e.g., use of information technology to support knowledge management) may be appropriate for all parts of the organization. Even so, effective implementation may require an incremental approach or pilot testing of approaches selecting for capturing, storing, and accessing knowledge.

Conducting a pilot study on one or two selected knowledge management processes can be very helpful. A pilot study is essentially an initial investigation used to test the feasibility of ideas and procedures that you will make use of in your larger KM plan. There are a number of benefits to this type of study:

a. Provides the opportunity to learn how to do something on a small scale before doing something organization-wide.

b. Protocols can be tested and corrected, and feedback can be managed on a small scale. This allows the organization to “get the bugs worked out” before undertaking an initiative on a larger scale.
c. Gives the organization a sense of the level of effort and associated cost required to carry out a particular initiative.
d. If managed with good communication and transparency, the piloted initiatives can help get buy-in from stakeholders who are important to lifting the KM plan off the ground. (Stewart, 2004).

After you have piloted one or two KM processes in your organization and evaluated them with the KM team, continue to implement the KM strategy in phases. Return with your team to your initial plan and review it in light of the processes that you piloted. Does the next process on the list make sense to implement next, given what you have learned? If so, move ahead. If the pilot work leads you to identify a different process or strategy that should be done next, then put your energies there.

Besides enabling an organization to carry out a KM plan in manageable chunks, phased implementation allows you to take the lessons learned – what worked well, what worked in a limited way, what did not work at all – in the early phases and bring them to bear on subsequent phases. You are then building on strategies and tools that work for your culture and organization.

4. **Identify staff who will take the lead in the knowledge management process.**

It is valuable to have one or more knowledge management champions who are willing and able to lead knowledge management programs, and key staff groups that work as knowledge teams, developing methods and taking ownership of the process. The KM leaders do not have to come from the ranks of upper management; in fact, in some organizations it is best that they do not. But they do need to possess good communication skills, be respected in the organization, have the ability to see the big picture and how the different components fit together, and have a persevering attitude that will keep the organization on track through the inevitable challenges that lie ahead.

The key staff groups are held together by a common purpose – to share knowledge by means of their experience, tools, and best practices. They also help to foster a knowledge sharing culture within the organization. Where are knowledge sharing initiatives already working in the different divisions or groups in the organization? The groups can build and expand on these successes and expand them to other parts of the utility/organization. (L. Blankenship, et al, 2009)

The San Francisco Public Utilities Commission’s Health and Safety workgroup established a Toolbox Team to work on use of wiki technology for knowledge management. Their example and mentoring was extremely valuable for other parts of the organization to learn from and use.

5. **Look for and create learning opportunities.**

Your staff members can learn from each other, from retirees, from staff at other utilities, and a combination of formal and informal coaching and mentoring programs. Training
can be provided by your own personnel, using web/video resources, and external sources. Learning should be tracked as a basis for prioritizing future investments.

6. **Look for opportunities to optimize the cost-effectiveness by your efforts by partnering with others.**

Even in better economic times, most utilities had insufficient resources to provide a full range of documentation, training, and knowledge management programs. In a time of diminished resources, many large organizations may be inadequately prepared, and small ones may be even more challenged. Historically, most organizations in the water/wastewater industry have independently addressed the training and knowledge management needs of their staff, with some assistance from professional associations and community colleges. The efficiencies of scale potentially possible through increased coordination have yet to be realized. Video-conferencing, shared development and use of training materials, use of shared knowledge management systems, and shared scheduling of training opportunities are examples of areas where utilities could both leverage their investments and increase staff learning.

7. **Measure to see how well the tools and strategies are working**

Begin with the end in mind – establish your desired outcomes and “then work backward to design KM activities and measures that focus on those outcomes.” (KM Edge, 2010). There are a number of helpful measurement frameworks available. One example is APQC, a measurement framework showing the relationship among inputs (investments of time, resources, technology costs), process (participation levels, the time it takes to transfer and document knowledge), and outcomes (the objectives of your organization, which could include specific knowledge capture and transfer, cross training, and/or employee retention).

The measures need to be pertinent to the KM approaches you have adopted. Mentoring initiatives will have different costs and desired outcomes than an on-going video training course; therefore, the measures for these initiatives need to be different.

Quantitative measures such as time, resources, and cost are important, but qualitative measures are also valuable and can generate greater organization-wide interest in the KM program. Employees can share stories of how the initiatives have helped them gain the valuable knowledge they need to do their jobs effectively. Their testimony can show how a particular investment made by the organization in terms of time or money has paid dividends in terms of the capture and transfer of critical knowledge that would have walked out the door had the KM program not been in place. Lessons learned and shared about initiatives that fell short also provide value in helping management and others involved in the KM process to decide upon future direction and new KM initiatives to undertake.
C. Sticking With It

1. **Recognize that development and maintenance of staff knowledge is a long-term commitment to changing how you do business.**

   Documentation, staff training plans and materials, and knowledge management systems must be embedded in work processes so that knowledge management becomes a sustained, ongoing effort. Timely updating of materials is necessary in order for them to remain relevant and beneficial. One-time investments of staff time and funding are not enough; unless money and staff time are dedicated for this purpose, investment in the knowledge infrastructure of the organization will be crowded out by daily operations and maintenance responsibilities.

2. **Reinforce the successes of the organization in knowledge management by acknowledging achievements and mentoring others in the industry when knowledge management efforts prove effective.**

   The Health and Safety Team of the San Francisco Public Utilities Commission was awarded the O’Shaughnessy Team of the Year Award for their work in using miToolbox (the SFPUC’s customized version of Confluence wiki technology) to document health and safety policies, procedures, forms, and training materials. This and numerous other water industry examples of effectiveness in knowledge management practices are available to read about and will encourage any utility that is ready to make significant progress in their own organization.

3. **SIX KNOWLEDGE MANAGEMENT TOOLS YOU SHOULD CONSIDER**

   There are numerous tools available for knowledge management, capture, and transfer that are having success in the water industry and other industries. Because of the diverse learning styles and technological comfort level among the different generations in the workplace, several different tools should be used at any given time and additional tools should be tested for their goodness of fit in that utility’s culture. The tools described in this section include mentoring and apprenticeships, formal education and classroom training, competency-based training, communities of practice, wiki and on-line document storage, and video technology.

1. **Invest in mentoring and apprenticeships**

   With many water industry workers slated to retire in the next 5-10 years, it is important to make use of tools designed to help transfer knowledge from older to younger workers. A formal **mentoring or coaching program** has proven to be a successful approach to knowledge management in many utilities and organizations. Mentoring is particularly useful in the sharing of tacit knowledge.

   Traditional mentoring pairs a mentor – a person with organizational knowledge and years of experience and expertise – with a mentee, who may be new to the field or Consider creating a pool of available mentors who can share their diverse skills and expertise.
interested in promoting to a leadership position. Though it has proven to be of value, the traditional approach to mentoring has limitations in that the mentee is formally exposed only to one person’s expertise. An alternative approach is to create a pool of mentors with diverse skills and expertise, within and across divisions, to increase overall knowledge sharing with mentees. In some communities of practice mentors and mentees meet face-to-face as well as on-line to share knowledge.

One interesting facet of mentoring that has come out of studies in other work fields has to do with “out-loud thinking.” Situations where mentors talk through their lines of thinking as they encounter a particular problem can be particularly effective in knowledge sharing. For example, an experienced nurse training a nursing student in a formal mentoring role would look at a patient’s chart and the results of the most recent tests and describe what she/he is thinking based on the information at hand. The mentoring nurse would then describe the probable next step, but at the same time could also describe several other options based on his/her intuition and experience. (M. Roberto, 2009)

Similarly, an experienced water system operator would walk a new operator through the paces of an emergency shutdown of a major pump station. The mentor would ask the mentee(s) “How do you ‘size up’ the situation? What should be done first? What should be done next? What are the rules of thumb? Is there anything that does not look right or feel right about the situation? What indicators are there that would lead you to consider an exception to the rules of thumb, to “go with your gut” and not necessarily the next step in the formal protocol?”

The mentor can also take the opportunity to describe situations in the past where they were led to make a certain decision, and their decision or action failed to achieve the desired results. Failure can be a great teacher, and mentees are often helped and encouraged when their mentors share their failures as well as their successes and job knowledge.

Successful mentoring programs link mentoring to existing organizational priorities. Mentoring requires strong internal support and has broad benefits beyond knowledge sharing. These benefits include the development of a strong network of peers, an increased number of employees who understand the value of mutual support and shared learning, and increased job satisfaction and meaning for both the mentors and mentees.

An additional item to keep in mind: many utilities have a multi-generational workforce in place. Each generation has different preferences for how they learn. The tools and strategies that pertain to mentoring and coaching should be sufficiently diverse to be able to meet these different learning styles.

East Bay Municipal Utility District (EBMUD) in northern California has a leadership development program in which mentoring plays an important role. Over the last 10 years they have created internal leadership academies with clear objectives for identifying candidates to fill new positions of leadership, shaping the skill sets required for these new positions, and transferring critical knowledge from older to younger staff.

EBMUD uses internal mentors and coaches, and looks for people who are good listeners, able to ask powerful questions, and can provide effective feedback. The mentor/coach provides as much
real-world application and perspective as possible to the development of a new leader. They act as **thinking partners**, helping the younger employee to develop and hone their own innovative thinking and problem-solving skills with the use of open-ended questions such as “How would you approach this particular problem” or “What might be the consequences if this or that were to take place?” (Marques, 2010)

**Apprenticeships** are also an effective means of transferring knowledge from experienced workers to new workers. The apprenticeship has a long history, and continues to be used extensively in countries such as England and Australia. Historically, master craftsmen would hire an apprentice and train them in exchange for a period of service. (Jacoby, 2010) In today’s water sector, numerous utilities have developed formal apprenticeship programs where apprentices receive on-the-job training as well as some classroom instruction – and paid while in training. The apprenticeship is most often designed as a structured program leading to a recognized level of qualification as well as certification. (Connexions Direct, 2010) In some city utilities, such as San Francisco, unions handle the training aspects of apprenticeship programs.

In a 2009 study (Lerner et al, 2009) sponsored by the Urban Institute Center on Labor, Human Services, and Population, sponsors/employers of registered apprenticeship programs were asked to complete a survey which included questions about the value they see in apprenticeships, the drawbacks, completion rates, their sources for recruiting apprentices, and related items. Of the nearly 1,000 respondents, 86 percent stated that they would “strongly” recommend the program to others and 11 percent indicated that they would recommend it with reservations. The primary benefit of the apprenticeship program listed by the respondents was that it “helped meet their demand for skilled workers.” Additional benefits included the role of the apprenticeship in “reliably showing which workers have the skills needed”; increased productivity; strengthened morale and pride; improved worker safety; and improved worker recruitment and retention.

Drawbacks of the registered apprenticeship programs cited by the employers included competitor firms’ offering higher wages to trained apprentices, called “poaching”, and the failure of apprentices to successfully complete the program. Some saw the costs of instruction and the investment of time required by experienced workers as problems. Generally speaking, program respondents reported high completion rates.
2. **Develop or expand staff training programs to capture and transfer knowledge**

Many utilities have in-house training programs and/or send staff to periodic training off-site to bolster the knowledge and skills of their employees. The training content is most often specific to their immediate job duties. Utilities should also develop their own specific training materials and programs for knowledge capture and transfer. As each knowledge team makes progress in developing tools and strategies for sharing the knowledge within and across the divisions of the organization, it is important to document protocols, successes, and failures of the knowledge transfer processes. A learning management system (LMS) can be helpful here. An LMS is a software application designed to track the many aspects of a training program, including administration, training initiatives, how training is delivered, classroom and on-line events, content, and evaluation. (Wikipedia, 2011).

For those items deemed by the utility to be priority items, the documents should be brought together in an overall training manual in hard copy and in video format such as DVD, and training sessions from these materials given on a regular basis. These training sessions can include not just handouts and video / PowerPoint, but also “what-if” scenarios in the classroom and in the field, as well as bringing in outside experts to share KM best practices in specific practice areas and lessons learned elsewhere.

Metro Vancouver has developed a multi-pronged training program. (Metro Vancouver, BAYWORK, 2010) Their web-based training materials are organized into modules and are focused on “the what and the why” of their specific water and wastewater facilities. The web materials also include troubleshooting guides that list indicators of certain problems, possible causes, and potential solutions. Field training starts in the classroom, where procedures and operating scenarios are laid out. Under supervision, field trainees then walk through these procedures in the field, observing skill demonstrations from senior operators or other subject matter experts. After walk-throughs and observations, trainees are then asked to demonstrate their proficiency with the procedures and scenarios. The session outcomes are documented. The web materials and field training are organized and developed to enable new scenarios to be added at any time.

Colorado Springs Utilities (CSU) has a long history of developing their workforce through initiatives such as apprenticeship programs and employee development. (Thomas, 2009) They have moved from a decentralized to a more centralized training approach that has paid dividends in terms of overall staff development and workforce recruitment and retention. Each staff
training initiative is linked to the Utility’s overall objectives and strategies, and great care is taken to select the most appropriate training delivery system.

CSU has a Workforce Planning and Development Unit of 32 employees organized into four sections: Technical Craft Development; Business Skills Development; Workforce Planning; and Instructional Design. Each section has specific training programs and/or develops specific training materials designed to build the skill levels of each employee. The Utility has not fully quantified its overall return on investment of its training systems, but has been seeing clear examples of financial savings due to streamlined training efforts, increased efficiency, improved employee performance, and good communication across their various sectors.

<table>
<thead>
<tr>
<th>CSU’s Four Sections of their Workforce Planning and Development Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Technical Craft Development</td>
</tr>
<tr>
<td>2. Business Skills Development</td>
</tr>
<tr>
<td>3. Workforce Planning</td>
</tr>
<tr>
<td>4. Instructional Design</td>
</tr>
</tbody>
</table>

3. **Use Competency–based training to determine best job fit based on knowledge and experience**

Another valuable training system used by utilities to capture and transfer knowledge is competency-based training. The process involves determining the kinds of knowledge, abilities, and other performance characteristics – in other words, competencies – that are critical for job success, and then developing a program in which employees are evaluated and trained to assess and ultimately meet those competencies. Learning materials, real-life scenarios, and role plays are typically developed and used. (Broome, accessed 2010)

There are numerous approaches that work, but the program developed and maintained by Union Sanitary District in the San Francisco Bay area over the last six years has some excellent features. Prior to 2004 the District provided training to its staff primarily to meet regulatory training requirements. The District then developed a competency-based training system comprised of training modules and standard operating procedures. (McPherson, 2010) A training module is normally comprised of a Job Competency Requirement (JCR), Standard Answers (SA), and often one or more Standard Operating Procedures (SOPs).

A JCR represents the minimum knowledge and skills needed by an individual to be qualified or certified to perform a specific task. It provides a uniform, standardized expectation across the utility for qualifications of a particular job, and gives clarity to the employee about the objectives and training requirements of the position. After management approves a JCR, those competencies are used in staffing plans, succession planning, performance reviews, and professional development.
Standard Answers (SA) are the standards or expected outcome to which staff are measured when accomplishing a certain skill or knowledge-based task. The SA is normally just a paragraph explaining the process but also contains a measurement – a number, percentage, period of time, etc. – that staff must meet in performing the task.

The District then performs competency assessments based on feedback from the training system. If an employee fails to accomplish a certain task based on the standard answers, questions are posed to determine why, such as an unsuccessful transfer of information from trainer to employee; defectiveness in equipment or tools that hindered the employee from completing the task; lack of knowledge, skill, or ability on the part of the employee to accomplish the task; and/or the influence of the training environment. After the reasons why an employee failed the task are identified, the training system is corrected and refined to ensure the employee’s success in the future.

One of the District’s additional goals for the future is to be able to provide what is called “just-in-time” training to employees. One example of this is to distribute training videos via hand-held devices, enabling the necessary work to be accomplished in the field as quickly as possible.

4. **Form Communities of Practice to build relationships and share knowledge**

A community of practice is “a group of people who share a concern, a set of problems or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an on-going basis.” (Wenger et al, 2002) Software and related tools (described in the final subsections below) are effective means of organizing and managing knowledge, but on-going human interaction brings life to the process and engages people in ways that other tools cannot.

By providing a stimulating and comfortable environment for people to learn and exchange ideas (Smith, 2008), a community of practice in a water utility can accomplish a number of things. New staff are made to feel at home immediately and can be acclimated into their roles and responsibilities. The group can identify the crucial areas of knowledge that need to be captured and transferred within the organization, and determine how that knowledge will be shared and captured during the community meetings. Veteran staff share their experiences, tools, and knowledge, and describe typical scenarios that they have encountered. Newer staff learn critical information and problem-solving skills from these interactions.

The community can begin as a regular weekly meeting, perhaps centered at first around one or two topics. As relationships build, members can introduce additional topics and define some structure for how knowledge can be captured and communicated within the organization. It is important that someone administers the community and that discussions are facilitated to ensure they stay on target.
It is perfectly fine that a community of practice have many different levels of participation. People will participate in a community for a variety of reasons – for personal connection, to improve their skills, to capture critical knowledge that will soon be leaving via retirement. There will typically be a coordinator and a core group of people, but there is value in inviting others who contribute only on occasion or who simply listen. They are learning from the process and will put their knowledge to use. Peripheral members may even become core members as topics evolve over time and these members see the value in what the community of practice brings. (Wenger et al, 2002)

The value of the community to the organization might change over time. When first formed, the community could be focused on solving certain problems say in operations and maintenance, or building basic skills for new operators. As the group continues to meet and mature, bodies of knowledge are organized and mechanisms for accessing that knowledge within the organization are developed, bringing increased value. In addition, as relationships are built among members in the community environment as well as outside the community meetings, elements such as trust and interdependence are strengthened. These are healthy qualities for any organization.

5. Create a Knowledge Management System Accessible from the Utility’s Intranet

Currently many options are available to utilities for using computerized information systems to help staff store information and retrieve it for future use. Some software packages have strong records management capabilities, such as the capacity to store multiple versions of documents, and (upon request) display only the most recent records. Software packages that emphasize document management capability may also have the capacity to purge data after a pre-selected records retention time.

However, some records management systems are geared more toward long-term data storage than ease of information access. To accommodate information access, some utilities have developed customized information systems that reflect their particular information needs (e.g., with a focus on easy access to Standard Operating Procedures, and links to other operational systems such as SCADA). There are also numerous versions of WIKI software (with a widely known application being Wikipedia). Depending on the software product chosen and the degree to which it is customized, wiki-based knowledge management systems can provide:

- User-friendly data submission, editing, and retrieval;
- A technology that is familiar to many employees;
- The capacity to structure information in meaningful hierarchies (e.g., by organization or by project), to supplement the search function provided by the software (e.g., search by keywords or tags);
- A knowledge management system that requires relatively little programming support from information technology staff.
It is also possible to mix and match a number of information systems in order to optimize the information available to employees. For example, the user may access information through a front end based on wiki software, but can find links on the wiki page to documents stored in a records management system. This hybrid approach enables many workgroups to access the same document from different pages, while ensuring that the document accessed is the most recent version of the document. Links can also be created between wiki pages, to external websites, and to other web-based systems maintained by the utility (e.g., a geographic information system). Content can be created on wiki pages, attached to wiki pages (e.g., in the case of pre-existing Standard Operating Procedures), or linked to wiki pages. This content may be text documents, but may also be photographs, videos, maps, or drawings, which are valuable sources of information to utility staff.

Examples of use of computer software to support knowledge management are the systems developed by the Littleton/Englewood Wastewater Treatment Plant in Englewood, Colorado – which reflects customized software development (Goodburn, 2010) and the mIToolbox system developed by the San Francisco Public Utilities Commission – which is a customized version of Confluence wiki software (Smith and Davis, 2010). The system developed by the Littleton/Englewood Wastewater Treatment Plant is described in the case studies attached to this report.

The term Enterprise Content Management (ECM) has evolved into a helpful term that largely represents what utilities and other organizations are trying to accomplish with their information management systems. The latest definition of ECM, developed by the Association of Information and Image Management (AIIM) International (Wikipedia, retrieved September 2010) is “the strategies, methods and tools used to capture, manage, store, preserve, and deliver content and documents related to organizational processes. ECM covers the management of information within the entire scope of an enterprise whether that information is in the form of a paper document, an electronic file, a database print stream, or even an email.” (Wikipedia, September 2010) There are essentially five components and technologies – capture, manage, store, preserve, and deliver. These are briefly summarized below.

- **Capture** – converting information from paper format into electronic format by scanning. It also signifies collecting and organizing the electronic files into a cohesive structure.

- **Manage** – this component connects the others, and applies to document management, web content management, records management, and workflow / business process management.

- **Store** – the term “store” is defined as temporary storage of information, as separate from **Preserve**, which is the next component on the list. Storage can be in repositories such as file systems, databases, and data warehouses, using technology such as hard drives, compact disk and DVD, tape libraries, and cloud computing servers.
- **Preserve** – this is the long-term, secure storage and backup of information. *Electronic archiving* is a related term.

- **Deliver** – essentially divided into *transformation technologies* (transforming data from one form to another), *security technologies* (e.g., electronic signatures and watermarks), and *distribution* (intranet, extranet, e-mail, mobile phones and other devices, CDs and DVDs, digital TV). (Wikipedia, September 2010)

Regardless of the specific software used, here are some general implementation guidelines and additional questions to consider:

1. Start with a information needs assessment, not an assumed solution.

2. Select and develop software consistent with your organization’s needs.
   a. What kind of information should we put on the system, and how should it be organized?
   b. What is our plan for information security?
   c. How user-friendly is the software/system?
   d. How will this system connect to other information systems we have in place, or that are planning to bring on-line?
   e. How much IT support will be needed to support this system?

3. Teach and learn from each other, across the utility.

4. Provide management support and direction, and develop an effective implementation plan.

5. Keep in mind that it does not matter how good your knowledge management tool is if people do not take the time to use it.

6. Where open communication is not the organizational norm, there will be a tendency for staff to use components of the system that improve communication in small workgroups, but resist making information available to the rest of the organization.

6. **Capture knowledge by video technology**

Presentations designed to share knowledge are done in a variety of ways, including meetings, conference calls, conferences, and classroom training. There are challenges with these methods of knowledge transfer. Sometimes people do not need the information at the time that it is presented, and many of us forget much of what is verbally communicated to us in a fairly short period of time. It is advantageous that the knowledge be captured and made available at a later
time and “on-demand” so a person can access it at the times he or she truly needs it. (Cocheu, December 2008)

The use of video technology can help overcome these problems. Presentations by in-house managers and staff as well as outside experts can be recorded and then transferred into a variety of formats – CD/DVD, streaming video, downloadable MP3 audio, and MP4 video. Audio and video podcasts can also be made accessible. Related information such as the presentation transcript and PowerPoint files and animations can be also be added.

“Screencasts” can also be used in certain circumstances. A screencast is a digital recording of computer screen output, or video screen capture, which can also contain audio. (Wikipedia, December 2010) Screencasts are helpful for software demonstrations and, and could conceivably be used in training on SCADA systems and other operating and maintenance systems specific to a utility.

The Metropolitan Water District (CA) has been using knowledge capture videos in its overall KM program. They capture key operations and maintenance activities and have subject matter experts provide narration. The subject areas are selected and prioritized based on several factors – impending retirements, criticality to the utility, and uniqueness are just a few of the categories. Skilled staff provide sequencing and transcription of the video, attach supporting documentation, and make the video available online. Videos are then used for training and reference. (Chapman, 2010)

BAYWORK, a regional collaborative of Bay Area water and wastewater utilities working together to address workforce development issues, have emphasized increased use of video technology to support knowledge management. One area that seems to have considerable promise is creation of video Standard Operating Procedures (SOPs). This provides information in a form that may be more appealing to and effective with staff than written procedures. BAYWORK initiated a pilot test of this concept, producing a video for machinists on how to remove and install a motor.

Since utilities are in general unfamiliar with how to use video technology effectively, one of BAYWORK’s planned projects is to develop a video on how to produce a video SOP, checklists that provide information on software and hardware, and a workshop on how to produce video SOPs. In addition, BAYWORK has been investigating the possibility of increased use of videoconferencing to allow staff from multiple utilities to receive training simultaneously at different sites. Although videoconferencing requires an initial investment, long-term savings are possible through avoidance of travel time and costs.
4. CASE STUDIES

Eight case studies have been provided by committee members that describe a wide-range of knowledge management activities conducted by water and wastewater utilities. Below is a short abstract of these case studies. For additional information refer to Appendix A.

1. **College Business Model** – Colorado Spring Utilities links staff training to organizational objectives. Training opportunities include apprenticeship programs, safety and environmental training, and ongoing journey-level training. Though the University of the Springs Utility (USU) model they identify training needs and then explore new approaches for the appropriate delivery of the training content. Colorado Springs Utilities has discovered a strong, coordinated candidate development and staff training program is essential in order to create and maintain a positive, performance-oriented organization.

2. **Creating a Learning Community** - North Coast County Water District (CA) created a learning community by starting with a change from top down. Management adopted a strategy where they’d not only lead by example, but would participate in all aspects of the change on every level, and with every individual in the operations group. One approach adopted was to replace old organizational rules with new ones. For example, replacing “We do the job the way we’ve always done it,” with “We’ll constantly look for the best way to get the job accomplished.” Another rule replaced was “Designated rigid rules” with cross-training and flexibility. The new rules reflected the new corporate model: a learning community. Modular work groups were a key component of implementing this model. Today employees of varying skill levels and experience are assigned to work together on the Districts’ various projects. This promotes collaboration, knowledge sharing, and skills development.

3. **Mentoring as a Component of Leadership Development** – East Bay Municipal Utility District (CA) employs mentoring and coaching as one important component in its overall leadership development program. The utility and its employees have reaped benefits from the mentoring program, and have learned numerous lessons that they share in the case study.

4. **Designing Around Regulatory Requirements** - Zone 7 Water Agency (CA) developed an approach to supplement the California Department of Public Health mandated Operations Plan with in-house procedures such that the plan meets regulatory and in-house operations requirements. Existing procedures were documented and a series of working sessions were conducted with staff and an external consultant to finalize procedures. The final Operations Plan and documented procedures were converted into a training plan.

5. **History As A Knowledge Management Tool** - Famed American Astronomer Carl Sagan reportedly said “You have to know the past to understand the present.” That thought captures the essence of Seattle Public Utilities’ (SPU) research chronology project. Under a contract with SPU, History Ink, a Seattle nonprofit, produced a 500-
entry research chronology detailing the history of water supply in Seattle from the earliest private systems through the current regional system managed by SPU.

6. Knowledge Capture In A Small System Setting – Both Public And Private – Two examples are provided of small systems that used developing small operations and maintenance manuals as vehicles for identifying and capturing operational knowledge. In both examples, a consultant was used to document existing facilities and identify operations and maintenance strategies. Manuals are used for training new and existing staff, and educating City Council and regulators.

7. Key Directory to Support Finding and Using Institutional Knowledge for Customer Service - Salt Lake City Department of Public Utilities (SLCDPU) focused on identifying and documenting information needed to improve the ability of all employees to find and use the institutional knowledge located at SLCDPU to support customer service programs. To support this effort a comprehensive subject matter expert directory was developed and delivered to all employees.

8. On-Line O&M Manual and Knowledge Capture System – In conjunction with a major plant expansion, The Littleton/Englewood Wastewater Treatment Plant developed an on-line Operations and Maintenance Manuals (O&M Manuals). This web accessible site is the central repository of plant information, available to all plant employees, that includes everything from safety procedures to manuals for equipment and instrumentation, and standard operating procedures for numerous plant procedures. New content is continually added, and Operators are utilizing the program with greater frequency. An additional benefit has been the ability to capture the priceless knowledge of long-time operators and record this information in a usable format that will ensure the continued optimal performance of the treatment plant through the years to come. The content is managed by a Knowledge Management Team that ensures that content is added and continually updated.

5. FUTURE NEEDS

1. Addressing the knowledge needs with changing demographics. With younger workers replacing retiring workers, the particular skills and interests that characterize younger generations should be viewed with the question in mind of “how can these skills and interests transform knowledge management in our industry?” For example, many younger people are versed in social media applications such as Facebook and Twitter. These applications are currently not designed around storing large amounts of data or for training purposes, but they are strong in their ability to connect people and move ideas quickly. To date, the water industry has not adopted social media tools as a knowledge management tool to any great degree, but there should be focus on these tools in the years ahead.

2. Understanding and addressing the barriers to the use of new knowledge management technologies. New technologies (wiki, handheld devices, video technology) have emerged that
can aid in knowledge capture. However, being new and not in common practice, there are many questions that need to be addressed before wide-scale adoption.

3. **Continued discussion on knowledge management best practices.** This committee report represents one of the first attempts to identify best practices for using knowledge management in addressing workforce issues. The committee hopes that this document leads to more discussion within AWWA and the water supply community as a whole.

6. REFERENCES


http://www.connexions-direct.com/index.cfm?pid=79&catalogueContentID=156


http://en.wikipedia.org/wiki/Learning_management_system


http://hbswk.hbs.edu/archive/2855.html


http://en.wikipedia.org/wiki/Enterprise_content_management

