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Creating Effective Organizations Through People

INVESTING IN HUMAN CAPITAL: THE LITTLETON/ENGLEWOOD WASTEWATER TREATMENT PLANT KNOWLEDGE MANAGEMENT INITIATIVE

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For the past ten or fifteen years, the water/wastewater industry has acknowledged two critical issues facing the industry: aging infrastructure and aging workforce. There have been a lot of discussion, debate, and conference presentations centered on these two issues, both of which have been described as "crises" facing the industry.

In 1972, the Clean Water Act was established. The CWA provides the statutory basis for the NPDES permit program and the basic structure for regulating the discharge of pollutants from point sources to waters of the United States. The nation was forced to expand existing infrastructure and advance technology for water and wastewater treatment in order to meet the new stringent regulations. With the expansion of infrastructure came the need to increase personnel to operate the facilities. The 1970's became a frenzy of capital investment, both infrastructure and human.

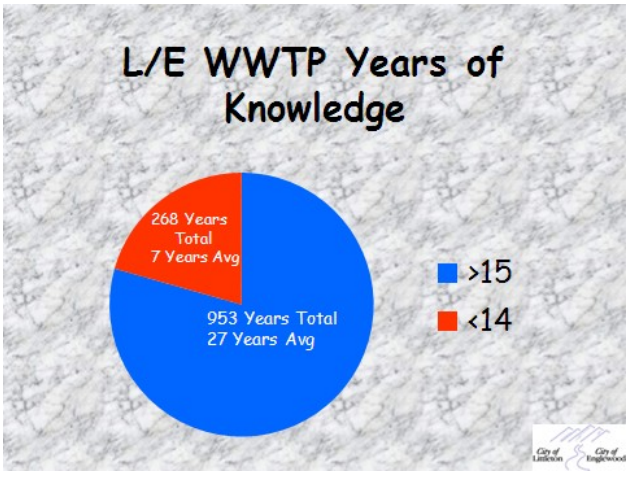
By early 2000, personnel that were hired in the 70's to manage and operate the treatment facilities and the conveyance systems had been in their jobs for 30 or more years. The Water Environment Research Foundation estimated that, "*with the looming departure of senior personnel, utilities will lose an estimated 80% of knowledge that is tacit, that is, understood but not documented.*" WERF further noted that the average retirement age in the water/wastewater field is just over 56 and the average length of employment at the same facility is 24 years. These were the operations and maintenance personnel that knew how to run the facilities and where all the assets are – and it was all nicely tucked away in their heads! Few facilities had a plan for capturing this knowledge before it was lost to retirement or other symptoms of an aging workforce.

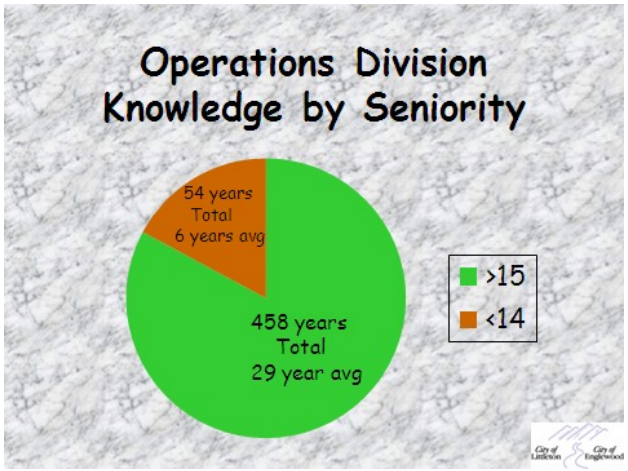
Fortunately for the industry, the past five or six years of poor economy have discouraged much of the retirement-eligible workforce from retiring. This has provided the industry time to implement programs to capture knowledge and asset information in a tangible format that can be retained in the organization and retrieved by those who will assume the reins of the organization.

Now that the economy is beginning to realize some improvement and the retirement eligible workforce is a few years older and closer to 65, the benefits of Social Security and Medicare are attainable, the retirements are becoming actuality.

At the Littleton/Englewood Wastewater Treatment Plant, the retirements have begun. Since February 2012, five staff have retired, those staff representing over 100 years of facility knowledge and experience. There will be at least one retirement in early 2013 and 5 staff announced definite retirement dates within 3 years. Numerous others are soon to follow.

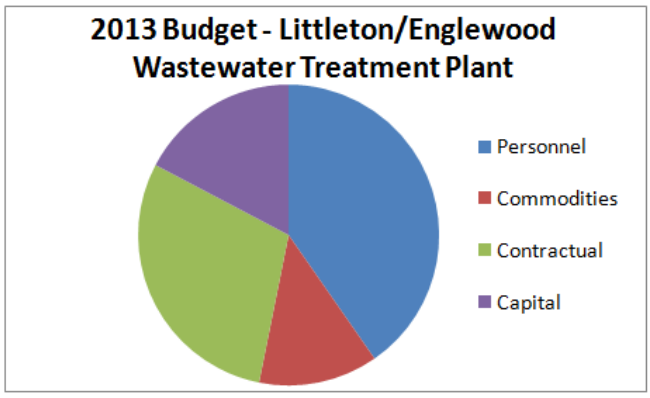
Below are charts showing the years of knowledge by seniority and the average years of employment for each group within the L/E WWTP workforce as a whole and the L/E WWTP Operations division.





When thinking about the capital assets of an organization, what are the first things that come to mind? Pumps, blowers, buildings, pipes? Indeed, these are all capital items. However, studying a pie chart of organizational expenditures can paint a different picture of monetary focus. Capital investment is not the highest organizational cost; in fact it may be the smallest piece of the pie. The largest piece of the organizational expenditure pie is typically personnel costs.

Below is a pie chart of the L/E WWTP 2013 budget. The largest single expenditure category is personnel, followed by contractual. The argument can be made that the majority of the contractual expenditures are due to the need to either augment staff or augment skills to accomplish special projects.



When an organization hires an employee, it is actually purchasing non-tangible capital: knowledge, skills and abilities. And just like a capital purchase, there is an upfront cost to recruit, hire, and train, and an on-going cost to retain, maintain and develop. But what happens when an employee retires or leaves the organization? What happens to the knowledge and skills the organization has invested time and money to develop? What's the replacement schedule for that asset? What happens to the investment? What is the impact on the organization and its operation? Is there redundancy? This non-tangible capital, if not maintained and properly planned, can become an organizational nightmare.

The industry standard for employee longevity is 24 years at the same facility. When an operator is hired at a facility, the hope is that they will be there for at least 20 years. If the employee is hired at a salary of $50,000, the cost of that initial investment for the expected 20 years is $1,000,000. This doesn't include benefits and employee maintenance and development such as training. A capital equipment purchase of $1,000,000 is often very difficult to justify and get approved by a Board or Council. A good replacement program or business case for the equipment is required. However, replacing an employee or the loss of knowledge is rarely planned and the cost of the loss to the organization rarely documented.

The L/E WWTP has a Long Range Master Plan which addresses plant/treatment expansion through ultimate service area build-out. This plan details the 'how's' and 'whys' of plant process and infrastructure, and the capital investment required to meet treatment demands through the year 2020. In 2004, the plant embarked upon its Phase 2 construction project, which will nearly complete the build-out of the Long Range Master plan, leaving plant staff with an entirely new facility to operate.

While the Long Range Master Plan has been an invaluable capital plan, it does not address the issues of 'who' will operate and maintain the facility. Additionally, the plant faces the potential of losing 25% of its workforce over the next 4 to 5 years due to retirement. The knowledge and experience of these staff members is a vital asset to the plant because they are the only personnel who understand certain processes and equipment and have gained the knowledge of new equipment and processes as the Phase 2 project has proceeded. Plant management recognized a need to develop an action plan to address their 'non-tangible capital' for long-term success. An initiative has been developed to address the knowledge exodus and succession planning by developing a Knowledge Management Plan.

The L/E WWTP is the third largest wastewater treatment facility in Colorado, serving a population of 300,000 residents in the cities of Englewood and Littleton, and 18 sanitation districts in the southwest Denver metro area. The plant faces many challenges in the future and has begun several significant initiatives to position itself positively for successful and sustainable operation after

completion of the Phase 2 Project and well into the future.

The major challenges facing the plant are:

1. The Phase 2 Project: This major construction project addressed infrastructure improvements, capacity expansion needs, and added a new process; denitrification. Staff had to be prepared to operate a new plant with new equipment upon project completion in 2008. The foundation of this preparation required development of all new Standard Operating Procedures (SOPs).
2. Regulations: Faced with increasingly stringent regulatory responsibility, advancing treatment technology, there is an on-going need for plant staff to be well trained and continuously up-to-date on treatment and technology that supports successful operation and meets regulatory requirements.
3. Workforce Retirement Eligibility: Approximately 25% of the plant workforce will be eligible for retirement in the next 5 – 10 years. There will be significant knowledge loss, particularly in the Operations Division. There is a critical need to capture knowledge before it is lost and store it in a tangible, accessible format.

One of the most important initiatives that the L/E WWTP has embarked upon is the plan to capture the knowledge of its workforce, develop Standard Operating Procedures and provide on-going training programs to ensure knowledge transfer and long-term operational success. This paper will preview how the information is being developed and managed in a living, tangible form and the incentive program that supports this effort. This is a critical program that will sustain the organization and support its most valuable capital: its employees.

PAST KNOWLEDGE MANAGEMENT

Prior to the Knowledge Management Initiative, the L/E WWTP had an intranet site called *InfoNet*. *InfoNet* was a repository of information that pertains not only to plant specific information, but contains personnel policies and procedures and other general and frequently used information. The site was established and maintained by the Process Specialist, who also did the majority of training for the Operations staff. This site was used frequently by operators to gain understanding of new operational procedures through staff developed narratives, such as SOPs, video clips and training. Knowledge and troubleshooting techniques, which veteran operators have gained over the years, had not been adequately captured and the content only represented about 25% of the processes and was very time consuming to maintain.

In addition to the web site, there were in-house notebooks and manuals for certain procedures and equipment. In many cases, these documents are outdated and no longer reflected current operations' methods, or cannot be quickly located. Inexperienced operators often had to rely upon the help of veteran staff to recognize problems, troubleshoot, or to make appropriate operational decisions.

THE NEW '*INFONET*'

As part of the Phase 2 Project, Brown and Caldwell, design engineers for the project, was asked to provide an On-line Manual containing all facility Operations and Maintenance Manuals. The On-line Manual was to also provide the platform which would replace the previous plant intranet site. The new *InfoNet* was designed to provide more functionality and will be much easier for in-house staff to administer than the existing site.

Brown and Caldwell was responsible for developing all O&M Manuals related to the Phase 2 Project, and the responsibility for populating all other information, including the daunting task of creating thousands of new SOPs, was assigned to plant staff.

GAINING MANAGEMENT SUPPORT

The Operations Management realized the enormity of developing new SOPs, particularly in the chaos of the P2 Project, was going to require some guidance and assistance from an outside source. Inflection Point Solutions, Inc. (IPS) was retained to assist in the endeavor. IPS has guided and assisted in the development and implementation of the project. Development of Key Assumptions and the project plan was accomplished through a series of meetings and workshops involving all levels of the organization.

Support of upper management is key to the success of any project, particularly an endeavor requiring the level of staff participation and on-going staff support of this project. Prior to the beginning of the project, certain assumptions and awareness items were identified. These assumptions and awareness items were presented to upper management and the facility governing Board. A strong commitment was made by the Board and upper management for this project. Getting this commitment was an important step to help ensure staff dedication and participation in the project. The following are the topics

considered important for successful implementation of the Knowledge Transfer/Management Plan:

- *Operations Knowledge* is the collection of information, data, and procedures, which can be appropriately recalled to assist in observations, trouble-shooting, problem solving, or decision-making.
- Knowledge is valued as a vital asset in supporting successful operations and management appropriate resources and support shall be allocated.
- Management and staff will work together to promote knowledge transfer.
- Knowledge must be captured and stored in either an electronic or documented format, and be managed as a living, evolving process.
- Staff must be able to easily access information when necessary.
- All mission critical elements of the operations process must be captured.
- An environment of information exchange needs to be in place in which operators are willing to share information without feeling threatened by staff members eager to learn.
- The plant must have a person(s) dedicated to and responsible for the maintenance and administration of the knowledge management program.
- Information systems must be in place to support the knowledge management program.
- A dedicated schedule must be followed to ensure knowledge capture will occur before veteran staff retires.

KEY PLAN ELEMENTS FOR KNOWLEDGE TRANSFER

Knowledge Transfer is an enormous endeavor that needed to be broken into stages. The following presents each stage of the plan with a brief explanation:

1) *Promote the importance of knowledge management*
The importance of knowledge management needs to be championed at all levels of the plant; from the Utility Director to each Operator. Everyone must realize the significance of knowledge as an asset and its long-term impact on future plant operations. Promoting this awareness over the next five years can be achieved via meetings, the plant newsletter, presentations, "pep talks" from managers.

2) *Form a Knowledge Management Team (KMT)*
Change occurs best if more people own the outcome. In addition, by using the concept of "divide and conquer", tasks can be divided amongst more resources, as opposed to the entire burden falling on just one person. The core team consists of the Process Specialist, a Lead Operator, and the Data Analyst. The extended team consists of 2 senior operators, 2 less experienced operators and supervisors, who are responsible for documenting the knowledge for their assigned area.

3) *Tie knowledge management to pay for performance*
In order to increase participation, pay can be used as an incentive. For example, each employee can be given a target of SOPs to complete for the year. If that target is met, they receive a higher rating in that section of their evaluation.

4) *Identify knowledge content elements by plant areas*
A list of all the various process areas, procedures, troubleshooting techniques, preventative maintenance methods, and key knowledge areas need to be compiled by the KMT. This list serves as the guide for the entire knowledge management project with each area owner responsible for completing his or her portion of the list. See Table 1. This list should be updated on a regular basis.

Table 1. Knowledge Content Project (KCP) List

Plant	Area	Owner	Knowledge Source	Topic	Method	Target Date	Complete
Old	Headworks	Operator A	Operations Manager	Gate Maintenance	Narrative	11/04/06	Yes
New	Dewatering	Supervisor B	New SOP to be developed	Sampler Calibration	Narrative & Video	11/12/06	No

5) *Identify Knowledge Sources* – Identify key knowledge sources throughout the Operations Division who may be retiring over the next 5-10 years or who has become an "expert" in a specific area. List the person's name next to the topic area. See Table 1.

6) *Determine the appropriate format(s) for capturing information* - For each topic, an appropriate means for capturing the information needs to be determined, such as a written narrative, video, audio, pictures, flowcharts, etc. To address this, a survey of learning styles for all Operations staff was conducted and 90% of the Operations Division staffs' learning style was visual. The second preferred learning style was auditory and third was kinesthetic. With this information, the KMT was able to customize style and format for SOPs and training that will best reach all Operations staff.

7) *Capture the knowledge* – Having the KMT meet on a monthly basis and by using the KCP List as a guide,

operators can be given assignments to accomplish during their work time. It is vital that the KMT members facilitate and monitor the capture of information. In addition, knowledge exchange meetings can be set up for instances where select people retain knowledge and expertise.

8) *Develop Migration Plan to B&C System* - The B&C System is more user friendly and easy to manage, and will be used in the future as the knowledge repository. The Process Specialist has developed a migration plan in conjunction with B&C and migration of information is in process.

9) *QA/QC the Information* – A means of validating the information for each topic needs to be developed to ensure information is up to date and accurate. This includes testing of the procedure and testing the usability of the content on the InfoNet. The KMT will have the oversight role in this effort.

10) *Train staff in using the InfoNet* – All operators will be trained on how to access information on the InfoNet and be encouraged to use it on a regular basis.

11) *Assess the knowledge management program on a yearly basis.* – The knowledge management program is an on-going endeavor requiring a long-term commitment to monthly program assessment and refinement. Additionally, to ensure the relevance of plant SOPs, the author of each SOP is responsible for an annual review of the SOP to ensure that all information is current. This is accomplished by using the facility Asset Management System.

THE KNOWLEDGE MANAGEMENT TEAM

The Knowledge Management Team (KMT) convened in June 2007, under the Chairmanship of the Process Control Specialist. The team is comprised of one senior Lead Operator, one senior Plant Operator, two junior Plant Operators, and the facility Data Analyst who is responsible for *InfoNet* administration.

The KMT was charged with establishing a process for development and maintenance of SOP's, capturing the knowledge from senior operators before they retire, capturing new Phase 2 knowledge as it becomes available, and for review and critique the Brown and Caldwell developed O&M manual content. The KMT is also responsible for reviewing existing SOP's and making determination on relevance and/or revision.

All existing SOP's were identified and categorized and the categories for the new plant processes were defined. Based on the construction schedule of equipment and processes being put into service, the KMT developed an order of completion for the SOP's. A template for each SOP type was developed so operators have a clear and standard format to follow for developing SOP's.

USE OF THE ASSET MANAGEMENT SYSTEM

Using the theory that knowledge is an asset, the KMT Team determined that the best way to track SOP development, staff involvement, and SOP review, is to use the Enterprise Asset Management System (EAM), Infor EAM. When an SOP is identified, a Work Request is written in EAM and assigned to the appropriate staff person as a Work Order to develop the SOP. The hours dedicated to developing, refining and reviewing are booked on the Work Order, just as a mechanic would book hours to a work order to repair a pump. Once completed and reviewed, the Work Order is closed and turned into a Preventive Maintenance (PM) Work Order, which will appear in the in-box of the author in one year so the SOP can be reviewed.

This system has numerous benefits. First of all, hundreds of SOPs have been developed and this system automatically tracks and gives notification for the annual review, without the need for manual tracking, thus retaining that knowledge in a retrievable format. Further, each operator has a KMT hours report available on his/her dashboard that can be run and used as part of the self-evaluation process. Management reports on hours dedicated to SOP development are also available to provide information such as program cost, hours spent, SOPs developed, etc.

KNOWLEDGE MANAGEMENT INCENTIVE PROGRAM

The members of the Operations Division staff have been tasked with developing thousands of SOP's and reviewing thousands of pages of O&M manuals for accuracy and relevance. These tasks require enormous effort, which is outside the usual scope of plant operation. Operations Division Management has made a strong commitment to rewarding operations and engineering staff for individual contributions toward this effort. SOP development is tied directly to pay for performance by requiring each Operator to reach a negotiated number of authored SOP's each year. If an individual exceeds the negotiated number of SOP's, the evaluation score is increased and the pay-for-performance reward is increased.

CONCLUSION

The program was originally developed for the Operations Division to address an urgent need. It has been in place for 5 years and offered out to all divisions. The *InfoNet* is now a one stop shop for all information; drawings, schematics, policies, procedures, etc. The site is available via wireless network throughout the plant and can be accessed via laptop or iPad. The ease of access to the site has improved the success of the Knowledge Management Initiative. Numerous efficiencies have been realized in the work routine of staff. Hours previously spent retrieving paper drawings or SOPs have been virtually eliminated. Limited access to computerized systems in the field has been virtually eliminated, which has reduced many two-man jobs (one person stationed at a computer with a radio and the other at the job site receiving information via radio) to one-man jobs.

The hours of work and staff time dedicated to getting the program details established have been enormous. Ahead still lies a ginormous effort, requiring the dedicated participation of each individual and each division within the plant to accomplish these goals. With continued support and commitment to the dedication of resources, and ongoing staff commitment and involvement, this initiative will be one of the most important to sustain successful operation at the Littleton/Englewood Wastewater Treatment Plant for many years to come. This program truly demonstrates reliance upon and commitment to the organization's most valuable capital investment: its employees!

Call us at (303) 561-3788 or email us at info@tapresource.com to make your organization more effective.