THE WATER AND WASTEWATER KNOWLEDGE MANAGEMENT SYSTEM, DEVELOPED BY OPERATORS FOR OPERATORS

Clara Laydon, Jim Keary, Steve Blanshard
Hunter Water Australia, Newcastle, NSW

ABSTRACT

Paper based operations and maintenance manuals have been produced as the traditional method for delivering plant information. However they are often 'left on the shelf' and the original investment spent on these documents declines over time as the information becomes out of date.

This paper outlines how Hunter Water Australia (HWA) developed a knowledge management system (KMS), a 'one stop shop' where all aspects of plant operation are fully integrated and accessible in a timely manner. The benefits being how the KMS has improved training, operational consistency and has provided an extension of the quality management system to field operations.

KEYWORDS

Operations, knowledge management, training, manuals, procedures

1. INTRODUCTION

After the 1998 cryptosporidium incident in Sydney, Hunter Water reviewed their water treatment plant operational information and found that the information systems were decentralised and unsystematic, and with a large number of operators reaching retirement, critical information was likely to be lost to the organisation. As a result Hunter Water sought to find the most integrated approach to capturing plant information.

2. A SYSTEMS APPROACH

Reviewing the current information and collating previous information into one central document appeared to be the most straight forward method for reviewing and capturing information. This was undertaken as an initial trial at a major water treatment plant. This included documenting the knowledge of senior operators in regards to the operational control of the treatment plant. Pulling in all relevant information was also useful in that it identified the knowledge gaps in operational understanding and documentation.

Once this information was collated a new document was created, it was noted that the paper based manual was a difficult media to manage. Ensuring information was kept up to date required each copy to be recalled and updated, control copies often become misplaced and were not easily available to the operators that the information was intended to assist.

A second trial was proposed in which this information would be copied into HTML based system which would create an 'electronic' based operations manual that would be accessible from any Hunter Water computer.

The overarching concept of the system was to provide a central location in which all relevant information to successfully run a treatment plant could be accessed. From this primary concept the system was built.

For any successful product it is important that it is designed for the target audience. With HWA's operational experience this provided a unique insight in creating a system which operators felt comfortable in using.

Using the centralised concept and operational experience, Hunter Water developed the first integrated electronic system. From this initial system it was found that there were three (3) key requirements to developing a successful system.

Firstly, the need for continuous improvement. It was found that in a number of similar systems changing information required sending changes to those that had HTML/code skills. This appeared to be a fundamental impediment in encouraging operational staff to be involved in making improvements to the information. Therefore, the system was designed with an editor that was similar in nature to commonly used Microsoft Word product.

The second requirement was to ensure the system would provide first level information and then be able to link to supporting information. This was the key to providing a fully integrated system. The system was not only to provide access to internal information, but also to the vast external sources of information that are important to the operation of treatment facilities such as Work Cover, Environmental Agencies, Department of Health, Bureau of Meteorology, etc.

The final key requirement, which was the most critical, was to make the interface as friendly as possible and structuring the information which reflected the needs of operators.

While the integrated electronic system was an overall success and provided a large step forward for Hunter Water, there were some constraints that were noted within the existing system.

This included the need to provide access to everyone within the operations team to ensure continuous improvement without compromising on data security, as well as ensuring that the level of information was sufficient to provide operational support without encumbering the system (i.e. database size and access speed).

Since the development of the online system and its implementation throughout Hunter Water's 5 water treatment plants and 17 wastewater treatment plants there had been large developments in online technology and code base. As a result the electronic system was no longer representing the most contemporary technology and it was increasingly becoming difficult to provide improvements to the system.

There were also non technical issues that had arisen, as the operators that held the most operational experience and information were of the generation that were not as familiar with computer interfaces or website navigation. Whereas the new generation of operators where intuitively using the system to access information without requiring any training.

As HWA was providing operational support to other water utilities in Australia it was noted that many of the regional councils were experiencing a similar problem in managing operational documentation and maintaining operational knowledge as experienced operators retired. Coupled with the new Australian Drinking Water Guidelines (ADWG, 2004) which contained elements on documenting operational information and document control, Element 4 - Operational Procedures and Process Control and Element 10 -Documentation and Reporting, HWA observed that there was an increasing need for a similar system in other water utilities.

3. SOFTWARE DEVELOPMENT

Using some of the original concepts that were part of Hunter Water's integrated online system, HWA developed a new software system using a local website designer. The overarching concept of the original system was maintained, in that the new system was to be designed to be a 'one stop shop' where all aspects of plant operation are explained and accessible in a timely manner. The result was an open information system.

This included links to drawings, procedures, external websites, etc, so the linked information could be accessed at the plants.

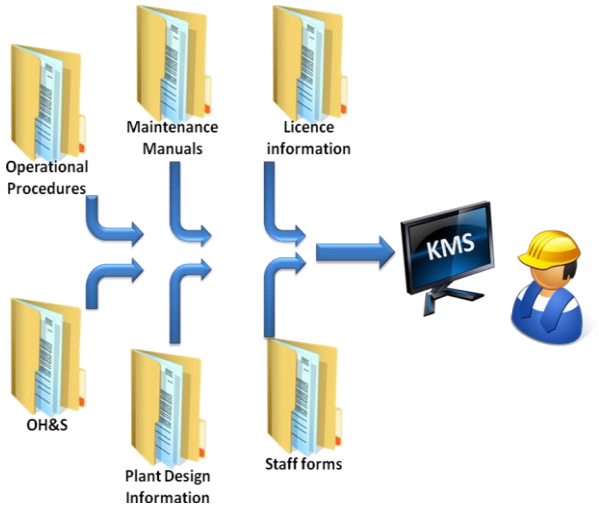

Figure 1: Integration of Operational Information

The new system was not only designed to address the issues that were identified through using the previous system but also to capture a number of new aspects of online technology. The new system which resulted was called the HWA Knowledge Management System (KMS), which is shown in Figure 2 at the end of the paper.

To address the previous constraint of accessibility and size, the KMS was designed to be web-based and therefore available from any internet connection. Making use of the internet rather than using a utility's internal network was considered to be a more strategic decision as internet technology throughout Australia is improving at a rapid rate, and once the federal government fibre optic project is completed the internet will provide the fastest information delivery system.

As the new code of KMS was based on website design, the amount of information stored within the KMS does not impact on speed or performance of the KMS. This was a large step forward on the previous version of the integrated online system.

By utilising the internet to deliver operational information to each water utility, the overall KMS database was able to be centralised and is hosted and maintained by a professional data entry company. This data centre provides virtually unlimited storage and guaranteed minimum internet bandwidth. The professional centre also provides data security and guaranteed response time to technical issues.

However, by opening up access through the internet and centralising the database also increased the chance of a security compromise. To ensure each utility's data is secured, a unique URL is created for each water utility and each user is provided with a username and password.

By providing each user with a unique username and password was an opportunity to address the issue regarding access and limiting permissions to make changes to information within the KMS. Three (3) levels of accessibility were built into the system, general user, editor and publisher access.

General users have read only access where they are able to access the system and view all information within the system. This includes opening links to drawings, operational procedures, technical reports, photos, video etc.

Editors have the authority to make changes to the content of the KMS. This includes the addition of new material, modification of existing material and the removal of material.

Publishers have the highest level of KMS access and have the authority to accept or reject changes made by editors. Any changes a Publisher makes within the system can be made live straight away without further approval.

From the experience gained from the previous system a user friendly editor was installed. This allows both editors and publishers to make changes to text without needing to understand source code. The editor is similar in nature to MS Word and has a spell checker that allows for the addition of technical words. While this may appear to be a small consideration, from the experience gained in developing operational information having a spell checker in which technical words can be added has made a significant difference when creating and reviewing information that contains a number of abbreviations, acronyms and technical jargon specific to water and wastewater.

It should be noted that these types of considerations, that appear to be small can make a considerable difference and been developed over time through experience. These are the elements that are often missing in similar systems as software developers aren't as familiar with the needs of an operational based system.

Another aspect that was carefully considered was that the operators that held the most operational experience were not as familiar with computer interfaces, but it was still very important to enable these experienced operators the ability to review information and suggest changes and improvements, ensuring that everyone could contribute and keep information as up to date and accurate as possible.

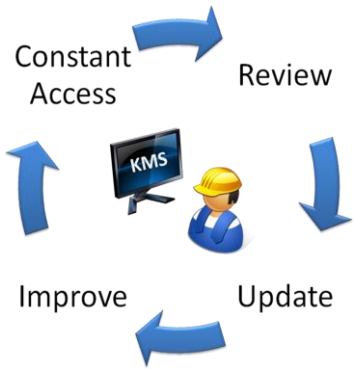

Figure 3: Constant Review Process

From past experience it was found that those operators that were not as experienced in website navigation or using a computer on a daily basis were also having difficulties navigating the previous system which was based on an expanding and collapsing tree structures. However these operators were becoming increasing familiar with Supervisory Control and Data Acquisition (SCADA) control interfaces and drop down lists. While the software developers that were working in conjunction with HWA thought having two (2) navigation systems inbuilt to the system was overkill, it has been proven that providing a more interactive method for navigation has made many operators more comfortable with using the KMS.

Following from the navigation issue, it was found that when applying the KMS to a number of different water utilities that the system needed to be flexible in design and layout. The system would need to present information that is aimed at a number of different levels from plant overviews for management to technical details for those operations staff in the field.

In order for this system to meet the varying needs of each water utility and those within the operational team, the tree structure would need to be as flexible as possible. Those personnel within the water utility that have publisher access have full control of the framework, allowing the operations team to build the system to suit their facilities and management systems.

HWA recognised that for an operational system to be successfully implemented and maintained, each water utility would need full control over their information. The KMS would need to grow and change as required and not be dependent on external software developers or limited to a few within the organisation to make

modifications.

It was also noted that it was important that the KMS can work in with the existing systems that are currently in place within a water utility. As treatment processes have become more complex this has lead to the development of more sophisticated tools. Often these tools have been added as required and do not have a coordinated approach to addressing the operational requirements of the plant as a whole. The KMS does not aim to replicate existing tools but to integrate and work in unison with current systems. In essence the KMS is to be the 'information coat rack', providing operators with a single interface to access a range of information. This could include linking in tools that are currently in place within each utility whether this be existing document control systems, or active operational databases or spreadsheets.

While the KMS addresses many issues that were related to the previous system, it also incorporated a number of new elements. The KMS supports multi-media files, so not only can operators access operating procedures, they can also click on and activate video clips which demonstrates how to undertake the task safely. Alternatively the KMS can play sound files, so for example, new operators can gain an understanding of the sound difference when a pump is experiencing cavitation, or if bearings require replacement. This takes operational procedures to a whole new level and into the new technology era.

4. RESULTS

There have been a number of direct and indirect benefits from centralising information. The most obvious is in maintaining operational information to ensure that the information is always up to date and relevant. The previous integrated system and the new KMS also provided the critical link in demonstrating a commitment to quality and continuous improvement. It is an extension of quality management out to an operations level. This also demonstrates a commitment by water authorities in meeting the ADWG in developing operational information and managing documentation.

However beyond the initial objective of centralising information, providing access to the system throughout the water utility has also opened up information. As knowledge is no longer 'owned' by one individual, The KMS has improved internal communication and understanding of the treatment processes, hence benefiting the organisation as a whole and minimising the risk of losing vital plant knowledge as experienced operators leave the organisation.

As information is collated for each treatment plant it also identifies data gaps, which may have previously been overlooked in maintaining the daily challenges of operations. These data gaps are usually important elements in understanding plant operations but are not critical in maintaining the plant operation on a daily basis, such as PLC control logic or chemistry or biological theory.

Identifying the information gaps and progressively developing information benefits the operation of the plant through improved optimisation of plant performance. Also by improving the information base on each treatment facility has significant benefits if any future design and augmentation work is required.

In addition to improving the level of information for each treatment process, the online systems have significantly improved operational consistency, training and safety. New operations staff have the capability to work through plant information, supported by a logical list of plant procedures, each with links to photos or videos demonstrating how each of the activities are performed. This has benefited with faster trainee progression and more consistent and safer work practices.

5. DISCUSSION

While the integrated electronic system provided a large step forward for Hunter Water, the new KMS has been created to be a modern and advanced version which can be applied to other water utilities. In spite of this there will always be the need to improve on the functionality of the system.

HWA is actively investing in new developments to the KMS to ensure it continues to improve. However, it was recognised that development should only be driven from experience and not just from the software designers. With an expanding user base the KMS is being used more actively and a number of improvement suggestions have already been requested. A number of these suggestions are already under development with the software developer.

Continuous improvement is an important aspect in the evolution of the system and HWA also reviews current and future technology concepts and the water and wastewater industry to ensure the system moves in line with the most current conditions.

Current wireless internet cards which link to the 3G network can be used to access the KMS from most locations around Australia, and as smart phones and tablet based technology is improving there is the potential to have the KMS as a paperless operational support system. Where operators can access the KMS in the field, open drawings, operational procedures and watch the video clip before commencing a job.

With the future possibility of smaller water authorities being amalgamated, there would be an increasing number of decentralised systems with a centralised management. Without a centralised operational support system, operation of these remote facilities will be an increasing challenge. HWA is investigating the concept of including forums and interactive troubleshooting as part of the KMS to provide additional support which would be invaluable if these amalgamations do occur.

6. CONCLUSION

Hunter Water has taken the concept and developed an online integrated operational management system and applied the system to all Hunter Water water and wastewater treatment plants. There have been a number of direct and indirect benefits from the project and has been an overall success. The system provided a large step forward for managing operational information through improved training, operational consistency and providing an extension of the Hunter Water quality management system to field operations.

HWA used this experience to develop the KMS which was designed to address a number of the issues that were identified through using the previous system and to capture a number of new aspects to online technology.

This new system can now be applied to other water utilities and is leading the way in managing operational information in the water industry. The KMS's success clearly comes from the fact that it has been developed by operators, for operators.

Figure 2 HWA Marketing KMS, Homepage