Singapore International Water Week
WATER UTILITIES LEADERS FORUM
18 - 19 SEPTEMBER 2013

Position Paper for Session 5A - *"Running Like Clockwork: Good Practices for Operational Optimisation"*

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Introduction

1. The core function of a water utility is to provide water and wastewater services. Consistency in the provision of quality water and treated wastewater effluent earns consumer confidence and trust in a utility. This reaffirms the utility's authority in delivering these services, and more importantly ensures its continued presence. However, a balance needs to be achieved as rising quality of water and treated wastewater services will inevitably be associated with higher costs. In order for utilities to be self sustaining, cost recovery tariffs may rise to the extent which becomes unacceptable to consumers. The utility's existence will likewise be at stake.

2. To ensure sustainable and consistent product / service quality without unnecessary tariff increases, both (1) technologies and (2) intellectual management of performance need to be employed. Appropriate technologies can be harnessed to improve operations: smart meters for volume control, on-line measurement of quality, and advanced modelling software, just to name a few. To complement technology's influence, there needs to be a similar level of intellectual management of performance, which encompasses management of knowledge and company culture, and choices of quality target and standards. This can be exemplified by web-tools for payment, which allow better control of the cash position and work force management with detailed preventive and planned maintenance.

3. In this paper, we will look at some of the major issues faced today by a utility in the determination of appropriate level of product / service quality, improvement of operation efficiency and resource management; and how technology or intellectual management of performance can be relevant in resolving them.

A. Determining an Appropriate Level of Service and Product Quality

4. One of the key steps to resolving the conundrum of ensuring sustainable and consistent product / service quality lies in determining an appropriate level of quality. Depending on the prevailing environment conditions, socio-economic development and consumer expectations, "fit for purpose" services should be supplied where possible to optimise the allocation of resources. One such example is the use of seawater for flushing in Hong Kong. Since its implementation in the 1950's, the Water Supplies Department is now supplying seawater for flushing to nearly 80% of the population. In 2012, an average of 745,225 cubic metres per day of seawater was supplied for flushing purposes, conserving an equivalent amount of potable water. This substantially reduces the demand for potable water and also the resources required to produce it, given that the seawater supplied is not treated to the same standards.

5. Besides the quality of water and treated used water, such a "fit for purpose" approach can also apply to areas of service delivery such as an acceptable flow and pressure of water supply to consumers and response time for service disruptions impacts upon the infrastructure and manpower required.

(i) While membrane technology can remove pathogens such as Cryptosporidium[1], some utilities may not afford such technology and may adopt conventional treatment such as coagulation and filtration processes which are effective but less robust than membrane technology.

(ii) This "fit for purpose" approach is reflected in water billing in the United Kingdom, where consumers were billed based on the size of the housing before water meters were mandatory. The size of housing was considered to represent both water consumption and the capacity to pay. The metering policy is introduced to develop awareness among consumers on actual consumption[2].

6. With a wide array of issues to be considered, **how can utilities decide on the appropriate level of product/service quality and select the relevant technological solutions?** For larger and more developed countries, convenient and relevant answers may lie with counterparts within the borders. Nevertheless, inspiration can also be drawn from external references. Benchmarking exercises can help a utility to gauge its level of service and efficiency in comparison with similar setups around the world. These may also bring out certain best practices to note for future implementation.

7. The wastewater sector often sees such exercises being carried out, particularly for energy usage. In 2004, the Swedish Water & Wastewater Association initiated an energy saving program targeted at all members with the goal of identifying benchmarks to lower energy consumption. Similarly, a manual for energy optimisation covering nearly half of all wastewater treatment plants in Germany was published in the 1990's under the coordination of the Ministry for the Environment in North Rhine-Westphalia state. However, there is a balance to strike in treating wastewater to desirable levels at higher energy consumption and reducing the energy consumption with the risk of not treating the wastewater to desirable levels.

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[1] Clean water has provided a major boost to human health in recent decades and disinfection has provided a major barrier to pathogens. However, as knowledge progresses, pathogens such as Cryptosporidium are found to resist chlorine-based disinfectant.

[2] Although metering has become the 'norm' for water utilities for the purpose of billing consumers, debates on the need for metering are still ongoing.

8. While there may be debate over whether a benchmark should focus on the minimum acceptable level or reflect the progress of a utility, it will certainly be more significant and constructive if the information collected during the exercise is well organised to serve as a convenient one-stop best practices and solutions database. Also, benchmark indicators may work well especially in their initial phases but quickly become the norm and all too often simply represent a minimum level of service as opposed to optimum. They generally do not recognise skill, expertise, knowledge or risk. It is therefore necessary then to assess operations in a pragmatic way which assesses the current performance of teams / systems and is able to monitor progress. One possible tool to facilitate this process is the Aquarating, which is a performance rating tool developed by Inter-American Development Bank and International Water Association to rate water utilities. It helps utilities to establish an appropriate level of service quality. Technology can help in the benchmarking of product/service quality. For example, with the advent of technology, on-line analysers can be used to measure parameters in real-time such as water quality, pressure, quantity. **What are some benchmarking systems that can help utilities to establish an appropriate level of product/service quality? How may technology play a role in this process?**

B. Resource Management and Operational Optimisation

9. Another key step to ensuring sustainable and consistent product / service quality is through keeping resource consumption and operation costs under control. Utilities are large users of resources in terms of energy, chemicals, land and manpower. Global trends like population growth, greater urbanisation climate change and aging demographics, all add pressure on the availability of these resources and raise their costs.

10. To maintain or even raise the product/service levels while keeping tariffs constant, utilities will constantly have to endeavour to keep resource consumption and operation and investments costs under control. This is usually achieved by targeting the following broad areas for efficiency improvements:

- Technology and Process Design
- Automation, Monitoring and Control Systems
- Manpower Competency and Productivity[3]

11. One common challenge for utilities is to systematically identify focus areas for efficiency improvements. Top management may not have clear sight of challenges and opportunities for efficiency improvements while operational people may not have a view of

[3] Manpower cost sometimes constitutes up to 40% of total cost.

the "big picture" to recommend operational improvements in line with corporate strategic direction or be able to identify gaps between functions like wastewater treatment, water treatment etc. **How can utilities systematically identify areas for efficiency improvements? Will a top-down or bottom-up approach be more effective in implementing improvements? To what extent or degree should utilities continue with efficiency improvements?** For example, is achieving zero Non-Revenue Water (NRW) a realistic goal? While lower NRW can be achieved through network improvement, it will incur more cost.

12. In the context of the 3 broad areas mentioned above, this can refer to the employment of new innovations to enhance process or system design/control, implementation of automation or instrumentation to reduce dependence on human interference, and empowering of personnel to handle complex decision making processes through comprehensive training. Some examples are highlighted as follows.

- **Technology and Process Design**

  Utilities should keep abreast of technologies in water and wastewater applications and leverage appropriate technologies to review and optimise existing process designs. Oftentimes, when process designs are fixed and infrastructures are in place, improvements that involve changes to processes would be difficult to implement. As a result, process design optimisation may be a lengthy process, which needs commitment from the management to follow through. For example, the Strass WWTP (in Austria) took over 10 years to attain energy self-sufficiency by embarking on a 4 pronged approach comprising (a) optimising transfer of organic load to digesters for enhanced biogas production; (b) installing high electrical efficient power cogeneration unit; (c) installing precision control of aeration via online monitoring of effluent ammonia; and (d) using energy saving technologies for side-stream treatment. The achievement of Strass WWTP further underlines the potential of WWTPs to function not just as a nutrient removal plant but also as a resource recovery centre, which helps to reduce resource requirements and cost. Other examples of improvements in technology and process design include:

  (i) Another example is Singapore's national water agency, PUB's project on Deep Tunnel Sewerage System (DTSS) which eliminated the need for intermediate pumping of used water to several Water Reclamation Plants across the country. Sewers in the eastern catchments of Singapore would now convey the used water solely by gravity flow right up to the Changi Water Reclamation Plant (WRP) at the eastern tip of the island. This freed up the land occupied by the pumping installations and also allowed the reduction and centralisation of manpower to maintain the sole pumping main now located at Changi WRP.

(ii) Some water utility companies in the Netherlands are using a water demand forecasting model called OPIR to optimize the control of the water supply system. The software contains an adaptive demand prediction control, which identifies the specific consumption patterns of an area to predict water demand and minimises the fluctuations in treatment flows and pump flows. The benefits would be stabilisation of treatment processes, improvement of water quality and optimisation of energy consumption.

(iii) An industrial synergy to treat sludge was uniquely proposed in Suzhou Industrial Park, China, by integrating a sludge drying plant, a sewage treatment plant and a co-generation plant. This project was realized by utilizing waste heat from steam coming from the co-generation station as an energy source and then providing the dried sludge as a replacement fuel source to the co-generation plant thereby recovering energy from dried sludge. The bottom ash after incineration is also recycled into construction materials.

- **Automation, Monitoring and Control Systems**

Automation involves the use of equipment, monitoring and control systems and information technologies to increase productivity on delivery of service and product. For example, PUB has installed wireless sensors to detect water quality deviations and leaks in the water distribution system in the city. The sensors can detect transient changes in pressure and water quality in real time, and serve as an early-warning, event-locating and water-demand prediction system.

Automation reduces dependence on human interference and may free up manpower, which can be better deployed elsewhere. This would address the challenges of utilities that are facing aging demographics, manpower shortage and have difficulty in recruiting the right candidates. In water treatment plants, automation reduces manual work (e.g. chemical batching) and improves the precision, reliability and efficiency of the treatment processes. Although a three-shift work arrangement can efficiently perform the task of operating the plant, these manpower can be better used for preventive maintenance. Another example is the "Mage" software in Paris, which uses prediction on rain and hydraulic on-line modelling to anticipate and optimise the management of rain water, avoiding major rejections directly to the river. This job would be too intense and cumbersome for human to do and the manpower can be better used elsewhere. **What are other ways/examples of how automation, monitoring and control systems can help to improve efficiency?**

- **Manpower Competency and Productivity**

Much of the current optimisation focuses on enhancing process design/control. This is likely due to the immediate material returns in terms of lower resources consumption. However, it should also be noted that the effectiveness and success of implementation is also dependent on the relevant capability of personnel. A competent operator with relevant know-how could also bring about better operational reliability, a result which is intangible. In Algeria, Suez Environnement was asked to put in place a know-how transfer in order to increase the level of maturity of the water utilities delivering service to the City of Alger. The International Water Knowledge Transfer Initiative (WIKTI) program was put in place to train 3000 staff to assist the utilities to develop knowledge, networking and coaching tools.

How can personnel be empowered to maximise their potential and contribution to the operations of the utility to ensure consistent and sustainable product / service quality?

C. Future Trends, Questions and Solutions

13. Currently, the driver for resource management is often determined by the resource's market value. For example, against a backdrop of rising energy prices, energy utilization became an important issue for wastewater treatment plants due to the energy intensive nature of the process. The concept of a "zero net energy" plant was derived, following extensive research into harnessing the energy potential of sludge by-products of the treatment process. As research in the water-energy nexus continues to develop, nutrient recovery has also gradually gained attention due to its role in food production, the nutrient rich nature of wastewater and the declining sources of raw material supply (e.g. phosphorus).

14. To avoid being caught off guard by such changes in the world market conditions, utilities may need to consider the likely trends for resources in order to pre-empt and mitigate the possible impact they may have on operations. Similarly, future trends or emphasis for operational optimisation should also be identified early with resources devoted to their research and development. By staying at the forefront of developments, these will collectively contribute to the utility's continual efforts to stay cost competitive.

What are the likely future trends for resources which could have an impact on the way utilities manage them in operations?

D. Conclusion

15. In dealing with the challenges of both present and future, leaders of utilities will need to have their ear to the ground and an eye on the horizon. A sound understanding of the operations will facilitate assessment and judgement on the options available to further enhance efficiency, reliability and productivity of the organisation and bring it to greater heights.

Disclaimer: This position paper has been prepared by staff from PUB Singapore and Suez Environnement to provide outline information to stimulate dialogue at Session 5A of the SIWW Water Utilities Leaders Forum. The views expressed in this paper do not necessarily reflect the opinions and policies of PUB and Suez Environnement. The contents contained in this paper are strictly for personal, non-commercial or internal use only.