Smart Water Networks Put Information to Work

IT solutions support water loss management, enable performance measures that support enterprise optimization.
A common challenge for water utilities is to maintain or improve service and profitability levels at current rates. The reduction of Non Revenue Water (NRW), intended as the sum of real (or physical) loss and apparent (or commercial) loss, is a key issue in increasing efficiency and improving financial performances.

In addition to improving performance, managers need to document results for enterprise evaluation and continuous-improvement purposes.

It is accountability, literally, that allows true determination of business effectiveness and efficiency. Key Performance Indicators (KPIs) are the quantitative determinations that help any business, including water utilities, objectively assess the performance of their operations and identify where they can improve service, control costs and plan properly.

In this paper, we describe the Smart Water Network (SWN) as the integration of state-of-the-art information technology (IT) systems, put to work to optimize the water utility’s capacity at a minimum capital expenditure. This advanced IT solution provides fast and accurate information that not only helps the utility control and reduce losses but also efficiently quantifies KPIs related to water loss management, to improve subsequent operations and sustainability.

Smart networks are the future of service utilities

The SWN also can be defined as “the collection of data-driven components helping to operate the ‘dumb’ – or data-less – physical layer of pipes, pumps, reservoirs and valves.”¹ SWN solutions improve the efficiency, longevity and reliability of the underlying physical water network by better measuring, collecting and analyzing data from, and supporting appropriate action for, a wide range of network events.

The SWN integrates information technology (IT) systems to manage the massive amount of data generated during operation and translate that data into actionable business information – the same concept now popular in ‘smart grid’ deployments in the energy industry.

¹ Source: Smart Water Networks Forum (http://www.swan-forum.com/index.html)
Overall, the SWN allows:

- Real time monitoring, automation and optimization of complex operating processes
- Database sharing and synchronization, avoiding inefficient duplication of information and discrepancies
- Visualization of information coming from different systems in unique – yet standardized – platforms such as a Geographic Information System (GIS)
- Streamlined business intelligence functions – KPIs, benchmarking, report generation, planning

**SNW ideal for water loss management**

Because NRW management involves different departments of the utility and multi-disciplinary teams, it is a process that can see significant benefits from the SWN solution described above.

The SWN, in fact, supports efficient water loss management by:

- Implementing software that performs specific tasks such as automatic leak detection
- Introducing new technologies in traditionally manually executed activities; for example, GIS mobile solutions supporting outage management operations
- Integrating systems for value-added information; for example – on-line connection of the supervisory control and data acquisition (SCADA) system and the hydraulic model to detect leaks or faulty metering equipment

In particular, the SWN addresses the four pillars of a management strategy for the *real loss* component of Non Revenue Water: active leakage control, pressure management, pipe repairs and asset management.

**Active leakage control.** Leak Detection Systems (LDS), also known as Computational Pipeline Monitoring (CPM), are specific software tools that analyze real-time signals from SCADA systems. They allow the operator to assess the presence and the approximate location of leakage in different areas of the water network; see Figure 1.

→ The Leak Management Module of Telvent’s Water Management Suite (WMS: LM) provides advanced applications that apply real-time data to network analysis and simulation for leak detection; see Figure 2.

**Speed and quality of repairs.** An Outage Management System (OMS) using the utility geodatabase and interfaced with other
enterprise systems – such as the Customer Information System (CIS), the SCADA system, the Computerized Maintenance Management System (CMMS) and a hydraulic model – provides an advanced and comprehensive solution for managing pipe repairs. This integrated-information approach streamlines field communications and operations to save utility resources and minimize customer inconvenience.

→ Telvent’s Responder OMS using the ArcFM™ GIS database and integrated with the water distribution network hydraulic model creates a system that reduces not only the time to detect the leak and identify its location but also the time required for repair, the cost involved and the water lost; see Figure 3.

**Pressure management.** Efficient pressure management usually combines the installation of equipment and devices such as pressure reducing valves, variable speed pumps and other equipment with their respective control software. Advanced network operations rely on dynamic valve settings and pump scheduling based on changing water demand.

**Pipeline and asset management.** Asset management is a key factor for long-term sustainable leakage management. Most utilities burdened with obsolete assets and financial constraints have to deal with the well-known “replace or repair” dilemma. Hydraulic models, GIS, CMMS and other IT tools have proven to be effective in supporting decisions involving preventive versus corrective maintenance – and similar asset management decision-making processes.

→ Telvent’s ArcFM Enterprise GIS provides a unified distribution network geodatabase – a single version of the truth – that eliminates duplicate asset databases and redundant work processes, simplifying planning, analysis and operational response times.

Implementation of a SWN also addresses some of the issues related to the **apparent loss** component of Non Revenue Water by:

- Reducing meter inaccuracies – through advanced water meter stock management that integrates Customer Information Systems (CIS) and specific software for optimum meter selection and replacement
- Eliminating metering data handling errors – through the implementation of Automatic Meter Reading (AMR) systems and Advanced Metering Infrastructure (AMI)
Telvent has successfully implemented some of the world’s largest AMI deployments. Telvent Conductor Meter Data Management™ (MDM) solution enables utilities to leverage meter data to automate business processes in real-time, sharing AMI data with key business and operational applications to improve efficiency and support decision making across the enterprise.

You can’t manage what you can’t measure

The water industry encourages utilities to develop and use KPIs to identify areas of improvement, define realistic targets, design action plans and track improvements over time.

In particular, KPIs related to water leakage are becoming more relevant: government legislators and economic and environmental regulators are setting increasingly stringent leakage guidelines and targets. Publication of reports and KPIs on water loss is now mandatory in many countries around the world. Water operators are requested to calculate different indicators to assess their performance on specific issues related to water loss and network incidents.

Here we focus on three benchmarks identified by the American Water Works Association (AWWA) that reflect water loss management:

- **Disruptions of Water Service**, quantifies the number of customers experiencing service disruptions as a ratio per 1000 active customer accounts
- **Distribution System Water Loss**, measures the percentage of drinking water placed into distribution that does not find its way to customers or other authorized users
- **Water Distribution System Integrity**, quantifies the condition of the water distribution system, using number of breaks and leaks requiring repair per 100 miles of distribution piping

Yet, quantifying KPIs becomes a tedious and labor-intensive process when it requires access to data stored in separate systems and the involvement of the entire organization – in which case the utility loses some of the value of performance profiling. Automated information management solutions provide the accurate and reliable data that allow efficient KPI compilation.

**Disruptions of Water Service.** The quantification of customers affected by outages can be obtained through the integration of GIS, OMS and CIS systems; see Figure 4.

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*Benchmarks are identified and defined in the Water Research Foundation’s “QualServe Performance Indicators Report,” 2007*
Distribution System Water Loss. The industry-standard process to determine the water loss level is to build a comprehensive water balance, like the one proposed by the International Water Association (IWA) and the AWWA\(^3\), pulling together data from SCADA, billing/CIS, CMMS and other sources managed by different departments within the organization.

Water Distribution System Integrity. The quantification of the number of pipe breaks requires data coming from OMS/CMMS and GIS systems.

SWN information also supports enterprise improvement

The periodic – usually yearly – calculation of the previously mentioned indicators at the utility enterprise level is useful in defining general trends and in competitive benchmarking that compares the utility’s performances with other organizations.

Yet, performance indicators can provide even more benefits. The SWN reinforces this concept by introducing Business Intelligence (BI) platforms that support the organization both in the operations and planning process:

- Compare achievements of different units within the organization (internal benchmarking)
- Provide real-time information updating and KPIs calculation for more effective process monitoring and fast decision making
- Set up indicators on a GIS base (geo-referenced benchmarking) to link KPIs to other factors, such as geographic units and asset conditions, and obtain information in a much more immediate and intuitive way
- Link water loss technical data to costs, through interface with Enterprise Resource Planning (ERP) and other corporate systems to obtain financial indicators
- Create additional, fully customized performance indicators by crossing any type of data stored in the data warehouse

→ Telvent offers extensive experience in all areas of data warehousing: from extract, transform and load (ETL) processes to the BI platform. For water utilities, Telvent has developed specific dashboards providing, among others, multiple, water loss-related KPIs calculation tools; see Figures 5 and 6.

Summary

SWN information technology helps streamline daily operations and maintenance and improves network water loss management and system planning. Because these solutions are scalable, they provide sustainability solutions for water utilities of nearly any size.

Further, with middleware software and business intelligence tools, the water utility can automatically extract data from different systems and calculate performance indicators that accurately and objectively represent water network performance.

Finally, with these benchmarks, and the ability to represent results in different ways, the utility can communicate performance measures in a consistent manner to all stakeholders.

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