THE KEY INGREDIENT FOR A TRULY SMART WATER METERING SYSTEM

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A range of external factors have placed an increasing responsibility on water utilities to adopt more sustainable approaches to urban water management, as the era of readily accessible and inexpensive water fades. Covering costs, monitoring non-revenue water and meeting customer demands for equity in billing in the face of rising water prices are some of the core challenges. Recognising that smart metering systems have the potential to revolutionise current utility operations and customer engagement approaches, Rodney Stewart argues that information systems and associated informatics are the (currently missing) essential ingredients for the successful deployment of smart meters.

To date, roll-outs of smart metering have been driven by the desire to reduce manual readings, increase data on time of use, leakage management, and end-use measurement (like length of shower and toilet flushes, amongst others). In the coming decade, the deployment of smart water metering will transition from being predominantly pilot or trial studies to mainstream citywide implementation. Citywide smart metering implementations have the potential to stream gigabytes of time stamped water use and other associated information (such as water temperature, pressure, quality) from pipe networks right down to the individual water use appliances (e.g. washing machine) and fixtures (e.g. tap). Such datasets are powerful for a range of water planning, engineering and customer response decisions – but only if processed, refined and reported in a way that is more intuitive and informative than traditional approaches.

ADVANCED METERING PRODUCTS PRESENTLY OFFERED

The terms 'intelligent' and 'smart' metering are often indiscriminately associated with some combination of technology that is in some way superior to conventional metering. This inherent ambiguity is, however, indicative of the plethora of technological configurations smart metering covers, and its relevance to both the energy and water sectors. For example, automated meter reading systems (AMR) are often sold as smart metering systems, but they merely serve as a better way to collect customer water use data and rarely better inform utility operator or customer functions.

Put simply, a smart metering system, should at a minimum, enable remote reading of water flow (consumption) and other optional data (e.g. water quality, pressure, etc.) at a resolution which improves current operational and customer decision making (e.g. collected in litre increments at least hourly), include accessible and user-friendly data registries of collected data, and autonomously produce readily accessible and useful reports for a range of purposes.

This latter requirement is really the critical component of a smart metering system and many of the current smart meter providers are just offering the advanced metering 'hardware' without the critical cloud or edge-based software systems that make collected data useful for water professionals and customers. Moreover, water utilities do not often have the in-house capabilities to build robust data acquisition and informatics algorithms and tools. Essentially, big data alone without effective and efficient data mining methods and informatics algorithms to achieve enhanced decision making is really not that smart at all and

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will actually bog down water utility operations as they drown in data.

EXTRACTING BENEFITS BY PUTTING THE 'SMART' INTO METERING

The benefits of smart metering have been declared at many conferences by the growing hoard of companies seeking to be the global leader of this burgeoning industry. However, while 'product' is ready, many of the potential benefits of smart metering systems have been unfulfilled due to the lack of focus on the necessary data mining and analytics functionality required for re-engineering the way the water utility sector goes about its business. Many of the unfulfilled benefits of smart metering include:

Better citywide urban water planning

Smart metering enables better understanding of the water consumption patterns of a city's various residential, commercial and industrial customers and will aid urban water planners to better understand consumption trends and extract greater efficiencies from the present system.

Near real-time water distribution network analysis

Accurate and up-to-date demand data collected at a high resolution is essential to ensure that future mains water supply networks reflects current usage patterns and are designed efficiently from an engineering, environmental and economic perspective.

Targeted water demand management

The prevalent reactionary policies to reduce water demand in supply crisis highlights the need for more detailed information at the "coalface". The use of smart metering and subsequent datasets could significantly improve decision making in relation to water demand management strategies.

Evidence-based water demand forecasting

Total and disaggregated water consumption data will also allow water businesses to monitor the effect of scarcity pricing or restriction regimes on water consumption in near real-time, and also monitor rebound trends following the removal of these strategies.

Proactive water loss management

A real-time monitoring system would also enable water utilities to intervene as soon as an exception alarm is raised.

Targeted demand efficiency

Regular monitoring of end-use consumption data provides the ability to immediately quantify the effect of targeted water efficiency programs on their intended water end-use(s) (e.g. can instantly establish savings from a washing machine rebate program implemented in a city).

Addressing water-related energy demand

Data from smart water metering systems coupled with energy specifications for water supply products and fixtures (e.g. pumps, water heating systems, etc.) enables unpacking of water-energy nexus implications.

Evidence-based economic assessments

Smart metering and water end-use data provides opportunities for detailed financial analyses on the cost and water saving benefits of implemented water supply programs, ultimately driving a true least cost planning agenda.

Cost reflective urban water tariff reform

Smart meters can also inform the development of different tariff systems (e.g. scarcity pricing) to influence consumption behaviour. While there are many fears related to tariff reform, it potentially has strong advantages for reducing consumption in water scarcity periods, peak network periods, etc. thereby reducing the average cost of water supply for the entire customer base.

Heightened customer satisfaction

The present customer water information and billing arrangements are vastly inadequate. A smart metering system provides the impetus for a new approach to knowledge transfer of water consumption data, directly to consumers via a range of communication platforms and in-house displays.

CASE STUDY: COUPLING SMART WATER METERS WITH INFORMATICS

Griffith University have teamed up with industry partners Yarra Valley Water, City West Water, South East Water, Cisco and Aquiba to develop the architecture for some of the critical informatics components of a truly intelligent meter.

This project develops intelligent pattern recognition algorithms using international data sets to autonomously categorise household water consumption data into end uses (e.g. showers, leaks, etc.). Significantly, the project resolves information synthesis concerns by using a hybrid combination of non-linear blind source separation techniques adapted from the pattern recognition, signal processing and decision science fields. Nguyen et al. (2015) provides a complete description of the preliminary system developed.

This project seeks to develop an autonomous and intelligent system for residential water end-use classification, customer feedback and enhanced urban water management that will enhance water businesses and their customers understanding of water consumption through providing near real-time reports on when, where and how water is being used in their homes. The prototype smart metering system developed from this project has significant potential for global commercialisation.

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WHY ARM CREWS WITH THERMAL IMAGING CAMERAS?

What drove Californian utilities Southern California Edison and Pacific Gas and Electric to add over 650 new FLIR thermal imaging cameras to their armoury? It all boiled down to simple common sense: who wouldn't want a tool that can help minimise risks and maximise the efficiency and effectiveness of their predictive maintenance program?

Safety is always priority one for a lineman or troubleman. Before entering an underground vault or using a disconnect stick overhead, it's vital to know whether an electrical component or connection is uncharacteristically hot before approaching it. A thermal imager can help spot that right away, whereas the naked eye cannot. In fact Southern California Edison (SC Edison), scanning underground equipment with a thermal imaging camera before climbing down into a vault is now written into the company's safety procedures. Thoroughness is also crucial for ensuring that components and systems are functioning at peak performance.

Following policies and procedures takes discipline, alertness and time – things that should never be sacrificed for increased productivity. What the two utilities discovered, though, was that such inspections were taking considerably longer when using an infrared (IR) thermometer, a fairly common tool of the trade. An IR thermometer can only target one spot at a time, often requires working closer than is practical and safe, and typically provide merely an average temperature across a circular area. Missing a hotspot could mean missing a brewing problem that signals an impending failure, which could also leave the technician with a false sense that all is well. That's why both SC Edison and Pacific Gas and Electric have chosen to invest more in FLIR thermal imagers.

Thermography groups at both companies had discovered that a FLIR camera could scan a larger area and more targets from a safer distance much faster, as well as capture literally thousands of accurate temperature measurements in each image. Select SC Edison crews already had FLIR i40s, so with credibility well-established, FLIR was a logical choice when SC Edison decided on nearly 300 additional i40s and when PG&E ordered over 350 i7s.

With more technicians and trucks armed with the technology, a far greater number of linemen and troublemen are now able to do quick scans and safety checks on their troubleshooting rounds. As a result, more potential problems are being caught and fixed in time to prevent outages, expensive replacements and injuries.

Both utilities are now benefitting from the confidence and higher productivity that comes with the greater accuracy, improved efficiency and safer working conditions that the lower-cost FLIR thermal imaging cameras help make possible.