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YOU ARE MEASURING IT, BUT ARE YOU MANAGING IT?

The Role of Active Monitoring in Smart Metering

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ABSTRACT

Water security and demand management are prominent issues whilst discussing Australia's future. Smart metering has emerged as an integral technology in this regard. However, there has been little research on methods that show how to employ these technologies to get measurable results. It is a common misconception that smart metering largely works on a 'plug and play' basis. This paper argues that the true benefit of smart metering lies in utilising the data obtained.

Due to workload and other priorities users often do not diligently analyse and utilise the data. This paper presents a possible solution by engaging an external party to provide an Active Water Analysis, Risk and Efficiency (AWARE) service. Three studies were conducted to demonstrate the advantages of implementing the active monitoring service. All three studies demonstrated that a clear return on investment (ROI) from smart metering can only be obtained by actively using the data collected. Key psychological and practical barriers of implementing AWARE by the users themselves are discussed.

By taking complete responsibility for water management, AWARE provides organisations time and resources to focus on more important issues. It helps customers avoid bill shocks and risks of property damage. The service helps justify budget allocation towards remote monitoring technologies and boosts the organisation's sustainability profile. Allocating resources for the active management of data collected is essential to achieve the savings and risk reductions possible from smart metering.

INTRODUCTION

With increasing population numbers, the emphasis on water security is more important than ever. Water resources in Australia vary considerably across the country. This is due to a range of climate conditions and terrains found in the large land mass. Some might argue that the water resources in Australia are sufficient in terms of per capita requirements. However, with rapid growth in agricultural exports, there are increased concerns regarding "virtual water" and how this may impact on water resources. Furthermore, climate change poses a significant potential threat. Projections by scientists show increased evaporation and rainfall variations across the country in the coming years (Charles & Williams, 2006). Thus far, measures that have been adopted for managing rapidly changing water demand include efficiency, metering, price management, water accounting, loss control and education. However, these strategies can only be successfully implemented with the assistance of reliable and accurate data that is easy to interpret. Even at the consumer level, promoting individual responsibility is only possible when users are made aware of their unsustainable consumption patterns. Receiving daily data on water usage activities helps consumers make better decisions and promotes sustainable resource use. This is made possible through smart metering (Boyle *et al.*, 2013).

A smart meter is a device linked to a utility or sub-meter which allows automatic collection of readings, eliminating the need for manual readings. The data captured by the smart meter is transmitted through mobile phone technology, wireless modems, internet or other technologies onto a web display platform where data can be viewed in near-real time. Typically, readings are collected every 15 minutes as this provides adequate granularity of data. Higher frequencies can lead to inundation of data which is not necessary for the task at hand.

These technologies have the ability to generate automatic abnormal usage alarms which alert users of unaccounted for usage as soon as it occurs, much before the arrival of the utility bill (Hauber-Davidson & Idris, 2006). A lot of time has been invested in comparing and assessing the different smart metering technologies available in the market today. Suitability of a technology differs on a case by case basis. There are a number of factors that influence the best remote monitoring technology for a particular project (Beal & Flynn, 2014).

However, there has been little research on methods that will help to employ these available technologies effectively. The value of any given technology can only be demonstrated through the results it delivers. This paper aims to establish that the true worth of smart metering can only be realised through actively looking, analysing, understanding and acting on data collected. Due to work priorities, lack of resources and time constraints, it is sometimes hard for users to exercise the necessary discipline. As such, a possible solution may be to engage an external party to do this on behalf of the user. This is known as an 'active monitoring' service. Sydney based engineering company WaterGroup was the first in Australia to provide such a service and named it the 'AWARE' (Active Water Analysis, Risk and Efficiency) service. Three case studies are discussed in this paper to compare the experiences of WaterGroup with and without the provision of the AWARE service. Psychological and practical barriers preventing users from carrying out AWARE themselves as well as advantages of the service are discussed.

METHOD

Three studies were conducted to assess the value of active monitoring of data.

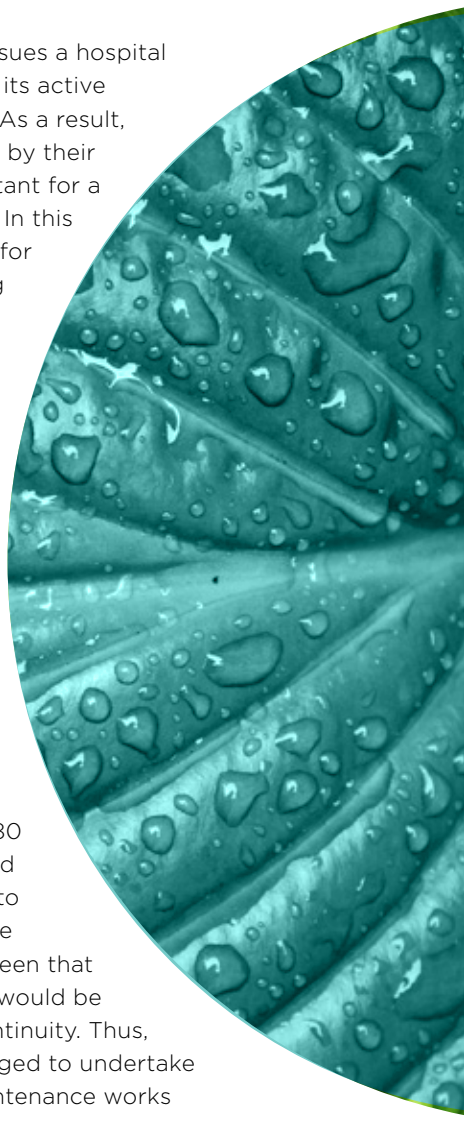
Study 1

A water smart metering system was implemented across 168 supermarkets in Australia. These supermarkets were covered by the AWARE service. Due to internal approval issues for a repair budget, loggers at 43 supermarkets were left offline for a period of up to six months. This presented an opportunity to compare the water consumption at the stores with and without the active monitoring service on three parameters:

- Average water consumption
- Amount of leakage found
- Number of leaks found

Study 2

Due to budget allocation issues a hospital in Victoria could not renew its active monitoring service in time. As a result, sites were left unmonitored by their designated external consultant for a period of up to six months. In this duration, the responsibility for carrying out the monitoring was on the internal staff. A comparison was conducted on the water consumption patterns at the hospital with and without a 3rd party AWARE service to assess the ROI achieved from the program.



Study 3

A smart metering project was rolled out across 90 public schools in Australia. Components monitored included solar, gas, water and electricity. A total of 280 smart meters were deployed as part of the project. Due to the size of the project at the schools, it was rightly foreseen that a sizeable amount of work would be required to ensure data continuity. Thus, an external party was engaged to undertake this work. Instances of maintenance works required as part of the project are explored.

RESULTS

Study 1

In the first study, it was found that the average water use at the 43 stores where the water monitoring system was 'offline' was 170 kL/month.store. In comparison, the average water use at the remaining 125 monitored 'online' stores was 143 kL/month.store. This translated to a total extra water use of 1,170 kL/month or $3,724/month at the 43 'offline' stores.

Once the water monitoring system was back online for these 43 stores, leaks were found at four of them, totalling 5,500kL and $19,100. Converting the kL usage in the period to litres/minute (L/min), this is equivalent to leaving ten taps running full bore.

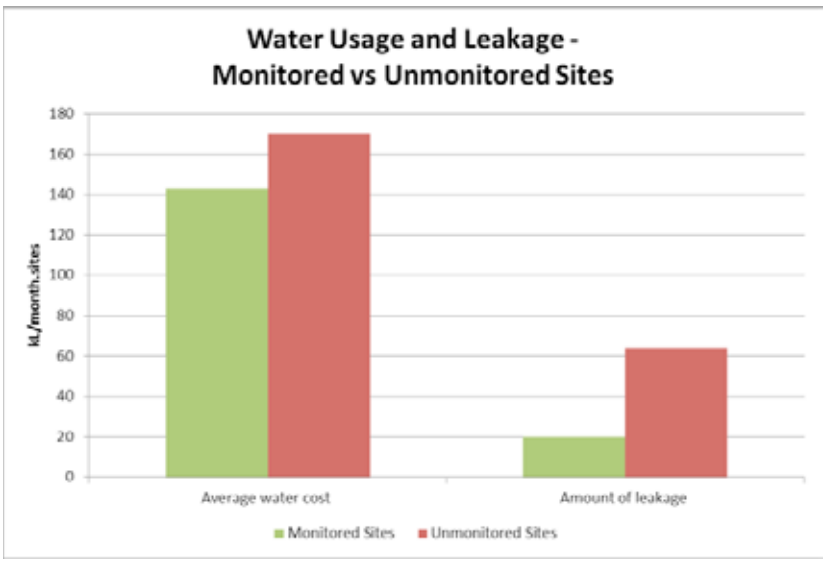


Figure 1. Water Usage and Amount of Leakage - Monitored vs Unmonitored Stores

Spread across all 43 stores this equated to savings worth 64kL/month.store or $222/month.store. In contrast the 125 online stores had leakage worth 20kL/month.store or $83/month.store only.

In the period the 125 'online' stores had two notable leaks. If the leaks in the online stores were pro-rated, one would have expected 0.7 leaks in the 43 'offline' stores. Instead, once they were back online and monitored again, they showed four leaks, i.e. the number of leaks at the 'offline' stores was almost six times greater than at the 'online' stores.

The active monitoring service cost the supermarket chain $36/month.store. Savings across all 168 stores were $72/month.store. Thus, the annual savings across 168 stores were $144,200, whilst the annual cost was $72,000. Hence, the organisation was saving almost exactly $2 for every $1 spent on the implementation of a smart metering and active water management system, presenting a strong business case.

Study 2

A spot check revealed an increasing leak at the hospital. Losses from the leak were estimated to be $8,436. The source of the leak was found to be a leaking valve in a flush tank top up. This was not the first time the meter had had leakage issues. When the site was still covered by the AWARE service in the previous year, the same leak was found and rectified within a month, resulting in savings of approximately $7,000.

The most important component of active monitoring is to ensure needed actions are taken to secure savings identified. This often takes weeks of follow-up emails and phone calls to the relevant parties (e.g. maintenance departments) responsible for the upkeep of the buildings. This was demonstrated through the study above. The increasing leak discussed had in fact been identified and communicated to the hospital when it first occurred. However, post the lapse of the AWARE service, there was no designated resource to keep track of actions that were being taken to remedy the leak. This led to the delay in the rectification of the leak.

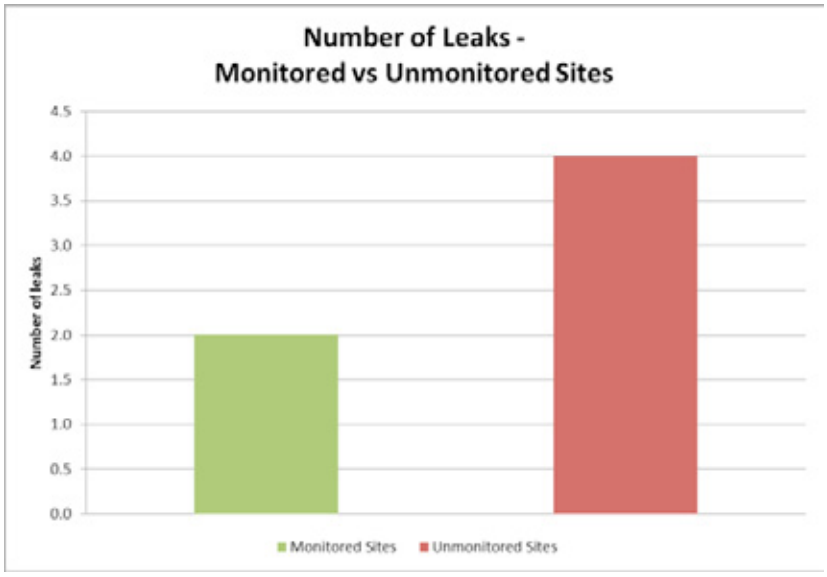


Figure 2. Number of Leaks Monitored vs Unmonitored Stores

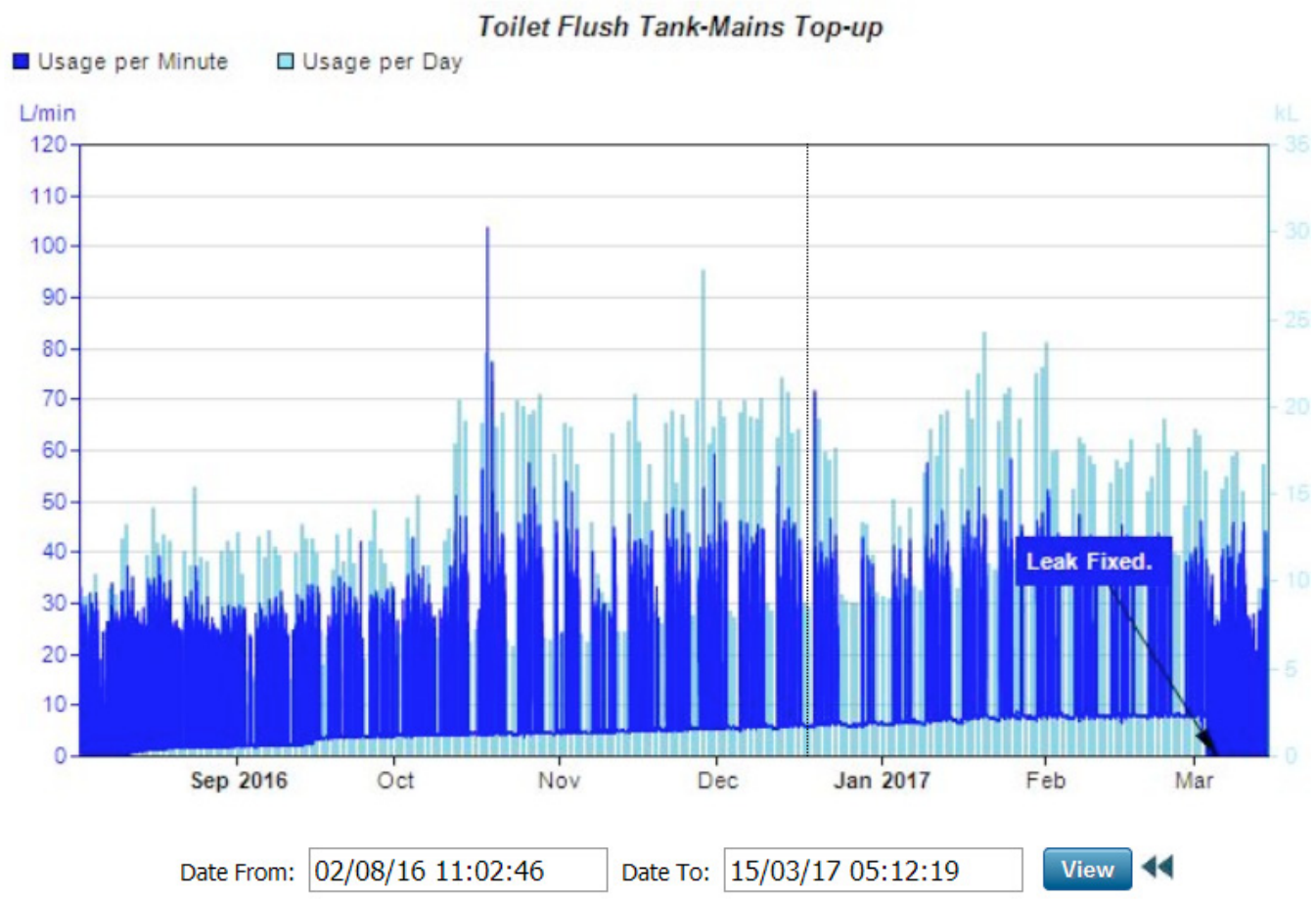


Figure 3. Increasing Toilet Leak

Study 3

Smart meters are often installed out in the field, where they can encounter harsh environmental conditions or deliberate tampering. This can cause interference between the smart meter and the meter it is connected to. If users do not log onto their portal on a regular basis, it is possible this issue could go undetected, causing lack of data for large periods of time and missing out on possible savings. As such, some smart metering technologies offer the ability to generate 'zero usage alarms'. This quite literally means an alarm that is generated if a logger registers zero usage. This is different to 'offline alarms', which is when the logger stops communicating altogether.

Similar to excess consumption alarms, the 'zero usage' alarms are often ignored by users. AWARE ensures a weekly assessment of all sites is conducted to pick up such sites and avoid loss of data. The listing below shows some of the issues encountered during the maintenance tenure at the schools.

1. **Vandalism:** There were a few instances of vandalism at the schools monitored. Schools by nature are prone to vandalism acts. Thrill seeking adolescents often take pleasure in destruction of school property as a source of amusement (De Wet, 2004). It is possible to add additional vandal protection, such as metal cages, to minimise such instances, although the experience of this project showed that the cost for vandal protection could not be offset by the few repairs caused by vandalism.

Figure 4. Vandalism at Schools

2. **Missing/ stolen loggers:** At times loggers were found to be missing altogether. If the logger continues to communicate, the only way to detect an abnormality is through zero usage alarms.

Figure 5. Stolen Loggers

3. **Meter replacement:** When electricity or water meters were changed over, the smart meter would be disconnected. More often than not the relevant authorities failed to notify schools of the disconnected smart meter.
Monitoring zero usage alarms aided in identifying such events. If the new meter was of a different model, a new probe was also organised to re-establish the smart meter's connection.

Figure 6. Logger Disconnected due to Meter Changeover

4. **Faulty meters/solar panels:** There were a few instances where water meters stopped turning. If the logger does not have any pulses to pick up it generates zero readings. Similarly, some instances of malfunctioning solar panels were also identified.

All of the above instances were picked up through monitoring of zero usage alerts. As a first step, schools were contacted to conduct preliminary assessments. This included taking a picture of the connection between the smart meter and the meter and also taking two meter readings to confirm functionality of the meter. Based on findings, further troubleshooting measures were undertaken.

The above are some of the common issues that crop up in a remote monitoring system. They are normal and should be expected. Measures should be implemented in advance to detect the issues as soon as they occur. In the case of the schools, the AWARE service ensured a weekly check was conducted on all loggers to confirm they are registering as expected. This helped the schools avoid loss of data and capture savings.

DISCUSSION

The above studies validate the importance of a committed resource actively monitoring data collected to utilise it effectively. It is easy to see that over the next few years our world will be more connected than ever.

With the advent of IoT (Internet of Things), we will have more data collected than ever before. A number of devices and everyday objects will be able to interact with each other, generating significant amounts of data (Atzori *et al*., 2010). In such a scenario, it will be imperative to make sense and exploit the data collected efficiently. Collection of information is futile unless it is turned into insights, actions and solutions.

It may be argued that analysis need not be outsourced but could be conducted internally. However, it has been found that there are some psychological as well as practical barriers which prevent this. These have been discussed in Table 1.

Ensuring data is utilised effectively benefits the organisation on multiple aspects. Active monitoring helps users identify abnormal consumption as soon as it occurs and not when the bill arrives, avoiding bill shocks. In some instances, leaks can also lead to unwelcome publicity for organisations. This may reflect on the sustainability management of the firm and thus invite criticism. Keeping on top of unauthorised consumption helps prevent this. Some leaks such as underground pipe breaks can also cause structural damage if gone undetected for too long. Active monitoring helps avoid this.

A smart metering program can be an expensive investment, ranging from thousands to millions of dollars. The program's success, especially in the case of government bodies, can come under scrutiny. Active monitoring ensures that maximum value is extracted from the program; warranting the budget allocation. It also generates an audit trail. By helping users understand the consumption patterns across their site, AWARE assists users in prioritising future spending on certain activities or equipment.

Table 1. Psychological and Practical Barriers Preventing Users from Carrying out AWARE

Psychological Barriers	Practical Barriers
Procrastination – Task difficulty, appeal, ambiguity and deadline pressure are attributes that contribute to the degree to which a person might procrastinate a task (Harris & Sutton, 1983). Regularly checking the smart metering portal and acting on data received might seem like a tedious task to a Facilities Manager which is why they may tend to delay the task.	Lack of resources – If an organisation has not allocated resources for effectively utilising the smart metering system, employees may find it hard to get time to do so. They may focus their energies on the core activities of the business.
Saturation of data – With repeated abnormal usage alerts, users might find themselves inundated with information. This may lead them to ignore or put off looking into the issue that is causing the alerts, leading to loss of savings.	Analytical skills – Most smart metering portals are built to be user friendly. They are designed such that users find it easy to interpret the information displayed on the platform. However, much more is involved in truly utilising information presented. For instance, most users may log on to only check any 'base-flows', i.e., the least amount of usage registered on their meters to check for any leaks on the site. Yet, depending on the granularity of data collected, it is possible to go beyond the most basic analysis and do further research on consumption patterns, weekly patterns, equipment efficiency, seasonal variations and other aspects. This may be most easily achieved through hiring an external consultancy with experience on the subject.
Prioritisation – Prioritising data assessment and taking action on information presented may vary from user to user, depending on time and resources available to complete the task.	Management tools – An advantage of engaging an external consultant with experience in providing the AWARE service is that they will have the necessary tools to log, follow up, analyse and summarise information presented by a remote monitoring system. This may be in the form of a database. As an example, managing alerts received by 168 supermarkets discussed in Study 1 would have been very difficult if it wasn't for a customised database developed for the unique purpose of assisting in the AWARE services.

By outsourcing resource management, the complete responsibility and thus accountability for sustainable consumption patterns can be assigned to the external consultant. By keeping on top of usage behaviours and accidental leaks, users can be rest assured their risk is being managed efficiently.

Companies providing services such as AWARE have extensive experience and tools in place which help analyse, capture and manage data most efficiently. For instance, a data base system helps keep track of abnormal leakage cases, assessed savings etc. These insights can also be captured in reports and used for sustainability reporting. By using the remote monitoring system to its fullest extent users can meet their sustainability targets, which is also good for the corporate image.

CONCLUSION

The first two case studies discussed in this paper highlighted the performance of sites monitored with and without AWARE and how this affected the savings of the respective organisations. It was found that without AWARE savings were significantly lower at the sites. The third case study detailed what is involved in the upkeep of a remote monitoring system. It demonstrated how active maintenance minimises the loss of data and assists in higher savings. We explored why it was not common for users to exercise persistence in utilising their data effectively and achieve the same results. Some key psychological and practical barriers were examined in this regard. In addition, key advantages of active monitoring were discussed.

Services such as AWARE will have even more advantages in the next few years when there will be a higher number of connected points than ever. We will require systems and processes which streamline the benefits of data collection. It is important to recognise that failure to do so will lead to poor ROIs in remote monitoring projects which can be very costly. AWARE combats psychological and practical barriers associated with analysis of data. It helps achieve benefits from remote monitoring such as avoiding bill shocks, managing risk, avoiding property damage, boosting sustainability profile, assigning responsibility, assessing future water spending priorities and streamlining case management successfully. It is thus argued that such active monitoring unquestionably has to be an essential part in any successful smart metering program.

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