Identifying and Quantifying the Value of Water Network Monitoring

A TaKaDu Whitepaper

1. INTRODUCTION

Water Network Monitoring is based on real-time analysis of existing data (such as flow, pressure and reservoir levels) from water network sensors and meters. This data is used to detect and alert upon network problems and inefficiencies. Utilities using Water Network Monitoring receive automated real-time alerts on various types of events, from water loss and energy inefficiency to faulty meters and transmission problems.

This paper focuses on identifying and quantifying the benefits of Water Network Monitoring. It also suggests a framework of how to measure them, based on the best practices from the use of TaKaDu's monitoring solution by water utilities worldwide.

TaKaDu's solution is used by utilities in Europe, Latin America and Asia-Pacific as a means to monitor the network and drive down the costs associated with maintaining the water network.

The use of TaKaDu has been proven to reduce the time and effort required to identify, detect, locate and resolve network problems and anomalies. The reduction in time and effort is evident when compared to traditional or conventional methods of fault and inefficiency detection.

1.1 Making the most out of existing data

Despite living in the age of information, water utilities often get too little insight from their current data. In many cases, leaks and bursts are brought to the attention of the utility only when someone calls in to report a visible event. Advanced utilities devote considerable manpower to detecting leaks and faults through tedious manual analysis of data (e.g. night-line analysis, fixed-bound alerts, etc) and physical detection (from manual listening sticks to acoustic loggers). These processes are labor-intensive and waste resources and are done after the fact and not in real time, resulting in a backlog of past events that need to be checked.

Some of the events detected by TaKaDu are:

- Leaks
- Bursts
- Flow anomalies
- Zonal breaches
- Consumption anomalies (e.g. water theft)
- Service-affecting pressure drops and increases
- Repairs
- Meter faults (transmission, reading errors, flips)
- Reservoir level anomalies

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1.2 Measuring the efficiency of Smart Water solutions

While utilities may find using Water Network Monitoring useful and efficient, the question should still be asked: How efficient and how useful are such solutions? Can we measure the cost reduction and efficiency savings that come with Water Network Monitoring?

This white paper attempts to address these questions. In this document, we will take a close look at some of the components that add up to the return on Water Network Monitoring. Since these returns cover a wide spectrum of elements, we will propose a cohesive framework for the measurement of benefits.

2. MEASURING RETURNS

Taking a utility's point of view, the returns on Water Network Monitoring can be grouped into five categories:

1. **Direct cost reduction**
2. **Operations efficiency gains**
3. **Increased compliance with water loss and operational targets**
4. **Improved maintenance, leveraging network insights**
5. **Better communication, collaboration and customer service**

This document will address each of the above categories in detail. Per each category, we will propose a formula or approach for measuring and quantifying the benefits.

Notwithstanding, it is important to keep in mind that while all benefits have a monetary value,return-on-Investment studies measure only some of the benefits. Other benefits, while significant, can't be measured easily – from staff efficiency gains to positive public relations. Yet, their positive and lasting impact on the utility's finances and operations can't be ignored, and their value might in fact be equal or higher than the measurable benefits.

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3. COST REDUCTION

Cost reduction associated with Water Network Monitoring is comprised of several components.

- **Water Savings: reducing water-related costs:** One of the key benefits of Water Network Monitoring is the reduction of water loss. Each m3 of saved water carries a cost-saving associated with the cost of water saved. After being pumped, treated, pressurized and transported into the network, the value of the water lost in the distribution network is at its highest.
- **Early warning on bursts:** while the average alerts on a burst may be several hours, in reality burst events are alerted on within a range of up to 12 hours. For the bursts where the advance warning is longer, significant savings can be achieved and less damages incurred.
- **Reducing repair and detection costs:** Early and focused alerts on leaks and other inefficiencies make detection and repair teams work better. For instance, in one of TaKaDu's deployments, providing efficient alerts with geo-location resulted in up to a 50% reduction in projected annual detection costs, by focusing detection crew efforts on the right parts of the network.
- **Prioritizing detection and repair work:** The ability to schedule detection or repairs based on prioritization of alerts can preempt large bursts and the damages associated with them. Proper prioritization can also prevent or delay unnecessary work on minor leaks. Another frequently overlooked fact is that earlier alerts on leaks mean cheaper repairs and maintenance (as repair cost increases with the magnitude of problem). In general, fixing smaller repairs as they occur is believed to cost one-tenth of larger ones.
- **Preserving water sources:** since less water is lost, the utility's ability to serve its customers with existing water sources is improved. In the long run this means less need to produce water from new sources whether they are natural, desalinated or provided by third parties. This can save considerable investments, such as pumping sites and desalination plants.
- **Maintaining a higher degree of service availability:** With less dramatic water loss events and quicker repair times, a higher degree of service availability to the utility's customers is achieved, since there is less network downtime.
- **Burst prevention and damage reduction:** when large and acute bursts are prevented, the third party damages associated with them are averted, resulting in additional cost savings. Some large bursts are inevitable but others are evolving events, that begin from leaks. By alerting on leaks, the overall count of bursts is reduced.
- **Reducing costs associated with inefficient operations:** late detection of inefficient operations, such as excessive pumping due to a meter fault or a zonal breach, typically results is an increase in operational costs. Water Network monitoring can detect such inefficiencies and save the related costs.
- **Energy:** one of the main cost components of water is the energy used to transport it, which typically reflects about one-third of the operational costs of a utility. Any water saving therefore implies energy savings and reducing the utility's carbon footprint. Energy savings can also result from the detection of inefficient operations, such as excessive pumping.

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3.1 Case in point: Earlier leak detection and early warning on bursts

There are several approaches for calculating the savings as a result of early detection. The simplest approach is to calculate the value of an "average leak" - in terms of water cost, time to detect/repair and magnitude. In such a case, if the average leak size indicates a water loss directly valued at $1,000/day, then detecting it 9 days in advance, through water network monitoring, would yield an immediate saving of $9,000. Since the average leak also occurs on average every certain number of days (per kilometer of pipe), we can easily calculate the resulting annual savings. The savings calculated here are direct savings, and do not take into account the probability that the magnitude of the leak can increase over time, or that the leak will become a burst, and therefore result in additional damages and repair costs.

To place a value on the ability to detect leaks earlier, Thames Water (London) has come up with the following formula:

Figure 1

- *Average leak size is based on utility flow and pressure estimates for a number of leaks*
- *Early detection days – average advance notice on leak events - are calculated in accordance with past experience and the time it took for ordinary methods, such as analyst work or customer calls, to find the leak, if at all. For instance, early detection days can be, on average, 9-15 days earlier than detecting those same leaks prior to the implementation of Water Network Monitoring.*
- *Water cost is the value of water including the original cost of water, treatment costs, energy costs, etc.*

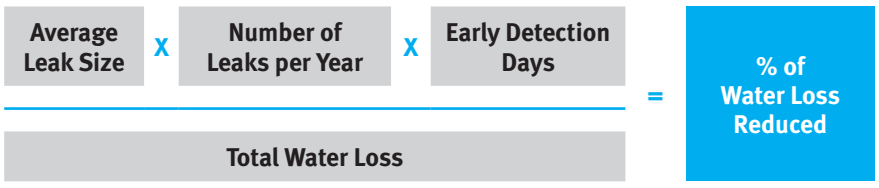
Calculating the value of early leak detection is different altogether for a utility with no active leak detection practices. In this case, without TaKaDu, the leak can remain undetected for several months or even a year. Therefore, "early detection" in the formula above would be replaced by "leak duration" which represents that time the leak went undetected. In many cases, this may take a year.

3.2 Case in point: Measuring the reduction in Non-Revenue-Water

One can measure the benefit of Water Network Monitoring based on the water loss rates before and after Water Network Monitoring was implemented. This works best when alerts created by the system are treated and fixed in a timely manner.

To place a value on the reduction in Non-Revenue-Water, a utility used the following formula:

Figure 2



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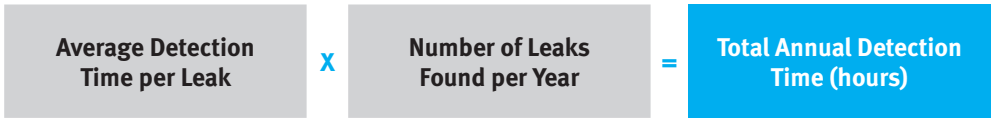
3.3 Case in point: Leak Localization for Faster Detection (detection efficiency)

Leak localization is a capability which provides the utility with an indication of where is the likely location of a specific leak within a certain zone/DMA, thus reducing the size of the suspected area and making detection and repair faster. A key benefit of leak localization is the ability to reduce detection costs and associated time and labor. This benefit can be quantified as follows:

Figure 3

The total original annual detection time could be calculated using this formula:

Figure 4



Lowering the average detection time per leak reduces the cost per repair and the time it takes to do it. In addition, since TaKaDu can verify whether the "right" leak was repaired, the crew can immediately know whether the work was performed or whether another leak was located by chance.

As with many of the benefits discussed in this document, quantifying detection crew savings is rather simple, but the savings associated with TaKaDu's solution are actually greater, and not always easy to quantify.

- **Detection costs are not only associated with labor; they may also result in mistakenly considering small leaks to be large, which leads to leaving the main leak unattended. This is fairly common in multi-leak environments.**
- **Fixing very small leaks may sometimes have a negative ROI (i.e. the savings are smaller than the repair cost). Using prioritization minimizes this inefficiency, but this significant benefit is not easily measureable..**

4. OPERATIONS EFFICIENCY GAINS

Efficiency gains from Water Network Monitoring include better operations within the utility as a result of early alerts and actionable data. Utility staff can better prioritize fixes and upgrades, and make informed repair and replacement choices that are based on a zonal history of leaks and other events. Significantly reducing the time spent on analyzing data, detecting and locating leaks, utility staff can perform more maintenance tasks. As network managers provide field crews with clear alerts on network issues, the work

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of all stakeholders can be done more efficiently and with increased precision. Other gains can result from the reduction in DMA or sector breaches, the identification of pressure problems and inefficient pumping.

Efficiency gains can also come from better return on personnel work, such as significantly improved analyst performance as a result of automated alerts, better insight into the network, early recognition of network issues that creates more efficient operations etc. The above are usually measured by calculating the efficiency of data analysts' work.

To summarize, the main operational efficiency gains associated with Water Network Monitoring are:

- **Prioritizing leaks and maintenance:** since TaKaDu provides indication as the size of a leak, its likely location and also general information about event occurrence within a zone or area, operations staff can make better decisions on repair prioritization and maintenance decisions. Since these decisions carry a high cost, the benefit is significant.
- **Accelerated problem resolution** (earlier alerts, higher accuracy) and automated recognition of issues; anomalies are corrected earlier, preventing potential damages and costs.
- **Action before problems escalates:** in some cases, a small leak can develop into a larger leak or a burst requiring disruptive and costly fixes or cause significant damages.
- **Better return on existing investment** in meters, sensors and network division.
- **Better monitoring of availability** increases network availability and operability.
- **Less time wasted on false alarms:** the data is cleansed within the TaKaDu system, and the use of sophisticated algorithms creates almost no false alarms. As a result, there is no time spent chasing the "wrong" events
- **Higher return on analyst and field crew work** as staff is made aware of problems earlier and with a clear sense of priority.
- **Better returns on the investment in Active Leak Detection.**

4.1 Increasing metering availability

Some efficiency gains are associated with a higher return on investments the utility has made in the past: investments in metering, sensing and division of the network into sectors / DMAs / pressure zones. A case in point is the ability to **increase metering availability** (or cost savings associated with the detection of faulty meters). In this case, although zones were created and meters were installed, the meters are faulty or stopped transmitting data. While the utility has invested with the intention of gaining 100% visibility into its network, it is actually monitoring only 80% or less. This results in areas where the utility has no true insight on the level of water consumption, water loss and occurrence of bursts or other issues that may result in decreased operational performance, such as pressure management issues.

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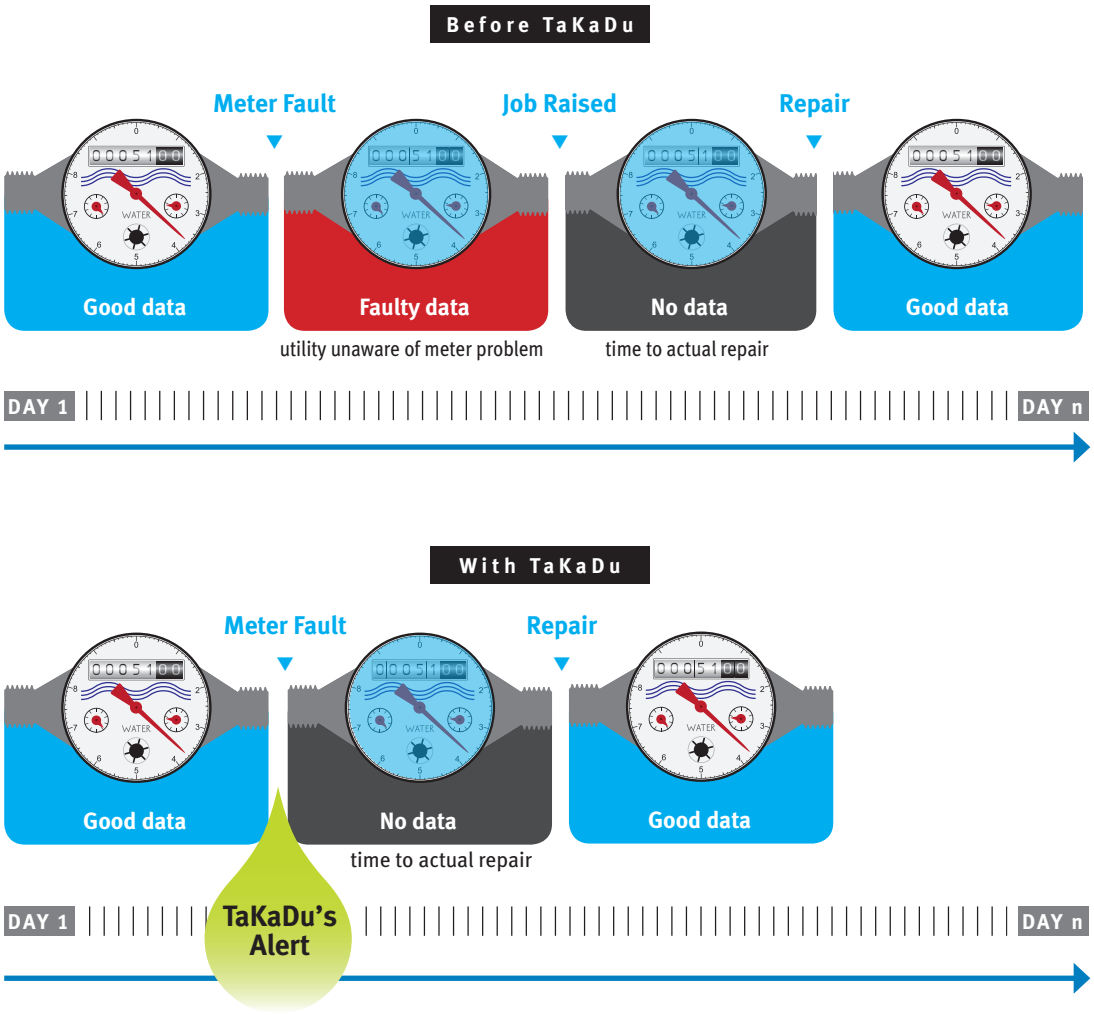
4.2 Case in point: Early Meter Fault Identification: Improved zone monitoring

Zone breaches and meter faults can make otherwise robust zones difficult to monitor. By providing early notification of faulty meters and network breaches, better control of the network is achieved just by ensuring that more parts of the network are available for monitoring.

Figure 5



Calculating the returns in this case is done as follows:

Figure 6

Average days to detect meter fault without TaKaDu	X	Monetary value of one day of sensor data	X	Average number of faulty meters per year	=	Annual savings due to early detection of meter faults

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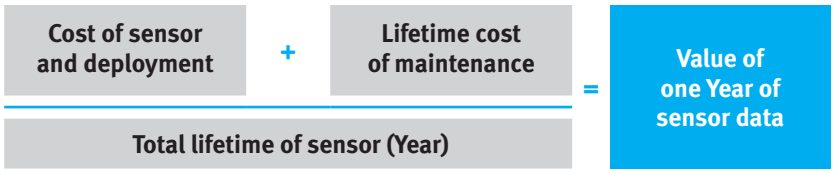
The monetary value of one day of sensor data could be calculated using this formula:

Figure 7



It is important to note that the above calculation is in fact the minimal value of fixing a meter fault. The cost of unavailability is significantly greater, since an unavailable network segment means that problems and events go unnoticed and unfixed for longer periods of time. Naturally, this significant gain cannot be quantified but should be taken into account.

5. INCREASED COMPLIANCE WITH REGULATORY TARGETS

In many countries regulators or other stakeholders require the utility to meet certain targets, such as Non-Revenue-Water rates, service availability and quality, dealing with customer complaints, ensuring water quality and more. Water Network Monitoring can provide the utility with the tools to meet those targets.

Preventing regulatory action and fines can provide the utility with significant cost and efficiency savings.

In addition, Water Network Monitoring can help the utility demonstrate its efforts to contain operational issues that may occur within the water network.

6. BETTER MAINTENANCE AND NETWORK INSIGHTS

Water Network Monitoring can also lead to better maintenance and investment decisions as a result of actionable alerts and better views of all network elements. Problem areas in the network can be detected quickly and action can be taken to see whether priority should be given these areas in maintenance work and replacement projects. Faulty meters and issues with reservoirs and pumping can be detected quickly.

In addition, Water Network Monitoring can give a utility good insight into consumption trends and provide the necessary 'clean' data required for calibrated hydraulic models, lowering the costs of maintaining such models.

Moreover, the inputs from Water Network Monitoring can be used for future planning. For example, in order to make more informed decisions about the location of new metering points in the network, to prevent breaches or make detection and geo-location simpler. Large network upgrade projects can take into account the existence of multiple events within a DMA. The information from Water Network Monitoring can be very valuable when determining the location of large pipe replacement projects.

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7. BETTER COMMUNICATION, COLLABORATION AND CUSTOMER SERVICE

The ability to get actionable alerts makes for better communication among utility personnel. Analysts and water supply specialists can use the information to better communicate with customer service personnel and detection crews. Each TaKaDu alert can be directed at a certain person responsible for that area, the alert is tracked in the same system and the communication regarding that specific network event is done in the system as well.

Executive management can use reports from the TaKaDu system to track and monitor the network as a whole, explore focus areas and examine whether targets, such as non-revenue-water targets are met. Reports are based on the network hierarchy and provide a real time or aggregated view of the network behavior.

8. CONCLUSION

Using Water Network Monitoring can provide utilities with a much needed positive return on investment and real gains in efficiency and reduction in water loss.

TaKaDu's Software-as-a-Service (SaaS) approach means that the utility is not required to install any software or hardware, but rather pay an on-going operational cost (pay as you go) and not undertake a long-term commitment to a capital expenditure plan. It also means that the risk in implementing TaKaDu's solution is minor, while the returns are quickly measureable and can be easily compared to the cost of the solution.

Notwithstanding, the benefit of having better control over the network, or the ability to prioritize work and repairs is not simple to quantify but yet remains significant and strategic. Calculating the ROI is different for each utility: TaKaDu's wide and flexible range of possible input and output information types guarantees that the solution is able to detect even anomalies of types unforeseen when deploying the system.

The positive ROI on Water Network Monitoring, at 250-400%, leads to a more sustainable water network

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