Impact of the Meter Health Analytics Solution on Water Utility Operational Expense Efficiency

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Abstract

Olea Edge Analytics Meter Health Analytics solution is changing the way water utilities manage and maintain large water meter assets. Beyond the exceptional revenue driven return on investments the Meter Health Analytics solution enables utilities to shift resources and valuable personnel from identifying meter issues and determining the cause of meter issues to repairing and maintaining metering assets. The follow discusses several opportunities for utilities who have implemented Meter Health Analytics to redirect personal to critical tasks, improve utility resilience, and operate more effectively. An analysis of operational and capital expense reductions do to a complete implementation of the Meter Health Analytics solution are presented for a portfolio of 500 large meters detailing $1,450,000 in savings.

Problem Statement

Current best practices for the management and maintenance of large water meter assets are inadequate for the demands of today's modern utilities. Valuable resources including trained personal and operational expense dollars are misdirected out of necessity into the identification

and determination of metering issues. Current approaches take months and years to identify critical issues with metering assets and months to repair and validate repair effectiveness. During this time utilities lose valuable revenue and have resources deployed to perform tasks manually which can be performed much more effectively with technology. Many times personnel responsible for the management and maintenance of large meter assets must follow a trial and error approach to repairing large meters. This results in many cases of months between repair iterations because maintenance personnel do not know the specific cause of the meter failure or if the repair they made was effective due to limited availability of data.

Background

Water utilities use several approaches to monitoring, managing, and maintaining the accuracy and health of their large meter assets. These include:

- Bench and/or field flow testing
- Billing and consumption analysis
- Field inspection

These approaches are limited by their frequency of application and the limited raw data available for analysis.

Bench and field flow testing evaluate a meter's accuracy at various flowrates, typically three to five, spread over the meters manufacturers design flow rates. The American Water Works Association's (AWWA) M6 Water Meters – Selection, Installation, Testing, and Maintenance manual provides recommendations by meter type and size. The recommendations include target flowrates and frequency of testing. AWWA standards are included in many local state legislations and are considered the primary standard for flow testing across the United States. Additionally, most meter manufacturers include flow testing recommendations in their recommended maintenance procedures for their specific meters. AWWA is frequently cited by the meter manufactures as the source for these flow testing recommendations.

The limitations of flow testing include the few discrete flowrates the meter is tested at, the lack of alignment between the actual meter service flowrates and the test flowrates, the time between tests, and the difference between the test conditions and the operational conditions the water meters operates at.

Large water meters typically have a wide range flow rates it can operate at during continuous operations. In a 6" water meter this continuous operational flowrate can range from 20 to 2500 GPM for a turbine type meter[1] and from 1.5 to 2000 GPM for a compound type meter[2]. The recommended flowrates from AWWA for these meters are:

Meter Type	Low Flowrate	Medium Flowrate	High Flowrate
6" Turbine Meter	30 GPM	Per Manufacturer Specifications	1400 GPM

[1] Neptune Turbine Meter
[2] Neptune Truflo Compound Meter

Meter Type	Low Flowrate	Crossover Point	High Flowrate
6" Compound Meter	Per Manufacturer Specifications	Per Manufacturer Specifications	1000 GPM

The recommendations above highlight the inherent weakness of normally accepted flow testing which is the lack of correlation between the actual flowrates of customer consumption and the test flowrates. Olea Edge Analytics in partnerships with 2 cities evaluated the Meter Health Analytics solutions with flow testing on 15 meters. The flow testing demonstrated the effectiveness of Meter Health Analytics to identify failed meters with a 100% success, Additionally, analysis of the flow test procedures showed a significant gap in two areas:

1. 30% of the flow tests performed were not consistent with AWWA or Meter Manufacturer specifications. The flowrates selected in many cases were based on a different meter type then were tested and, in the case of compound meters, the medium flowrate was rarely in the meter manufacturers specified crossover point.
2. The test flow rates failed to correlate with actual meter consumption rates in many cases.

In addition to the above, the frequency of testing can have a significant impact as to the success of a meter flowrate testing program. Olea Edge Analytics is still collecting quantitative data at the time of this paper. Qualitatively Olea personal have witnessed the following gaps in states meter testing programs:

1. Insufficient resources to complete the stated test program.
2. Statements that actual testing frequency varies significantly from test frequency goals
3. Meter test histories which show years since last test on meters where significant revenue was found due to inaccuracies.

Testing frequencies are commonly defined by state statues, a summary of which can be found in the AWWA M6 manual. The frequencies can range from 6 months for a high-volume meter to 10 years. Studies performed on samples more than 1000 meters and summarized in the AWWA M6 manual show little correlation between meter age, service consumption, and accuracy.

Maintaining an accurate large meter portfolio is very difficult, expensive, and may not be possible in many cases due to inherent limitations of the testing protocols. The lack of correlation between the test flowrates and actual consumption flow rates prevents a clear understanding of meter accuracy on customer billing. Implementing a successful meter test program in today's modern utility where operational expense dollars are limited[3] and there is a need to satisfy statutory and/or social perceptions is challenging.

Billing and consumption analysis are another way for utilities to identify potential changes in water consumptions. Consumption data is typically gathered manually, with an Automated Meter Reading system, or with an Automated Meter Infrastructure network. The value of collecting data with these approaches is well understood and not a focus of this discussion. Consumption data with these approaches is capable to be collected monthly, daily, hourly, and sometimes even every

[3] Read our blog for articles on the financial challenges facing modern utilities.

15 min. There is a direct correlation between sample rate, battery life, and local network bandwidth with AMR and AMI systems resulting in a typical sampling rate between 1 hour and 30 days. Manual readings are typically taken monthly or less frequently. Estimating is widely used when monthly manual readings are not taken, or AMR/AMI systems are not able to collect data.

Analysis of the collected data is used to understand changes in consumption patterns statistically. There are several statistical software packages available, some quite sophisticated, which can identify statistically significant changes to consumption. In some cases, assumptions are made regarding the pattern of change and the potential for a meter failure. But all these billing and consumption approaches are limited in the following ways:

1. The probability of success is directly related to the accuracy of the data input, namely the meter reading. Garbage in, garbage out.
2. Changes in usage can be noted, but the cause of the change in usage is bound by statistical probability. Statistical analysis can help users make educated guesses but guesses none the less.
3. In the case of an inaccurate meter, these approaches may be able to identify a failing meter within the bound's statistical probability, but they cannot determine which part on a meter has failed. They do not have the right data to understand meter performance.

Due to the limitation of traditional data collection approaches and the inherent limitation of statistics, utilities spend a significant amount of money to validate the meter is not reading accurately, to identify the specific cause of failure, and to correctly repair the meters. This presents a significant opportunity for a solution which can correctly and simply identify the failed meter and the cause of failure. This allows utilities to focus limited resources on repairs to return meter to accuracy.

Field inspection is another approach to identifying a failed meter. Field inspections may be conducted by the meter reader or by maintenance/operations personnel. Field inspections can identify visually obvious issues like a demounted register, a leak, or an open by-pass valve. An experience individual may be able to identify less obvious issues though observation of the register face(s) during flow, listening to the system operation, or feeling pipe vibration. But few utilities have a routine inspection program and typically a meter inspection occurs after a triggering event.

Triggering events can be a change in metered consumption, a change in account status, or another event. Situations like an open bypass can be difficult if not impossible to detect through billing and consumption analysis. Bypass valves are typically left open as a result of a maintenance event or opened by the customer to reduce metered consumption. Some property owners can be quite sophisticated by opening the bypass a few days after reading and closing a few days before the next reading.

Solution

Olea's Meter Health Analytics solution offers a new way to monitor and manage large water meter assets. The foundation of the solution is sophisticated edge computing technology designed to work in unpowered and adverse environments like meter vaults and pits. Our EdgeWorks platform harnesses the power of our edge computing technology in combination with sensors, cellular infrastructure, cloud computing, artificial intelligence and machine learning to deliver high value asset management solutions to Smart Cities and Smart Utilities.

The Meter Health Analytics solution primarily creates value by identifying and recovering lost revenue due to broken, worn, and mis-sized water meters. The payback period for Meter Health Analytics based solely on revenue is typically less than 180 days. For more information on revenue recovery using the Meter Health Analytics solutions please see our Success Stories articles.

The Meter Health Analytics solution also creates exceptional value by enabling utilities to shift valuable personnel and resources from tasks associated with identification and diagnosis of broken water meters to tasks focused on repair of meters and recovery of revenue. Specifically, the Meter Health Analytics solution can free up valuable personal and resources in the following areas:

- Reduce expense to identify & diagnose broken meters
- Reduced expense to flow test water meters
- Reduced expense by extending the life of accurate meters
- Knowledge management of meter assets and associated infrastructure

The personnel and resources freed up by the Meter Health Analytics solution are now available to focus on repair of meters and recovery of revenue. Overall, the solution enables utilities to bill for every drop of water by shifting personal and resources from easily automated workflows to higher value workflows.

Operational and Capex efficiencies for a portfolio of 500 meters are calculated based on simple assumptions of manpower and resources. The following savings are detailed in the following analysis:

Reduced expense to identify & diagnose broken meters		$375,000
Reduced expense to flow test water meters		$450,000
Reduced expense be extending the life of accurate meters		$375,000
Knowledge management of meter assets & infrastructure		$250,000
	Total	**$1,450,000**

The Meter Health Analytics solution enables utilities to reduce and eliminate resources associated with identifying broken meters and diagnosing the specific cause of failure. Traditionally identification of broken meters and diagnosing the specific cause of failure required multiple truck rolls to the meter over several months. In many cases utility personnel will follow a standardize repair process starting with register replacement followed by an evaluation period. If the meter is still not accurate the next step is to replace the UME followed by another evaluation period. One

utility, on average, sends a team to visit a suspected broken meter 4-5 times to return the meter to accuracy.

The Meter Health Analytics solution simplifies the process of returning a broken meter to accuracy by:

- quickly identifying the broken meter,
- diagnosing the cause of failure,
- recommends the specific repair needed to bring the meter back to accuracy,
- recommends the specific parts needed to make the repair, and
- validates the effectiveness of the repair to ensure meter is operating accurately.

This enables a meter to be repaired with one truck roll versus multiple truck rolls. We calculate the value of reduced personal and resources to identify & diagnose broken meters as follows for a portfolio of 500 meters:

- Without Meter Health Analytics (MHA) assuming 200 repairs, 5 truck rolls per repair, and a cost of $500 per truck roll.
    - Cost of Repairs (without MHA) = 200 * 5 * $500 = $500,000
- With Meter Health Analytics, we assume finding 25% more broken meters for repairs and requiring only 1 truck roll per repair.
    - Cost of Repairs (with MHA) = 250 * 1 * $500 = $125,000
- Value of Personal and resources available to be redirected to high value workflows
    - Value = Cost of Repairs (without MHA) – Cost of Repairs (with MHA)
    - Value = $500,000 - $125,000 = $375,000

The Meter Health Analytics solution enables utilities to significantly reduce or eliminate bench and field flow rate testing of water meters. The solution continuously monitors meter accuracy under actual use conditions and consumptions rates making a more effective approach to maintaining and managing portfolios of large water meters. We can calculate the value of reduce costs associated with reduction of flow testing as follows for a portfolio of 500 meters:

- Without Meter Health Analytics assuming 1 test per year per meter and $1000 per test
    - Cost of Testing (without MHA) = 500 meters * 1 test * $1000 per test
    - Cost of Testing (without MHA) = $500,000
- With Meter Health Analytics assuming 0.1 test per year per meter and $1000 per test
    - Cost of Testing (with MHA) = 500 meters * 0.1 test * $1000 per test
    - Cost of Testing (with MHA) = $50,000
- Value of personal and resources available to be redirected to high value workflows
    - Value = Testing (without MHA) – Testing (with MHA)
    - Value = $500,000 - $50,000 = $450,000

The Meter Health Analytics solution identifies and diagnoses broken water meters. The solution also validates accurate meters which enables utilities to approach capital improvements to a portfolio of meters more efficiently. Specifically, the average life of a portfolio of large meters can be significantly extended versus traditional total meter replacement approaches. We can calculate this avoided cost of total meter replacement as follows for a portfolio of 500 meters:

- Without Meter Health Analytics assuming a 10-year replacement cycle, $15,000 average cost of new meter and installation
    - Average Yearly Cost (without MHA) = $15,000 * 500 / 10
    - Average Yearly Cost (without MHA) = $750,000
- With Meter Health Analytics assuming a 20-year replacement cycle, $15,000 average cost of new meter and installation
    - Average Yearly Cost (with MHA) = $15,000 * 500 / 20
    - Average Yearly Cost (with MHA) = $375,000
- Value of personal and resources available to be redirected to high value workflows
    - Value = Annual Cost of Replacement [(without MHA) – (with MHA)]
    - Value = $750,000 - $375,000 = $375,000

The Meter Health Analytics solution includes a survey of the water meter, the water meter location, and surrounding areas. The survey includes detailed information about the meter, associated piping, meter vault condition, meter vault safety audit, and other critical information. The survey data is presented in the EdgeWorks user interface for easy access. Customer have characterized the value of the survey as equal to the cost of the entire Meter Health Analytics solution. We can calculate the value created by the meter survey as follows for a portfolio of 500 meters as follows:

- Value of Survey assuming $500 of value creation per meter
    - Value of Survey = 500 meters * $500
    - Value of Survey = $250,000

Conclusion

The Meter Health Analytics solution delivered exceptional value to Smart Cities and Smart Utilities though recovered revenue associated with broken, worn, and mis-sized water meters. Additionally, the Meter Health Analytics solution creates opportunities to shift personal and resources from easily automated workflows to higher value workflows. We have detailed four areas of potential value creation:

- Reduce personnel & resources associated with identification and diagnosis of broken, worn, and mis-sized water meters.
- Reduced expenses to flow test a portfolio of water meters
- Reduced annual capital expense by extending the life of accurate meters
- Knowledge management of meter assets and associated infrastructure

For a portfolio of 500 meters with the Meter Health Analytics solution utilities could save $1,450,000 annually. These people and resources can be redeployed to focus on high value activities like meter repair and revenue recovery.

References:

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