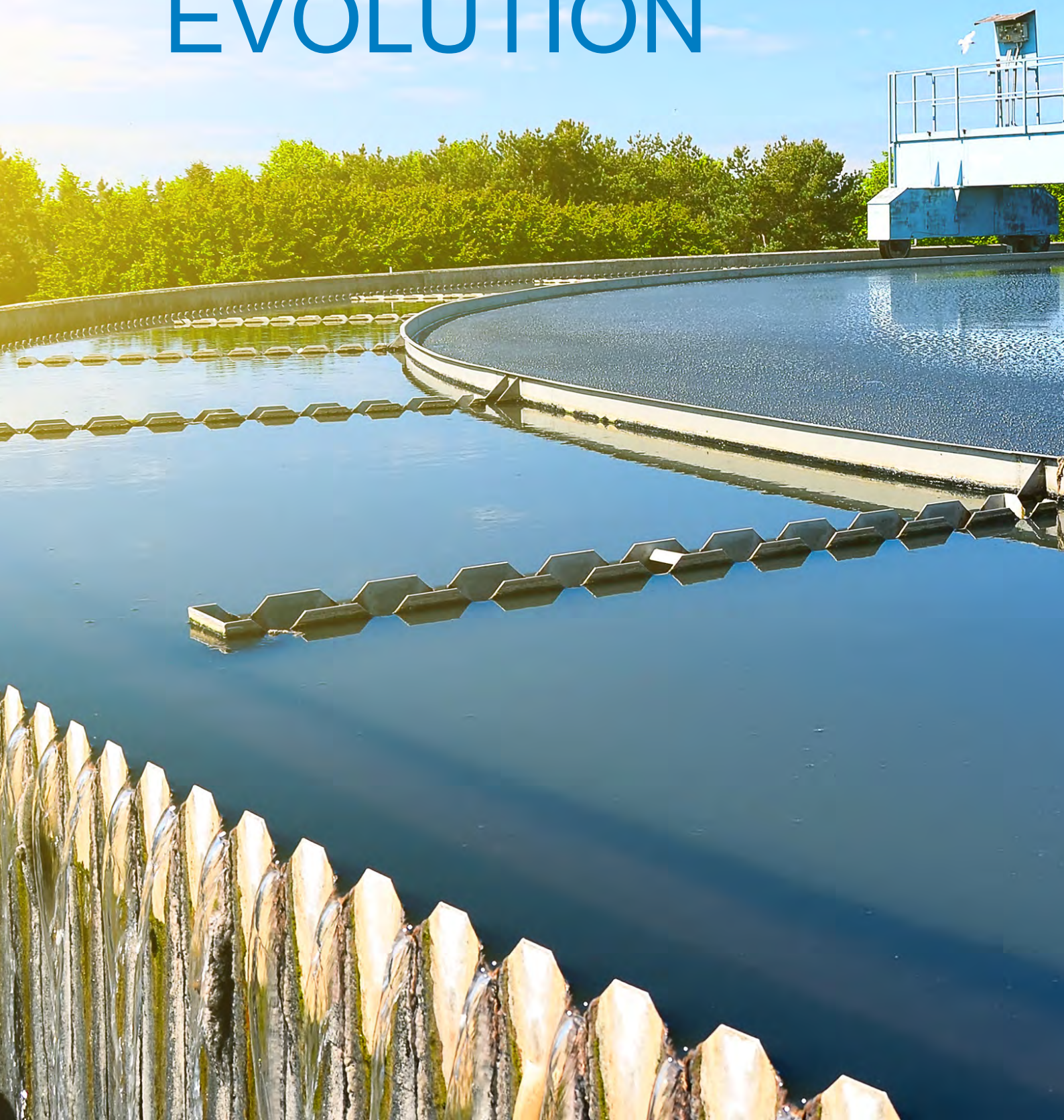
OSIsoft®

Success Stories in the

SMART WATER EVOLUTION



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Yorkshire Water

Industry

Utilities

Business Value

- Business Intelligence
- Operational Insight
- Performance Optimization
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- Process Controls
- Quality Management
- Predictive Analytics

PI System™ Components

- PI Server™
  - Data Archive
  - Asset Framework (AF)
- PI Vision™[1]
- Enterprise Agreement

Predicting Leakage Issues Using the PI System

Yorkshire Water produces 1.3 billion liters of clean water and treats one billion liters of water in its waste water networks every single day. The company has 686 treatment facilities spread across northern England and 83,000 kilometers of water pipelines, which is enough to circle the earth twice. The cast iron pipework makes the system prone to leakage, which can significantly affect water availability for its five million domestic and 136,000 business customers, drive up costs, and result in hefty fines. To mitigate leakage risks, Yorkshire turned to the PI System to take a predictive approach in order to significantly shorten the time it takes to identify and fix a system leak.

New Regulations Bring New Goals and Processes

In 2012, Yorkshire deployed the PI System as part of its rNet project to gain real-time insights into water pressure and flow in its pipelines. With 4,500 flow and pressure sensors and flat line notifications, this was a critical first step to gaining operational insights. However, with new Ofwat water regulatory targets taking effect in 2017, Yorkshire was at risk of missing performance targets.

For example, one recent leak, which was very difficult to find, resulted in over 4,000 customer complaints or inquiries from a single failure. “Ultimately, that’s pretty much 65 percent of our target for the year gone in just one event,” said Andrew Sewell, Telemetry Manager at Yorkshire Water during the 2017 OSIsoft EMEA Users Conference in London. Not only that, every leak over the target threshold netted a £3300 fine. “So… you see how we need to get more predictive with our analytics information to support leaks,” he stated.

The Visible Network Project

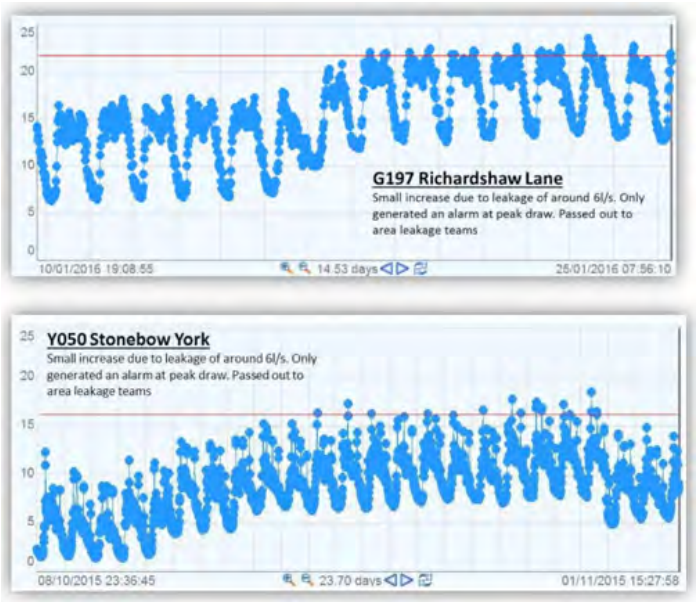
To detect leaks faster and meet the new Ofwat regulations, Yorkshire implemented the Visible Network Project to reduce leakage, customer contacts, and water supply interruptions. The project encompassed 26 performance commitments that included reducing leakage and water interruptions by 10 million liters, 4,000 per day, respectively. To meet these goals, Yorkshire partnered with Capula, an automation and real-time integrator in the United Kingdom, to reevaluate internal processes and revamp its PI System infrastructure.

A New PI System

With the help of Capula, Yorkshire implemented new PI System technology, including PI Vision, to gain better visibility into its pipeline infrastructure. The team increased the number of pressure and flow sensors to 6800 to improve its data profiling and developed five integrated modules to deliver full functionality. The new asset configurator populates the PI System, and

the asset update function syncs data across the different asset structures and automatically updates Asset Framework (AF). The analytics engine manages flow and pressure models based on seasonal variations and creates Event Frames in AF when a leakage event is spotted. All data is now visualized in the leakage viewer.

"Using AF really was a key enabler for the project and allowed it to be realized fully and automated in its data structure," said Alistair Norman, Business Sector Manager for the Operational Intelligence Division at Capula.



Faster Leakage Detection: The PI System allows Yorkshire to detect leakage problems a day and a half before the threshold alarm identifies the issue.

> "Prediction quality is looking at around a 96 percent success factor on the data we've got. So, a 30-day turnaround, which would normally take to dig and repair a leak, we can now turn that down in less than ten days."
>
> – Andrew Sewell, Telemetry Manager

Predicting Leaks Over Four Days Faster than Before

With the new PI System, Yorkshire is now able to identify developing leakage trends faster than ever before. Now, leakage events are detected 1.5 days before reaching the threshold and users are alerted by profile alarms. This is a full 4.5 days faster than previous alerts. "You can see from these two examples that significant time would be saved, and dispatching teams to site to investigate the leakage event would have been a lot quicker," Sewell noted. Thanks to the PI System, Yorkshire is now on track to achieve its targets.

Given the success of the project, Yorkshire is looking to integrate other operational data, such as energy and temperature, into the PI System model as well as integrate this information into its work planning system and to connect it to mobile devices. For more information about Yorkshire Water and the PI System, watch the full presentation here.

[1]PI Coresight was renamed to PI Vision in 2017.

Sewell, Andy / Norman, Alastair. *Predicting Water Leakage Across Yorkshire Using the PI System*. OSIsoft.com. 18 October. 2017. Web. 4 December 2017. <https://www.osisoft.com/Presentations/Predicting-Leakage-Events-Across-Yorkshire-Using-the-PI-System/>

White House Utility District
An Example Set

With the high-fidelity insights from the PI System, WHUD pinpointed a leak spilling nearly 147 million gallons a year, ***reduced its costs by over $1 million*** and ***postponed $15 to $20 million in upgrades***.

Situation

In 2007, White House Utility District (WHUD), a water utility serving approximately 90,000 consumers and businesses in Tennessee, faced a dilemma: how to meet a projected growing demand for water within the budget and capital constraints faced by municipal and mid-sized utilities everywhere. Early projections indicated that WHUD might need to invest up to $15 million to $20 million in transmission upgrades and treatment plant expansions to meet its service commitments. Expanded capacity would also mean higher expenses in terms of energy — electricity is approximately 30% of the cost of producing water — employees, chemicals and maintenance.

The Action

Rather than launch a major infrastructure overhaul, WHUD looked at the challenge through a digital lens: could it wring more performance and productivity of its existing assets with software and smart hardware? Delivering water by plugging leaks can be three times less expensive than new facilities. To that end, WHUD segmented its service territory into 33 district metered areas (DMAs) with Hydreka's Hydrins2 insertion meters, a product distributed through Matchpoint. Data from this network of meters was then delivered to OSIsoft's PI System™, a software platform that collects, cleans and structures data from different devices to give engineers and technicians real-time insight into their overall operations and asset health.

By combining data streams from the network of HydrINS2 meters and other assets such as pumps and valves already tracked by the PI System, WHUD was able to determine that it was losing approximately 32% of its water through water main leaks. PI System data was then streamed into ESRI's® ArcGIS® mapping software to precisely pinpoint the location of the leaks. In less than four days, WHUD found a leak spilling approximately 147 million gallons a year, or enough for 2,239 homes, which cost WHUD over $300,000 annually.

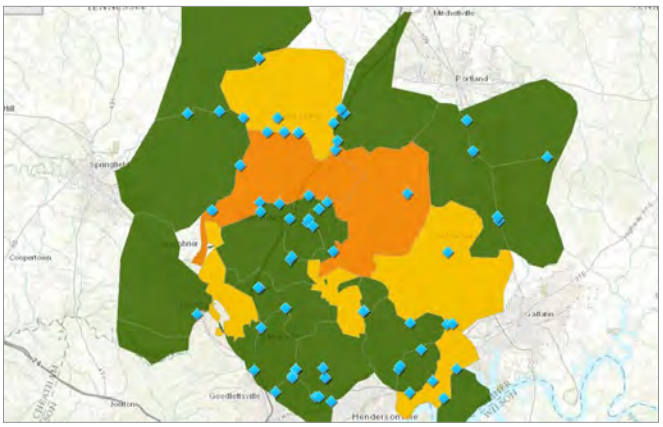
Because it was in a rural part of the district, local residents believed it was a stream. In two years, WHUD has been able to recover $900,000 worth of water. The 'smart meter' approach also allowed WHUD to avoid $200,000 worth of SCADA upgrades and recover $30,000 in employee time and productivity. Rather than having to wait six hours or more for data, repair technicians and others can get a status report detailing equipment health, energy consumption and maintenance issues, and other information within minutes after collection.

The Results

Perhaps most importantly, WHUD was able to avoid the $15 to $20 million capital expansion. Interest payments on the bond payments alone would have come to $600,000 per year, the utility estimates. WHUD predicts it will not need a major capital expansion until 2028, or 11 years after it took the digital first approach. WHUD is currently reducing water loss at a greater pace than legitimate customer usage appears in total water pumped through the water treatment plant.

HydrINS 2 meter technology

WHUD predicts it will not need a major capital expansion ***until 2028***, or ***11 years after it took the digital first approach***.



WHUD employees can evaluate the health of the water distribution system, energy consumption and the potential costs lost to leakage, quickly by combining ESRI and OSIsoft technology.

Authors:
Simon Wick, *VP of Matchpoint Water Asset Management*
Michael Kanellos, *Corporate Communications of OSIsoft*

TASWATER: SAVING OYSTERS WITH DATA

At 10am on August 24, 2017, a customer in Midway Point, a small suburb outside of Hobart, Tasmania, reported a sewage spill on his property. Midway Point stands adjacent to Pitt Water Nature Reserve, home to rare birds, butterflies, and the largest oyster lease in Tasmania, covering some 14 hectacres. In late August, Pitt Water oysters, prized for their briny flavor and consistency, were just coming into peak condition.

TasWater, the state's primary water and sewage service provider, responded to the call immediately, but unfortunately, 6,000 liters of wastewater had already spilled into Pitt Water, contaminating oyster beds and shutting down production for three weeks. It was an ecological and economic disaster for Tasmania, which harvests 48 million oysters annually as part of a $24 million industry. TasWater had to find a way to catch blockages and spills more quickly. In collaboration with Nukon, an OSIsoft System Integrator, TasWater began using the PI System as part of a pilot program to use sewage pump stations (SPS) data to spot and respond to blockages and spills before they turned into ecological disasters.

SEWAGE NETWORKS AND SENSITIVE ENVIRONMENTS DON'T ALWAYS MIX

Sewage systems and pump stations are by nature finicky assets. "Sewage spills are an unavoidable reality of managing a sewage network," said Matt Jordan, Manager of Network Asset Performance at TasWater, during his presentation at PI World San Francisco 2018. "With the volume of our network, keeping it blockage free is impossible." TasWater, which manages almost 5,000 kilometers of sewer mains, suffers about 2,000 spills and main breaks a year. About 70% of these are due to tree roots, but those can be predicted and prevented through root cutting.

"The one that really gets us is foreign objects," said Jordan. "These are items like nappies or diapers or hand towels or coke bottles. You name it, and it somehow ends up in the sewage system. You may have the best maintenance strategy in the world, but the day after you clean it, a foreign object can end up in there. They are the ones that are unpredictable."

SPS MONITORING SOLUTION: A NEW AND SIMPLE INNOVATION FOR THE WATER INDUSTRY

Sewage pump station (SPS) sites have defined operating characteristics. There are peaks in pump activity at the beginning and end of the day when people are generally

CHALLENGE:

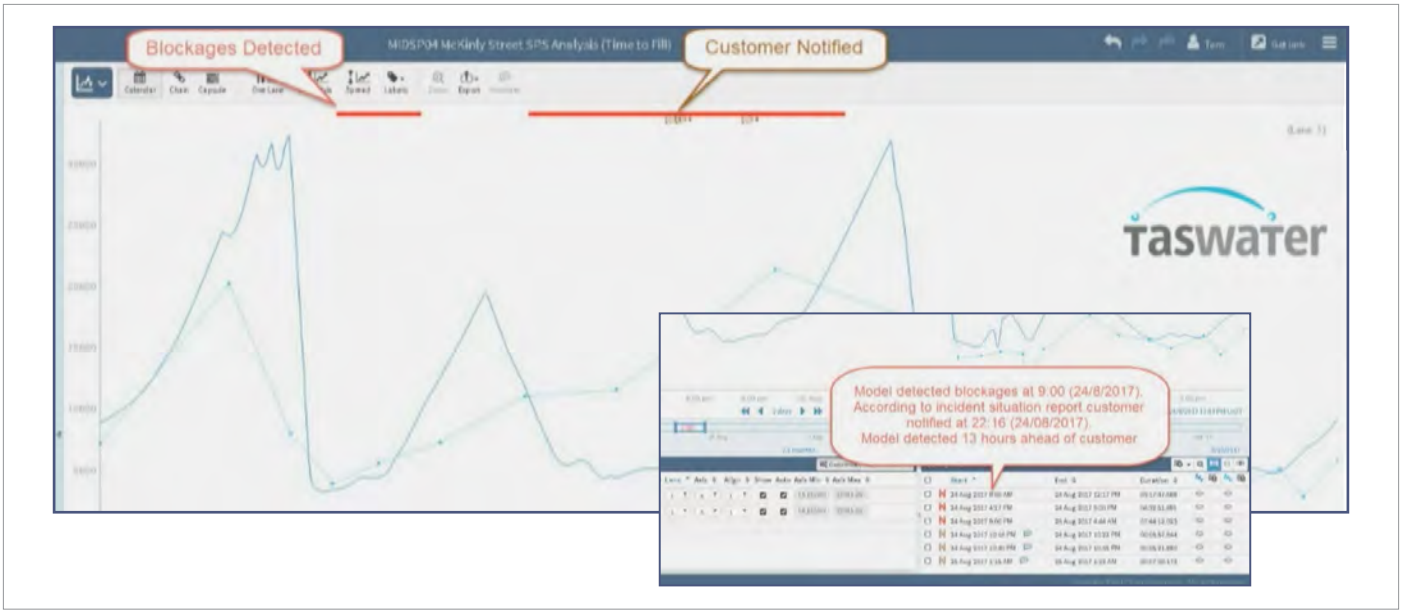
Preventing & responding to spills in ecologically sensitive environments

SOLUTION:

Use pump data from the PI System & analytics in Seeq Workbench to identify potential sewage blockages

BENEFIT:

Reduced blockage response time by up to 13 hours



Modeling reveals ability to detect potential blockage 13 hours ahead of when customer would report a spill.

using more water. Utilizing advanced analytics from Seeq, some of Nukon's own tools, and the infrastructure provided by the PI System, Nukon and TasWater devised an innovative method for identifying potential blockages. By analyzing just a single data point, whether a pump was running or not, TasWater discovered that the "time to fill" or time between pump runs was the key determinant of a station's operating profile. When the time between pump runs goes beyond what is normal, it suggests that the wet well (which collects the incoming water from the sewer system) is taking too long to fill and a blockage may be occurring upstream.

First Nukon and TasWater created models of normal pump behavior. Then they used Asset Framework, a part of the PI Server, to set up Event Frames and Notifications for out of bounds conditions. "The notifications happen in real time so there is no waiting around," said Andrew May, a Senior Consultant at Nukon. Had they had this data model in August 2017, they could have detected the Midway Point blockage 13 hours before the customer called to report it.

NEW INSIGHTS & EASY ROLL OUT

The low implementation cost and quick deployment were a great benefit to TasWater. Using the templates feature of Asset Framework, they quickly expanded the pilot project from the initial pump station to all of the SPS sites in Midway Point within a month. Currently they track about 50,000 data points, a number that should quickly increase to over 200,000.

Though they haven't yet experienced another blockage event, their data model has already given them unexpected insight into their sewage network. For example, an increase in pump activity during a recent storm event revealed leaky segments in the sewer system. This knowledge about the location of leaky sewers has allowed them to target funding to minimize inflow and infiltration and avoid excessive pump usage.

After their pilot program concludes, TasWater hopes to roll out their new system to all of their pump stations located in sensitive areas, thus expanding their ability to protect the health and safety of their customers, the environment, and those delicious oysters.

For more information about TasWater and the PI System, watch the full presentation here.

PARTNERS:

Seeq and Nukon

PI System™ Components Used:

PI Server™
- Data Archive
- Asset Framework
- Event Frames
- Notifications
- Asset Analytics

PI Vision™

> *We're hopeful this program can be used wherever our assets are in high risk areas… and help TasWater work more responsively with shellfish growers for better outcomes."*
>
> — Alexander Jovcic, Department Manager of Service Optimisation, TasWater

Jordan, Matt and May, Andrew. "Enhancing Time-Series Data to Prevent Sewer Spills" <https://osisoft.com/Presentations/Enhancing-Time-Series-Data-to-Prevent-Sewer-Spills/>

OSIsoft

SUMMARY

Thames Water

Industry

Water, Wastewater

Business Value

- Data Quality
- Energy Efficiency
- Quality Control
- Operational Visibility
- Pollution Reduction

PI System™ Components

- PI Server™
  - Data Archive
  - Asset Framework
  - High Availability (HA)
- PI Integrator for Business Analytics
- PI Coresight™

Smart Water: Saving Millions and Cutting Energy By Combining IT and OT with the PI System

The OSIsoft PI System is at the center of Thames Water's "intelligence Hub" (iHub), which merges disparate data sources to drive operational performance. Thames Water can now garner critical insights from its network of water delivery and sewage waste removal systems that span the greater London area. During the 2016 OSIsoft EMEA Users Conference in Berlin, Simon Coombs, a consultant with over 30 years of experience in IT/OT convergence for utilities companies, and Nick Burkinshaw, a 20 year IT veteran at Thames Water, detailed how Thames Water successfully converged IT and OT systems with the OSIsoft PI System.

The Waters of London

Founded in 1989, Thames Water is the United Kingdom's largest private water and sewage utility provider. Every day, over 15 million customers rely on Thames for clean water and sewer services. With 31,100 kilometers of water mains, including the Thames Water Ring Main around London, Thames manages a network of 88 water treatment works, 109,400 kilometers of sewer lines, 350 sewage treatment works, and 7,500 sewage pumping stations to deliver water, handle sewage waste, and manage storm runoff. In total Thames handles six times the volume of water in Sydney Harbor[1] each year – delivering 1 trillion liters of water to customers and processing 2 trillion liters of storm and wastewater. "It's a massive amount," said Combs.

In order to extract water from any local source, treat it, and deliver it to customers, Thames constantly needs to balance where to extract and treat water in a way that meets demand, reduces leakage, and delivers high-quality water. One of Thames' primary concerns is pollution avoidance, which can be highly unpredictable. Some surges – such as during rainfall or periods of high demand – can be predicted, but others, such as breakages and pump performance changes, are unexpected. Identifying the source of the surge can also be difficult. It is also an energy-intensive enterprise: the total amount of energy used by Thames is equivalent to 1 percent of the production energy within the entire United Kingdom. While water quality and demand are Thames' primary goals, regulators are also encouraging the company to reduce costs, energy consumption, and chemicals.

As a result, Thames needed to rework its entire big data and IT systems as well as its internal processes to create better visibility between its operations and its business decisions. That meant using operational data in a new, expanded, way. "What we are focused on is a new way of working enabled by Big Data and of course the PI System," said Coombs.

The IT/OT Convergence

When IT and OT converge the same data needs to be used in different ways across corporate firewalls. "It really is a difficult job to get it from one side to the other," adds Burkinshaw. "We had this lovely view that we would have this wonderfully clean data coming off sites, it would all feed up through various tears of the SCADA system, and pile into PI beautifully then up into iHub platform where it would be combined with the

[1] Sydney Harbor (or Sydharb) is an official Australian unit of measurement and a common unit of measure in the water industry. 1 Sydney Harbor (1 Sydharb) is approximately 500 gigaliters, 500 billion liters, 500 million cubic metres, or just over 132 billion gallons of water.

SAP data. In reality our data comes from all over the place it doesn't all come thru SCADA. Some comes from dial modem, some times things just blip in when they've got a problem. It comes from all over the shop in different times and different places," said Burkinshaw. Because of the volume and velocity of information being collected operational data is often incomplete. In fact, Thames discovered that 80% of the data be delivered to the PI System was out of order. "This was a serious constraint on what we were attempting to achieve," said Burkinshaw.

For Thames, the first steps toward IT/OT convergence was organizing their data better. To address these issues, Thames launched the AORTA (Asset and Operations Real Time Analytics) project to create a trusted data architecture. That project also meant changing the way Thames viewed it's data and it's systems. "We had to realize that we were never going to live in a perfect world. We almost never build a new SCADA system from scratch," said Burkinshaw. "We just put a bit more on something that was already there and as a result you're never going to have wonderfully clean layer at the operational data level – it's always going to be lumpy and full of gristle – so now we're looking at as system where we collect directly from source feed that into PI, almost circumnavigating the SCADA system. We'll still take data from SCADA obviously because a lot of the site SCADA data is very very valuable to us."

Now, under AORTA, data from SCADA systems and other devices are delivered into a PI Server. Asset Framework is then employed to organize the data by assets so operators and others can better understand performance. This cleaned, trusted, operational data is then channeled through the PI Integrator for Business Analytics to iHub, a system designed by Thames for combining operational data with enterprise applications like SAP to deliver customer services. PI System data now helps support 19 critical applications including My Meter Online, a customer-facing application that lets consumers check their water consumption.

Thames has also steadily expanded the scope of AORTA. At first, AORTA involved only data from potable water systems and tracked only 25,000 data streams. The data from wastewater operations was added. Thames now collects information from 600,000 tags and can potentially track over 5 million signals. "OSIsoft," he added, "has been a valued partner".

Benefits

With greater visibility into its operations, Thames has been able to reduce energy consumption while maintaining water quality and service. By studying and modulating day-to-day variations, that can't be explained by physics or equipment anomalies, Thames has reduced production energy by nearly 10%, noted Coombs. Thames, for instance, found that operators in one location were using two pumps, rather than one, for a particular task. By flagging and fixing the issue, Thames has saved £10,000 a year. "The good news is that because it is behavioral…you can actually change those behaviors," he said, adding that Thames has reaped "multimillions" in benefits over five years.

In addition, Thames can also now determine the cause behind pollution surges (sewer overflows), i.e. is it a normal increase in demand, a pump on the brink of failure, or a blockage? By intercepting these events in time and making the appropriate fixes, Thames can prevent pollution events, helping the company avoid complaints and save hundreds of thousands, if not millions, of dollars in fines.

"It [the PI System] is the one application that spans the IT and OT domains."

– Nick Burkinshaw
Operations Manager

Coombs, Simon and Nick Burkinshaw. *Navigating the IT/OT Transformation Journey at Thames Water.* OSIsoft.com. 28 September 2016. Web. 01 January 2017. <http://www.osisoft.com/Presentations/Thames-Water--IT/OT-Convergence---Navigating-the-Transformation-Journey>.

OSIsoft®

SUMMARY

Colorado Springs Utilities®

Industry

Energy and Water Utility

Business Value

- Data Democratization
- Enterprise Visibility
- Cost Reductions
- Corporate Reporting
- Regulatory Compliance

PI System™ Components

- PI Server™
  - Data Archive
  - Asset Framework (AF)
  - Notifications
- High Availability (HA)
- PI Interface for Relational Database (RDBMS)
- PI Interface for OPC
- PI Vision™
- PI DataLink™
- PI ProcessBook™

Colorado Springs Utilities streamlines operations with centralized PI System data

One of the nation's largest four-service utility providers, Colorado Springs Utilities supplies energy and water to over 450,000 people. The state-certified laboratory of the Water Quality Assurance section processes over 14,000 samples and 80,000 analytes per year from eight watersheds, seven finished water treatment facilities, 38 finished water reservoirs, four post-chlorination stations, two wastewater treatment facilities, and over 2700 miles of pipeline. Along with Jeannette Ortiz, David Mora, Environmental Scientist Lead of Water Quality Assurance explained to the 2015 OSIsoft Users Conference how Water Quality Assurance has rolled out a PI System data infrastructure to increase data accessibility and decrease operational costs and reporting times.

Multiple enterprise interfaces pose operational challenges

Mora opened the talk by describing his company's operational challenge of "multiple enterprise interfaces." Before implementing a centralized solution, Mora and his team were "really dependent upon our SCADA operators… We would actually call our operators to find out what's going on with our system, asking them what the current residuals are, what the tank levels are… And you are hoping that the operator on the other end is giving you the right number… because you are actually making operational change based on the information."

Pulling data from multiple interfaces also meant it could take as long as three weeks for Water Quality Assurance to collect data and prepare a report for customers. As Mora explained, "It's almost like checking your checkbook three weeks later. You are not going to be successful if you are doing that. That was one of the complaints from our customers that [they] need the data to make these process control changes, [they] need the data now."

Implementing a centralized data platform

To improve data accessibility, Mora and the Water Quality Assurance team began a small trial of the PI System "looking at 220 monthly data points" from a "bacteriological sampling site." According to Mora, "that worked great, and the next step was… post-chlorination stations and water quality monitoring stations… Once that was successful, we moved onto process control and compliance sampling… Next we moved on to watershed and source water management."

Mora said, to build trust, they chose to "start on smaller or easier processes and then convert to the more complex, time-consuming ones." Today, Colorado Springs Utilities has successfully centralized its water data systems onto a PI Server. Ortiz explained that "17 interfaces feed into our Water PI Server. These are remote interfaces, typically OPC… and we also use RDBMS interfaces to pull and push data into Oracle… We have 12 interfaces that feed from SCADA directly into our PI Collective."

The benefits of centralized data

The shift from multiple interfaces to a centralized data platform has led to a "58% reduction in overtime," "30% reduction in vehicle usage," and "10% reduction in effluent chlorine costs." In addition, Mora said that the 3-week reporting time has decreased and "15 minutes after authorization, our operators, our customers are getting our data."

These operational improvements have enabled Mora to better allocate his resources and further improve operational systems. "Prior to the PI implementation, we only had six operating systems. When I say operating, they were powered up, that as close as we would get. We had the confidence that they are about 50/50, and 50/50 doesn't cut it in water quality. Since then, we have installed all new instrumentation… We will have 18 operating units by the end of the year. Operating meaning they are calibrated to 99%. This is the pulse of our distribution system, and this is realized because we saved that money in our resource allocation and reallocated it to a cause that would really help us fine tune our system."

"I can see what is happening with my infrastructure 936 miles away from my hometown."

David Mora
Water Quality Assurance Lead
Colorado Springs Utilities

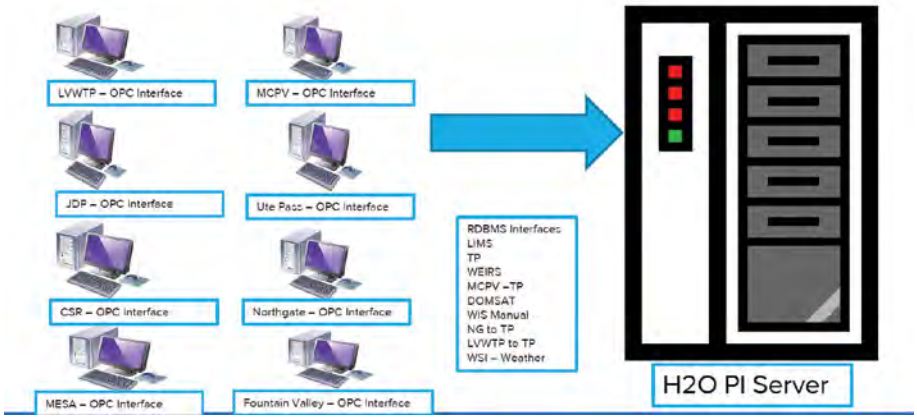


Figure 1. Colorado Springs Utilities Water PI Server with 17 Interfaces

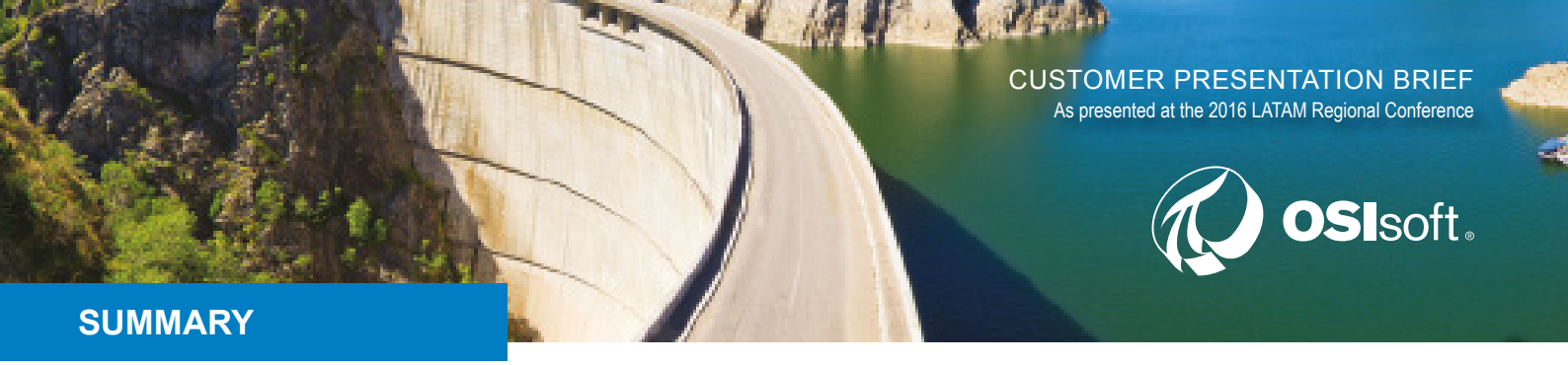
Future data plans for Colorado Springs Utilities

Recently, Mora and his team added PI Coresight[1] as a real-time data tool. Mora believes PI Coresight "is really going to change how we do business. In the past, you had to have [PI] ProcessBook in your computer. You had to have [PI] DataLink on there to pull any of this data. Now, it is actually available anywhere… I can see what is happening with my infrastructure 936 miles away from my hometown."

Next, Colorado Springs Utilities plans to increase use of Notifications and incorporate the PI Integrator for Esri ArcGIS. Mora said, "We want improved process control sampling and compliance sampling, we want to expand the data sharing side. To be able to provide that integration into the ArcGIS is going to be huge. Now we are going to be able to get our spatial analytics with all of the data and put it together. That's going to be powerful for us as we move forward."

[1] PI Coresight was renamed to PI Vision in 2017

Ortiz, Jeannette and David Mora. *Improving Business Processes through Operational Intelligence in the Water Industry.* OSIsoft.com. Oct. 2015. Web. 02 December 2015. <http://www.osisoft.com/Templates/item-abstract.aspx?id=12421>.



CUSTOMER PRESENTATION BRIEF
As presented at the 2016 LATAM Regional Conference

OSIsoft.

SUMMARY

AES Tietê

Industry

Power Generation

Business Value

- Process Productivity
- Safety and Security
- Regulatory Reporting

PI System™ Components

- PI Server™
  - Data Archive
  - Asset Framework (AF)

Improving decision making at AES Tietê with data

One of the world's most important energy producing companies, AES generates and distributes electricity in 17 countries, employing around 21,000 people around the globe and serving over 10 million customers. In Brazil, the group's operations are divided into five different companies: AES Eletropaulo, AES Ergos, AES Sul, AES Uruguaiana, and AES Tietê. At the 2016 LATAM Regional Conference, Carlos Macedo, operations engineer at AES Tietê, describes the company's operations and how the PI System was used to streamline decision-making, minimizing risks and optimizing the operation of power plants at the AES Tietê division.

The presentation started with an introduction to AES Tietê, which has 12 facilities that generate hydroelectric power in the state of São Paulo and operates the Tietê - Paraná waterway. To manage all of these locations, power plants, floodgates, and ancillary services are remotely controlled and supervised. This control is crucial for: dam safety, preventing flooding of downstream plants, avoiding detrimental effects on the population who lives in areas where plant water drains, and navigating waterways as boats cannot go up-river when the flow is high.

To illustrate the consequences when such control doesn't work properly, Macedo described a case that occurred in 1977 at the Euclides da Cunha hydroelectric plant in Rio Pardo, which is a rocky and mountainous region. Macedo explained that the terain in Rio Pardo keeps rainwater from being absorbed by the soil so it flows directly into the plant's reservoir. "Heavy rain makes the volume [of the reservoir] change very quickly. Similarly, we have to decide very quickly how much water we will release," he continues. In 1977, that decision to release water was not made fast enough and the dam burst. "This case is frightening, because even more damaging than the loss of the facility was the damage to the population," Macedo explains. "The wave that emerged from this burst was approximately 3,000 cubic meters per second, while the river's average is 90. It was an avalanche that descended, destroying everything in its path."

To keep an accident of this scale from repeating, AES Tietê adopted the following measures:

- Created an operating manual for emergency situations for each facility, that describing the procedures to be followed if a critical water level in the reservoir is reached;
- When a critical level is reached, decision-making and control must be decentralized and switched to the local facility, as soon as possible;
- Construction of a telemetric network, so the plant can measure water flow rates before they reach the reservoir and measure rainfall in the water catchment area.

Macedo continued the presentation saying "But if [the set of measures] worked, why do we then use the PI System?" He explained that the manuals generated a set of standards and tables that operators had to refer to but then had to run calculations manually. This whole analog process ended up making operations slower. "In some situations, timing is crucial, which is what happened in Euclides da Cunha. Precisely for this reason, we used the PI [System] to help us make such decisions."

Macedo explained, that to streamline the process the team input data from the telemetric network and the tables that were scattered around the operations center into the PI System. Moreover, logical calculations were created to estimate the inflow into the plants, which made simulation of reservoir conditions possible. "We managed to give the operator a single view of everything that was happening in the reservoir," he says.

Demonstrating the success of using the PI System, Macedo says that in January 2016, heavy rainfall threatened the same dam in Euclides da Cunha. However, the tools made it possible to predict and calculate the flow rate, allowing action to be taken quickly. He explains that if the same measures had been taken just one hour later, the reservoir water level would have reached a critical level. The PI System gave plant operations the ability to predicting trends and speed up information delivery so remote plant control was more accurate and reliable, thus ensuring the safety of both the facility and the residents living near the reservoir.

"In some situations, timing is crucial, which is what happened in Euclides da Cunha. Precisely for this reason, we used the PI [System] to help us make such decisions."

– Carlos Macedo,
Operations Engineer,
AES Tietê

Macedo, Carlos. *Aprimorando a tomada de decisões na AES Tietê através dos dados*. OSIsoft.com. 08 Jun 2016. Web 15 September 2016. <http://www.osisoft.com/Presentations/PI-System-e-Hidrologia--Uma-Uni%C3%A3o-Promissora>.

CUSTOMER PRESENTATION BRIEF

As presented at the 2015 EMEA Users Conference

OSIsoft.

SUMMARY

Qatar Power®

Industry

Power and Water Utilties

Business Value

- Regulatory Compliance
- Resource Conservation
- Employee Safety
- Real-time Analysis
- Analytic Rich Visualization
- Energy Efficiency

PI System™ Components

- PI Server™
  - Data Archive
  - Asset Framework
  - Event Frames
  - Notifications
- PI DataLink™
- PI ProcessBook™
- PI Manual Logger™
- PI Vision™

The PI System helps Qatar Power reduce costs, improve safety, and conserve resources

Qatar Power is an Independent a in the Ras Laffan Industrial City in the Gulf State of Qatar. Since implementing the PI System, it has been named Power and Water Utility of the Year within the Gulf Cooperation Council in 2012, 2013, and 2014, and, in 2014, was the first Middle Eastern company to receive a Commended Electricity Industry Sector Award. In his presentation, Parshu Borkar, Senior Engineer – Commercial and Performance, explained how his company has leveraged the PI System to optimize O&M, reduce resource consumption, and improve worker safety.

Supplying reliable power & water to a growing population

“Our main focus is to make power and water available,” Borkar began. However, that mission has become increasingly difficult because “the power demand and water demand has grown… exponentially” in Qatar to support population growth and “changing lifestyle and life expectancy.”

An additional challenge is that the plant is configured to maximize flexibility in water availability and reliability. “Any HRSGs (heat recovery steam generator) or any GTs (gas turbines) in service, we can always produce the water,” Borkar explained, but “it is very tough to optimize the performance of the plant… as it is integrated so much.”

The desert climate exacerbates these challenges. “Every day, our load fluctuation is more than 45%, and during the summer, our weather conditions are adverse…. the relative humidity goes to more than 90% at very high temperatures,” Borkar said. “To support this business environment and to operate the plant in the most efficient way, I require the data.”

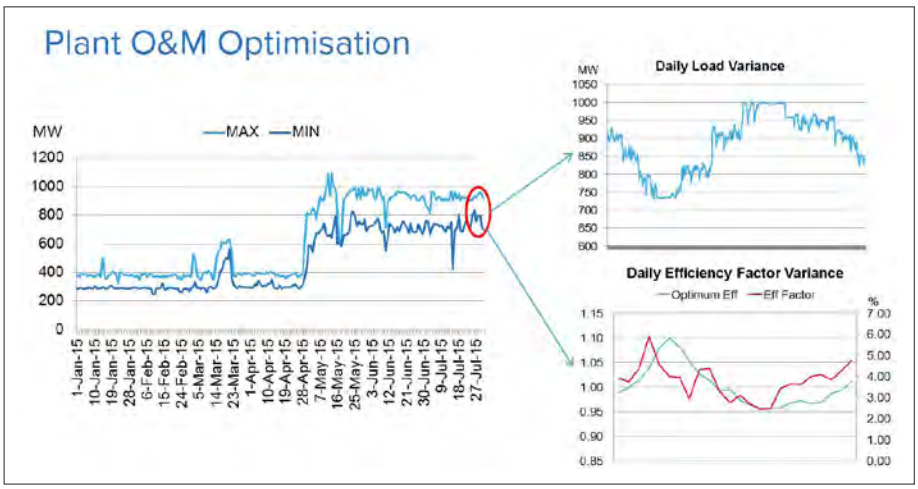
Optimizing O&M through the PI System

The PI System has provided that data. Borkar showed a snapshot of gas turbine “cycle efficiency, compressor efficiency, operator efficiency, the inlet and outlet conditions along with the environment monitoring.” Because the plant has “three gas turbines which are identical, [there is] a great advantage to monitor the performance of [all] three. With these PI ProcessBook reports, real-time reports can be generated, which can be compared with the other gas turbines.”

Borkar and his team review these reports every morning to optimize the plant processes. “Our O&M meetings start with energy inefficiency,” he explained. “We discuss plant efficiency, loading, equipment efficiency, seawater consumption, and any other related parameters. If we have any deviation, we are required to take some actions. We discuss early in the morning so we can make decisions during the day time.”

ROI through Reduced Seawater & Fuel Consumption

As it has optimized O&M, Qatar Power has reduced its consumption of fuel and seawater which are "the main resources that we are using for power and water generation." Because water is scarce in the region, seawater must be purchased and represents a substantial overhead for the company, which uses "almost 90,000 cubic meters per hour." Through the PI System, "seawater **margins have been improved by $1.3 million (USD) in the last two years**." In addition, Qatar Power has "**improve[d] the fuel efficiency factor by almost 0.98%... which has result[ed] in $1.4 million (USD) per year**." These reductions in fuel and seawater consumption equate to a strong ROI. "I spent almost $300,000 for the PI System, and within a short span of time, I recovered the money," Borkar said.



At Qatar Power, we are using this PI System not only for operations, but for maintenance and for the well-being of people who are working in extreme conditions.

– Parasram Borkar
Sr Engineer – Commercial & Performance

Improved Worker Safety & HSE Compliance

In addition to O&M efficiency and ROI, Qatar Power has improved worker safety in conditions of high heat and humidity. "Initially, it was very difficult to monitor this heat index [because] we were using the conventional method," Borkar said. Now, Qatar Power uses Asset Framework "to calculate the heat stress" and Notifications for heat-stress index "categories of yellow, brown, and red," "In the last three years, we did not have a heat stress related incident, even with the high humidity and the extreme working condition within Qatar, which helped us to achieve **4.2 million man hours in 3,452 days without LTA (lost time accidents)**."

The Future for the PI System at Qatar Power

Borkar concluded by summarizing the multi-faceted benefits of real-time data and analysis. "This is the business impact after the implementation of the PI System. We could really improve our HSE performance. We improved our availability and reliability…. We improved the fuel efficiency. Also, we reduced the seawater consumption, which has improved our seawater margin…" In the future, as the company and the region strive to provide reliable energy and water amid increasingly stringent global environmental initiatives, Qatar Power plans "to cover Event Frames" and "to develop the displays in the [new PI] Coresight[1]... work that will help us to create value for the stakeholders."

[1] PI Coresight was renamed to PI Vision in 2017

Borkar, Parshu. *Optimisation of O&M Efficiency at Qatar Power using the PI System*. OSIsoft.com. 13 Oct. 2015. Web 11 January 2016. <http://www.osisoft.com/Templates/item-abstract.aspx?id=12817>.

THE SMART CITY OF RIVERSIDE, CALIFORNIA

"We had disparate data and systems – everything was everywhere," said CJ Smith, a Project Manager for the City of Riverside Public Utility (RPU), which operates grids, substations, water plants, and maintenance fleets to provide 120,000 residents with essential resources. Faced with an aging workforce and aging infrastructure, the city invested in an aggressive initiative that connected myriad systems into a data-rich integrated system. The result has transformed how the city operates, and today, Riverside has a digital and connected utility that has streamlined reporting, maintenance and emergency response and that is projected to save the City of Riverside $3 million over the next five years.

AN AGILE START

In July 2016, the City of Riverside signed an Enterprise Agreement with OSIsoft to implement the PI System as the city's data infrastructure. A group of stakeholders from the City of Riverside IT department, Riverside Public Utility, and OSIsoft designed an architecture that could support an ambitious five-year plan for the city's digital transformation.

Their first priority was to wrangle data scattered across disparate systems into a single place. The PI System became the data hub and systemic glue that helped RPU turn disparate reports and data streams – including financial data, work orders, weather data, customer information, and even call center data – into meaningful information. By October 2016, 80 percent of RPU's systems were connected to the PI System.

A core implementation team of five people then used an agile approach with 4-6 week sprint to develop applications feeding off PI System data. Every sprint, they delivered a new dashboard, report or solution based on end user needs. They worked with subject matter experts upfront to validate data quality. To make it easy for anyone to access data, Smith and her team created an internal web page for quick navigation to a wide range of PI Vision dashboards as well a custom application – called "Search PI" – that makes it easy to search and locate data within the PI System.

"We were able to say to a user group I only need you for five weeks. If you can give me five weeks of your time, we promise you will have your product that will change how you do business," said Smith.

HIGHLIGHTS:

Projected ROI of **$3+ million over 5 years** from process automation alone

Automated water operations reporting and **saved 8 hours employee time** per report

Connected **80% of disparate** utility systems to the PI System

Riverside Public Utility provides a single web interface that any user can drill down into to see what is happening in real time.

SMART CITY DASHBOARDS

Preparing reports on water operations used to be a manual task that required eight hours of work with a series of Excel spreadsheets. Today, those reports are automated and easily accessible on a water operations dashboard. Another dashboard shows the real-time blend in Riverside's water wells.

Riverside has also set up dashboards that allow managers to drill down and see how substations are performing. System alerts are set up for key performance indicators, so that automated notifications are sent anytime something is operating abnormally.

For water field work orders and power outages, data is now available on a map, so employees out in the field can see field work orders and outages in real time and better prioritize work. "Before there would be an outage and a customer would call and say we have an outage on this line. We would then dispatch someone, and he would drive the line in his truck from one end to the other looking for a blinking grid sensor to see where the outage was," said Smith. "Now instead of driving the entire line and trying to find a grid sensor blinking, they can see it on a map on their iPhone or iPad."

Ultimately, better information in the hands of employees has transformed how the City of Riverside works. Over the next five years, the city projects over $3 million in savings from process automation alone. But they aren't done yet, Smith and her team plan to continue rolling out dashboards and data solutions to make Riverside an even smarter city.

For more information about the City of Riverside and the PI System, watch the full presentation here.

PI System Components:

PI Server™
- Asset Analytics
- Asset Framework
- Data Archive
- Event Frames
- Notifications

PI DataLink™

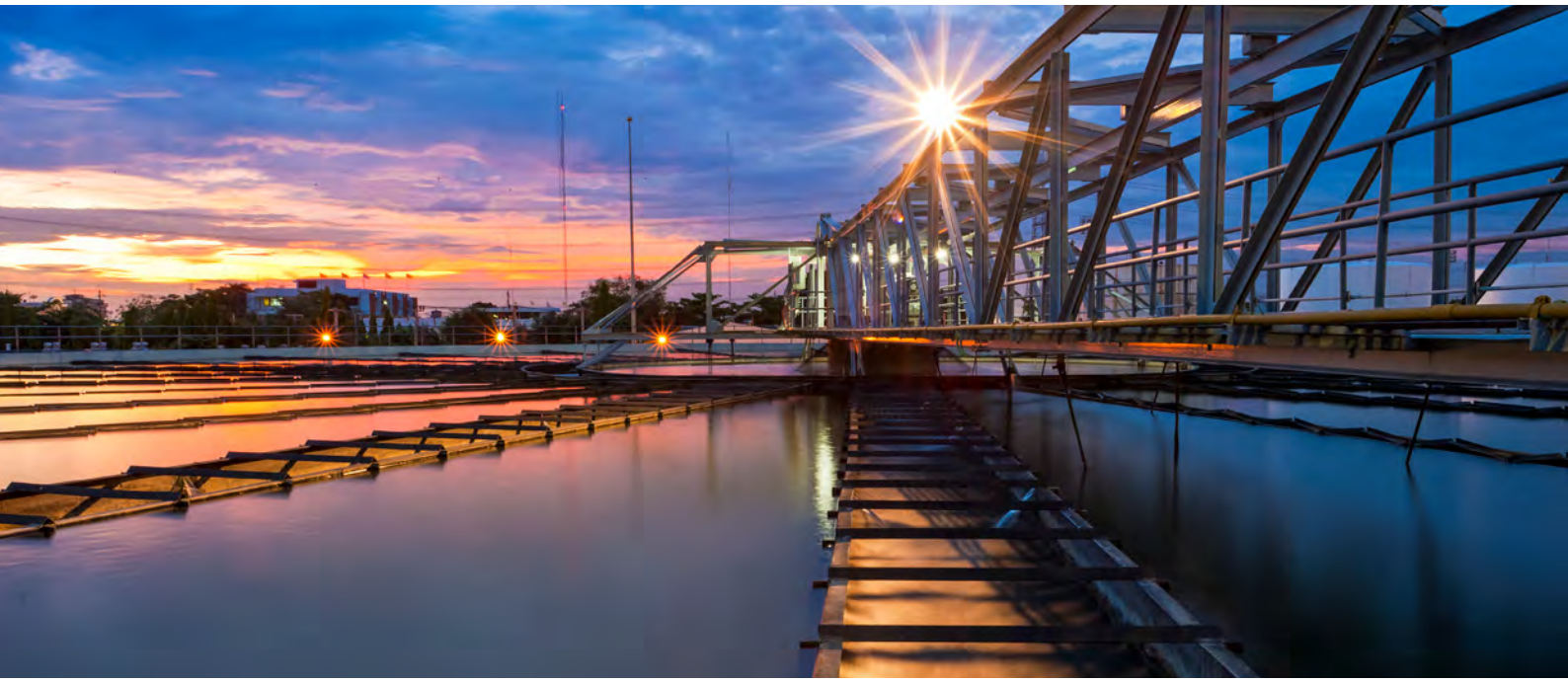
PI Interfaces and Connectors™

PI Integrator for ESRI ArcGIS™

PI Vision™

> ***"The OSIsoft team that we worked with – we had a great partnership and they were instrumental to our success."***
>
> — CJ Smith, *MPA, PMP Project Manager, City of Riverside, Public Utilities*

CJ Smith. "From Paper-Based Processes to a Digital & Connected Utility."
<https://www.osisoft.com/Presentations/From-Paper-Based-Processes-to-a-Digital-and-Connected-Utility/>



PKN ORLEN COMBINES REAL-TIME FINANCIAL AND OPERATIONAL DATA FOR WATER MANAGEMENT

PKN Orlen is a Polish integrated energy company that operates multiple refineries and thousands of gas stations in Central Europe. The company is also the largest industrial producer of electricity and heat in Poland and operates water and wastewater treatment plants. Lack of real-time visibility into its water operations made it hard for PKN Orlen to tackle issues like leaks, profit loss, and resource management. To thread the needle, the company began using the PI System™ for its water and wastewater management in 2002 and shared the results of its digital transformation at PI World San Francisco 2018.

A COMPLEX SYSTEM IN NEED OF A SIMPLE ANSWER

The challenges at PKN Orlen's water and wastewater department were three-fold. First, the team had no unified platform for their data. "Data was not collected in one place or stored somewhere, so we weren't able to check and improve our operation," explained Kacper Rosiński, Energy Efficiency Specialist at PKN Orlen. Second, the lack of real-time data made environmental regulations and requirements difficult to meet, resulting in increased costs and penalties. And third, managers were unable to easily manage their assets, which led to decisions and planning based on intuition, not data.

CUSTOM SOLUTIONS BRING ECONOMICS & TECH INTO SYNC

What PKN Orlen needed was a solution uniquely suited to their complex systems and processes. They put together a team to build the tools they needed using the PI System. Paweł Vogtt, Head of the Energy Management Department, described their goal: "The purpose of this tool was to bring many measurements in one place and combine them with economics… So not only do we have marvelous efficiency, marvelous electricity use, but we also save money."

What they created was just that: a one-stop-shop portal that translated complex data and heavy-duty algorithms into easy-to-process dashboards for their users. Now, managers

CHALLENGE

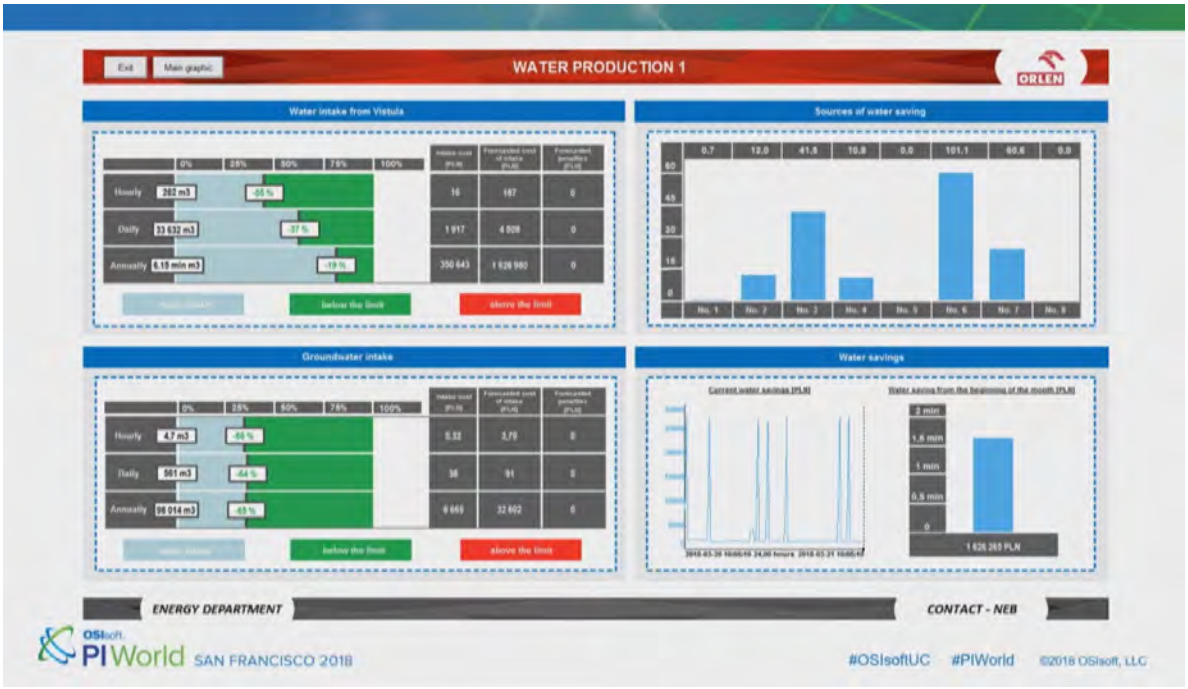
Minimize leaks, malfunctions, and environmental impacts while maximizing cost effectiveness

SOLUTION

Build tools to combine operational and economic data, updating based on historical benchmarks in real time

BENEFIT

Managers can quickly understand the goals and needs of their department, and confidently plan valuable changes for the future



PKN Orlen uses real-time dashboards to monitor the impact of water and wastewater operations on the environment and to control deviations from acceptable operating limits.

can look at their individual Profit and Loss statements and immediately tell if something is wrong with wastewater operations, if water cooling units are using more water than can be accounted for, or exactly how much water is being drawn from the river versus the groundwater — and how much money is being saved or spent over time in each of these sectors. The key to these complex visualizations? Dynamic benchmarks. "Benchmarking is a progressive average," said Vogtt. "We use the PI System to get the data, and… convert it per minute, so the average changes continuously. And the average is a very simple metric, but when you measure it every minute, and you have one year ahead, it makes it more complicated."

REAL-TIME DATA ANALYSIS POWERS BETTER STRATEGY

With the PI System, PKN Orlen is now well-equipped to take advantage of its data. By merging technical data with economics, the company's decision makers are able to visualize efficiency curves, compare benchmarks, and predict trends. "The head of Water and Waste Management can sit in her office and look at her computer screen and have a good idea of what is happening at that time with her assets," says Vogtt. "She knows the technological indicators, and she knows the value of the processes that her team is performing."

The PI System has become a vital business intelligence tool across PKN Orlen's departments, and it has reduced the amount of time engineers spend generating reports, while freeing more time and energy for mission-critical insights waiting in the data. But PKN Orlen does not intend to stop there. "Our challenge will be to make it even more dynamic, to add some other functions to benchmarking such as temperature, weather, or the waste condition itself," said Vogtt. In the near future, the team is also planning to adopt PI Vision™, OSIsoft's web-based visualization powerhouse for PI System data.

For more information about PKN Orlen Water & Wastewater Management and the PI System, watch the full presentation here.

PI System Components:

PI Server™
- Data Archive
- Asset Analytics
- Asset Framework

PI ProcessBook™

"What we like about using the PI System in this project is that we use PI as a really useful and common communication platform within many different operational levels of our company."

— Paweł Vogtt,
Head of the Energy Management Department

Przychodzień, Arkadiusz. "Real Time Water and Wastewater Plant Management" <https://www.osisoft.com/Presentations/Real-Time-Water-and-Wastewater-Plant-Management/>

OSIsoft®

SUMMARY

Evides Waterbedrijf

Industry

Water, Wastewater

Business Value

- Business Value
- Asset Health and Value
- Data Democratization
- Situational Awareness
- Process Optimization

PI System™ Components

- PI Server™
  - Data Archive
  - Asset Framework
- PI Integrator for Esri ArcGIS
- PI ProcessBook™
- PI DataLink™
- PI WebParts™
- PI Coresight™

Partners

- Esri

Parting the Waters With Data to Improve Service For Consumers and Industrial Water Customers

To better serve its 2.5 million consumers and over 600 large industrial customers, Evides Waterbedrijf created a software platform called GAMEs that leverages the OSIsoft PI System, Esri® ArcGIS®, and TaKaDu to give its employees the power to isolate pipe bursts, monitor water flows, enhance situational awareness, and improve responsiveness across Evides' extended service territory. Jan Urbanus described the program at the 2016 OSIsoft EMEA Users Conference in Berlin and outlined next steps.

Evides Waterbedrijf is responsible for managing a highly complex network of resources spread across a large geographic area that is absolutely critical for the daily lives of the people and cities within its service territory. The company serves an estimated 2.5 million consumers in the Netherlands and industrial customers in the Netherlands, Belgium, and Germany. It is the second largest water company in the country and the largest one for industrial water: Evides delivers 160 million cubic meters of water to consumers and 144 million cubic meters of process water to industrial users every year through a far-ranging infrastructure that includes 14,000 kilometers of water mains and 7,000 kilometers of connections. Evides also processes 100 million cubic meters of wastewater.

In 2014, Jan Urbanus, Manager Unit Project Management at Evides, saw a presentation at the OSIsoft EMEA Users Conference by Brabant Water on visualizing water data. The ideas from that session helped spark the inspiration for GAMEs, or Geographic Asset Management @Evides. GAMEs is a technology platform that combines operational and equipment data from the PI System with geographical and other information to give employees a richer sense of Evides' operations and help them collaborate on strategies and solve problems. GAMEs is part of H2020, a company-wide research program. "There is useful information hidden in the data," said Urbanus. "A picture is worth a 1,000 words, or in this case 1,000 figures."

In the first stage, Evides launched a pilot program called GAMEs Playground with the goal of creating four "functionalities" or widgets for combining PI System data with ESRI ArcGIS in the first twelve months. Instead, it created 50 functionalities in GAMEs Playground, including functionalities for "seeing":

- data on the current state of the soil across the service area
- the current status of production plants
- the location of potentially vulnerable customers
- flooding depths
- charts detailing the status of existing risks

After the initial integration and set-up, "building functionalities is not difficult and not expensive," he said.

Every ten seconds Evides collects data on water pressures and flows from the sensors on its water mains and every thirty seconds the data on GAMEs is refreshed. On a single screen, employees can view multiple functionalities – current pressures, the relationship of municipal boundaries with Evides' assets, the location of water meters – at the same time. Users can also examine a wide geographic area or zoom down to individual households.

In 2016, a large (630 mm diameter) pipe burst in Vlaardingen. Pressure dropped from 30 meters to 6 meters while flow increased from 700 cubic meters per hour to approximately 4,300 cubic meters per hour. Urbanus showed how GAMEs pinpointed the individual pipe that burst and delivered information on which valves needed to be closed to isolate flooding. With this information, Evides restored normal operations in around two hours. GAMEs also allowed Evides to send messages to customers in the affected area to warn them of the problem.

Big Data analytics in GAMEs is also used in conjunction with TaKaDu, an event management solution developed for the water industry that uses smart analytics. The PI System sends five minute snapshots of raw data every hour to TaKaDu. TaKaDu then analyzes the data, detects anomalies, and enables Evides to manage events such as leaks, pressure issues, data and sensors problems, and more.

GAMEs is also helping Evides detect poor quality data and "orphaned" data by visualizing data that would otherwise not have been reviewed or combined with similar sets of data in different silos.

Evides is now developing a production version of GAMEs Playground called Serious GAMEs which can be integrated into Evides' day-to-day operations. Serious GAMEs will initially include 20 of the most robust functionalities from GAMEs Playground. "We expect our control system will be able to act faster and be more effective and be more efficient because of this too," Urbanus said. "And as a result, we expect a decrease in customer minutes lost."

Urbanus further said that GAMEs has sparked collaboration between younger and older employees and interest in using data in unusual, novel ways. "Once we started and could show them some pictures from the GAMEs platform, they became enthusiastic and began asking questions like 'Can you show me the relation between hydraulic data and water quality," he said. "From the push in the beginning it became a pull to the end. We now have a backlog of some 13 functionalities we have to build."

"There is useful information in the data. A picture is worth a 1,000 words."

– Jan Urbanus
Manager Unit Project Management

Urbanus, Jan F.X. *Intuitive Interpretation of Big Data Using Esri ArcGIS and the PI System.* OSIsoft.com. 27 September 2016. Web. 01 January 2017. <http://www.osisoft.com/Presentations/Evides--Intuitive-Interpretation-of-Big-Data-Using-Esri-ArcGIS-and-the-PI-System>.

ABOUT OSISOFT

OSIsoft is dedicated to helping people transform their world through data. The OSIsoft PI System captures data from sensors, manufacturing equipment, and other devices and turns it into rich, real-time insight for improving productivity, making critical decisions, and developing new products. More than 1,000 leading utilities, 90% of the largest oil and gas companies, and more than 65% of the Fortune 500 industrial companies rely on the PI System to get the most out of their business. Worldwide, the PI System manages more than two billion data streams.

Visit our **Connected Water Utility** page to learn what the PI System is doing to improve water and wastewater management or you can **learn more** about OSIsoft and the PI System.

To learn more, please visit **www.osisoft.com**.

Corporate Headquarters:
1600 Alvarado Street
San Leandro, CA 94577, USA

Contact:
+1 510.297.5800

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