New Perspectives on IT and OT System Integration for the Water Industry

How digital transformation can reduce costs, optimize efficiency, and improve conservation in water and wastewater processing

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Introduction

Digital transformation enables asset performance management by automating and integrating information, operations, and communications technologies. Collecting operational data from connected asserts such as pumps and sharing it with real-time decision support applications -- in the cloud or on premises – is how digitalization improves asset performance. Bringing the information technogloy (IT) and (OT) together represents an increasingly large opportunity for system integrators.

Chapter I explores that opportunity from the perspective of a Schneider Electric Certified Alliance and Preferred Partner in Water and Wastewater industry, who describes how his company is adapting to the evolving customer demands for digitalization.

Chapter II provides an overview of asset performance improvement and how digitalization is making decades of asset performance management advancements feasible for improving performance of water and wastewater assets. System integrators can use this chapter to help customers take advantage of the coming of age of years of asset performance improvement technology.

Chapter III focusses specifically on applying asset performance improvement to pumping stations, including a real world case study, which will give you a glimpse of Schneider Electric's methodology for pumping performance improvement.

Chapter IV shifts the focus from pumping performance to human performance, highlighting augmented reality as an example of workforce empowerment that is just beginning to take hold in the water industry. This chapter lays out what would be needed to get a client started with augmented reality.

Chapter I

System Integration Ramps up for Digitalization

Digital transformation from a system integrator's perspective

Schneider Electric's system integration partner network is a key asset in bringing digitalization to the water industry. Today that network numbers more than 1000 partners around the globe, all of whom are carefully selected and trained in deploying Schneider Electric solutions in the context of end user business strategies and legacy deployments.

While the Schneider Electric partner network has always been involved with the implementation of digital technology, they are now ramping up to meet customer demand to gain business advantage in deploying increasingly intelligent and connected production assets, big data, cloud computing, and advanced analytics.

As partners demonstrate expertise in business segments, Schneider Electric designates them as "preferred partners" for that segment. This section is based on an interview with Simon Pape, Strategic Account Manager for Cougar Automation – a preferred partner for the water and wastewater industry.

Pape's comments on how digitalization is evolving in the water industry are instructive for system integrators at all levels – whether they are in engineering firms or employed by utilities. He describes an industry in transition, one which is increasingly interested in IIoT, cloud, and other aspects of digitalization, but is moving slowly and cautiously. He sees system integrators becoming more IT savvy and moving eventually to the broader integration of assets at all levels.

Although his comments are based primarily on his experience in the UK water industry, they relate to what is going on with water industry integration around the globe.

Bringing IT and OT together

Schneider Electric: How is digital transformation affecting system integration?

Simon Pape: Everyone is talking about the cloud and the internet of things and how to get more out of existing assets without spending too much. Where clients previously were asking "What's IoT? What's the internet of things?" Now they are asking "How could we deploy this application? What is the use case?"

We've seen a shift towards virtualized systems in the last few years. We deliver more virtualized systems than applications in boxes and that's been happening within the last five years. We've shifted now to more of a virtualized SCADA environment. Maybe nine out of ten of new engagements involve virtualization. We are now offering clients a more IT-literate solution. A few years ago, we became a Cisco partner, for example.

SE: What's driving the need for more IT expertise?

SP: The need for more IT expertise among system integrators is driven by both cost savings and operational benefits. Some of the virtualized systems we have implemented have to be built on very old operating systems, such as XP or NT because many clients do not have the budgets to upgrade from scratch. Deploying them in a virtualized environment requires some workaround, but it does get them on the right path.

We are implementing virtualization in the cloud, on-premises, and in hybrid applications. We've also had more interest in online historian solutions, probably because network security and dependability have advanced to the point at which people feel more confident putting critical data in the cloud.

Heading for the cloud

SE: Are you seeing changes in how pump stations operators want to interface with the data?

SP: Most pumping stations have a PLC with which people interface via a conventional HMI but there is already some movement away from that. One client, for example, is planning to remove HMIs entirely. They have a site-wide SCADA system plan that will equip all instrumentation and control technicians with industrial tablets. They would serve the SCADA information to those tablets from wireless access points in the motor control centers. They too are talking about online historians based in the cloud. Our customers expect us to be in touch with the latest technologies, so we know what we can and cannot do for them.

The role of the EcoStruxure Integration Platform

SE: Where does an integration platform like Schneider Electric's EcoStruxure fit in?

SP: We are also implementing low-power wide-area networks which enable long range communications from connected devices. such as battery-operated sensors for long range communications. Implementing PLCs, HMIs, and field devices has always been our bread and butter. But we are now extending that to site-wide SCADA systems. On a very large site there could be multiple client/server architectures and even wide area SCADA systems, coordinating data from multiple sites. We are also getting involved in developing smart apps for phones.

The EcoStruxure platform encompasses all of that and extends it to the cloud, with cybersecurity protection, which is a prerequisite for IT and OT integration, whether it involves remote or local connectivity. This is where everything seems to be going.

On cybersecurity

SE: How concerned is the industry in general about cybersecurity?

SE: Increasingly government bodies are telling the water industry that it needs to do more in cybersecurity. They are asking utilities to start paying attention to their vulnerabilities and showing evidence that they're putting checks in place. We offer reporting and audits of current systems. We can identify vulnerabilities in their systems as well as in human behaviors.

Do they allow memory sticks? What's the policy on USB ports on laptops? What's their password security and how does that stack up? It's sometimes the little things that they can tighten security up very quickly and start making systems more resilient. We've had quite a bit of success with services that talk water utilities through suspected system vulnerability and security issues, including the behavioral issues.

On asset performance improvement

SE: How do you help water industry clients improve asset performance?

SP: Some people call it “sweating the assets”, implementing efforts to get the most value out of your current asset base. Predictive maintenance is quite high on people’s agendas and that’s where the cloud and analytics come in.

To help customers get the most out of high-value assets, like pumps, we run condition-based monitoring systems, where we might equip assets with accelerometers, vibration monitors, and the like. We collect that data and bring it back to the cloud through an industrial gateway, to run analytics on it or serve it up on a smart phone.

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You can then remotely adjust the set points in duty/standby pump set, setting pumps at/on duty or standby, manual or automatic. Or use it for alarm management or to access plant specifications.

Digitizing energy monitoring

SE: How might digitalization impact energy consumption?

SP: You could monitor power on a starter-by-starter basis or on a panel-by-panel basis, to determine what assets are the most power hungry. We have, for example, deployed power meters in power intensive areas, such as aeration lanes or aeration blowers, and are deploying additional code to control it better. We might integrate DO (Dissolved Oxygen) probes and maybe put in variable speed drives on each blower which will give better control while also reducing power consumption.

In one case an electrical engineering partner installed power monitors on the main feed coming into the plant. We got readings back from that and from selected drives and sent it to the SCADA system for communication with higher level systems.

Looking ahead

SE: How do you see the system integrator's role changing going forward?

SP: Delivering value at the IT level is raising the service profile in the industry. In the past we didn't need to interface with utility IT departments. They handled the telemetry systems and operated dedicated control rooms and pressure and flow instruments in the delivery network. We worked more with teams controlling the processing water and wastewater treatment and delivery options, focusing on the control systems in the control rooms or maybe on kiosks or remote sites.

But now, people are beginning to look at the big picture. Some people are talking more now about situational awareness, where they merge a SCADA system with a telemetry system as well as with a billing, and perhaps even an incident reporting from the public and they are trying to get that all merged into one very large system. Not necessarily a SCADA system, but one that would give you that kind of situational awareness. Everything would be accessible through the same interface.

And that might also be an interface through a geographical map of the area, so if people call in to report a water leak or a pipe burst in a certain location you could use the integrated telemetry network to dispatch teams or send alarms. We have seen varying degrees of success with this approach. It is not quite there yet but is coming.

We see end users being very interested but moving slowly. They are getting more knowledgeable and more educated all the time. This represents a tremendous opportunity for systems integrators to deliver additional value to clients.

Simon Pape

Business Development Manager at Cougar Automation Limited (a VINCI Energies company). Cougar Automation is a Schneider Electric Certified Alliance and Preferred Partner in the water and wastewater segment in the United Kingdom. Preferred partners have demonstrated extensive industry experience by submitting related project examples, receiving sign-off by relevant clients; and having their engineers complete a training Program.

About Schneider Electric's Partner program

Schneider Electric's System Integrator Alliance Partner Program is a global network of independent integrators with training and experience in delivering Schneider Electric automation solutions.

Joining the network brings integrators into a higher level of business partnership and a closer working relationship with Schneider Electric. A global sales support organization and large solution portfolio, connected across the EcoStruxure platform, provides a unique business advantage in delivering digitalization solutions to clients. Powerful software applications and proven digital tools help boost profitably. Extensive training and certification programs help broaden your technical capabilities that increase business value to clients.

For more information on the Schneider Electric System Integrator Alliance program download our latest brochure here.

Chapter II

Realigning water industry assets in digitally-enhanced operations

The need for change

The water industry has reached a turning point. Utilities are finally recognizing the power in digitizing operations and increasing economies of scale to extend asset life and address legacy funding issues.

As the industry focuses more on sustainability, value and innovation, a new water economy appears to be emerging: Utilities are embracing data and infrastructure in new ways to maximize efficiencies…"

Black and Veatch Report on the Water Industry, 2018[2]

Water and wastewater operations around the globe stand to gain significantly from the digital transformation of global industry. This opportunity comes at a time when water is increasingly recognized as a limited, high-value resource. The United Nations projects that If current water usage trends continue, by 2030 the world will have only 60 percent of the water it needs[1]. This pending scarcity compounds pressures already mounting in the industry:

- Aging infrastructures contribute to water losses and inefficiencies
- Cash-strapped municipalities demand greater fiscal accountability to reduce the cost of supplying, treating, and conserving water
- Skilled personnel are aging out of the workforce faster than the replacement pool is growing
- Climate extremes challenge water treatment, supply, wastewater, and stormwater management capabilities
- Regulations on energy, water quality, standard of service, and emissions are increasingly stringent

While the industry attacks such challenges on many fronts — including water conservation and demand management — improving infrastructure performance is a logical first place to start. It can help counter the effects of aging assets, reduce total cost of ownership, empower maintenance teams to do more with less, and ultimately optimize the performance of each asset. Indeed, asset management has become a top concern among a growing number of water operations.

Water industry respondents citing "maintaining or expanding asset life" as their most significant sustainability issue:

42.7%[2]

Water industry respondents "very interested" or "interested" in implementing asset management programs:

82.5%[2]

Water industry respondents "very interested" or "interested" in real-time control or big data system analytics:

69.6%[2]

Do these numbers match with your experience?

Asset performance improvement in a digital age

As recognition of the value of asset management grows, the practice is steadily maturing, advancing from reactive run-to-failure approaches to predictive and prescriptive strategies in which increasingly intelligent assets all but manage themselves.

ARC Advisory group reports that moving up the scale from preventive and condition-based approaches to predictive and prescriptive strategies has enabled users to cut the cost of maintenance labor and MRO (maintenance, repair, operations) materials by 50 percent[3]. ARC analysts also estimate that on average, industrial operations lose about 5 percent of their operating budgets to downtime, which can be significantly reduced through more sophisticated asset management techniques. Eliminating downtime can ripple benefits, well beyond maintenance productivity, impacting service delivery, product quality, cost and many other factors.

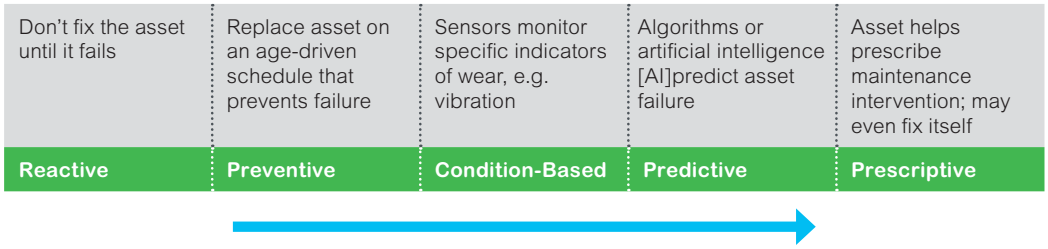
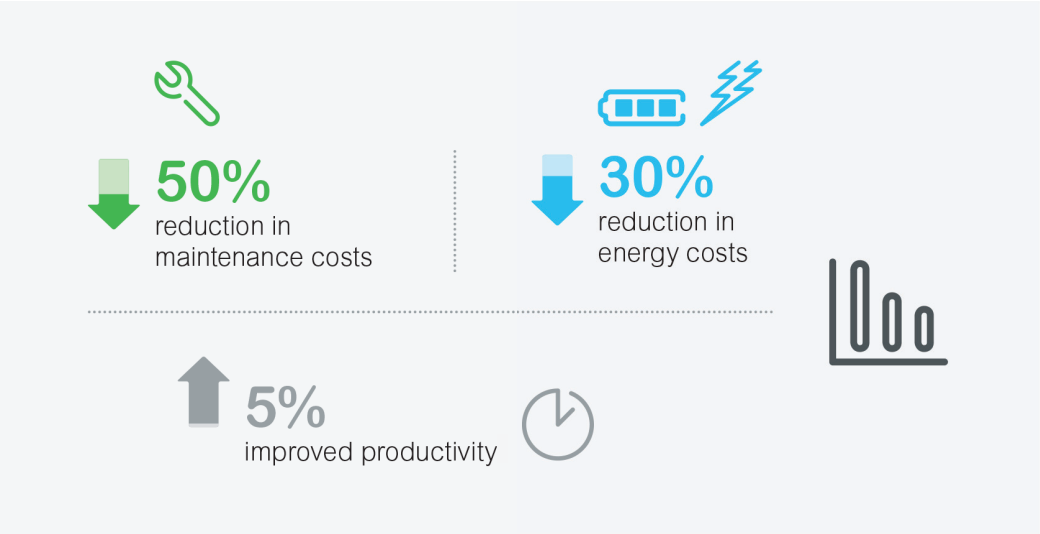


Figure 2.1
Maintenance Maturity.

The increase in maintenance maturity, from a break/fix approach to a critical bottom-line component of operational success, sets the stage for the transition from baseline asset management — which seeks to ensure asset availability — to more strategic optimization of asset performance. (Figure 2.1) Asset optimization, according to ARC, is the result of *"more information sharing and application integration among operations and maintenance to provide a comprehensive view of production, asset performance, and product quality."*[4]

Asset performance improvement program architecture and objectives

Water and wastewater infrastructure operators have always had much to gain by sharing information and integrating applications, but it has been primarily the early adopters or better-funded water operations that have been able to see significant return on their investment. Today, however, new capabilities to collect, analyze and share process data digitally bring the benefits of asset performance improvement well within the reach of even the smallest operations. Early adopters in the industry are applying mature asset performance improvement strategies already to attain results[3] such as:



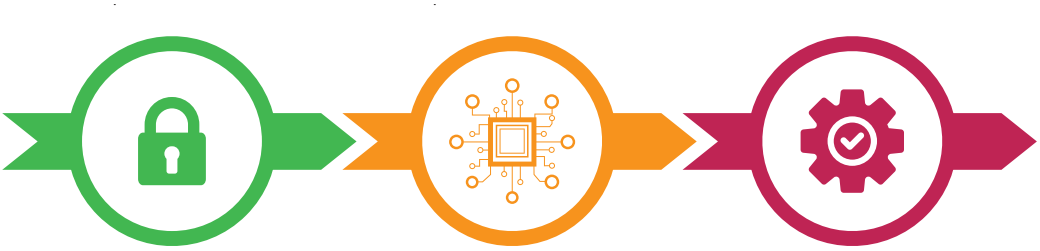
The average plant loses 5% of production capacity to downtime. With prescriptive, high level of maintenance maturity this can be significantly reduced according to ARC.[2]

Achieving asset performance management in a cost-effective way involves augmenting traditional client/server information architectures with technologies such as IIoT gateways, edge analytics, and cloud computing, which are open and more amenable to digital control. It involves bringing information technology (IT) and operational technology (OT) together securely in ways not previously feasible. The EcoStruxure architecture provides a platform that can guide the management, integration, evolution, and protection of digital infrastructures as clients transition to the benefits of asset performance improvement. (Figure 2.2)

Figure 2.2
The EcoStruxure architecture provides a framework for the organization, integration and protection of water and wastewater assets

*The Schneider Electric Industrial Business and AVEVA have merged to trade as AVEVA Group plc, a U.K.-listed company. The Schneider Electric and Life is On trademarks are owned by Schneider Electric and are being licensed to AVEVA by Schneider Electric.

The EcoStruxure architecture for water and wastewater models the flow of information from smart field devices at the base layer, through gateways and controllers at the middle and edge layers, into IT applications and analytical services for ultimate presentation to decision makers. Partitioning your digital infrastructure in this way provides an orderly framework for introducing digital technologies to improve asset performance. It will help you achieve the following three objectives:



Secure baseline reliability of OT assets

Enhance baseline reliability through advanced IT and digital applications

Optimize asset performance strategically, enhancing digital tools and techniques through further integration with multiple assets and all relevant operating data

Attention to these objectives can help you:

- Optimize asset availability and utilization
- Manage aging infrastructure
- Reduce CapEX
- Control OpEx
- Manage energy costs
- Reinforce physical and cyber security
- Empower your client's workforce
- Comply with environmental and safety regulations

Program Objective I: Securing baseline reliability

Much of the action for securing baseline reliability takes place at the connected devices level of the architecture. It entails application of best practices defined in emerging standards such as ISO 14414 for pump system energy management and ISO 55000 for general asset management.

Digitalization at this level involves taking fuller advantage of the digital diagnostic and monitoring techniques that are already available in many drives, motors, actuator, process instrumentation, and other devices. These can extend preventive strategies beyond the fewer percentage of assets to which they currently apply and help rationalize condition monitoring alarms.

Traditional preventive maintenance and condition monitoring, however, tend to focus on individual, isolated assets. As assets get more connected and have more onboard intelligence, the possibilities for enhancing reliability through interaction among analytical applications grows considerably.

Program Objective II: Achieving maintenance excellence through IT/OT integration

While digitalization of OT has benefits in and of itself, sharing the data with advanced, water-savvy applications can take cost control and efficiency to a new level. The advent of pervasive communications, cloud storage, and mobility now bring the possibility of applying advanced IT tools to reach new levels of reliability and availability. Information from anywhere can now be shared cost-effectively with applications and users anywhere.

Capitalizing on intelligent assets

Variable speed drives are a good example of what digitalization can accomplish. They record and log energy use and display energy consumption trends on an hourly, daily, weekly or monthly basis. They can diagnose when a gearbox is exceeding a preset torque level or when a pump is operating outside parameters. They can detect instantly if, for example, pump efficiency drops and can trigger notifications. The drives can also be integrated with pressure, flow, and level control to compensate for flow losses.

Making the most of real-time and historical data

Helping interpret such data are applications such as EcoStruxure Pumping Performance Advisor. Pumping is one of the largest consumers of industrial energy, so optimizing it can reduce costs and improve overall operations dramatically.

The Pumping Performance Advisor coordinates predictive and prescriptive maintenance-based on data produced by smart drives; pressure, temperature, and flow sensing instrumentation; or power monitoring devices. (Figure 2.3) From these devices the IT application receives data on energy, costs, maintenance, and other key performance indicators (KPIs); runs algorithms that evaluate them against desired targets; and shares the analyses with other applications and decision makers via browsers, dashboards, or mobile devices — all of which help keep pump stations and other assets running at peak performance.

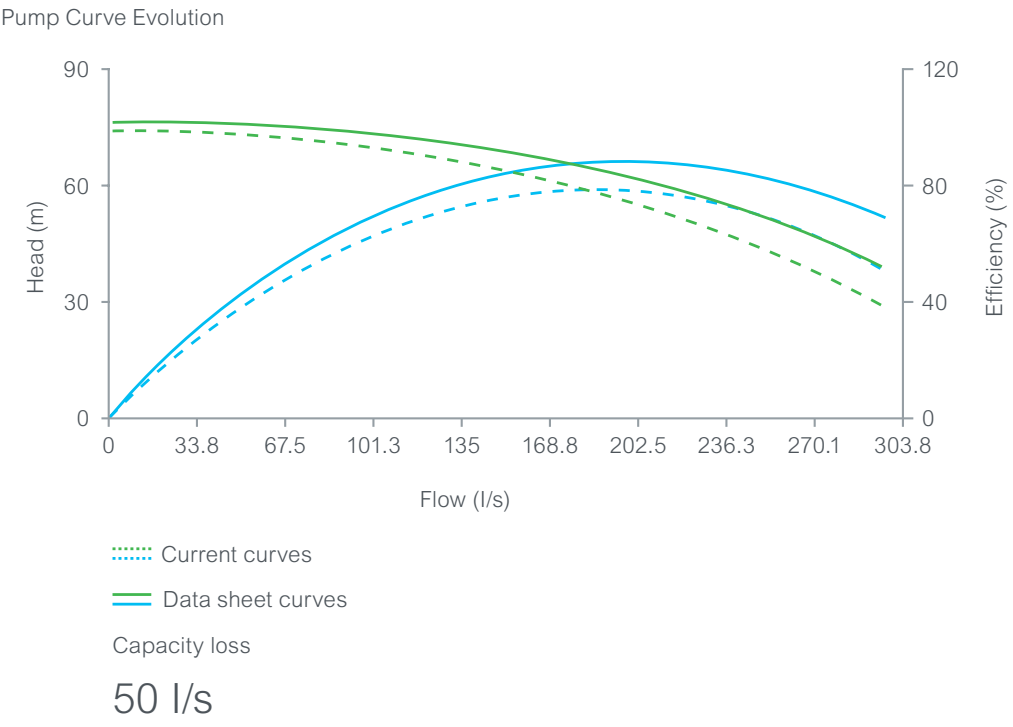


Figure 2.3
Pumping advisor software provides operators with a real-time comparison of the operating pump curve to the curve presented in the pump manufacturer's data sheet.

The Pumping Performance Advisor is just one example of a digital application that can improve water asset performance. We called it out here because pumps are such a critical component of water operations. Other digital applications available include engineering and planning applications, enterprise asset management, resource management, power management and augmented reality support for technicians.

Excellence at the edge

A digital application might receive data from smart drives via an edge gateway such as an IIoT edge box that connects to data on the cloud, on premises, or both. Edge controllers such as PLCs, PACs, RTUs or DCSs might also perform real-time calculations and buffer results to send to enterprise applications in the cloud. This local buffering enables cloud-based applications to factor-in critical data they might never see otherwise.

The Black and Veatch researchers mentioned earlier found high interest in remote sensing among the industry professionals they surveyed. Remote sensing is a key enabler of asset management. Edge devices can receive operating data by digital radio links, and built-in data buffering then ensures data integrity. Digital radio links could simplify data delivery from smart products and edge controllers, collecting data from remote pumping stations and sending it to apps and analytics levels, enabling a more complete real-time picture of pumping station efficiency.

Security across the board

Critical to the cost-effectiveness of the EcoStruxure platform is simplifying plug-and-play deployment of field devices, edge controllers, and applications, which entails a commitment to using standard communications and interfaces. Minimizing any vulnerability that this might introduce, requires implementing technology certified secure at each layer of the architecture.

- At the connected product layer, for example, products are designed to IEC 62443 standards, certified to Achilles level 2 and adhere to a strict security development lifecycles.
- At the edge layer, the platform uses advanced encryption key management, unified extensible firmware interface (UEFI) for Windows 10 applications, McAfee whitelisting, and secure transport layer security (TLS) connections to SCADA systems.
- And at the application layer the platform utilizes the secure Microsoft Azure cloud, secure authentication with communications for cloud, authenticated integrated database managment (IDMS), and requires compliance with ISO 2700 standards. All such protection is transparent to users.

Program Objective III: Optimize asset performance strategically, in context of all operations

While the first two legs of an asset performance improvement program will offer significant benefit in and of themselves, this greater control over asset reliability and availability will free end users to put more attention on maximizing the production from each asset with optimal resource investment and without compromising safety or environmental conservation.

"We can produce much more efficiency by treating the whole business as a proper core system," said Michael Teller, Water & Wastewater Business Unit Managing Director, Schneider Electric. "Part of the solution is equipping operators with systems that and alert when leaks or pipe bursts are imminent; the other part is training them to use it".

Understanding asset performance in the context of its impact on all assets and processes is what moves maintenance beyond just securing reliability, to becoming a critical contributor to cost control and strategic management. Accessing and integrating data from a wide range of facility systems — such as power distribution, water demand forecasting, procurement, and quality — and analyzing it with productivity and software applications, will give you a more complete picture of water processes, output, and energy consumption. This helps meet performance objectives by making it easier to:

- Monitor asset performance against KPIs
- Adjust for predictable surges in demand for water
- Maintain a safe and secure processing environment
- Reduce procurement and inventory costs by building in time to shop and negotiate
- Avoid unnecessary penalties, through real-time reporting capabilities
- Improve end-user satisfaction

Of course, getting such results from information cloistered away in unconnected locations and multiple formats is all but impossible. The EcoStruxure architecture guides consolidation of diverse information so it can be shared consistently and cost-effectively across a variety of applications.

For more information about Asset Performance Management

Implementing a successful asset performance program requires a team with knowledge of the local operations supplemented by remote expertise informed by collected data and analytical tools. A project typically begins with a clarification of management and operating objectives and an audit of existing assets to gather baseline data on your systems, operating and maintenance costs, P&IDs (process and instrumentation diagrams), annual operating time, and recent history, all guided by the latest industry best practices and standards.

Evaluation of asset parameters and application of advanced tools leads to insight and recommendations for potential savings that are achievable through reliability improvement initiatives. This usually entails use of connectivity tools, dashboards, and instrumentation, deployed within the EcoStruxure architecture.

It is critical to monitor improvements against KPIs over a few months and tune operations for maximum reliability control. Maximizing baseline availability will give you an infrastructure on which to focus asset performance optimization and achieve maximum utilization of the most strategic assets.

Most of our clients who implement asset performance improvement programs begin seeing return on investment within as few as three months.

For more information about how you can collaborate with Schneider Electric in delivering these types of benefits to your water industry clients, visit the System Integrator Alliance portal.

Chapter III

Managing Pump Station Assets for Lowest TCO and Maximum Effectiveness

Managing pump station assets for maximum effectiveness

This chapter focusses on how the asset performance improvement techniques described in Chapter II can impact pump operations. Applications described within can bring the following benefits:

- Reduce operational expenditures by up to 15%
- Improve the management of your aging pumping infrastructure and extend asset lifespan
- Manage synthesis of pump station performance
- Improve alarming with email notifications
- Improve continuous operations through KPI monitoring
- Select potential investments based on profitability

Modern challenges in a critical industry

Water and wastewater operations around the world are under increasing pressure to achieve ambitious targets for service delivery, regulatory compliance, and resiliency in managing a large and ageing infrastructure.

With limited capital they must find ways to extend the lifetime of vital assets, prioritize renovation, and fend off cyber security threats. For funding to meet these challenges, many are looking for new savings in their pump station energy maintenance and operating costs areas, which consume an estimated 75 percent of a typical pump station budget. (Figure 3.1).

Addressing such issues requires timely access to, and manipulation of, performance data, which is becoming available to the water industry through the digital transformation that is now taking place industry-wide.

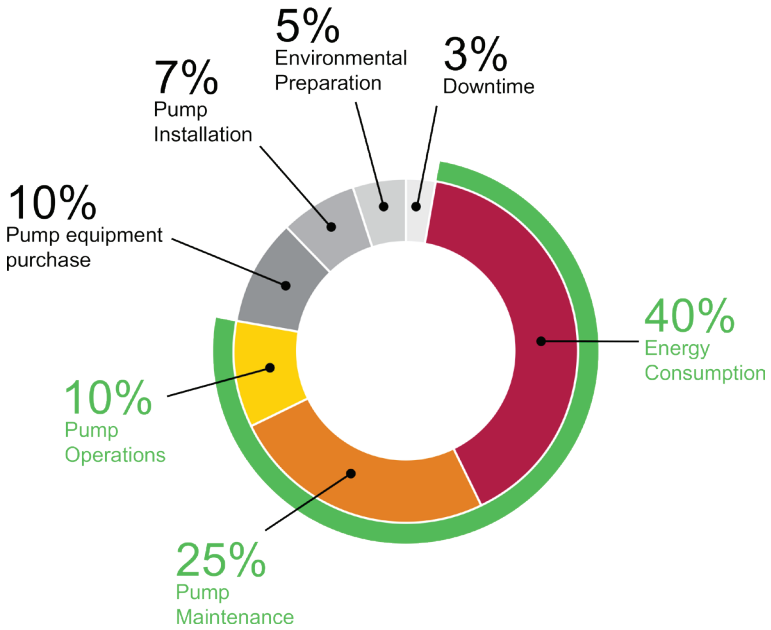


Figure 3.1

"Today, thanks to the Industrial Internet of things, cloud, analytical applications, mobile technology and other digital innovations, we are addressing many of the pain points the water industry has always faced, more directly".

Jean-Pascal Riss,
Marketing Offer Director,
Schneider Electric

Managing pump station performance improvement

In Chapter II, we discussed some of the broader trends that are impacting water asset performance improvement, including the maturing of asset maintenance and the digital transformation of technology.

Here we focus on management of pump station assets and how a program based on digital monitoring of energy usage, maintenance, and operations against targeted objectives can deliver maximum performance at the lowest total cost of ownership (TCO).

The digital promise

Digitizing operations for improved engineering maintenance and operational performance

Digital transformation promises to harness the volumes of information that are emerging in the wake of industrial operations and apply it to improving those operations. It does so by adding intelligence and connectivity to previously isolated assets, synchronizing control and communications among them, and sharing information with analytical applications.

As illustrated in Chapter II, the EcoStruxure platform provides a framework for organizing, integrating and protecting of water and wastewater assets.

At the base of the architecture are the pumps, motors, drives, and other assets that are becoming increasingly intelligent and connected. At the middle “edge” layer are controllers such PLCs, or other edge control devices like internet boxes that coordinate exchange of data with analytical applications at the top layer.

Managing pump station improvement

For pump stations, such a structured approach to digitalization means greater ability to contain energy, maintenance, and operational costs. It could reduce pump station energy costs by enabling operation closer to target curves; by leveraging most efficient equipment and lower cost periods while matching set points to; or by optimizing charges on energy bills to avoid demand charge and power factor penalties. (Figure 3.2)

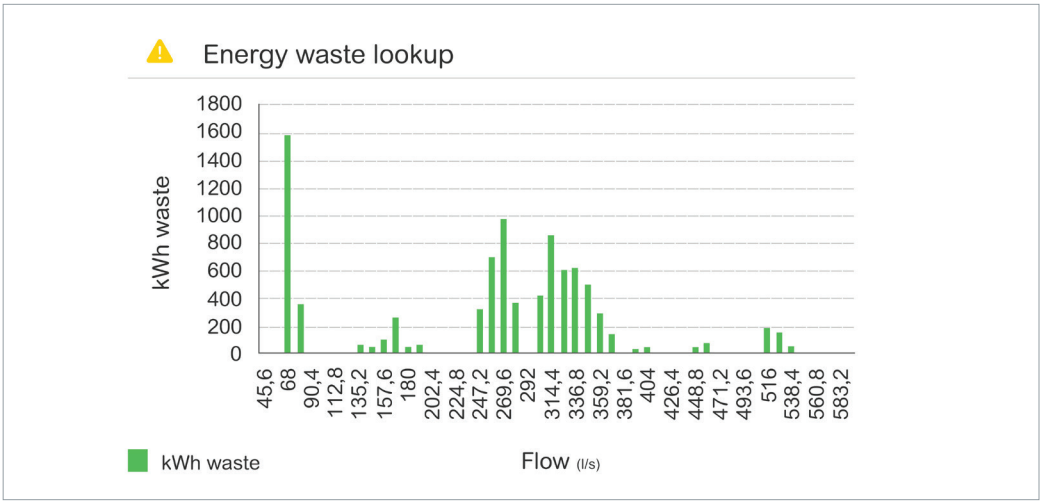


Figure 3.2
Dashboard from EcoStruxure Pumping Performance Advisor reveals points of energy waste.

Reducing maintenance costs

Digitalization could reduce maintenance costs by enabling pump operation closer to best efficiency points (Figure 3.3):

- Eliminating inspection through advanced monitoring
- Augmenting routine maintenance with condition-monitoring to identify pending points of failure before they happen
- Protecting assets by eliminating operation in low flow conditions

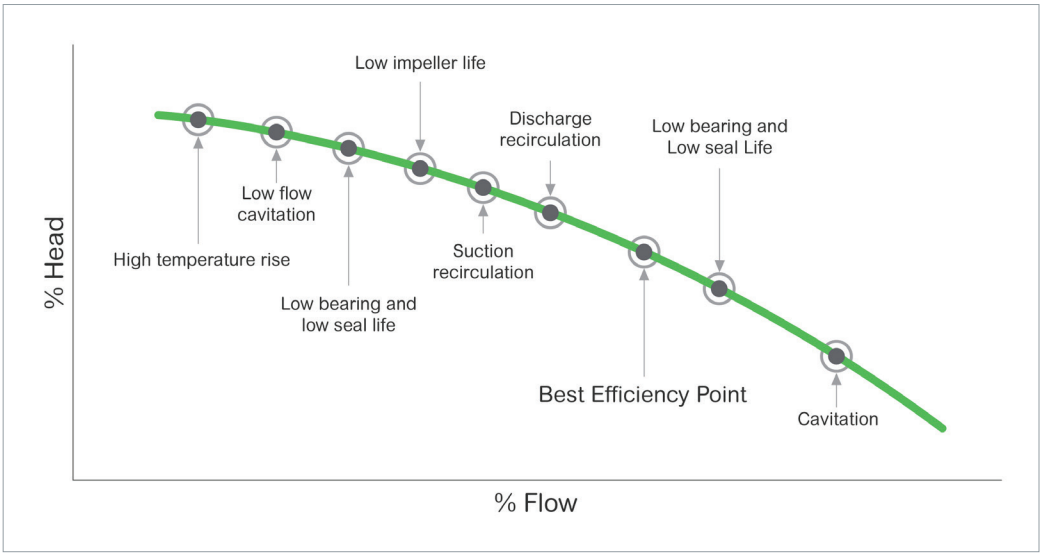


Figure 3.3
Improved monitoring minimizes stress as pumps can operate closer to optimal efficiency levels.

Reducing operating costs

Digitalization could contribute to overall operational cost reductions through enhanced, real-time monitoring against target performance points; varying motor speeds to achieve established targets; and synchronizing pump performance in the wider context of pumping installation. This context might involve hydraulic systems, pump control strategies, or auxiliary control functions like chlorination dosage. (Figure 3.4)

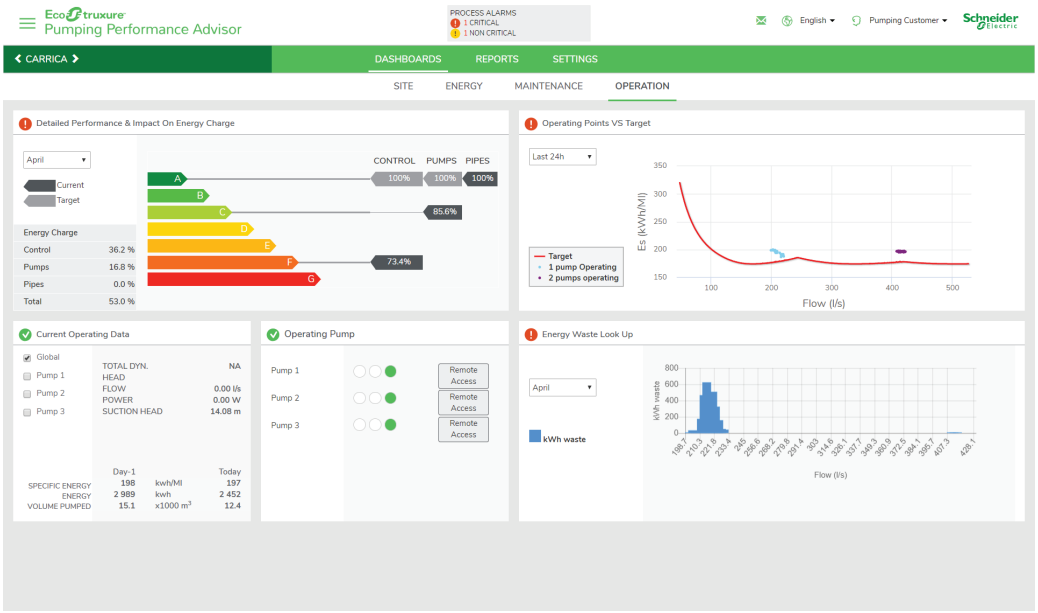


Figure 3.4
Ability to visualize pump operations on context of other assets helps optimize operations

Asset Reliability, Maintenance Excellence, Asset Optimization

Detailed, timely access to information enables performance to reach new levels. This includes:

- Cost-effective application of condition-based maintenance
- Improvements in overall operating conditions
- Reduction of frequency and therefore labor costs of inspections

Three maintenance improvement paths

1. Condition-based maintenance

Impellers are among the first pump parts to go and once erosion and corrosion begins, it accelerates. Analytics can provide insight into pump health index and capacity losses, which can correlate directly with energy usage as reported by energy meters. Monitoring pump suction with pressure transmitters can send alerts when pump suction dips below a certain level.

2. Improving operating conditions

In addition to monitoring pump conditions, the improvements of pump operating conditions improve the mean time between failures (MTBF) by reducing the axial forces that contribute to shorten gaskets and bearings lifetime.

3. Reducing inspection frequency

When information on pump operations is limited or unreliable, frequent manual inspection is necessary to identify need for maintenance intervention. Continuous digital monitoring of assets and key operating variables can reduce the frequency – and labor costs – associated with manual inspections. With modern digital tools, you can track electrical variables, mechanical variables, and hydraulic variables of motors and pumps and receive alerts when performance drifts from established thresholds.

Pump asset performance improvement in practice

Case study: Non intrusive, agnostic pumping performance solution

An asset performance improvement initiative begins with setting the objectives of the pump station management. In a water treatment plant in northern Spain the plant manager wanted to reduce energy costs by improving plant-wide communications regarding operating actions and their results. In addition, he needed to reduce operating expenses (OpEx). His technical and production managers shared the same objectives and were considering replacing aging pumps as a way to accomplish those goals.

We started this project by deploying the architecture shown in figure 3.5, to gather and analyze operating data. Utilizing instrumentation already installed on each of the station's three pumps, water industry specialists configured energy meters, intelligent drives on the motors, as well as pressure and flow sensors to monitor key process points.

SCADA software and PLCs at the edge control layer supervised the data exchange and production logic and in addition connected with an IIoT edge box across PROFINET and Modbus TCP networks. The IIoT Edge box was housed in the plant control room and delivered data to the EcoStruxure Pumping Performance Advisor hosted in the cloud.

Performance Improvement Architecture

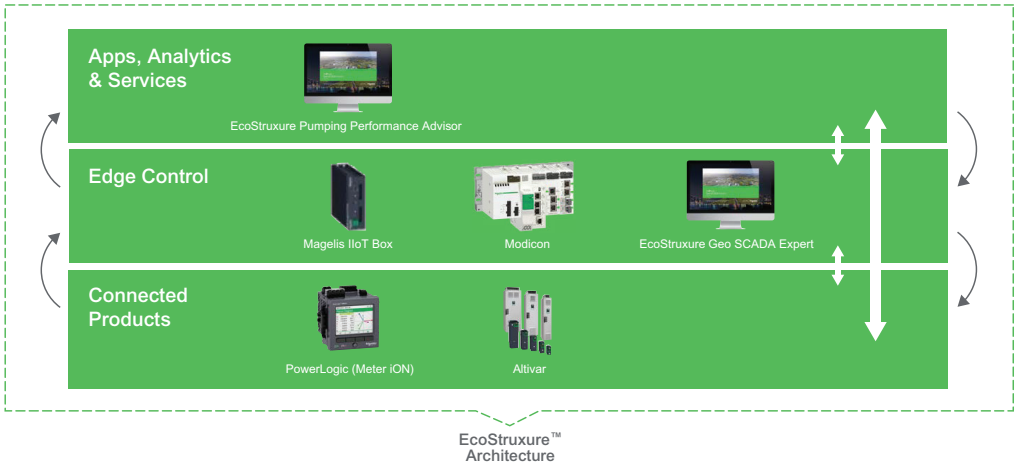


Figure 3.5
The performance improvement architecture that saved this water treatment plant 12% of OpEx in the first year of implementation in the first year of implementation; with a return on investment in less than three months.

Return on investment in less than three months

After about three months of monitoring the Spanish facility, we reached the following conclusions:

- There was no need to replace the old pumps. Wear and corrosion impact could be managed through control loop tuning. We did, however, recommend refurbishing impellers and wear rings.
- Changes in pump speed control improved performance and reduced the energy bill. Controlling speed variation with the drives would be more effective than running the control loop in the PLC.
- The need to inspect every two weeks was eliminated.
- Reduced operation cost. Automating switching in the chlorination valve reduced operation costs by €4,500.

Implementing all recommendations except the impeller and repair ring refurbishment and the automated ozone system warnings saved €18,500 a year, which represents 12% of OpEx. (Figure 3.6)

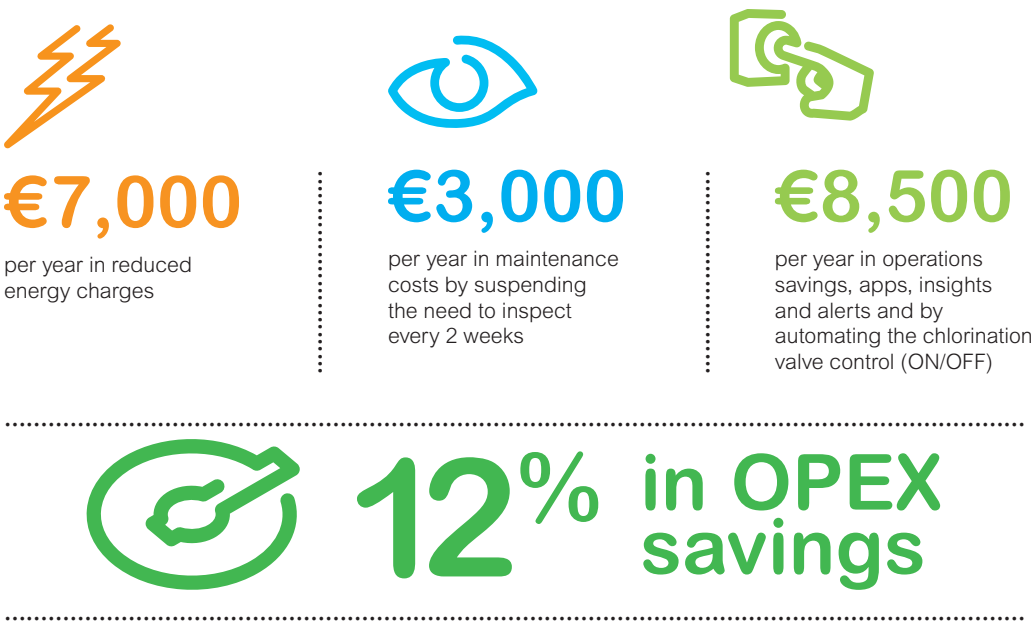


Figure 3.6
Reducing OpEx through asset performance

From reliable operation to continuous optimization

The fundamentals for asset performance improvement initiatives

Although the previous example related to potable water, the same basic architecture can be applied to pumps in almost any setting. For example, the same customer operates a wastewater treatment plant and water collection network and engaged Schneider Electric to accomplish similar objectives on their lifting station.

Similar variable speed adjustments based on monitoring, increased pumping performance, reduced energy consumption, wear and tear, and vibration. The monitoring also revealed the need for reducing the size of wastewater screens to keep out larger objects from increasing pump wear. Total additional savings here were over €18,000 (representing 14% OpEx).

Achieving such results involves three fundamental steps:

1. Evaluate current operations to assess the potential return and set targeted improvements.
2. Implement the improvement and monitor progress against targets over a few months.
3. Adjust performance accordingly

Your clients will eventually reach a point of consistently meeting targets, but the process should not end there. Water and wastewater operations will always need to go beyond initial objectives to adapt to changing economic circumstances and physical realities. EcoStruxure as the optimization platform, provides an architecture that will help reach increasingly higher performance optimization plateaus.

For more information about how you can work with Schneider Electric in water industry modernization projects, visit the System Integrator Alliance Partner portal.

For more information visit EcoStruxure Pumping Performance Advisor

Chapter IV

Empowering the Water Industry Workforce for Asset Performance Improvement

This chapter describes how the IIoT, big data, and applications such as augmented reality are connecting the water industry workforce, equipping it with real-time decision support, and enabling collaboration with anyone at any time, empowering your workforce to:

- Maximize return and capital invested (ROCI)
- Reduce downtime
- Lower operating and maintenance costs
- Accomplish more with fewer resources
- Operate sustainably
- Optimize overall asset performance

Read on to learn more about how the coming age of digitalization is empowering the water industry workforce by facilitating asset performance improvement through improved data transparency, resulting in benefits such as:

50%
Reduction in time to locate relevant resource materials

3%
higher revenue

10%
higher margins

Workforce empowerment in the digital age

If your clients are concerned about having a sufficiently-trained workforce to run their water treatment plant or distribution network, they are not alone. Four of five water industry users interviewed in this year's *Water and Wastes Digest* "State of the Industry Report"[5] cited workforce as their major concern – and with good reason.

A 2018 U.S. Government Accountability Office report estimates that about one in three water and wastewater utility workers in the U.S. will retire within the next decade.[6] All indications are that this is not just a U.S. issue. As a result, competition for the most talented workers is increasing, which puts additional strains on already strapped budgets and jeopardizes critical water operations.

Digitalization comes into play here in at least two ways. First, it enables workers to be more effective by giving them real-time access to operational insight, gleaned from analysis of previously unfathomable amounts of operating data. This also equips them for collaboration with remote expertise.

Second, it speaks to the digitally-native and increasingly-mobile workforce in a format with which they are comfortable. They increasingly view the world through phones and tablets, so why not have them carry this into their work? Today's handheld devices, for example, can deliver highly accurate information to guide their responses to operating or emergency scenarios.

Empowering the water industry workforce for asset performance improvement

Human judgment and feet-on-the-street will still be essential for many years to come, so the water industry has much to gain from emerging digitalization that is enabling its workforce to optimize assets around key performance indicators (KPIs).

Digitalization is empowering the water industry workforce for asset performance optimization by presenting operating data with transparency and accuracy not previously possible. In Chapter III we described an application for optimizing pump performance. This empowers workers by corralling vast amounts of data from connected assets, analyzing it for historical and predictive insight, and serving it up to operators and technicians for real-time decision support. In this chapter we take a deep dive into augmented reality as another example of an IT application that connects the IT and OT worlds. Like virtual reality, augmented reality simulates industrial operations so that people can learn to operate and maintain equipment safely with minimal need to disturb real systems.

"Engineers who maintain control panels and machines often spend up to half their time searching for technical data in assorted software, databases, activity logs and even old-fashioned filing cabinets. Digital solutions such as augmented reality applications, provide engineers with instant access to the information they need to speed up operations and reduce human errors commonly associated with traditional maintenance procedures."

— Simone Gianotti, EcoStruxure Industry business development manager, Schneider Electric.

But augmented reality goes beyond just modeling a procedure or asset. It puts contextual information and insights at the fingertips of maintenance workers, blending physical, real-life objects with virtual objects. The objects are linked to databases containing digitized manuals, process data, troubleshooting guides and much other information that can help increase efficiency, reduce and costs and otherwise improve maintenance productivity.

REAL TIME ANSWERS:

Predictive information.	✓ *How will this problem develop if unchecked?*
Real-time contextual information.	✓ What pumps are running now? ✓ At what speed? ✓ Are they running optimally?
Procedural displays.	✓ *What do I do next?*
Vendor manuals	✓ *How do I troubleshoot this pump?*
Historical data.	✓ *Is this first time this has happened?*
Connections to remote experts	✓ *Can you walk me through this?*

Maintenance workers in a water treatment plant, for example, might run augmented reality software on a tablet or other mobile device. Aiming the tablet at a specific area of the plant, an asset or pump or other real-world point of interest (POI), would reveal real-time data such as volume, flow rate, and other information critical for effective maintenance. It would also link to guidance materials such as manuals and troubleshooting guides, making them easily accessible on that equipment. (Figure 4.1)

Figure 4.1
Aiming a tablet at an asset or a group of assets reveals operational details

Augmented reality in operation

1 Operator points a tablet computer at the site or equipment to be monitored.

2 The system matches the visible image with stored images through markers called points of interest (POIs).

3 When a match is made, POIs are overlaid on the live scene visible on the tablet.

4 The operator taps the point of interest markers to display information, display process variables, operating and maintenance insights; documents, instruction sheets or wiring diagrams; audiovisual materials such as web pages, videos, audio, stored Procedures.

Such instant access to critical information shortens response time as well. If there is an alarm in the pumping room, the technician sees it immediately. Instead of taking maybe 15 minutes to walk to the location and wait another 10 or so minutes for an authorized person to open the door, they can begin their diagnosis immediately based on the information displayed on the mobile device.

Additionally, they can access multiple views and levels of the system (Figure 4.2) and depending on how the application is populated zoom in even deeper to get schematics or blueprints.

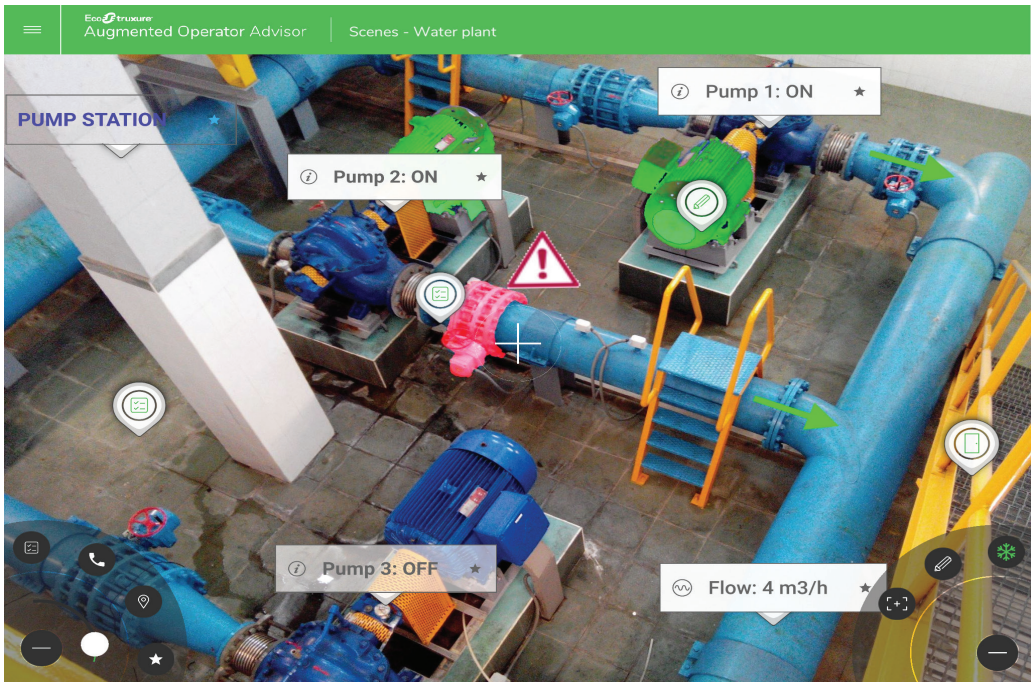


Figure 4.2
Depending on how the application is configured, operators can drill deeper

How asset performance improvement pays off

Asset performance improvement increases return on capital investment (ROCI) in the following ways:

Reducing downtime.

Approximately 70 percent of water and wastewater utility's capital goes into its assets and maximizing return on those capital expenditures requires those assets to be running at peak performance. Responding to downtime threats consumes a good part of the day of many maintenance workers. Virtual reality delivers context-sensitive insights that direct technicians in performing the actions that will help avoid downtime or troubleshoot it when it does occur. Operators can quickly find information with immediate access in the field to real-time data, user manuals, instructions, diagrams and more. Spare-parts management is also a very important contributor because of knowing where to find the spares when something breaks.

In addition, virtual reality reduces downtime by enabling transition from reactive to proactive maintenance. This results from freeing up maintenance teams to devote more time to analyzing historical trending data that identify causes of failure and prescribe actions to mitigate it. Such proactive activity also maximizes ROCI in maintenance and repair supplies by avoiding overstocking.

Reducing operating costs.

Maintenance itself constitutes about a third of the operating cost of a typical water or wastewater pump station. It also has a significant impact on other cost factors, including energy consumption and pump operations. Therefore, anything that is done to improve maintenance will also contribute to lowering overall operating costs. Aiming an augmented reality tablet at a piping segment, for example, might present data revealing atypical flow rates indicative of leakage.

Improving Safety.

Safety is one of the key benefits of digital maintenance. By being able to open panel doors virtually, technicians can diagnose potential problems with minimal risk of contact with hazardous energy. This also has significant training benefits: before workers perform maintenance in a corrosive or hazardous environment, they can learn safe procedures and even experience simulated consequences of a mistake.

Reducing human error, improving collaboration.

In addition to presenting maintenance teams with the right information at the right time, digital maintenance enforces data and format consistency and significantly minimizes human error. The software locates the right equipment and guides operators step-by-step through complete maintenance procedures applying standard operating procedures.

When judgment calls are needed, technicians can augment their observations with access to specialists anywhere in the world. The information presented on the screen from a live expert not only helps the technician make better decisions on-site, it also maximizes ROCI even further by reducing travel costs. This has training implications as well: instead of sending multiple people to multiple remote sites for training, they could receive much of their training in a group at a single location.

Sustainability.

Identifying inefficiencies in areas such as energy consumption have implications for sustainability as well as cost and performance. Displaying a dial on an AR dashboard that compares actual power consumption against the ideal consumption at a designated flow rate, for example, can tell the operator whether the pump is consuming the right amount of fuel. If pumping 1.1M gallons per minute should consume only 800KW but is using 850KW, either something is wrong with the pump or it is wasting energy. Either way, AR can put that right in front of the eyes of people walking the floor in the pump station.

Optimizing asset performance.

The ultimate benefit of digital maintenance goes beyond the downtime reduction, energy, or even operator efficiency. By cost-efficiently optimizing maintenance quality, human resources can be redeployed, away from putting out fires that threaten uptime and on to high-value improvement of plant and network performance. When confident about keeping the plant running, they can devote time to answering questions like:

“How do we make this plant run better?”

“How do we reduce the overall cost of water?”

Digital architecture for workforce empowerment

The EcoStruxure architecture provides a platform for collecting data from connected operational technology (OT) instruments and smart devices and standardizing it for sharing with information technology (IT) analysis and decision support applications. Such a platform simplifies creation of plug and play applications built on five core competencies:

- Integrated connectivity and information technologies
- Intelligent operations building blocks
- Access to advisors and other applications to turn process data into business insights
- A cloud-connected digital services infrastructure
- Cybersecurity protection

Figure 4.3

As shown in Figure 4.3, the OT assets sit at the base “Connected Products” layer. This might include pumps, motors, drives, sensors, piping, and other utilities. Such equipment is increasingly intelligent, networked, and capable of storing and sharing operational and diagnostic data. In an IIoT architecture these devices would be discoverable by the engineering software used in designing systems.

At the middle “Edge Control” layer, servers receive field data from multiple sources, such as programmable logic controllers (PLCs), Structured Query Language (SQL) databases and OPC Unified Architecture and share it with the IT applications through communications gateways, such as internet boxes.

At the top, "Applications and Analytics" layer, are standards-based applications for which domain specialists are building new software to meet pressing industry needs. Much like smart phone app developers, they are continually bringing new functionality to market, with new ways to empower the workforce. EcoStruxure Augmented Operator Advisor is only one such application. The Pumping Performance Advisor, described in Chapter III, is another application and these can be integrated for even greater empowerment.

Like the Augmented Operator Advisor, the Pumping Performance Advisor might access the flow, volume, drive speed, and similar data collected from the field devices, and would analyze it mostly for proactive maintenance strategies instead of to support break/fix intervention. The same information is used to optimize pump performance, can be displayed before the eyes of the technician who is maintaining that pump.

Figure 4.3 shows additional examples of applications that can empower the water industry for asset performance improvement. For example: virtualization, enterprise asset management, and SCADA software applications from Schneider Electric affiliate AVEVA.

Thanks to the emergence of communications standards, lower-cost computing, and more secure and reliable networking, implementing an augmented reality program is much easier than ever before.

Getting started in augmented reality

A successful augmented reality program begins with top-down analysis of the operations that need to be supported, which includes identifying the following kinds of targets:

- Sites at which the application will be deployed;
- Areas within each site to be monitored – such as pump stations, wastewater lifts stations, motors, control rooms, and parts storage areas;
- Device scenes within each area, such as pumps, motors, and electrical cabinets;
- Subscenes, the parts of each scene into which the technician may need to zoom.

After identifying targets and checking all are in working order and connected to the plant network where relevant, you then decide whether to use photographs or tags to identify each scene. If using photographs, you would take high-resolution photographs of all the areas, scenes, and subscenes, and store them on a hard disk drive, USB key, or network folder. If you are using tags, you uniquely identify physically similar or identical items of equipment and attach database tags to them.

The files must be accessible from a device running an augmented reality engineering application such as EcoStruxure Augmented Operator Advisor (AOA) software, a free trial of which is available on the next page. The application will guide you through the process of connecting all photographs or tagged content.

Workforce empowerment in practice

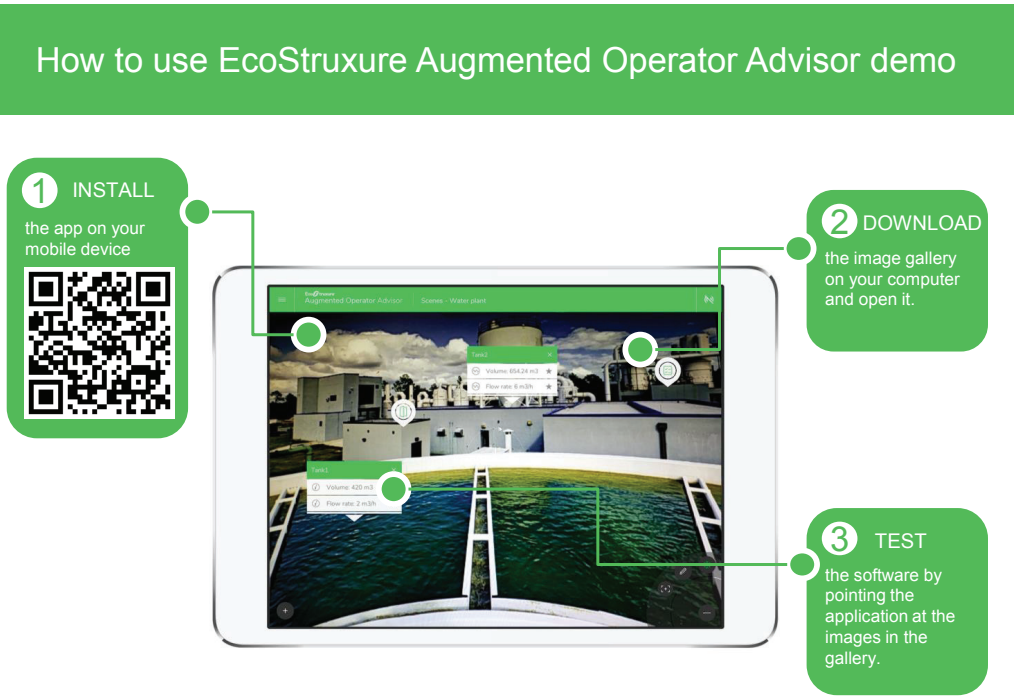
A South American integrated steel tube mill sought to reduce downtime through improved maintenance.

An augmented reality system that accelerated maintenance by enabling technicians to diagnose maintenance problems more quickly was implemented. Through their smartphones [or tablets] they were able to open panel doors virtually to see the data that enabled them to evaluate production and maintenance operation in real time.

The system superimposed data from the PLC, SCADA or SQL databases near images of the equipment, providing instant information on KPI progress and feedback in the context of the assets they are looking at.

If you would like to find out more about what EcoStruxure Augmented Operator Advisor has to offer, try the application now. Click on Figure 4.4 and then, with your tablet, scan the QR code to get direct access to the EcoStruxure Augmented Operator Advisor application.

Figure 4.4



Find more information on the Schneider Electric Automated Operator Advisor here.

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Resources for System Integrators

For more resources for system integrators register to access the Schneider Electric System Integrator portal here.