



WHITE PAPER

Finding the ROI in Digital Transformation

Case Studies and Analysis of the OSIsoft PI System

Commissioned by OSIsoft

Published 1Q 2019

Neil Strother

Principal Research Analyst

Stuart Ravens

Principal Research Analyst

Section 1

INTRODUCTION

1.1 Scope of Analysis

OSIsoft commissioned Navigant Research to analyze its PI System through interviews with customers, market data, and analyst insights into the market. This analysis does not represent an endorsement of the PI System but rather a review of key findings and case studies from the user perspective. Findings from the interviews show compelling evidence for positive returns on investment (ROIs) from a PI System deployment. However, a critical element Navigant Research's analysis uncovered the need to select the appropriate use case for the system.

This white paper contains Navigant Research's view of key trends within the digital transformation market, case studies from PI System customers, and Navigant Research's recommendations for industrial customers considering digital transformation platforms.






1.2 Key Findings

Navigant Research found the following from its research and analysis:

- A successful transformation requires a solid digital platform that is robust, flexible, and secure at the outset. Such a platform sets up the business to not only reap immediate benefits but also to capture long-term value as a company's transformation roadmap evolves.
- The primary objective of a digital transformation must be to have a positive and meaningful impact on the business's bottom line. Favorable results must show up on the profit and loss (P&L) statement when adopting a new platform or the effort is close to worthless.
- The platform needs to have a proven record of helping enterprises fundamentally transform processes, creating greater efficiencies and positive outcomes. Companies are unwilling to risk making changes to essential processes based on unproven platforms that do not work as promised or do not scale to meet the enterprise's needs.
- Businesses should have realistic expectations for how long it might take to realize a positive ROI from deploying a transformative digital platform. Many factors will go into this calculation, but this analysis found the average time to ROI was about 7 months, with the longest period being 1 year.
- A valuable digital platform enables a company to find hidden or added benefits beyond those it originally seeks. For instance, after first helping to significantly lower costs on a production line, new insights from the platform could also help improve worker safety, provide new details necessary to meet changing regulatory requirements, or significantly delay previous plans for capital spending.

- A savvy digital platform deployment focuses on one strategic problem or small set of related problems at the start to achieve a successful outcome. This approach lays the foundation on which future use cases can build.
- A successful digital transformation deployment requires broad upper management support. If the C-suite is missing, the effort is likely to fail if the project drifts off course or when frictions arise among different teams.

Figure 1-1. Summaries of PI System Case Studies

					
CHALLENGE	<ul style="list-style-type: none"> • Processes were generating a lot of underutilized digital data 	<ul style="list-style-type: none"> • Growing rapidly, creating a significant data management challenge 	<ul style="list-style-type: none"> • Unwanted temperature spikes in new fermentation tanks during the cooling process 	<ul style="list-style-type: none"> • Losing ~32% of managed water due to water main leaks 	<ul style="list-style-type: none"> • Hera plant underperforming • Large debt burden
OUTCOMES	<ul style="list-style-type: none"> • Realized a return of \$20-\$25 million in 1 year • Incremental return of \$20-\$25 million expected in 2018 	<ul style="list-style-type: none"> • \$A21 million estimated (\$15.2 million) savings in first 3 years • Payback in software investments in 9 months 	<ul style="list-style-type: none"> • Shortened the process time by 24 hours <ul style="list-style-type: none"> ◦ Led to estimated \$450,000 of more beer produced/yr • Achieved payoff in first ~3 months 	<ul style="list-style-type: none"> • Recovering ~\$1.6 million water annually • Delayed \$15-\$20 million upgrade • Cut data prep from 6 hours to 10 minutes/day 	<ul style="list-style-type: none"> • Within 12 days, improved gold recovery by 1%, paying for investment • Gold recovery climbed from 74.6% to 88.6% in 1 year

(Sources: Listed companies, Navigant Research)

1.3 Navigating a Digital Transformation

Industrial managers face a difficult journey along the digital transformation path. They must not only control digital technology but also manage the complex processes and disparate teams of people involved in this journey. The situation can appear daunting given the number of tools involved and the potential for making serious mistakes if the wrong choices are made early in the journey.

Many of these managers operate within established industrial sectors that use functional processes that have been in place for years, if not decades. They have steadily adopted systems like SCADA, distributed control system (DCS) architecture, and programmable logic controllers (PLCs). But often those systems have not kept up with technology changes, and the people with the skills needed to implement new solutions are in limited supply.

It is easy for managers to recognize some of the more immediate outcomes promised by digital solutions, such as lower costs, reduced energy use, increased productivity, reduced downtime, improved safety, and the ability to meet sustainability goals and make critical business decisions faster. There are also the critical outcomes from digital solutions that promise longer-term advantages, such as creating margins above the competition, empowering a broader range of employees to use digital tools, reducing the time and costs needed to meet regulatory standards, and the ability and flexibility to concentrate on new products and services.

Digital transformation has a foothold among early adopters across many industrial sectors. Indeed, the early adopters are at the forefront of a trend expected to accelerate. Navigant Research estimates cumulative spending on industrial Internet of Things (IIoT) will reach more than \$1 trillion over the next 10 years. Much of this spending on transformation is expected to take place in industrial and large commercial operations.

To make the shift toward digital transformation requires a new view of operational data. This type of data needs to be thought of and treated differently. Well instrumented and architected machines, devices, and processes create a much more dynamic use of data. A new strategic mindset needs to imagine how rich data coming from a fully instrumented operation can achieve a realistic ROI in a timely fashion.

1.4 Digital Transformation Presents Several Roadblocks

To digitally transform a business is not a trivial task. The journey has several roadblocks. Existing tools were not designed with enhanced data analytics, advanced machine learning, or to manage large data volumes. There is only so much an Excel spreadsheet can handle when devices and sensors in the thousands start collecting data in terabytes, and there is a desire to analyze that data instantly.

In addition, a majority of staff have little training or experience in this much richer data environment. They can be trained, but that takes time and money. Most are not prepared for the volume, velocity, and variety of data that needs to be gathered, cleaned, and analyzed. For instance, Shell conducts some 100,000 calculations a minute in its global operations, which translates to more than 4 billion per month. Similarly, California's manager of bulk electric power, California Independent System Operator, refreshes 500,000 data points every few minutes. These types of data volumes can be daunting for firms that lack the tools and strategy to overcome the challenge.

Another roadblock for managers is uncertainty about the payback—the ROI—when taking steps along a digital transformation journey. Questions that vex them typically include the following:

- What are the initial hardware, software, and service costs?
- What is the total cost of ownership (TCO)? Are there additional ongoing costs?
- How long will it take to see a payback from my investment in data tools?

- How much increase in revenue can I expect?
- How can this help lower my costs?
- Will it increase safety for my workers?
- How can this help with regulatory compliance? Is there a benefit in this area?
- Can the strategy scale and how much handholding will my systems need?

These roadblocks and questions are neither easily surmounted nor answered. Each firm is different, and how a new set of digital tools might transform operations can be difficult to calculate.

1.5 The Need for Advanced Tools

Overcoming these barriers requires proper tools and focus. Data must be the centerpiece and the tools must be robust and flexible enough to meet the increasing volumes and complex datasets generated by modern businesses. The best and most advanced tools not only manage and cleanse data, but also go deeper to synthesize and analyze data so it produces critical business insights and can be used directly by people across an organization.

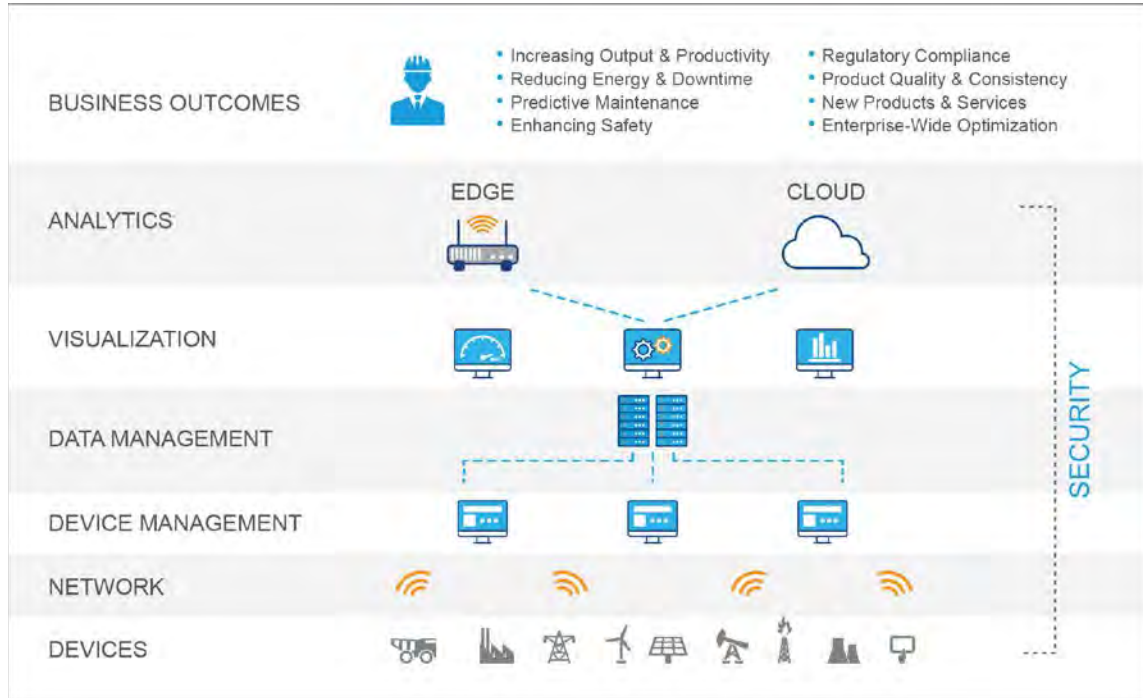
1.6 Digital Transformation Goals

Companies have a variety of goals when starting a digital transformation journey. Based on Navigant Research's interviews and overall view of the market, there are eight prominent digital transformation goals:

- Improving process efficiencies that drive net income gains on P&L statements
- Extending the lifetime and productivity of existing capital
- Reducing energy and other operating costs
- Ensuring regulatory compliance
- Reducing downtime
- Enhancing product quality and consistency
- Increasing safety
- Aftermarket services and products

Figure 1-2 depicts the relationship between many of these digital transformation processes and business outcomes.

Figure 1-2. IIoT Business Outcomes and Benefits



(Sources: Navigant Research, OSIsoft)

1.7 Market Drivers for IIoT and Digital Transformation

Industrial processes undergo regular if not constant change as managers seek to improve efficiency throughout operations. While achieving greater efficiency is an overarching force in the marketplace, multiple drivers fuel the digital transformation trend:

- More efficient use of energy:** Equipment that senses how it is operating in terms of energy use and makes intelligent adjustments (e.g., slowing down or turning off when rates are high) is inherently more energy efficient, leading to lower energy costs for the business. Connecting multiple sets of equipment across an organization and orchestrating their usage can drive even greater energy efficiencies.
- Predictive, preventive maintenance:** These approaches to maintenance, as opposed to scheduled repairs, can dramatically lower costs and downtime as well as labor costs by enabling maintenance crews to prioritize. For instance, a food distributor could receive alerts and accurate diagnostics hours or days in advance of when a specific chiller is about to fail and make appropriate repairs ahead of schedule. Predictive maintenance can be particularly important for remote assets like wind turbines.

- **Competitive differentiation:** As leading companies deploy IIoT solutions and gain efficiencies, they can offer new services or connected products at lower costs, separating themselves from competitors. Customers will want to work with companies that learn from and master IIoT technologies.
- **Transforming businesses, changing customer experiences:** Firms that deploy IIoT solutions can transform their business, offering customers enhanced services and more efficient, reliable operations. For example, Schindler Ahead, a digital solution that leading elevator manufacturer Schindler calls its Internet of Elevator and Escalator strategy, provides real-time equipment status, operational metrics, and personalized services for improved passenger experiences.
- **Increased worker safety:** A sophisticated system of temperature sensors, air quality sensors, chemical sensors, cameras, and the like can all contribute to a real-time monitoring process that boosts worker safety. For example, a chemical plant with such a system could accurately sense that toxic fumes are building quickly and set off alarms for workers to take evasive action well ahead of current sensing equipment, which can be less reliable. Such an IIoT system can have the added benefit of lower insurance costs to the company since an insurer would be exposed to a lower level of risk.
- **Falling component costs:** Over time, IIoT components—sensors, chipsets, networking gear—will tend to fall in price as volumes increase. As this occurs, more companies will be able to justify investing in IoT equipment to take advantage of the benefits associated with a deployment.
- **Falling data management costs:** Affordable data management solutions like Hadoop, an open-source software library that allows for processing large datasets, help move companies toward IIoT deployments because this is one area where operational costs can be pared down.

1.8 Market Barriers

While market drivers and megatrend forces are many and compelling, the IIoT faces significant hurdles. The main ones include the following:

- **Security threats:** Adding hundreds, thousands, or millions of two-way communicating devices and sensors to industrial systems—not to mention the vast amounts of data involved—increases the surface for cyber attacks. Reported attacks against critical grid infrastructure heighten awareness and anxiety. For instance, the May 2017 global WannaCry ransomware attack had a chilling effect on industrial managers as they sought to balance IIoT benefits against these risks.
- **Added costs:** Even though device and sensor costs are expected to decline as volumes rise, the cost of new IIoT hardware and software can slow adoption by companies unable to make the financial hurdle.

- **Unclear value propositions and outcomes:** Because IIoT technologies are new and often untested by potential industrial customers, the value of an investment is unclear, and managers have little or no experience that expected beneficial outcomes will truly happen. They have a distrust of reported ROIs. In time, Navigant Research expects these concerns to dissipate, but for now they linger.
- **Unfamiliar, untrained staff:** Many bright and technically trained people work across all industries, but few are prepared for the scale of IIoT technologies and how to handle the avalanche of data. In time, this issue will wane but not for several years.
- **Complexity:** IIoT platforms are intricate. The potential volume of devices and data to manage can seem overwhelming. With most companies still in the planning or trial phase, it will take time and a keen focus on steps toward simplification to overcome this barrier.
- **Cloud-averse:** While industrial customers are becoming acclimated to cloud technologies, questions about bandwidth, subscription fees, and security remain.

Section 2

CASE STUDIES

2.1 Introduction

The PI System has been adopted by numerous companies across a variety of industrial sectors to help them harness data. The specific goals vary by company, but each of the following case studies provides a window into how the technology can be used to solve problems and provide ROI benefits.

2.2 The PI System

OSIsoft developed the PI System in the early 1980s to enhance industrial data management tools. The PI System initially functioned as a data historian—a database for equipment. Over time it has evolved into a data infrastructure for diagnostics and decision-making to reduce costs, increase output from fixed capital, and improve safety, among other capabilities. Today, companies like Canadian oil producer Syncrude and Duke Energy have reported saving millions of dollars using the PI System for condition-based maintenance. OSIsoft also has technologies like Asset Framework (for digital twins), Event Frames (for batch or excursion summaries and notification), and PI Vision (visualization), as shown in Figure 2-1.

Figure 2-1. OSIsoft’s PI System Modules and Processes



(Source: OSIsoft)

The PI System manages data from numerous sources and sensors within an operation and transforms it into information that can be used for a wide-ranging spectrum of tasks and by a broad number of people and departments. Fundamentally, the system functions as a three-step process: collect, manage-enhance, and deliver.

- **Collect:** OSIsoft has developed more than 450 tag-based interfaces for integrating sources of data and more than 20 smart, asset-based connectors for nearly any type of industrial communication standard or specific assets, saving time and lowering risk. The intelligent connectors handle crucial steps in the process such as data buffering, filtering of bad data, and auto-discovery of data sources to ensure clean and reliable data.
- **Manage-Enhance:** The PI System stores, organizes, and continually curates asset data across organizations. Asset Framework can be used to bundle related data streams from pieces of equipment, process lines, or facilities to improve diagnostics or conduct analytics within the PI System or on third-party platforms. The PI System can also perform built-in calculations on data streams—from simple key performance indicators to unit of measure conversions, event tagging, and alarm notifications. If there is a need to perform historical analysis, a user can also query data from decades ago in seconds.
- **Deliver:** PI ProcessBook, PI DataLink, and PI Vision are the primary delivery, or visualization, tools of the system. The system also features a set of PI Integrators that shape and translate data so it can be shared with applications and platforms such as Microsoft Azure, AWS, SAP Hana, Falconry, SparkCognition, and others. Integrators reduce data prep and data quality risks. For instance, Cemex, the largest cement company in the world, reduced the number of employee hours preparing data reports from 744 to less than 1 using the PI System for contextualized operational data.

Figure 2-2. Screenshot of PI Vision in a Mining Operation



(Source: OSIsoft)

Cloud Capabilities

While historically deployed as on-premise software, OSIsoft has extended its capabilities into the cloud. OSIsoft Cloud Services, such as PI Cloud Connect, allow customers to share data, link isolated assets, and perform other tasks via the cloud. Connected Services Agreements, meanwhile, allow hardware, software, and service providers to integrate PI System functionality into their smart offerings. Caterpillar, for instance, embeds PI System Connected Services into its CAT Connect services for marine and shipping companies.

2.3 Company Summary Findings

The five examples provided in Sections 2.4-2.8 are based on Navigant Research interviews with company representatives who have deployed the PI System and its various components as well as information provided by OSIsoft. The summaries included in the following sections provide insights into the range, capabilities, ROI, and efficiencies enabled by a digital platform. These case studies from DCP Midstream, AGL Energy, Deschutes Brewery, White House Utility District, and Aurelia Metals provide insights into the investments required across hardware, software, and personnel to generate compelling direct financial near-term ROI and indirect cost savings (avoided costs).

2.4 DCP Midstream

\$20-\$25 Million in Annual Savings through Data-Optimized Production

Overview

DCP Midstream is one of the largest producers of natural gas liquids and natural gas processing in the US. This Fortune 500 company operates in many of the key gas-producing basins in the country, including the DJ Basin (Colorado), the Permian Basin (Texas and New Mexico), and the STACK/SCOOP areas (Oklahoma). DCP Midstream manages 61 gas plants, 11 fractionation plants, 1,400 compressors, and 57,000 miles of pipeline. The complex system requires constant monitoring to ensure the natural gas, natural gas liquids (NGLs), and associated system meet quality, reliability, environmental, and safety standards.

Challenge

In 2015, DCP Midstream managers recognized the firm's operations had not changed fundamentally in 30 years. The company had just weathered a market downturn and responded by doing more with less. In that process, DCP saw a larger opportunity to position the firm in a new way and operate differently. The company's management cited the need to lower the cost structure to ensure profitability in any commercial environment.

DCP's executive leadership team decided to embark on a companywide digital transformation. The company's processes were generating a lot of digital data, but it was underutilized. There was minimal analytics done with the operational data and engineers were not using the latest advanced analytical tools.

Response

After an extensive analysis of digital tools, including visits to leading Silicon Valley software companies, DCP Midstream kicked off an aggressive 5-year digitization plan starting in late 2015. The company invested around \$20 million in people, consultants, systems integrators, hardware, and software with the majority of spending on hardware and personnel to create its Integrated Collaboration Center (ICC) for optimizing assets and processes across its network. DCP's goal was to pay the investment back in 1 year. At the core of the effort was OSIsoft's PI System used as an operational data integration, applications, and analytical infrastructure, augmented by a partnership-focused enterprise agreement with OSIsoft for services and support.

Use of PI System

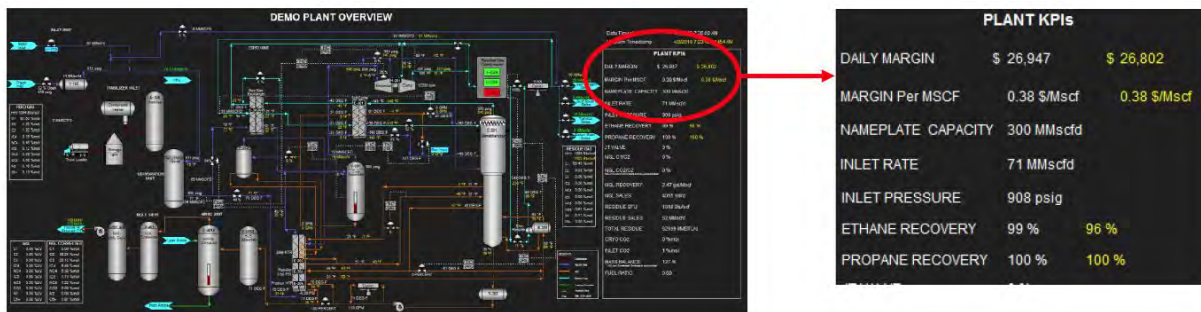
DCP created and started using its data infrastructure within the first 2 months of 2017. In this time, the digital engineering team reported it was able to leverage the PI System to create 12 different operational applications such as blowdown management, operator rounds, tank levels, and compression performance. As part of its smart gas plant solution, DCP is now able to perform financial-based gas plant optimization every 15 minutes.

For example, DCP created a PI Vision dashboard that allows gas plant managers to compare actual margin performance versus potential margin in real time. DCP reported that, on average, if each of its gas plants could produce an additional \$2,000-\$5,000 per day through data-driven optimization, that over the course of 365 days per year, the overall potential gain would be more than \$50 million.

DCP also reported it can shape its product mix—e.g., increasing ethane recovery due to market conditions by examining scenarios in the PI System in real time.

Having timely data about the price of ethane, contract details, and plant operations is important in a dynamic market like gas processing. Depending on the variables, a manager needs to make critical decisions quickly, and this cannot be done on spreadsheets or in one’s head. Also, the company must prove it operates within environmental standards and that requires data collection and reporting. Previously, that was done manually, but the PI System has automated that process as well.

Figure 2-3. DCP Midstream’s Daily Margin Data Output Using the PI System



(Source: DCP Midstream)

Outcome

DCP Midstream reported it was able to meet its two main objectives: to make substantial progress on its digital operations journey as defined in the DCP2020 vision and realize a return of \$20 million-\$25 million on its investment in people, hardware, and the PI System in 1 year. The company also expects to achieve an incremental \$20 million in 2018. With a more efficient operation in place, company managers intend to continue the digital journey, with additional real-time analytics in the PI System as a foundation for higher level predictive analytics, such as advanced pattern recognition, which is the next area to invest.

Added Benefits

There has been a cultural change throughout DCP Midstream—not only among operations but in many functional areas such as sales, marketing, finance, procurement, and supply chain. What started in operations is now affecting all segments of the company. One process that has changed dramatically for DCP is the time needed to manage monthly summaries of plant operational data. Before the PI System, DCP leadership reported it took about a week to collect and organize this data from each plant—or 61 total weeks when considering all plants. With the PI System in place, the reporting time has been nearly eliminated with data available on-demand.

Table 2-1. DCP Midstream’s ROI and Benefits

Category	Result
Goal: Create Integrated Collaboration Center	\$20-\$25 million investment (hardware, personnel, other expenses and software)
Reported Breakeven Time	10 months
Benefits	<ul style="list-style-type: none"> • \$20 million-\$25 million saved in first year • Anticipated additional savings of \$20 million-\$25 million in year two (2018) • New areas of optimization • Regulatory compliance • New applications • Increased productivity • Cultural change • Avoid installing new capital

(Source: DCP Midstream)

2.5 AGL Energy

Going from Data Blind to Digitally Transformed

Overview

AGL Energy is Australia's largest producer of electricity through its portfolio of gas, wind, solar, hydro, and coal operations. AGL also serves more than 3.6 million customer accounts across Australia.

Challenge

AGL was growing rapidly, creating a significant data management challenge. AGL's generation portfolio grew from 300 MW in 2005 to more than 10,000 MW in 9 years. Simultaneously, the mix of fuel types was becoming increasingly diverse. During this rapid growth the company was, according to managers, "data blind." The company dealt with multiple issues:

- System engineers operating with live read-only SCADA screens for real-time visualization
- Data skillsets that were not transferable
- High reliance on human data champions at each site to provide data
- Poor data precision and tractability
- Numerous manual data collection processes
- Data holes or black spots that reduced the ability to investigate asset performance and incidents effectively

Response

The AGL asset management team spearheaded an effort with AGL's IT group to find and deploy a solution. The group reported that it chose the PI System in part because it could scale and be future-ready as technologies evolved. The company also set up an operational diagnostics center staffed with people who would use the PI System to integrate existing data and create user-friendly applications to track assets and monitor performance.

Use of PI System

The AGL Group Operation licensed the PI System in late 2012. In the first phase, AGL encouraged technical and non-technical employees to create dashboards to monitor and optimize hydroelectric dams, solar arrays, and other assets.

Following this success, AGL set up an Operational Diagnostics Centre (ODC) in which the PI System would be used in conjunction with select applications such as Engineering Consultants Group, Inc.'s Predict-It tool. Since then, AGL has been using the PI System as the core solution for its real-time data infrastructure, which connects nearly all of its power station field devices including DCS, PLCs, and other digital devices (instruments, controllers, etc.) in the field. AGL employees have built more than 2,700 digital models that monitor 45,000 critical points of data every 5 minutes.

The company is also leveraging the PI System for advanced analysis and visualization tools, secure mobile data access for all AGL users, and to connect to OSIsoft partner products.

Outcome

In the first 3 years of the ODC, AGL reported it achieved an estimated savings of A\$21 million (\$15.2 million) through reduced downtime, early fault detection, and other expenses. In the last fiscal year (2017-18), the company estimates it saved more than A\$8.5 million (\$6.2 million) through the ODC. The total setup costs for the ODC came to approximately A\$1.2 million (\$870,000), with most of the budget going toward software (incremental PI System technology and Predict-It), developer time for building digital models, and training AGL staff. Ongoing operational costs for the ODC total approximately A\$650,000- A\$750,000 (\$470,000-\$544,000) annually. Return on the initial investment for the ODC was achieved in approximately the first 9 months.

Added Benefits

One of the added benefits AGL reportedly derived from the PI System was its ability to detect anomalies. In one such case the system detected an aberration that turned out to be a serious thermal failure mode within a 560 MW hydrogen cooled generator stator. The early detection allowed AGL to perform a 4.5-week repair that avoided a longer and costlier 14-week effort had the device suffered a stator thermal failure. AGL estimates the savings from this early detection at more than A\$50 million (\$37 million).

AGL recently launched two new programs:

- **Thermodynamic Performance Optimization System (TPOS)** to reduce fuel burn at fossil plants by 0.5% by running optimization calculations every few minutes
- **Wind Yield Optimization System (WYOS)** to increase wind yield by 1%-2%

Table 2-2. AGL Energy's ROI and Benefits

Category	Result
Goal: Create Operations Diagnostics Centre	Approximately A\$1.2 million (\$870,000) invested in ODC with annual OPEX of A\$650,000 to A\$750,000 (\$470,000-\$544,000) (software and digital asset modeling)
Reported Breakeven Time	Approximately 9 months payback for ODC
Benefits	<ul style="list-style-type: none"> • A\$21 million (\$15.2 million) saved in 3 years at ODC • Avoided generator failure, est. A\$50 million-A\$70 million (\$37 million-\$50.7 million) • New areas for optimization • Regulatory compliance • New applications • Increased productivity • Avoided costs • Energy savings

(Source: AGL Energy)

2.6 Deschutes Brewery

ROI in Less than 3 Months through Increased Output

Overview

Deschutes Brewery is a craft brewery based in Bend, Oregon. The company distributes its beer and ale products in 29 US states and two Canadian provinces. The business is family owned and operated and was founded in 1988.

Challenge

Deschutes installed new fermentation tanks on one of its brewing lines in 2014, but the tanks were not working properly. Brewers noticed unwanted temperature spikes in those tanks during the cooling process, not a desired outcome, and a rise in diacetyl, a fermentation byproduct that tastes like buttered popcorn. Brewers lacked the visibility they needed to correct the problem.

Response

In response, Deschutes managers decided to deploy the PI System. They added new sensors to the tanks and sent the data from those sensors into PI's Asset Framework repository.

Use of PI System

By collecting data in Asset Framework, the brewers discovered yeast bed temperatures were continuing to heat the center of the tanks, causing warm beer to rise to the top. With this enhanced visibility into the brewing process, they installed a temperature sensor at the bottom of each tank. Data from these additional sensors flowed into Asset Framework. With this granular data, the brewers were able to more closely monitor the yeast bed temperatures, keeping them cooler and in sync with the tank's other layers.

Outcome

The insights from Asset Framework allowed brewers to shorten the process time by 24 hours, according to Deschutes. This faster process reportedly yielded a 4% increase in production, which translated into an estimated \$450,000 of more beer produced per year and achieving payoff in approximately the first 3 months. It also allowed Deschutes to postpone a planned \$8 million equipment upgrade. The initial investment for the project came to less than \$50,000.

Added Benefits

In 2017, the company installed a new line for racking, a delicate step when transferring beer from a primary fermentation tank to a secondary one that requires limiting the beer's exposure to oxygen. The goal is to avoid dumping beer that has been overexposed. By ingesting all the sensor data from the racking line into the PI System, the brewers now have greater visibility into the process and can quickly diagnose and fix problems such as changing pressure in the line and avoiding a wasteful dump of beer. In another example,

Deschutes was able to remove a backup chiller by using the primary ones more efficiently, saving \$30,000-\$40,000.

Similarly, Deschutes' brewers have created a fermentation prediction tool that automates a tedious task previously done manually three times a day. Cleaned and organized PI System data gets sent to Microsoft Azure. Brewers then analyze real and ideal situations and course correct if necessary.

The adoption of PI System technology has also created a culture shift around data at Deschutes. Before the focus had been mainly on spending for new assets or ingredients to improve the beer. Spending on data tools was rather new. Given the quick success with the PI System, the brewing and technical staffers now clamor for new data projects. "That is the challenge now. What do we work on, and how do we prioritize these requests?" says Tim Alexander, brewery operations technical manager at Deschutes. To that end, Alexander and his team have several projects on their PI System roadmap, including bringing in more data for the racking line, adding data from the brewery's packaging lines, and bringing in data from new tanks installed to handle wastewater.

Table 2-3. Deschutes Brewery's ROI and Benefits

Category	Result
Goal: Increase productivity and quality	Initial investment less than \$50,000 (PI System and other expenses)
Reported Breakeven Time	3 months
Benefits	<ul style="list-style-type: none"> • \$450,000 in increased output in year one • Postponed \$8 million upgrade • New areas for optimization • Extended lifetime of existing capital • Enhanced product quality and consistency • New applications • Increased productivity • Avoided costs • Cultural change

(Source: Deschutes Brewery)

2.7 White House Utility District

Millions of Gallons and Millions of Dollars Saved through Data Diagnostics

Overview

White House Utility District (WHUD) provides water and sewer services to more than 100,000 residential and business customers in two Tennessee counties: Robertson and Sumner. Its service territory is vast—it covers more than 600 square miles, the largest geographically in the state among water and sewer utilities.

Challenge

In 2014, WHUD estimated it was losing about 32% of its managed water due to water main leaks. Financial projections indicated WHUD might need to invest between \$15 million and \$20 million in infrastructure upgrades and expansion of its treatment plant to meet its service commitments. Such a large investment would also mean higher operating expenses due to increased energy costs (about 30% of the cost to produce clean water goes toward energy needed to filter and move water within a system), added employees, additional chemicals, and ongoing maintenance.

Response

WHUD officials chose a less expensive path. The utility invested approximately \$1.3 million in a set of cellular-based meters for the field, the PI System, and the PI Integrator for Esri ArcGIS, with the vast majority of the cost going to the meter installations. The meters allowed WHUD to effectively divide its territory into 33 district metered areas (DMAs).

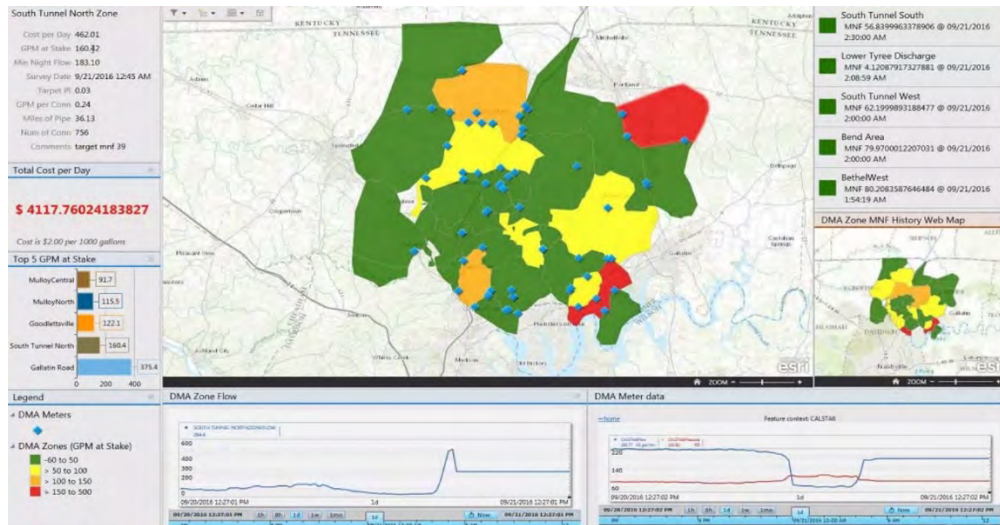
Use of PI System

Data from the DMAs was then captured and organized by the PI System so that WHUD could triangulate the location of water consumption anomalies that indicated leaks, more precisely understand the cost and volume of the losses on a day/month/year basis and take other actions. Like many other water utilities, WHUD previously had to rely on acoustic sensors to find leaks. The PI System data was also cross-referenced on Esri GIS maps via the PI Integrator map to help managers and repair crews in the field see the location of leaks and prioritize repairs.

Outcome

In a few days, WHUD engineers discovered a rural stream that was actually a water main leak spilling 147 million gallons per year—or enough water to supply more than 2,200 homes. In the first year (2015), WHUD reportedly found and repaired leaks losing an estimated \$400,000 worth of water per year. In the second year, WHUD found and repaired leaks spilling an additional \$900,000 worth of water per year. Another \$350,000 worth of leaks were found the following year, including another stream that may have spilled up to 500 million gallons since the 1980s.

Figure 2-4. Screenshot of WHUD’s System Showing Water Leakage Areas



(Source: White House Utility District)

WHUD estimated that software investments around the PI System paid for themselves in the first 12 months, with return on the overall digital transformation project, including water infrastructure and metering upgrades, being achieved in 2 years. Additionally:

- The meter data to PI System approach allowed WHUD to avoid \$200,000 in SCADA system upgrade costs.
- Time spent on report preparation and merging data sources dropped from 6 hours to approximately 10 minutes a day (estimated savings of \$30,000 annually).
- The amount of water recovered has pushed back the need for a major plant expansion until 2028.
- Avoiding a plant expansion allowed WHUD to avoid \$600,000 a year in bond interest payments.
- The district’s approach to leak detection transitioned from reactive, relying on customer calls, to largely proactive.

Added Benefits

WHUD believes it received an unexpected benefit: its credit rating went up. When the utility goes to borrow money for future projects the interest payments should be lower because of its more efficient operations.

In addition, WHUD is in a better position in terms of regulatory compliance. Several years ago, Tennessee regulators set new rules for reporting water losses. With the PI System now providing more detail about such losses, the utility says it no longer has the same level of concern about having to meet this regulatory obligation.

Table 2-4. White House Utility District’s ROI and Benefits

Category	Result
Goal: Reduce leakage and increase operational awareness	\$1.6 million in water recovered annually
Report Breakeven Time	12 months (for software portion)
Benefits	<ul style="list-style-type: none"> • Reduced data prep from 6 hours to 10 minutes per day (\$30,000 per year savings) • Postponed major capital upgrade • Avoided \$600,000 in bond payments • Increased productivity • Energy savings

(Source: White House Utility District)

2.8 Aurelia Metals Ltd.

Gold Output Increased, Costs Reduced, and ROI in 12 Days

Overview

Aurelia Metals is a publicly listed mining and exploration firm based in Australia. Aurelia’s key asset is the Hera-Nymagee Project, which includes the high grade gold and base metal Hera deposit and the high grade copper discovery at the nearby Nymagee copper deposit. The company also operates the Hera process plant, which is the company’s key producing asset. The Hera process plant is responsible for processing ore from these deposits into gold, silver, lead, and zinc products.

Figure 2-5. Aurelia Metals’ Hera Processing Plant



(Source: Aurelia Metals)

Challenge

Aurelia Metals reported to Navigant Research it faced a twofold crisis at the end of 2015: its Hera processing plant was underperforming, and the company faced a large debt burden of A\$125 million (\$90 million). The company estimated it had 6 months to turn things around or it might have to shut down the business, putting 700 jobs at risk. From a metrics perspective, Aurelia’s gold recovery was low (74.6%), its net debt to EBITDA ratio was low (2.7%), the cash-net debt ratio was low (7.5%), and the gold margin was low (7.1%).

Response

Given these circumstances, company managers knew they had to take immediate steps to optimize their processes to improve productivity and lower costs. However, they were not sure how. The company hired Convergio, a consulting firm specializing in process

automation, as a first step. Working with Convergio, Aurelia's staff installed a new PI System and started improving its mining operations.

Use of PI System

The Aurelia and Convergio team began by capturing data from the stage of the processing plant that turns raw material into gold since that was the main source of instability in the process and a driver of unwanted costs. According to Convergio, by using the PI System, Aurelia was able to evaluate its processes in real time and dynamically adjust processing parameters to maximize gold extraction as the composition and quality of the ores changed. Previously, Aurelia could only take actions retrospectively, which may not have been optimal for future ores. Starting with grinding and crushing processes, the first stage in metals processing, Aurelia moved methodically through each stage to optimize production and reduce waste.

Outcome

With PI System technology in place, Convergio reported that Aurelia's production improved significantly:

- After the first 3 months, the operation had improved gold recovery by 6.6%. The value of Aurelia's PI System investments was recovered within 12 days.
- Over the first year, gold recovery climbed from 74.6% to 88.6%.
- Gold ounces produced in the plant per quarter climbed from 9,432 ounces to 13,427 ounces.
- Aurelia's all-in sustaining cost, or operating costs, dropped 39% from A\$1,348 (\$977) per ounce to A\$821 (\$595) per ounce.
- The operation did not shut down and several hundred workers retained their jobs.
- The company's large debt was fully paid off in April 2018, with cash more than doubling.
- Because of its improved financial performance, Aurelia was able to buy another mine.

Insights from the PI System also enabled plant managers to shut down a complicated crushing circuit. The analysis showed the circuit was of no help to the overall process; by not operating it, the company could lower its power consumption.

According to Convergio, the plant also made valuable gains related to safety. Processing gold requires cyanide to recover the metal, which is an ongoing hazard. The Hera plant processes complex ore, making it difficult to control. After the PI System was deployed, engineers were able to reduce the variation in cyanide concentration from ± 650 ppm to ± 85 ppm.

Added Benefits

The PI System has proven valuable in other parts of Aurelia’s operations, according to Convergio. In mining, an important downstream step is to accurately determine the content and quality of a metal, a laboratory process called assaying. Data previously in spreadsheets now flows to the PI System for analysis, and Aurelia’s lab staff can then more easily correlate the end product with what is happening in the physical plant process and suggest better adjustments.

Convergio reported that the PI System has also given engineers more freedom to concentrate on more strategic tasks related to operations, looking for new insights from optimized data. Previously part of their job required time-consuming manual data gathering throughout the plant. The data is critical to meet regulatory reporting requirements, but the task was seen as onerous work. The PI System has automated the data gathering, freeing staffers to concentrate and innovate in other areas according to the company.

Table 2-5. Aurelia Metals’ ROI and Benefits

Category	Result
Goal: Turn mine operations around	Investment in PI System, software, system integration, and other technologies under A\$1,000,000 (\$750,000)
Reported Breakeven Time	12 days
Benefits	<ul style="list-style-type: none"> • Gold recovery from 74.6% to 88.6% • All-in sustaining costs lowered by 39% • Debt retired • Avoided plant closure, layoffs • Changes paved way to buy additional mine • Enhanced safety • Better regulatory compliance

(Source: Aurelia Metals)

Section 3

RECOMMENDATIONS

3.1 Successful Pathways

A digital transformation journey begins with a mindset focused on data and infusing operations with the necessary tools to exploit that data.

To capture the full value of a digital transformation platform, Navigant Research recommends the following strategic approach:

- **Establish a strategy for a data platform as a foundational tool.** The strategy should define short-term and long-term goals and outline specific actions on how to achieve these goals. At a minimum, a strategy must answer several fundamental questions:
 - Why should the business invest in a new data platform? Or, what is likely to happen if it does not make this investment? How will that affect the business' bottom line?
 - What are the immediate and longer-term objectives the business expects to achieve with a data platform?
 - What changes internally need to be made once the business adopts a new data platform (e.g., staffing, training, equipment)?
- **Define the costs and TCO.** Count new hard out-of-pocket costs (hardware, software, services, cloud fees, bandwidth) for digital transformation projects as well as the incremental increase existing costs such employee time lost to data management, report writing, ensuring data quality, and curating data that can be often overlooked.
- **Scope the monetary and non-monetary benefits.** ROI can come from reduced costs, increased productivity without an investment in heavy capital, new revenue sources, or an accelerated time to market. There are often more elusive benefits such as enhanced safety, support for regulatory compliance, and increased satisfaction among staff and customers as well.
- **Keep ROI expectations realistic.** A data platform is crucial, but this process is a journey, and the ROI from adopting a new data platform will unfold in stages for most companies.
- **Go step by step.** While there are many steps in adopting a new data platform, a roadmap, even a simple roadmap, is essential to keep the initial phase on track and the people focused. This approach helps break the overall strategy into manageable pieces or steps. It also defines for various teams within the business what is expected for them to support a successful deployment.

- **Top-level management needs to fully support a new data platform.** Sponsorship from the C-suite is essential for such a fundamental shift in the use of data that potentially reaches every level of the organization. This type of support keeps teams focused and provides needed guidance on key spending decisions as those issues surface in the initial phases.
- **Share the strategy and roadmap internally with staff.** This is important all along the journey, so staff members understand the key objectives and can aim for the expected ROI.
- **Select key partners to help reach the expected ROI.** The volume and complexity of data management continues to outpace even the most sophisticated of firms—most cannot do it alone. Choose partners with a proven track record when it comes to a data platform that meets immediate business needs but is also durable and adaptable for the longer term.
- **Adopt a flexible stance.** Achieving a reasonable ROI is not a checkbox. The process of deploying a new data platform involves fundamental changes to the business and its people. A healthy dose of adaptability is in order.

Section 4

TABLE OF CONTENTS

Section 1	1
Introduction	1
1.1 Scope of Analysis.....	1
1.2 Key Findings.....	1
1.3 Navigating a Digital Transformation	2
1.4 Digital Transformation Presents Several Roadblocks.....	3
1.5 The Need for Advanced Tools	4
1.6 Digital Transformation Goals.....	4
1.7 Market Drivers for IIoT and Digital Transformation	5
1.8 Market Barriers.....	6
Section 2	8
Case Studies	8
2.1 Introduction.....	8
2.2 The PI System.....	8
2.3 Company Summary Findings.....	10
2.4 DCP Midstream	11
2.5 AGL Energy.....	14
2.6 Deschutes Brewery	17
2.7 White House Utility District.....	19
2.8 Aurelia Metals Ltd.	22

Section 3	25
Recommendations	25
3.1 Successful Pathways	25
Section 4	27
Table of Contents	27
Section 5	29
Table of Charts and Figures	29
Section 6	30
Scope of Study	30
Sources and Methodology	30
Notes	30

Section 5

TABLE OF CHARTS AND FIGURES

Figure 1-1. Summaries of PI System Case Studies	2
Figure 1-2. IIoT Business Outcomes and Benefits	5
Figure 2-1. OSIsoft’s PI System Modules and Processes	8
Figure 2-2. Screenshot of PI Vision in a Mining Operation.....	10
Figure 2-3. DCP Midstream’s Daily Margin Data Output Using the PI System	12
Figure 2-4. Screenshot of WHUD’s System Showing Water Leakage Areas	20
Figure 2-5. Aurelia Metals’ Hera Processing Plant.....	22
Table 2-1. DCP Midstream’s ROI and Benefits	13
Table 2-2. AGL Energy’s ROI and Benefits	16
Table 2-3. Deschutes Brewery’s ROI and Benefits	18
Table 2-4. White House Utility District’s ROI and Benefits	21
Table 2-5. Aurelia Metals’ ROI and Benefits	24

Section 6

SCOPE OF STUDY

OSIsoft commissioned Navigant Research to analyze its PI System through interviews, customer feedback, market data, and analyst insights into the market. This analysis does not represent an endorsement of the PI System but rather a review of key findings and case studies from the user perspective.

SOURCES AND METHODOLOGY

Navigant Research's industry analysts utilize a variety of research sources in preparing Research Reports. The key component of Navigant Research's analysis is primary research gained from phone and in-person interviews with industry leaders including executives, engineers, and marketing professionals. Analysts are diligent in ensuring that they speak with representatives from every part of the value chain, including but not limited to technology companies, utilities and other service providers, industry associations, government agencies, and the investment community.

Additional analysis includes secondary research conducted by Navigant Research's analysts and its staff of research assistants. Where applicable, all secondary research sources are appropriately cited within this report.

These primary and secondary research sources, combined with the analyst's industry expertise, are synthesized into the qualitative and quantitative analysis presented in Navigant Research's reports. Great care is taken in making sure that all analysis is well-supported by facts, but where the facts are unknown, and assumptions must be made, analysts document their assumptions and are prepared to explain their methodology, both within the body of a report and in direct conversations with clients.

Navigant Research is a market research group whose goal is to present an objective, unbiased view of market opportunities within its coverage areas. Navigant Research is not beholden to any special interests and is thus able to offer clear, actionable advice to help clients succeed in the industry, unfettered by technology hype, political agendas, or emotional factors that are inherent in cleantech markets.

NOTES

Figures are based on the best estimates available at the time of calculation. Annual revenues, shipments, and sales are based on end-of-year figures unless otherwise noted. All values are expressed in year 2018 US dollars unless otherwise noted. Percentages may not add up to 100 due to rounding.

Published 1Q 2019

©2019 Navigant Consulting, Inc.
1375 Walnut Street, Suite 100
Boulder, CO 80302 USA
Tel: +1.303.997.7609
<http://www.navigantresearch.com>

Navigant Consulting, Inc. (Navigant) has provided the information in this publication for informational purposes only. The information has been obtained from sources believed to be reliable; however, Navigant does not make any express or implied warranty or representation concerning such information. Any market forecasts or predictions contained in the publication reflect Navigant's current expectations based on market data and trend analysis. Market predictions and expectations are inherently uncertain and actual results may differ materially from those contained in the publication. Navigant and its subsidiaries and affiliates hereby disclaim liability for any loss or damage caused by errors or omissions in this publication.

Any reference to a specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not constitute or imply an endorsement, recommendation, or favoring by Navigant.

This publication is intended for the sole and exclusive use of the original purchaser. No part of this publication may be reproduced, stored in a retrieval system, distributed or transmitted in any form or by any means, electronic or otherwise, including use in any public or private offering, without the prior written permission of Navigant Consulting, Inc., Chicago, Illinois, USA.

Government data and other data obtained from public sources found in this report are not protected by copyright or intellectual property claims.

Note: Editing of this white paper was closed on January 11, 2019.