OSIsoft's Integration Technologies:
Bridging the OT and IT Gap

OSIsoft Integration Technologies
Enable Digital Information Architectures

OSIsoft®

EXECUTIVE OVERVIEW

As technology lowers barriers to capitalizing on machine and sensor-based data, industries are striving to enable timely, data-driven decisions at every level of the enterprise. Many attempts to undergo this "digital transformation," however, sputter over time or benefit only narrow business sectors.

Why? Although data seems to be everywhere, enterprises typically lack overarching frameworks so it can by used by employees or delivered to systems on both sides of the OT-IT divide. Typically, bridging operational and business systems to create meaningful information requires manual search-and-collation efforts, data conversion and custom coding.

OSIsoft® integrator technologies remove the burden of manually integrating and preparing operational time series data to work with popular business systems and analytics packages such as Esri® ArcGIS®, SAP® HANA® and Microsoft® Azure Analytics®.

Many leading organizations are already benefitting from OSIsoft integration technologies.

- Cemex has reduced the time it takes to prepare enterprise reports from over 70 production sites from 3 days to 1 minute.
- ADM's integrated architecture brings operational data into advanced analytics platforms to identify root cause of equipment failure.
- PJM created a single application to consolidate geographic maps with PJM territory, transmission lines, weather, real-time line and energy flow to improve its dispatchers' situational awareness, ultimately improving grid reliability.

As technologies like IoT, cloud services and advanced analytics disrupt industrial business models, facilitating OT-IT convergence will be key to capitalizing on digital strategies. This paper describes ways to reduce the time, cost and complexity of merging time series data with business systems to uncover latent value and drive innovation.

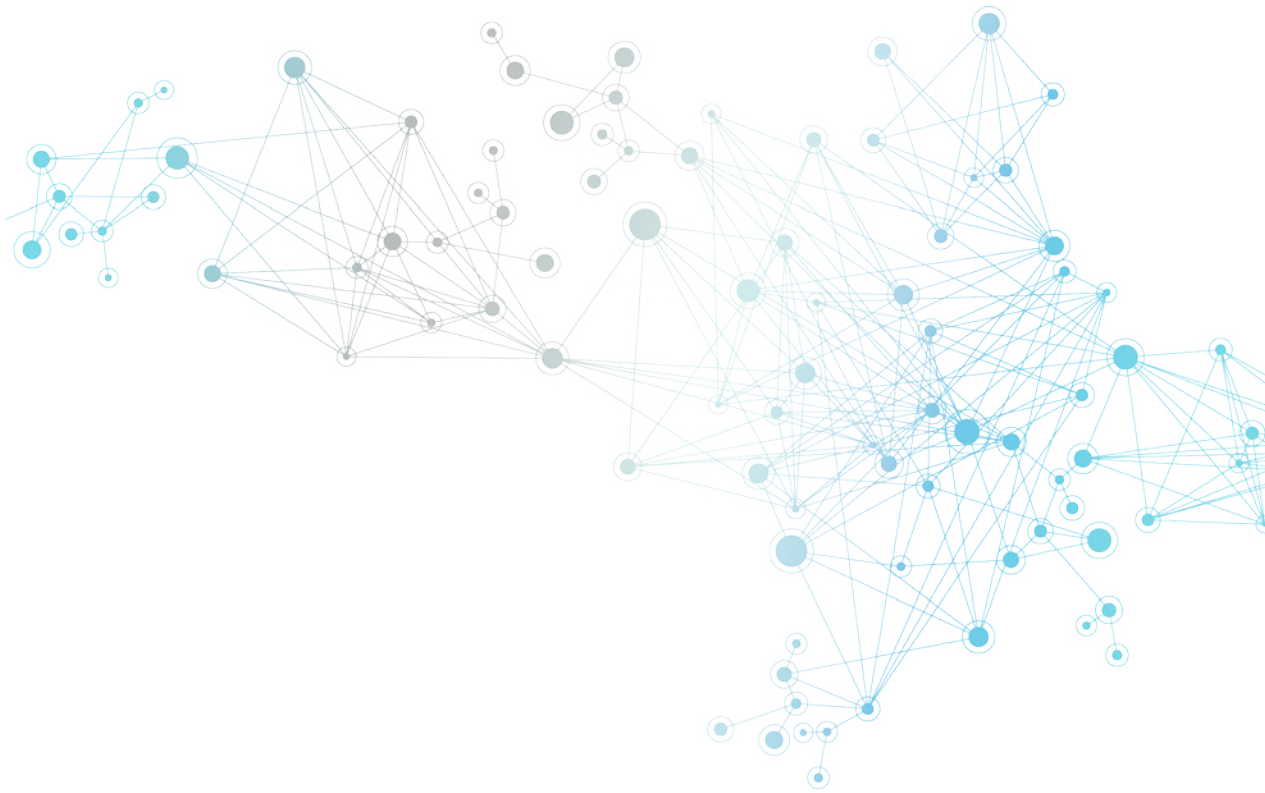
ADDRESSING NEW OPPORTUNITIES

Analysts regularly calculate the potential economic impact of business analytics, machine learning and Internet of Things (IoT) technologies in terms of trillions of dollars. Some of the biggest gains will be made in industrial markets by analyzing operational data from geographically dispersed networks, transportation systems and critical infrastructure from asset-centric industries including utilities, energy and mining. OT data will also be critical to enabling new, often service-based, business models.

Deployed at over 19,000 sites worldwide across multiple industries, OSIsoft's PI System is one of the world's most widely used software technologies for the Industrial IoT.

The PI System captures sensor-based data to monitor industrial energy consumption, asset performance or process efficiency. Engineers, analysts and managers on the plant floor regularly transform PI System data into rich information to make decisions that support lean operations and translate into significant cost reductions.

Integration technologies reduce time, cost and effort to make OT data "analytics-ready" through an automated Cleanse-Augment-Shape-Transform (CAST) process, enabling IT to join trusted operational and IoT data with other authoritative data sets for advanced analytics, geo-analytics and business applications.



PI SYSTEM INTEGRATION TECHNOLOGIES

Choosing to deploy PI System integration technologies instead of leveraging homegrown or custom solutions offers the following benefits:

1. Liberate Human Capital

PI Integrators remove the labor-intensive tasks of cleansing, shaping and pushing time series data for consumption by analytics platforms, data warehouses, GIS and other IT systems. Native connectivity automates data integration without the need for extensive programming or custom applications.

2. Leverage Resources Already in Place

Enterprises make substantial investments to protect and leverage their data - both in software and people. Advanced integration technology connects to systems already in place and includes intuitive user interfaces to quickly and easily publish PI System data to many standard business systems.

3. Reduce Risk and Complexity

Manual data processing, custom coding and multiple SQL queries can be error-prone, jeapordize critical operations and create inconsistency. Ready integration reduces investment risk and cost of implementing joint solutions, ensures consistency across sites and supports security best practices.

MANY FACTORS CONTRIBUTE TO THE OT-IT DIVIDE

Operational data often remains landlocked for many reasons. An article in the New York Times in 2014 said that companies estimated that data scientists spend 50 to 80 percent of their time on the mundane work of data preparation. Resistance to change, fear of security breaches, different organizational priorities and risk to process integrity also weigh heavily against efforts to align architectures across functional departments. Growing volumes of IoT will only amplify the need for governance, context and automated connections.

Data Cleanliness

Machine and sensor-based data reflects real-world conditions and is, by nature, messy. Analysts need to remove gaps, spikes and uneven spacing to make it compatible with table-based data sets. Communication failures, threshold exceptions and different scan rates amplify irregularities.

Fragmented Data Landscapes

Gartner cites that OT systems are typically purpose-built, limiting access and use of OT data for wider purposes. Enabling them to work with business systems to maximize business efficiency (while avoiding negative consequences, risks and pitfalls) makes CIOs' task more challenging.

Inability to Scale

A single mining site can generate over a petabyte per day of raw, sensor-based data. Converting sensor-based data for local insight is one thing – doing it at fleet or enterprise scale is quite another.

Context and Governance

Experts estimate that 80% of data is "dark" – underutilized, unavailable or forgotten. Only a few initial users fully benefit from value built into initial data naming structures. Lack of governance mean that others spend valuable time trying to find the "right" data for analysis.

Corporate Organization

OT often lives in a parallel, but separate, universe from IT and business groups. Even as technical barriers to OT-IT convergence fall, traditional cultural and functional boundaries remain.

Safety and Security

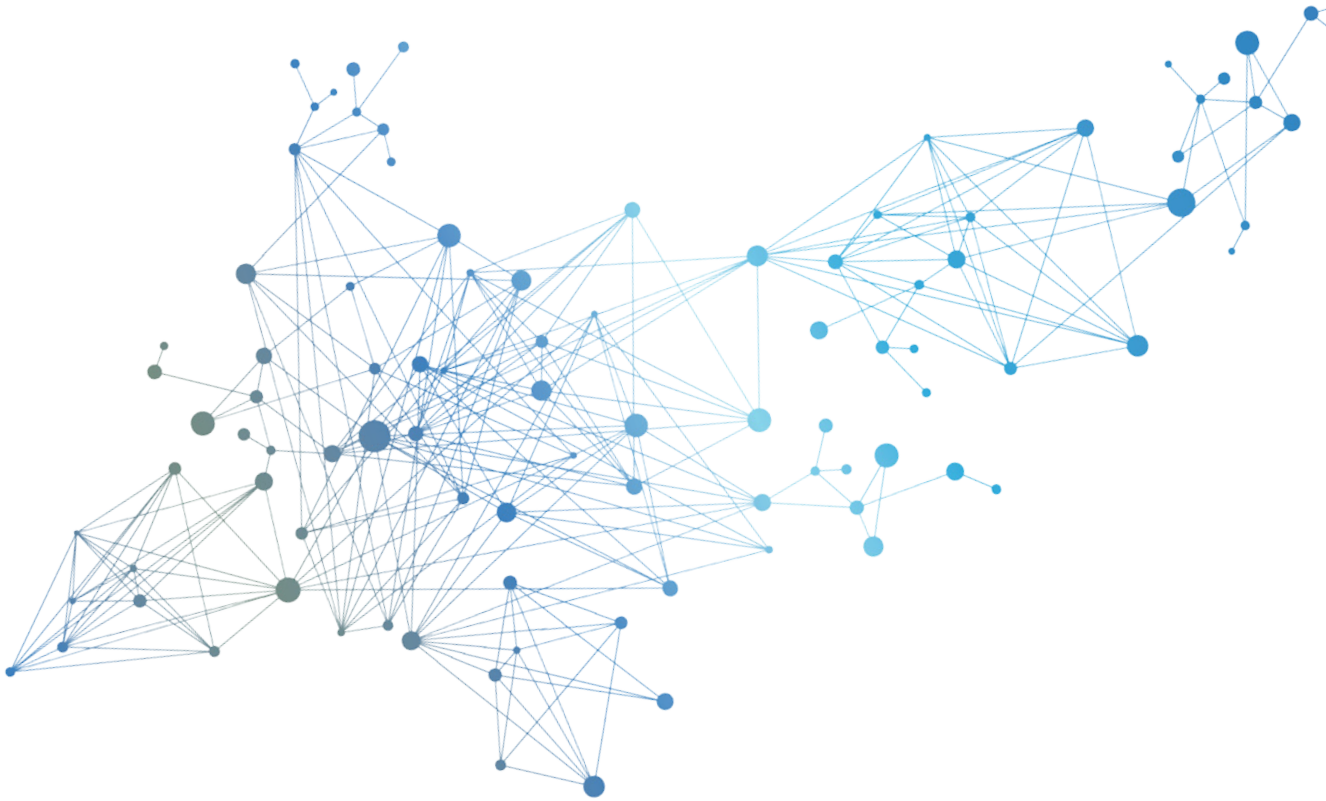
Many organizations create a demilitarized zone around OT systems that includes firewalls, data diodes and one-way networking systems as well as razor wire and personnel access control. Even when a company wants additional stakeholders to have access, clearance has to be obtained.

THE PI INTEGRATOR FAMILY

High quality machine data is the lifeblood of countless organizations. As industry re-imagines how it uses information, OSIsoft is creating a family of integration tools to remove barriers to bridging operational and business environments.

OSIsoft currently offers a suite of integrators to bridge the OT-IT gap. They include:

1. The SAP HANA Integrator by OSIsoft
2. The PI Integrator for Esri ArcGIS
3. The PI Integrators for Business Analytics
   - Business Intelligence Edition
   - Data Warehouse Editions
     - for Hadoop HDFS
     - for Hadoop HIVE
     - for Oracle RDBMS 11&12



SAP HANA IoT Integrator by OSIsoft

SOLUTION APPROACH

The SAP HANA IoT Integrator by OSIsoft extracts, cleanses and shapes time series data to create a purpose-built view that can be consumed by SAP HANA. Once consumed, HANA's pure in-memory design provides near real-time analysis results for rapid testing and decision support.

The SAP HANA IoT Integrator by OSIsoft enables customers to maximize the value of existing data and systems by removing the complexity of:

- Accessing rich data sets generated by a variety of control and automation systems as well as smart devices.
- Merging trusted operational data with transactional business data.
- Analyzing integrated data sets in time to impact business.

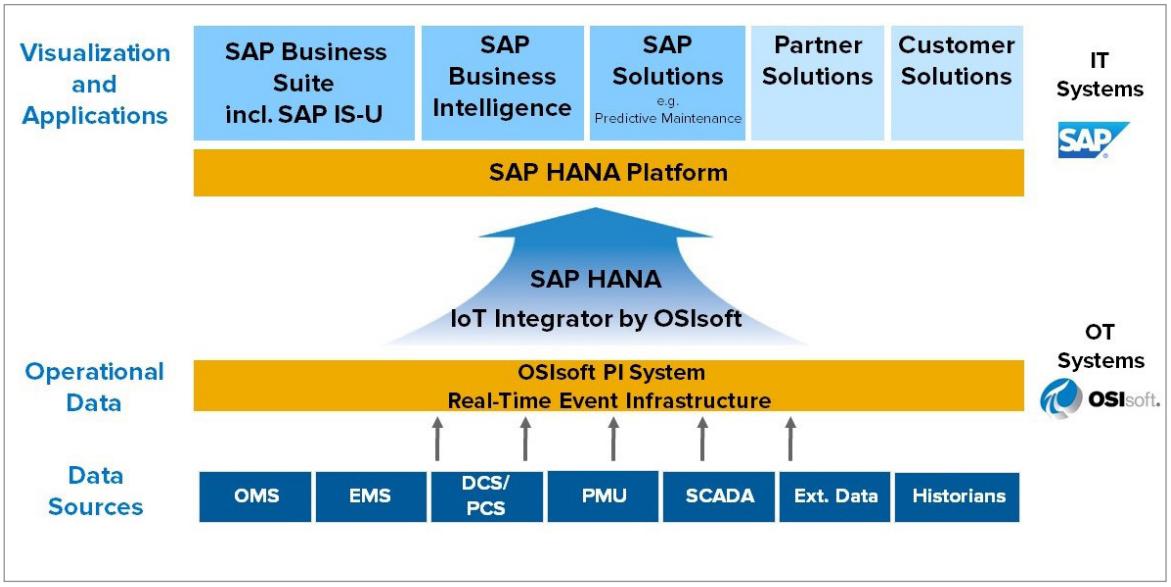
Ready integration reduces investment risk of implementing joint solutions, reduces costs and fosters collaboration by easing integration of normally siloed data sets.

SAP CUSTOMER EXAMPLE

EDF Renewable Energies (EDF-RE) is in the business of producing green energy. In North America, they design, construct, maintain and operate 4.1 gW large-scale wind farms and solar facilities. EDF's strategy as a responsible electricity company includes championing low-carbon growth included the following goals:

- Doubling the size of renewable energy
- Embracing digital transformation
- Growing closer to customers

Though EDF and OSIsoft are longtime partners, EDF-RE's North American PI System implementation is still growing rapidly. Recently, EDF-RE added the SAP HANA IoT Integrator by OSIsoft to their infrastructure to enable near real-time reporting of integrated operational, business and geospatial data. Using the integrator to send operational data into the SAP HANA platform enabled EDF-RE to bring diverse data types like contract, lease, geo-spatial and CRM data together to build business intelligence. EDF-RE's enterprise data platform supports a single source of truth and self-service analytics. They have already seen a 92% reduction in report run times and an 86% reduction in database size. Pulling data from SCADA and Excel spreadsheets for curtailment calculations used to take weeks – now it takes minutes. EDF-RE believes that the joint solution will ultimately enable them to grow closer to customers through better performance and service.

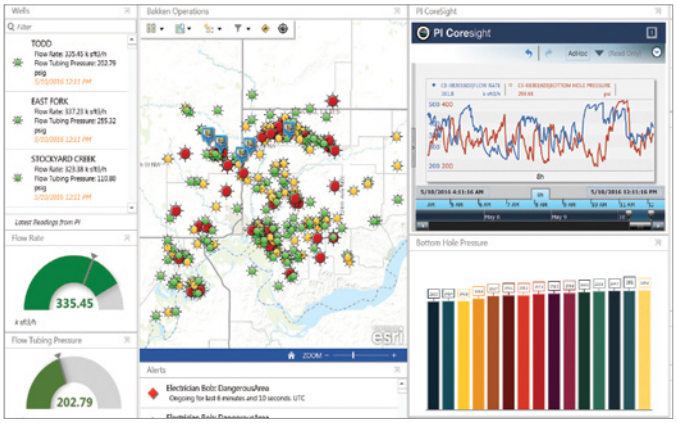


PI Integrator for Esri ArcGIS

SOLUTION APPROACH

More and more, enterprises are using data to manage operations outside enterprise walls. Vast pipeline networks, heavy trucks, wind farms, and miles of power lines are critical parts of the value chain, but often, operations staff is small. Many times, remote staff has to mentally integrate information from multiple applications or rely on tribal knowledge to optimize workflow.

The PI Integrator for Esri ArcGIS is an automated, no-code solution that publishes time series data using standardized methods to work in the Esri ArcGIS environment. Instead of juggling multiple applications, mobile workforces can converge on targeted solutions through a single application that combines geography, operational context and real-time data.



Digital maps animated with real-time data, customized widgets and self-service analysis tools enable customers to:

- Expand real-time situational awareness across geographically distributed operations
- Integrate diverse data to simplify information normally presented through multiple applications
- Eliminate the need for custom coding and in-house solutions

ESRI CUSTOMER EXAMPLES

PJM Interconnection

As one of the largest transmission operators in the country, PJM Interconnection is responsible for maintaining grid reliability and running energy markets across 13 states and the Washington DC area. To improve its operators' situational awareness during conditions that disrupt grid reliability, PJM developed the Dispatch Interactive Map Application (DIMA) to bring real-time grid, weather and spatial data together.

PJM uses approximately 1.6 million PI System data tags to monitor the statuses of lines, flows on lines, megawatts and various other data. To launch DIMA, PJM was considering custom solutions to deliver PI System data to GIS, but none were desirable. PJM states that "when the PI Integrator for Esri Arc GIS was announced, they shifted gears."

"This is what the dispatchers have been wanting to do for a very long time."

- E. Kovler, PJM Interconnect

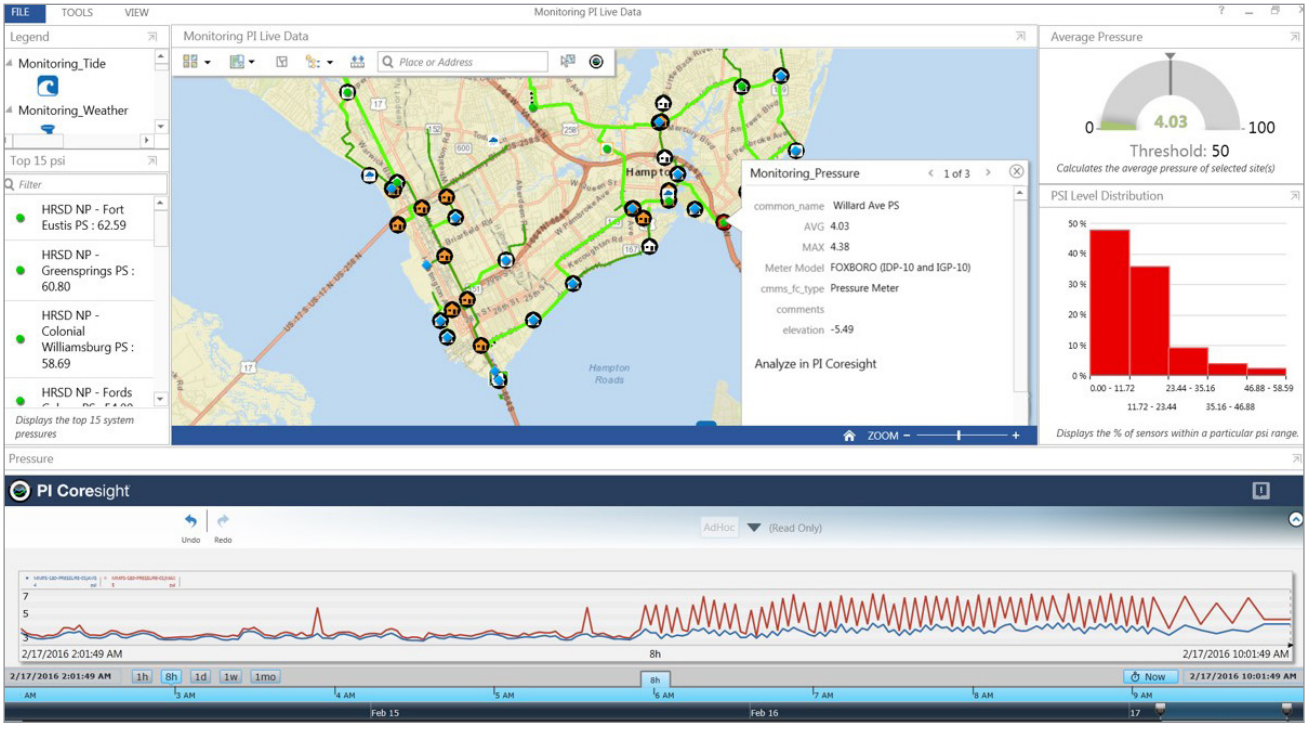
PJM's solution now allows operators to pull DIMA up to see the real-time status of transmission lines, radar for weather overlays as well as necessary operational data. The joint solution satisfies PJM's goal of creating a single application for dispatchers to accelerate time-to-solution and ultimately improving grid reliability.

Hampton Roads Sanitation

Hampton Roads Sanitation District (HRSD) treats 249 million gallons of water a day and has more than 500 miles of pipes, 112 pump stations and 9 major treatment plants. HSRD implemented the PI System to manage a “growing data monster” including flows, pressures, wet well levels, pump runtime events and rainfall throughout their system. Still, visualizing the status of their collection system quickly and effectively was a challenge.

With the release of the PI Integrator for Esri ArcGIS, HRSD combined Telog meter data with their ArcGIS platform. Working with OSIsoft, HRSD developed a pilot ArcGIS Operational Dashboard to quickly inform users of the “Top 15 Pressures” (see figure below) in the system. The dashboard included a histogram of pressure distribution in the collection system and enabled users to visualize averages, sums and KPIs for specific assets and quickly display the distribution of pressure over their entire coverage area.

With near real-time data on the ArcGIS platform, operators gained a better understanding real-time system conditions. Future goals include making the information available to mobile work forces and interceptor crews to increase safety during inclement weather events and decrease reaction time to system issues.



PI Integrator for Business Analytics — BI Edition

SOLUTION APPROACH

The PI System stores source data in its original fidelity, ensuring that the data accurately represent the physical behavior of industrial assets and processes. Because it reflects the physical behavior of assets and processes, high-fidelity time series data has natural gaps, spikes or uneven spacing, creating significant challenges when integrating with BI tools for large-scale analytics and automated reporting.

The PI Integrator for Business Analytics (BI Edition) extracts and cleanses PI System data to create a purpose-built view ready for consumption by many BI and visualization tools without disrupting production environments.

Alternative approaches directly query production archives, lowering the performance of BI tools.

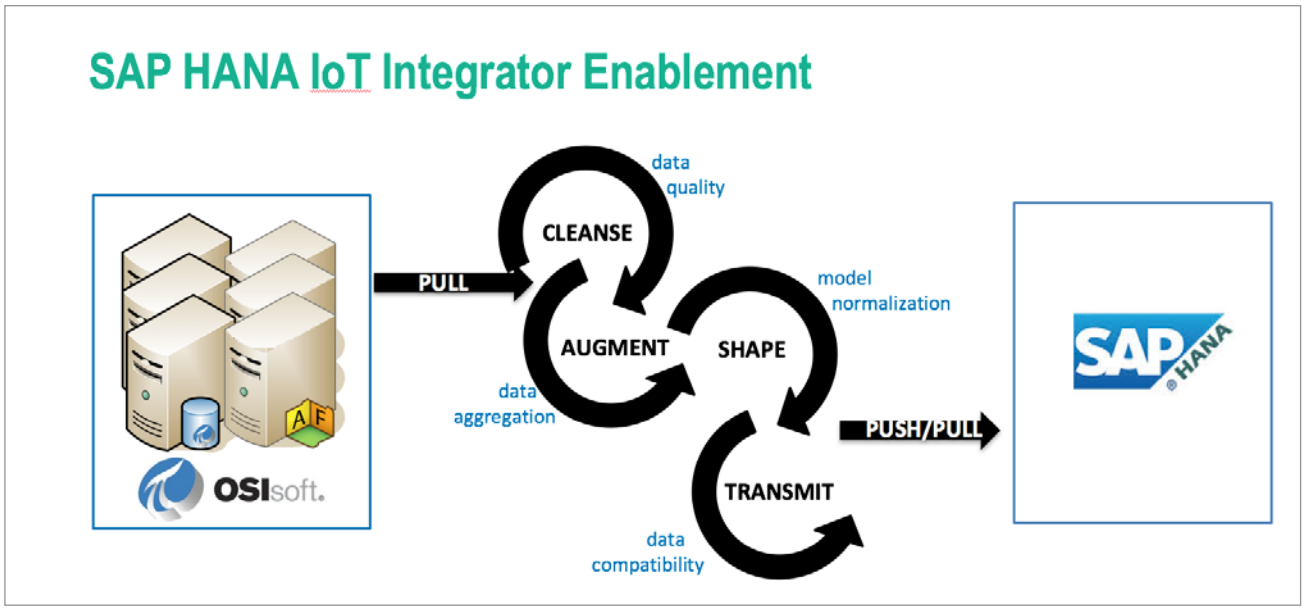
PI Integrators:

- Remove the burden of converting time series data to work with standard business analytics tools.
- Empower operations to deliver trusted data sets to the rest of the organization.
- Reduce costs and time to solution by leveraging existing tools, including Tableau®, MATLAB®, Microsoft® Power BI®.

CUSTOMER EXAMPLE

At its Leismer facility, Statoil Canada produces ~20,000 bbl / day of bitumen using InSitu steam-assisted gravity drainage (SAGD) production. To increase bitumen production while decreasing steam costs, they implemented a joint OSIsoft-Tibco Spotfire solution for fleet-wide SAGD production analysis.

As a technology-driven company, Statoil had already invested in a heavy sensor density for their production wells. The PI System was collecting high resolution data (sample rates of one time/second) for analysis purposes. Connecting Spotfire directly to the high-resolution PI System data overwhelmed the tool, taking hours to load.



"Our initial attempt was to connect Spotfire directly to the PI System. Something I'm sure a lot of us have tried..."

- S. Park, iSolutions

The team used the PI System technologies to compress data, align values across a consistent time stamp, and combine sensor data with data from other systems and build KPIs into the solution.

Now, engineers have a better handle on data. High resolution PI System data still supports daily operations, and Spotfire displays enable engineers to understand how each pad is performing. The solution has already surpassed its return on investment just by eliminating man hours spent on data conversion. Statoil has also seen uplift from production optimization, reduced need for training and unexpected collaboration with other teams in the organization.

PI Integrator for Business Analytics — Data Warehouse Edition

SOLUTION APPROACH

The PI Integrator for Business Analytics (Data Warehouse Edition) extracts PI System data from the Data Archive, cleanses it and securely delivers it into enterprise data warehouse platforms. Time series data can then be exported at scale into native tables and joined with other authoritative data sets such as financials, customer records and supply chain information so people can focus on higher level tasks.

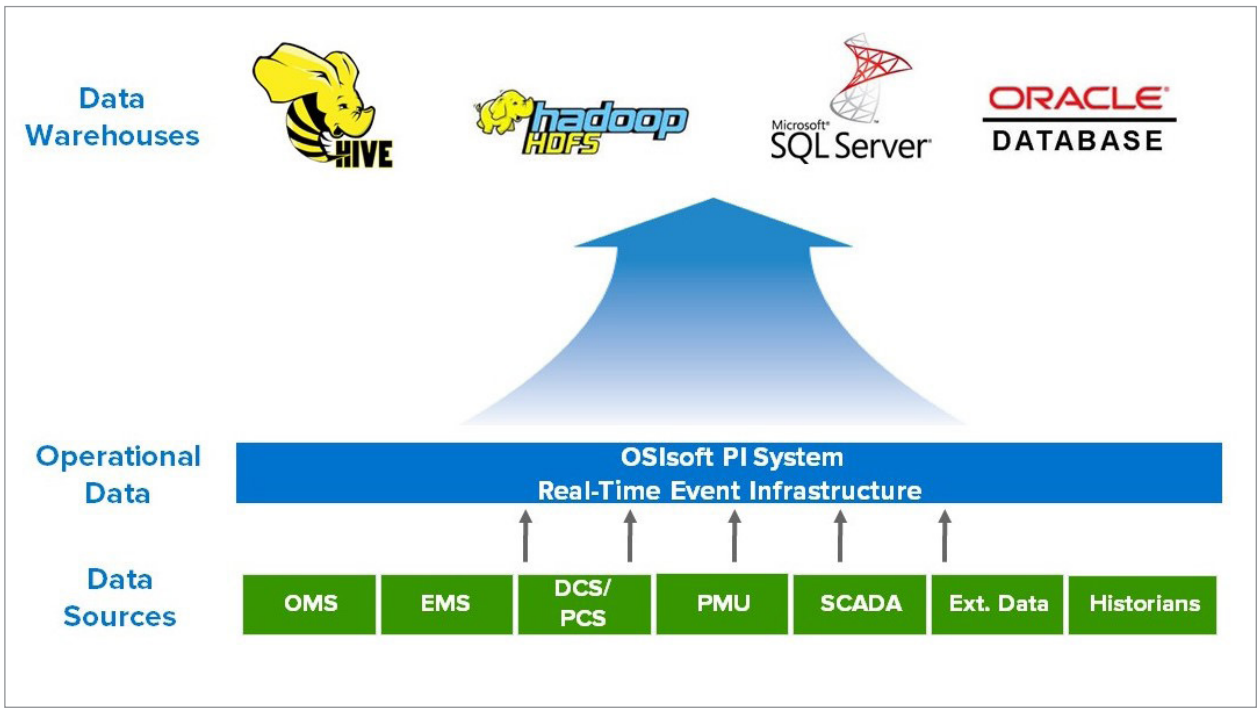
The integrator:

- Removes the burden of converting time series data to work with data warehouses
- Empowers IT to leverage operational data sets for business analysis and corporate reporting.
- Provides seamless, out-of-the-box connection from the PI System to reduce costs of labor-intensive data conversion and custom coding
- Leverages existing investments in people and tools.

CUSTOMER EXAMPLE

CEMEX has a presence in more than 50 countries throughout the world, yearly sales exceeding $15 billion and cement operations stretching across 21 countries. To accelerate business across their 70 sites, Cemex created an enterprse Cement Production Management initiative to integrate operational data with BI tools and ERP for sales, production planning, and finance.

While Cemex utilized the PI System for its operational data for years, this data was not immediately compatible with IT systems. Deep data analysis projects comparing plant productivity or other critical metrics typically started with extensive data harvesting, conversion and analysis – a lengthy and painful process.



"In the end, you are shortening the continuous improvement cycle because you have fast information"

- R. Quintero - CEMEX

To accelerate data management, Cemex adopted PI System integration technologies. By Cemex's estimates, the time just to extract data from 70 sites for production reports has declined from 744 hours to 5 minutes. Data preparation took 3 days. Now, it takes less than a minute. Automated data preparation also allows Cemex to share operational data with more employees. Cemex has said that this "democratization of data" will help the company achieve even better processing results.

EVOLVING THE INTEGRATOR FAMILY

New Data Warehouse editions of the Integrator for Business Analytics continue to improve usability, detect Asset Additions and update views. In addition, new releases convert native time series data to create event views for:

- Hadoop HDFS
- Hadoop HIVE
- Oracle RDBMS 11&12

Other upcoming releases include the PI Integrator for Microsoft Azure to provide decision-ready PI System data that works with Microsoft's Cloud so users can fully leverage Microsoft's PowerBI, SQL DataWarehouse or Azure SQL and AzureML for advanced machine learning.

CUSTOMER EXAMPLE

Archer Daniels Midland (ADM)

A global food processing corporation, ADM wanted to use predictive analytics to end the premature failure of a specific piece of farming equipment. When this specific type of machine fails, it must be completely rebuilt at a cost of $50,000 per unit. With hundreds of possible variables, pinpointing an exact cause can be problematic. Is the failure related to the flow of the feed? The composition of the feed? The physical location o the equipment? Do causes differ from location to location?

A longtime OSIsoft customer, ADM created Asset Framework and Event Frame models with the PI System to narrow down the problem to identify the key variables that affect the failure rate and then built Azure machine learning models that could analyze the interaction of these key variables.

"We have made more progress in the past 6 months at ADM with operational data via [the] PI System than we have had in the past 14 years."

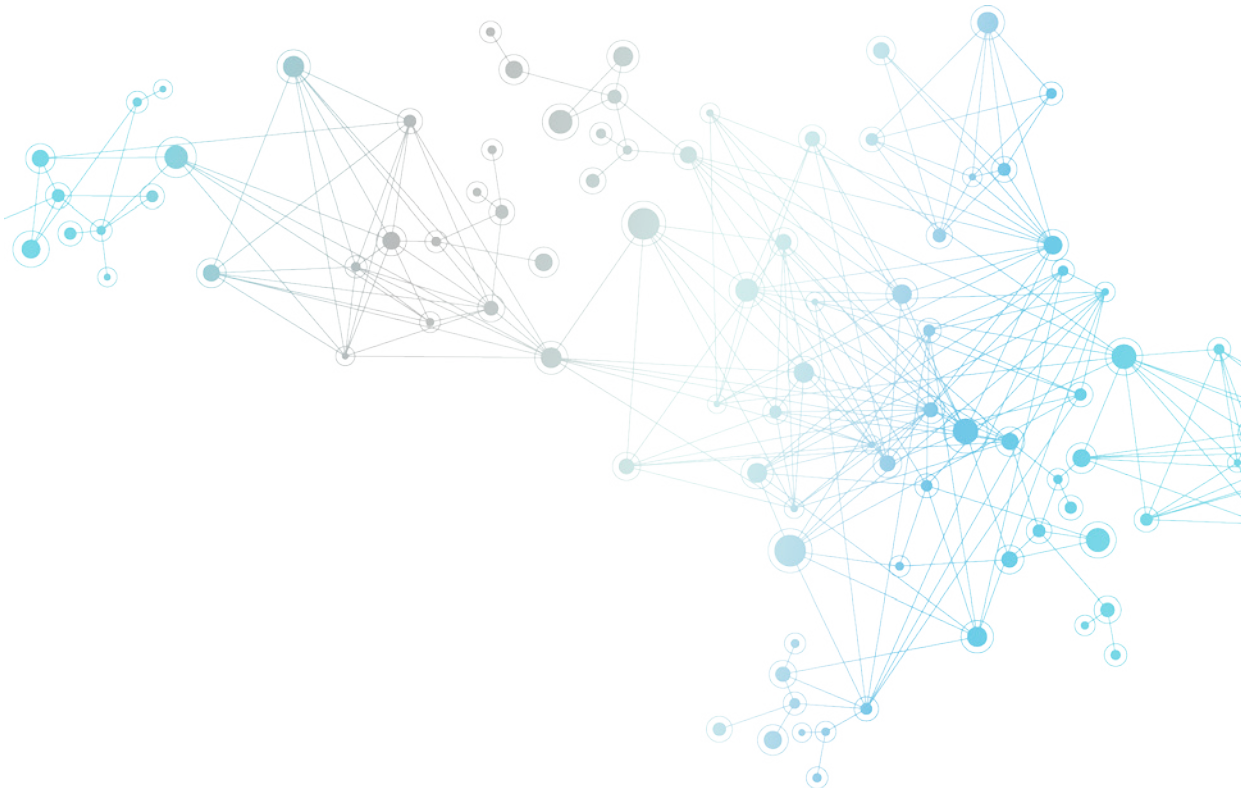
- Erik Roukens, Manager Operational Excellence

ADM integrated Cortana Intelligence and Power BI on their PI Systems and delivered analytics-ready data, context and events to Azure SQL Data Warehouse. ADM is in the process of deploying the Azure machine learning model to analyze data from 28 of the systems at two locations. Over time, the predictive model may potentially be used at hundreds of other locations.

CONCLUSION

Bridging the OT-IT gap is a critical step to enabling digital transformation. By automating data integration and eliminating information silos, everybody inside an organization – from an operator to the C-suite – can begin to understand how their actions affect profitability or productivity in real time. Live, active insight from operational data will play an instrumental role in cutting costs, energy and emissions, improving the return on capital and accelerating the development of new products. It's no exaggeration to say that data will be the most valuable resource for most companies in the future.

OSIsoft's PI System Integrator technologies reduce the economic and technical barriers to achieving OT-IT convergence. They build upon existing investments to create technical frameworks that protect operational environments yet extract the true value of their information.



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ABOUT OSISOFT

With the belief that people can improve process efficiency, manage assets and mitigate risk if they have access to the data they need, OSIsoft created the PI System as a common data infrastructure to capture and store real-time data and make it available however and wherever needed. For over 30 years, OSIsoft has delivered the PI System with the singular goal of creating a common data source to connect enterprise data with people making decisions and solving problems.

Today, the PI System is trusted to do just that. Processing over 1.5 billion data streams across 19,000 sites, the PI System is embedded in operations and critical infrastructure in over 125 countries. Our customer base includes Fortune 100 and Fortune 500 companies in power generation, oil and gas, utilities, metals and mining, transportation, critical facilities and other industries.

To see any of the 1100+ customer success stories, product descriptions or global initiatives, please visit **www.osisoft.com**.

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