

WHITE PAPER

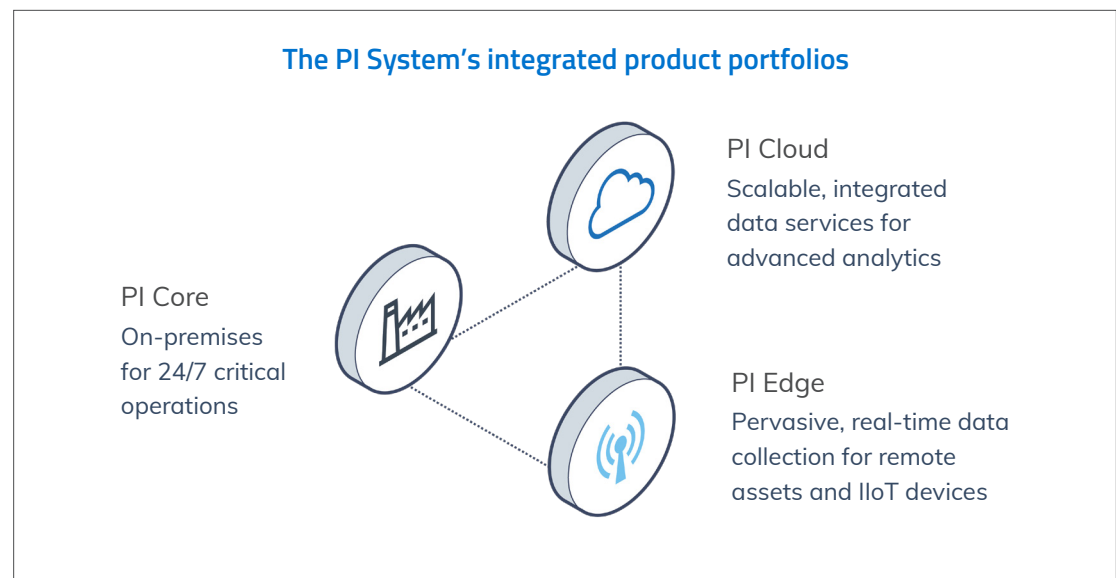
A real-time asset-monitoring system for railway owners and operators

Operational insights are instrumental to any railroad's future success. The PI System™ enables you to make data-driven decisions that drive bottom-line results.



The railroad industry is under pressure to improve reliability, optimize operations, and increase safety.

The PI System delivers critical insights anytime, anywhere, so you can strengthen rail operations and secure future success.



The PI System helps you collect, store, interpret, and share real-time operations data from plant (PI Core) to edge (PI Edge) to cloud (PI Cloud).

For over 200 years, railroads have cost-effectively delivered bulk items and hazardous materials to locations across the country. However, rail companies face increasing challenges while other modes of transportation continue to erode their market share. Network-infrastructure capacity is stressed, customers are demanding increased transparency, and rail operators must mitigate the risks associated with transporting hazardous material. To stay competitive, rail owners and operators need real-time situational awareness across every asset in the value chain.

The PI System lays the foundation for digital-transformation success. By acting as a single source of truth for operations data, the PI System delivers real-time contextualized insights so you can optimize assets, predict behavior, and prevent catastrophe. With the PI System, you can easily balance system capacity with efficiency, longevity, and risk.



End-to-end railway visibility

Most railroad companies collect data from numerous assets. However, fragmented sources and systems create data silos, making data difficult to access. This ultimately prevents companies from accessing real-time situational awareness and generating valuable insights.

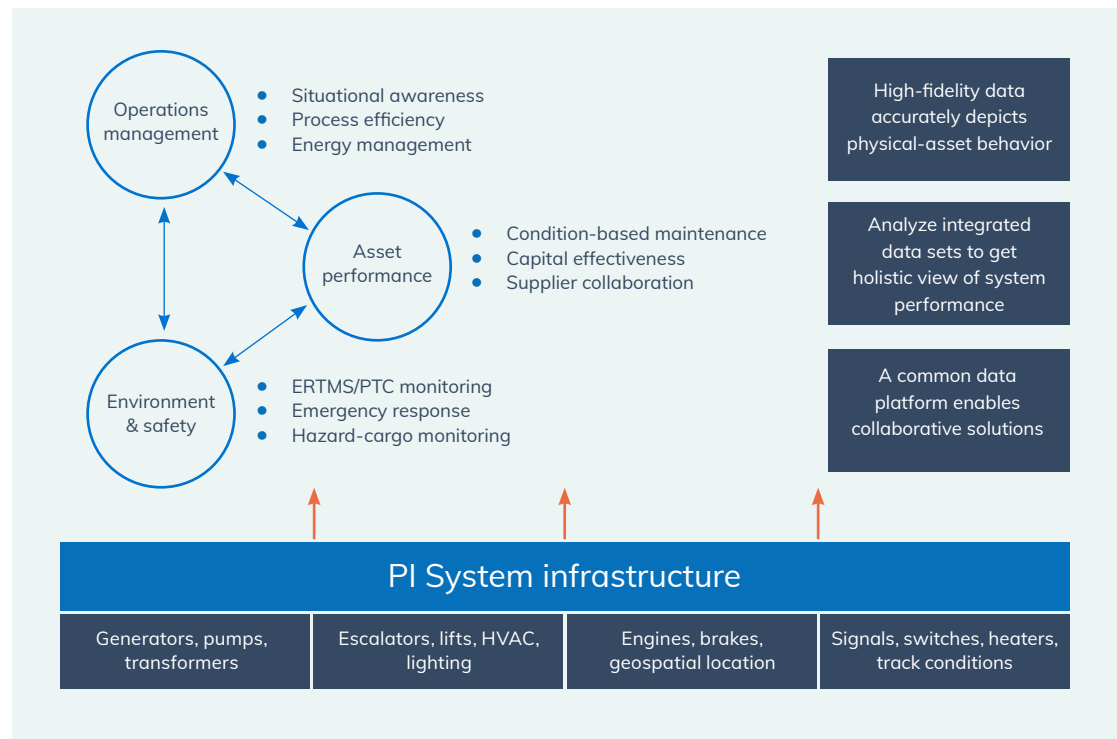
As industry pressure continues to mount, you must extract every bit of value from operations data. This requires all data—including rolling stock, track, signaling, and electrification—to be available in one system and in real time.

The PI System is a data-management platform that transforms operations data into information to validate the state of physical operations. Using the PI System, you can track asset usage and health, and even view asset data within your GIS platform.

Numerous railroads—and two-thirds of the industrial Fortune 500—rely on the PI System for:

- Energy, resource, and facilities management
- Asset health and condition-based maintenance
- Process efficiency and improvements
- Safety and regulatory compliance
- Emergency response
- Hazardous cargo monitoring
- ERTMS/PTC monitoring

Transform rail operations with the PI System



PI System capabilities:

- Integrate rolling-stock, signaling, track, and electrification data, regardless of vendor.
- Increase asset availability and network safety by analyzing holistic, integrated data sets.
- Optimize maintenance by using real-time asset-condition notifications to initiate MRO workflow.
- Centrally manage distributed-asset software components.
- Securely share data with trusted partners to forge collaborative solutions to cross-modal initiatives.
- Accurately assess and report operating costs to create transparency for auditors, stakeholders, and customers.



The PI System

Three integrated product portfolios turn operations data into valuable insight.

The PI System

- **PI Core:** Collect, store, enhance, and deliver sensor and time-based data from critical operations to people, platforms, and applications on-premises.
- **PI Edge:** Expand data collection to remote locations and sensor-enabled equipment outside your on-premises control system. Expand data access to field technicians.
- **PI Cloud:** Expand data storage and enable broader data access using cloud-based operations data management services.

Benefits for operations

- Single system of record for consistent decision-making.
- Add context and meaning to data without programming.
- Easy, self-service access and visualization of real-time data.

Benefits for business

- Full security across all domains.
- Data aggregation in distributed environment.
- Rapid integration with analytic tools, enterprise applications, and decision support systems.



Collect data from every valuable source

The PI System maintains a system of record for operations data collected from many sources and used by engineers and analysts across your organization.

The key to developing valuable and accurate insight begins with capturing data from every relevant source. Railroads contain a diverse set of assets, from proprietary and industry-specific systems and equipment that is no longer sold to remote, mobile, and smart Industrial IoT devices. The PI System lets you capture data automatically from any source to ensure full integrity and liberate your employees from tedious manual collection.

Operating sites and plants

On-premises at operating sites and plants, PI Core products pull real-time data from complex industrial systems such as programmable logic controllers (PLCs), distributed control systems (DCSs), SCADA, instrumentation, laboratory information management systems (LIMS), and others. Legacy equipment is no problem. We've developed over 450 native interfaces and 20-plus smart connectors across vertical segments that work out of the box to collect data and centralize it in a common data archive.

Remote assets and IIoT devices

As a result of digitalization, many industrial companies now have hundreds, or even thousands, of sensor-enabled devices located beyond their core operating facilities. PI Edge products collect data from these assets to expand insight across a distributed operating environment. Some companies even use data from equipment deployed at client sites as the foundation for new service offerings. PI Edge products let you tap data streams from:

- Smart IoT devices
- Mobile assets with intermittent connectivity
- Assets in rugged environments
- Assets deployed in environments without technical support
- Assets deployed at customer sites



Manage and enhance data to increase value

Once the data has been gathered, PI System software helps you transform, refine, calculate, and contextualize data, making it easier to uncover operational and business insights.

Single source of truth

The PI System maintains a system of record for operations data used by engineers in different domains and by analysts at the enterprise level. This architecture eliminates data silos and gives everyone access to a single source of truth. With the PI System, you can store millions of data points and decades of history to support trending, benchmarking, and predictive analysis. New data is seamlessly integrated as it arrives in real time, whether that is once every hour, minute, or fraction of a second.

Metadata and data context

Operations data arrives in massive volumes, and it can be hard to interpret thousands or even millions of data streams. PI System products let operators and engineers define metadata to help those using the data to understand the bigger picture. Additionally,

PI Core products let your team easily create reusable data structures to aggregate and organize data in meaningful ways. With this feature, you can view data by asset type, location, process, or any other useful category. Being able to see data in context helps new employees identify anomalies and trends just like more experienced engineers.

Analytics and event tracking

PI System products provide analytic tools you can use to track key performance indicators. Compute simple averages and unit conversions, as well as more sophisticated calculations like total energy usage or the days of raw material remaining. You can also define key events in your production process to trigger data collection and compare data to similar events. If performance degrades and action is needed, the PI System lets you send automatic email notifications in real time to appropriate team members.

Deliver data securely and efficiently

The PI System is a cost-effective choice for railroads deciding whether to buy or build an operations data store to support analysts and data scientists.



In operations, the more widely you share data, the more valuable it becomes. PI System products ensure the safe and fast delivery of high-quality operations-data across your enterprise—to the people, analytic tools, and applications that turn data into insight.

Operations engineers and management

PI Core is the heart of the PI System, running on-premises in critical operating environments. PI Core empowers operators and engineers with easy, self-service data-access tools to drill down and view relevant data without using programming skills. Plant managers can pull data into familiar Excel spreadsheets to see data trends and create regulatory reports. Process engineers can view data in mobile-friendly dashboards or process displays.

Data scientists and analysts

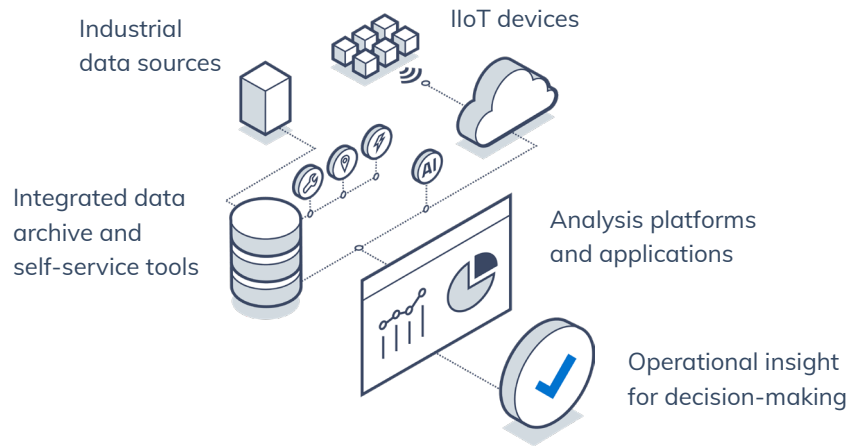
Operations data can also be a gold mine for business analysts, data scientists, and leaders

of digital transformation. The PI System includes products to shape and format operations data for fast and secure transfer to business and scientific platforms used for deeper analysis.

Integration products provide out-of-the-box data delivery to popular enterprise applications and platforms such as Apache Hadoop, Esri ArcGIS, Microsoft Power BI, SAP HANA, Seeq, TrendMiner, and more.

The PI System is a cost-effective choice for companies deciding whether to buy or build an operations data store to support data scientists. The PI System handles all the complexity associated with defining, integrating, enhancing, and maintaining operations-data, and offers programmatic access to data through standard REST APIs. This means data scientists spend less time on data hygiene and preparation, freeing them to focus on analysis and next steps.

The PI System's edge to plant to cloud architecture



The PI System enables data collection, enhancement, and sharing throughout a distributed enterprise and business ecosystem.

Secure data sharing

Digital transformation is expanding interest in operations data beyond the enterprise to a growing network of third-party service providers and supply chain partners. PI Cloud makes it easier to share operations data by offering an operations database management service, providing programmatic access to aggregated data for analysis and

decision-making. For example, an oil and gas exploration venture can share drilling data among its partners. Because the service is cloud-based, it easily and cost-efficiently scales to handle any volume of operations data. PI Cloud lets you share select operations data with authorized users anywhere, anytime.

Summary

The PI System is an edge-to-cloud data-management system that provides trusted operational data for data-driven decision-making and digital transformation in a distributed enterprise. The PI System supports pervasive data collection from operating sites, assets, and sensor-enabled devices. It enhances data streams with useful contextual information. The PI System delivers cleansed and formatted data to analysis tools, data science and AI/ML platforms, and

applications. The seamless integration of PI System products across the operations core, at the edge, and in the cloud ensures data integrity and allows data to be shared securely outside the industrial-control network. The PI System empowers employees across and beyond the organization with ready access to a rich set of operations data to visualize trends, reveal relationships, and support new business opportunities.

About OSIsoft

The world's most essential and complex industries rely on OSIsoft to manage the lifeblood of the industrial enterprise: operations data.

OSIsoft is a pioneer in data-infrastructure strategy and a global leader in operations data management software. The company brings over 40 years of experience helping industrial organizations meet next-generation demands for efficiency, reliability, security, sustainability, and resilience.

OSIsoft's market-leading PI System is the proven system of record for operations data in essential sectors such as power generation and utilities, water, oil and gas, mining, metals, manufacturing, pharmaceutical,

facilities, transportation, food and beverage, and more. Every day, industrial professionals in 146 countries rely on the PI System to improve performance, protect health and safety, keep the lights on, and make the world run more smoothly.

Learn why two-thirds of Fortune 500 industrial organizations choose PI System at www.osisoft.com.

Corporate Headquarters:

1600 Alvarado Street

San Leandro, CA 94577, USA

Contact: +1 510.297.5800

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