Secure, shared access to operations data is essential to capitalizing on the Industry 4.0 opportunity. Integrated edge-to-cloud data platforms are key to liberating operations data and removing the boundaries to broader use by multiple stakeholders.

Enabling the Industry 4.0 Ecosystem with Edge-to-Cloud Data Management

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Introduction

For industrial companies, new technology capabilities are creating opportunities to improve product and service experiences for customers and increase the efficiency of operations. These Industry 4.0 initiatives rely on interconnectivity, automation, machine learning, and real-time data to create value through data-driven decision making that crosses organizational silos and yields new visibility into assets and processes.
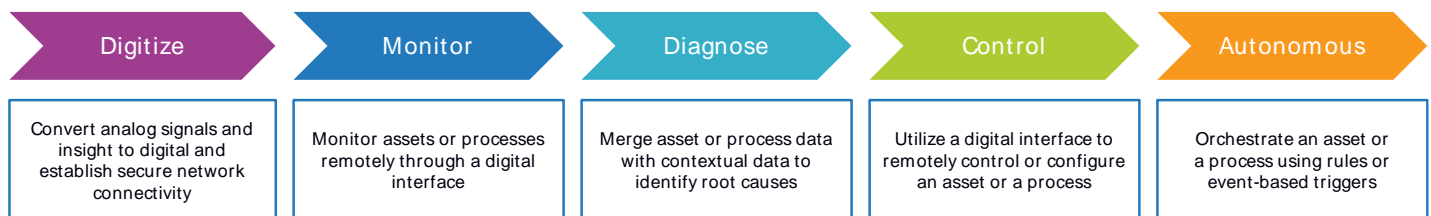
Industrial control systems and operating assets create immense amounts of disparate data, and with the increasing focus on Industry 4.0 opportunities, it is important for industrial companies to have the infrastructure in place to harvest and use this data. According to IDC's 2020 *Worldwide IT/OT Convergence Survey,* roughly 50% of companies surveyed expect their operational data to grow by 15% or more over 12 months. Industry 4.0 requires that companies effectively manage all relevant operations data as well as ensure the security of that data and efficiently use it to create value across a wide range of use cases (see Figure 1).

AT A GLANCE

KEY TAKEAWAYS

» Reliable, real-time operations data is vital to Industry 4.0 use cases that create new value.

» Sharing trusted data with key enterprise stakeholders and ecosystem partners maximizes mutual value creation and enables new operating and service models.

» Integrated edge-to-cloud data platforms harvest data from diverse control systems and remote assets and securely share with users outside operations to expand business impact.

FIGURE 1: *Industry 4.0 Continuum of Capabilities*

Digitize	Monitor	Diagnose	Control	Autonomous
Convert analog signals and insight to digital and establish secure network connectivity	Monitor assets or processes remotely through a digital interface	Merge asset or process data with contextual data to identify root causes	Utilize a digital interface to remotely control or configure an asset or a process	Orchestrate an asset or a process using rules or event-based triggers

Source: IDC, 2021

Complicating matters is that many critical use cases require that time series data streams from operational technology (OT) systems be analyzed along with nonoperations data managed by corporate IT. Enterprise-level analysts and decision makers, therefore, need secure and controlled access to domain-specific operations data to realize the full shared value across use cases such as predictive maintenance, intelligent supply chains, and remote monitoring and diagnostics.

The dual requirements to support real-time decision making and extend secure data access to new roles and systems demand that users have the ability to view, analyze, and act on contextualized operations data both at the edge and in the cloud. It can be said that in industrial operations, an enterprise cannot have a cloud strategy without an edge strategy. Integrated edge-to-cloud data platforms are critical to enabling seamless and synchronous operational data access for authorized users wherever they are located and for the different roles and ecosystem partners now requiring it.

Advancing Industry 4.0 with Edge-to-Cloud Data Platforms

Historically, industrial organizations have primarily gathered information on their operations in on-premises data management systems that allow for data access primarily by local engineers and plant managers. These on-premises OT systems were designed to meet the security, low-latency, and reliability requirements of operations. With increasing digitalization of operating assets, new industrial Internet of Things (IIoT) technologies, the growth of data science, and predictive modeling based on digital twins, the value of operations data has expanded far beyond local operations.

Industrial companies are now adopting edge technologies to collect data outside the primary control network from IIoT devices or remote sites. This data supplies critical information that can be used to increase asset efficiency and ensure operating safety. Cloud technologies allow operations data to be more holistically analyzed and democratized as well as support data sharing with previously siloed applications and stakeholders outside operations.

IT/OT convergence will be required to fully embrace Industry 4.0 opportunities. IT will need to confer with OT on the best way to share operations data more widely while maintaining operational security, critical data context, and real-time access for engineers and operators. Many use cases will require operations data be integrated into enterprise business systems to drive decision making outside the OT environment, where equally strategic decisions must be made in real time. Secure and controlled data access, therefore, must extend across internal functional roles as well as outside the organization with trusted partners. Importantly, the integrity and ownership of the data must be maintained to ensure operations continuity and resilience. An integrated, edge-to-cloud data platform lets companies realize the value of data sharing for use cases such as predictive maintenance, intelligent supply chains, and remote monitoring and diagnostics.

With the capabilities and opportunities of Industry 4.0, new stakeholders and operating models are emerging:

» **Remote engineers.** Asset management encompasses the top set of use cases for the application of new technologies. According to IDC survey data, the average cost of asset downtime for industrial companies is over $125,000 per hour. Many companies are pursuing these use cases through remote monitoring and diagnostics groups that deploy remote engineers and IT professionals to build, manage, and monitor asset models and analytics. But for remote engineers to take advantage of the efficiency of this approach to asset monitoring, performance data must be secure, reliable, and accessible.

» **Business analysts and data scientists.** Artificial intelligence (AI)-powered predictive models for drawing insights from operations data is a new discipline for most industrial companies. Previously, insights relied on the subject matter expertise of experienced engineers and operators. Now, business analysts and data scientists are merging data from operations with business applications to generate unique insights in an automated fashion. These converged data models are most practical to build and execute in the cloud, but the results must be delivered to local engineers and asset operators for implementation.

» **Enterprise decision makers.** Another key opportunity in Industry 4.0 is being able to more directly connect business planning and product/service development teams with operations data. This helps industrial companies develop the insight they need to optimize existing processes, products, and services or move into entirely new business models or markets based on connected product strategies.

» **Partners and suppliers.** Operations data also benefits a company's ecosystem of partners. As an extension of the intelligent supply chain, technology partners, materials suppliers, and channel partners are all becoming more tightly integrated into industrial operating models. The frictionless exchange of salient data to support efficient collaboration is the corollary enabler — or key bottleneck, if done poorly — to the success of these initiatives.

In each of these instances, data from a variety of sources must interact with and be analyzed in tandem with data from operations. Yet the applications and sources of these data are heterogeneous in nature, presenting distinct challenges. Based on the existing architecture and application landscape, sensitivity of the workload, and utilization and compute requirements, industrial applications and data sources will continue to exist in a highly diverse environment where vendor neutrality and interoperability will be key to achieving the organization's objectives (see Figure 2). To ensure secure, frictionless access to operations data requires an edge-to-cloud data platform that can meet the data where it lives and make it available to the new host of applications and stakeholders requiring it.

FIGURE 2: *Operations Data Exists Across a Diverse Environment*

Q *Where will the majority of new operational data be stored and processed?*
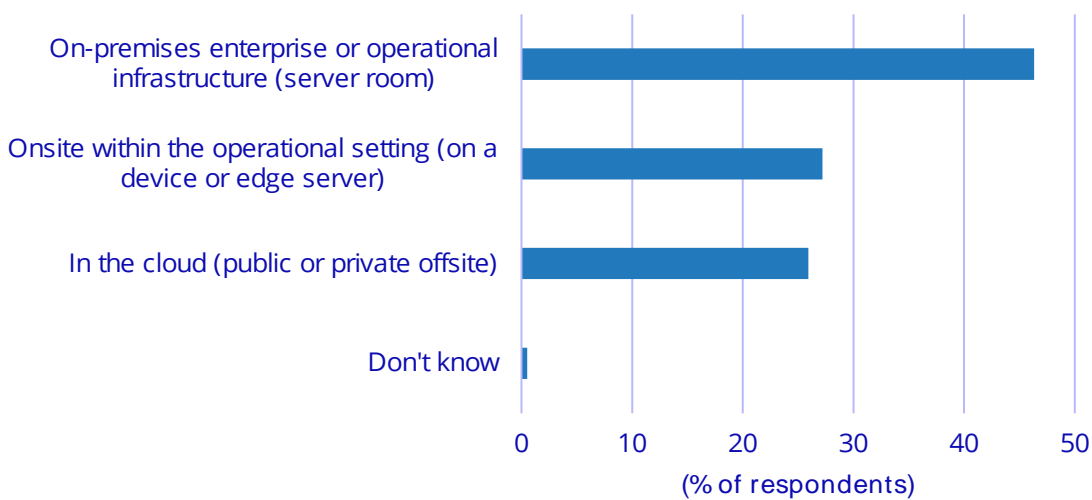
n = 1,014

Source: IDC's Worldwide IT/OT Convergence Survey, 2020

Context Is Key

In addition to offering "common plumbing" to reach experts in OT environments, in IT environments, and at third-party service providers, data platforms must preserve the context of operations data to ensure it is valuable as a resource. Operations are moving toward more standardization and governance in data tagging practices, yet even with common tagging nomenclature, the real context of where and how an asset is performing lies in the models and frameworks created by engineers and operators with subject matter expertise. This is why preserving the metadata and various data tags and models is essential as companies expand data usage to users outside operations.

IDC has observed many organizations struggling to realize value from IIoT pilots and analytics programs due to uncontextualized streaming data. In discussions with these companies, the "handoff" of the data from OT systems into the IT environment and wider enterprise is where the context and value are lost. Therefore, the critical opportunity for companies is to preserve this context and use a common data platform to collect from the operations edge, aggregate with on-premises plant data, and extend data access to any authorized user inside or outside the company, from any location. Given the central role that operations data plays in achieving the benefits of Industry 4.0, companies cannot afford to lag behind their peers in ensuring a smooth handoff from OT to IT systems.

For industrial organizations, having a comprehensive operations data management strategy is key to achieving the promise of Industry 4.0 and unlocking operations insights and efficiencies.

Benefits

For industrial organizations, having a comprehensive operations data management strategy is key to achieving the promise of Industry 4.0 and unlocking operations insights and efficiencies. An integrated edge-to-cloud data platform provides the ability to gather and analyze performance data beyond the primary control network, aggregate data across the organization, and give new users data access to increase operational insight and efficiency. Nonoperations experts get access to near-real-time data with meaningful context in their tools of choice — allowing these experts to conduct more accurate and meaningful analysis more quickly. In addition, this approach allows organizations to leverage a single architecture to manage operations data onsite and enterprisewide, which can then be securely extended to partners, minimizing integration costs and security risks.

Due to the complex nature of the equipment and systems used in industrial companies, assets are often maintained by the original equipment manufacturer (OEM) or a third-party service provider with unique insight on the assets. For these organizations, an integrated edge-to-cloud architecture provides the ability to securely access their clients' aggregated, real-time operations data from their own location. The operational insight they derive lets them develop customized services that deliver differentiated value and improve the client experience. Such services (such as remote monitoring and diagnostics) benefit industrial companies by increasing uptime, reliability, operating efficiency, and safety. In addition to these benefits, OEMs that monitor their own equipment can gather valuable data to help them improve future versions of those products.

Considering the PI System

OSIsoft, now part of AVEVA, is a provider of operations data management software. The flagship PI System was introduced in the 1980s with the vision to empower engineers to drive operational excellence by providing a trusted system of record for operations data. Over time, the PI System has evolved to enable data capture and access from remote locations and data sharing with authorized users outside operations. Today, over 20,000 industrial sites in 146 countries use the PI System to make data-driven operations decisions. In March 2021, OSIsoft was acquired by AVEVA Group, a global provider of industrial software.

The fully integrated PI System product suite is vendor neutral and offers hundreds of ready-to-use options for collecting time series data directly from control systems, operating assets, and sensors. PI Core products provide on-premises data storage and apply contextualization, perform streaming calculations, and make enriched data available to visualization tools. PI Edge products capture and provide access to operations data in remote environments. And, PI Cloud products offer additional flexibility to PI System users, particularly through OSIsoft Cloud Services (OCS), a subscription-based, cloud-native data storage and sharing platform. OCS lets organizations unify operations data across a distributed environment and provides secure, browser-based access to authorized users inside or outside the company.

Challenges for the PI System

While competition from other industrial technology companies has been present, the PI System is differentiated by its ability to collect time series data from a broad variety of industrial systems and contextualize and deliver that data to the tools, applications, and platforms companies use to monitor and analyze their operations.

Today, however, the competitive environment for managing operations data has expanded to include cloud service providers and companies previously focused on IT data management. This shift in the competitive landscape has happened because IT organizations are getting more involved in the architecture for OT data management. It is important for AVEVA to educate the market, especially enterprise IT teams, about the potential advantages of extending access to new users through the integrated edge-to-cloud PI System, rather than handing data off to another platform that could result in loss of data context or meaning. While the PI System caters to operations professionals solving problems in real time, the same platform can be evaluated to meet the needs of data specialists and other roles driving Industry 4.0.

Sharing data across a broader ecosystem offers many benefits and, at the same time, raises certain security and privacy concerns within organizations. To meet this challenge, AVEVA should support customers and partners in a couple of ways: first, by ensuring the security architecture of their edge-to-cloud platform can be well understood, and second, by providing case studies that demonstrate the value of sharing data across company boundaries to achieve the benefits of Industry 4.0.

> Important data context can be preserved by leveraging a common data platform across stakeholders and environments, enabling confident use of this data for a variety of use cases.

Conclusion

In summary, Industry 4.0 transformation and data-driven decision making rely on the availability of secure and contextualized operations data for experts in both operations and non-operations functions. Organizations create and maximize business value

through the secure, frictionless movement of data and context from the operational endpoints where they are generated to the data science platforms and enterprise applications where the data and context support new use cases and data-driven decision making. As in a game of telephone, the meaning of operations data can be lost along the way. Important data context can be preserved by leveraging a common data platform across stakeholders and environments, enabling confident use of this data for a variety of use cases. In this way, an integrated, edge-to-cloud data management platform can become the foundation to achieve industrial transformation and reach Industry 4.0 goals.

About the Analysts

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Jonathan Lang is Research Manager for IDC Manufacturing Insights responsible for the Worldwide IT/OT Convergence Strategies practice. Mr. Lang's research focuses on digital transformation strategies in environments where operations technologies are deployed including manufacturing, utilities, oil and gas, and healthcare provider settings. As IT capabilities redefine and extend the core value drivers of operations technologies, Mr. Lang's research examines strategies, road maps, and governance models to drive this convergence and manage the new data and processes it requires.

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Stacy Crook is a Research Director with IDC's IoT Research Practice. In this role, she provides coverage of key trends across the IoT landscape, with a specialization on the software organizations leverage to manage IoT endpoint devices and connectivity; collect, process, visualize, and analyze IoT data; and integrate IoT data into other applications, systems, and services.

MESSAGE FROM THE SPONSOR

The PI System: Edge-to-Cloud Operations Data Management

The world's most essential and complex industries rely on OSIsoft, now part of AVEVA, to manage the lifeblood of the industrial enterprise: operations data. The market-leading PI System provides edge-to-cloud operations data management to help organizations meet next-generation demands for efficiency, reliability, security, sustainability, and resilience. The PI System is the proven system of record for operations in critical sectors such as power generation and utilities, water, oil and gas, mining, metals, manufacturing, pharmaceuticals, facilities, transportation, food and beverage, and more. Every day, industrial professionals around the globe rely on the PI System to improve performance, protect health and safety, keep the lights on, and make the world run more smoothly.

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