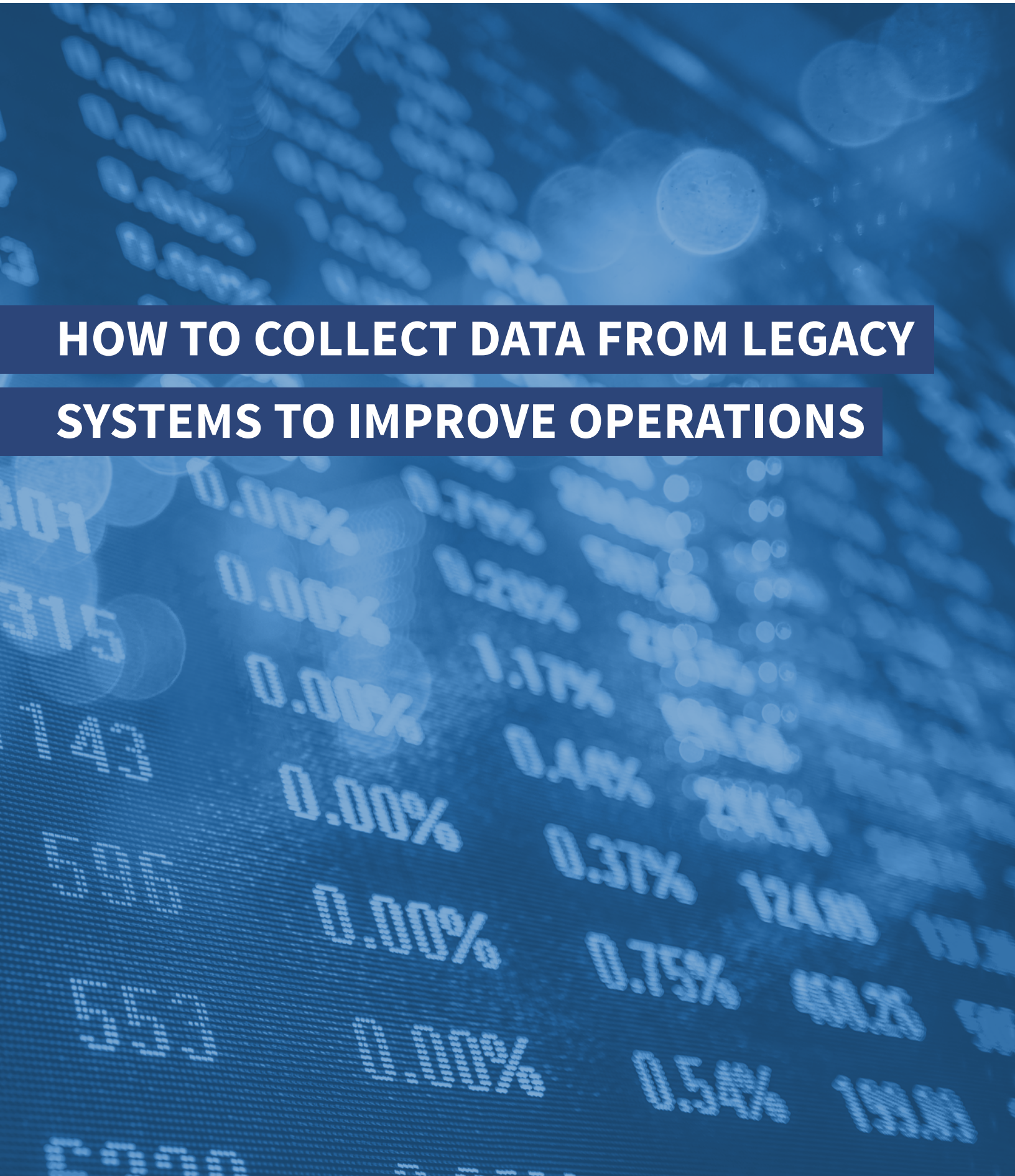
MachineDesign



HOW TO COLLECT DATA FROM LEGACY SYSTEMS TO IMPROVE OPERATIONS

Of all the benefits the industrial Internet of Things (IoT) delivers, one stands out: it's a next-generation solution that doesn't force adopters to abandon existing machines. Instead, industrial IoT offers manufacturers an opportunity to give new life to legacy equipment that can be complicated and costly to monitor and maintain. As they age, these assets suffer frequent breakdowns, resulting in expensive repairs and costly downtime. Also, decreasing efficiency and inconsistent performance leads to lower production yields.

Rejuvenating old assets, which can be a source of confusion, provides **real benefits.** The benefits are twofold.

By connecting and monitoring assets via an industrial IoT solution, manufacturers extract maximum value from them, as improved maintenance increases their uptime and extends their lifespan. Second, for most manufacturers working to achieve industrial IoT integration, a strategy of "rip and replace" of infrastructure is too expensive, costing too much money, time and disruption. Upgrading and connecting existing equipment is often the most viable option.

Still, the questions remain: how, specifically, can organizations connect existing systems—some which are several decades old and use an array of outdated and incompatible communication protocols and methods—to next-generation systems so they can maximize the industrial IoT's promised competitive advantages? Just as important: how do organizations achieve such integration quickly, cost-effectively and with little to no downtime?

According to a recent Forrester Consulting study, manufacturers struggle with network connectivity issues and data management complexity, but that isn't stopping them from "continuing to increase their investments in connected devices." The potential "business changing impact that IoT can have on their organizations," the report notes, is simply too compelling.[1]

The Fundamentals

The good news is that most manufacturers have made headway in what many experts say is the first stage of a digital transformation – the computerization stage. Starting long before IoT was a concept, most manufacturing operations computerized and automated specific processes to ensure quality and to drive efficiency.

The CNC milling machine is a prime example. Using computer numerical control, manufacturers can machine parts with great precision. Still, in most cases, the computer-aided design (CAD) data detailing the machine's operation often has to be transferred to the milling machine manually—in other words, the two systems lack a connection.

Another example includes business application systems, such as enterprise-resource planning (ERP), which integrate the management of business processes but often lacks a connection to all plant-floor systems, such as quality assurance. Without the integration of ERP and quality systems, it is difficult to associate recorded test results with a corresponding work order, making it challenging to associate quality issues with specific orders.

Connecting these "islands of automation" has long been a goal, albeit with limited options. Machine to machine (M2M) communication, for example, can connect a device to software that automatically performs a function, such as placing orders to replenish inventory. Computer integrated manufacturing (CIM) offers a more extensive integration across production. Yet CIM does not connect the entire enterprise.

These early integration efforts mean that manufacturers already have smart devices and fairly extensive networking on the plant floor. The sensors already in place will help move them into a digital future.

Where individual assets do not have integration capabilities, a small technology upgrade is often all that is needed to make the connection and increase efficiency. Adding sensor technology to these unconnected assets gives them the ability to capture data on critical operating conditions and send it to an IoT system.

With the industrial IoT, which standardizes communication protocols on the plant floor and throughout the manufacturing business, and with new, inexpensive sensor technology, these assets—devices, equipment, machines and applications—can be connected enterprise-wide.

Connecting and Monitoring

The most efficient path to digitalization is partnering with a best-of-breed, third-party IoT platform as a service (PaaS) solution that offers out-of-the-box connectivity solutions. Although a “rip and replace” or in-house solution strategy can theoretically deliver enterprise-wide connectivity and end-to-end integration, both strategies are cost prohibitive, time intensive, disruptive and unnecessary. With manufacturing equipment designed to last two to three decades, no one wants to decommission assets before they’re obsolete, even while deploying new, up-to-date equipment may seem the easiest way to become a digital enterprise. Further, embarking on a go-it-alone approach limits the speed with which integration can be achieved. An in-house solution requires

specialists and technicians that need time to design, test and deploy solutions, as well as to learn new protocols and technology. This approach tends to start with very small, specific pilots, which can be difficult and time-consuming to extend enterprise-wide as well as rapidly update.

PaaS IoT operating systems allow organizations to integrate their existing machines and physical infrastructure with web- and enterprise-based systems into a central location. As a result, the systems allow manufacturers to easily and quickly gather the data from all their devices and present it thematically in context in one place—even for legacy assets.

The first step toward making legacy systems IoT-ready is to fully enable the collection of data from them. Most plants will have a mix of old and new machines with varying protocols – which makes uniform connectivity difficult to achieve. But while this is challenging, it is not impossible. There are PaaS open, cloud-based IoT operating systems, such as Siemens' MindSphere, that offer a collection of hardware and software solutions that facilitate the connection of assets regardless of their type, brand, age, protocol or communication standard. A robust IoT platform allows organizations to enable communication with legacy equipment's protocols and components, such as PLCs, control applications and embedded sensors, as well as to integrate data from other systems, such as historians, ERPs, manufacturing execution systems (MES), supervisory control and data acquisition (SCADA), and distributed control systems. Furthermore, choosing a cloud-based solution means companies can enable such connectivity

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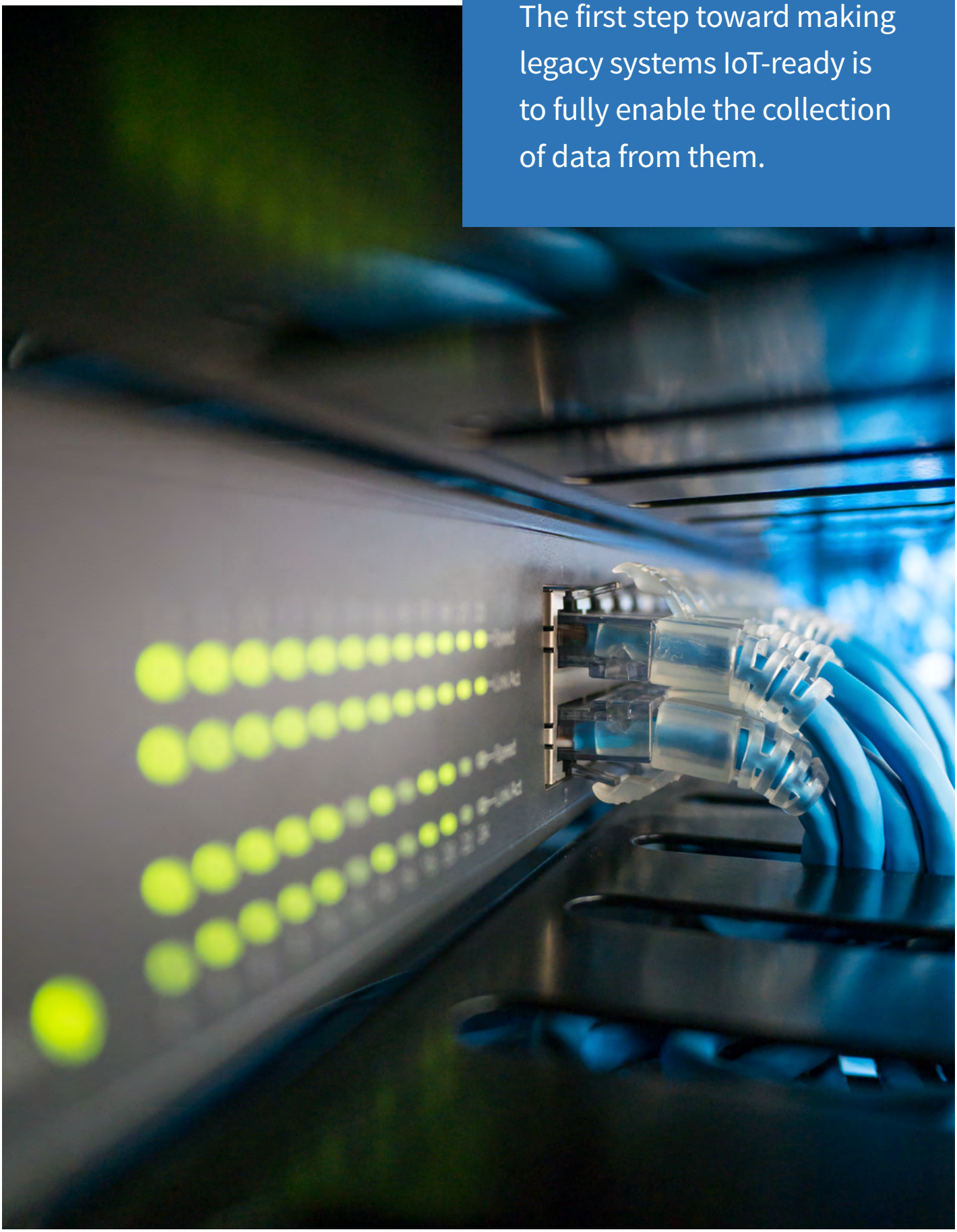


across multiple plants throughout the world, bringing the enterprise-wide data together under a single administrative platform.

Once machines are collecting data and sending it to the IoT platform, companies are able to have full transparency over their operations and flexibly access a global base of ready assets to efficiently extract data for observation and analysis. For example, sensors can monitor electric motors for operating temperatures, vibrations, rpms and power usage; they also can monitor conveyors for speed, energy usage, vibration, product counts, spaces between products and whether there is a misalignment of products.

In summary, connecting legacy systems will often involve adding devices to machines to capture and make available specific data to the IoT. Find an IoT solution that provides devices that enable direct and secure connection for both greenfield and brownfield installations. Also, look for plug-and-play connections, which reduces production downtime when adding assets. Once connected, manufacturers have unprecedented transparency across their entire operations to not only optimize processes, but also develop new business models that increase profitability.

Analyzing and Predicting

Robust IoT operating systems analyze the data produced by connected machines and devices, both on-premise and in the cloud, as well as at the edge. With quick access to all connected assets along with current and historical data in one place, manufacturers can quickly turn data into actionable insights. Look

for an industrial IoT platform that offers ready-made applications and APIs that facilitate advanced analytics. MindSphere, for instance, offers its Visual Flow Creator app, which transforms incoming data in real time. Aggregated data that's integrated with in-line analytics services generates actionable insights – often these insights are visible on dashboards and can be set up to send email notifications. These types of capabilities enable condition monitoring, predictive maintenance, asset performance optimization and similar use-case best practices that increase asset productivity, availability and utilization.

In addition to workflow-based data acquisition, management and integration, some IoT solutions provide a secure, raw data-access layer for integrated analytics. Manufacturers can deploy advanced analytic capabilities, which execute more sophisticated analytics and machine-learning techniques on data.

Securing

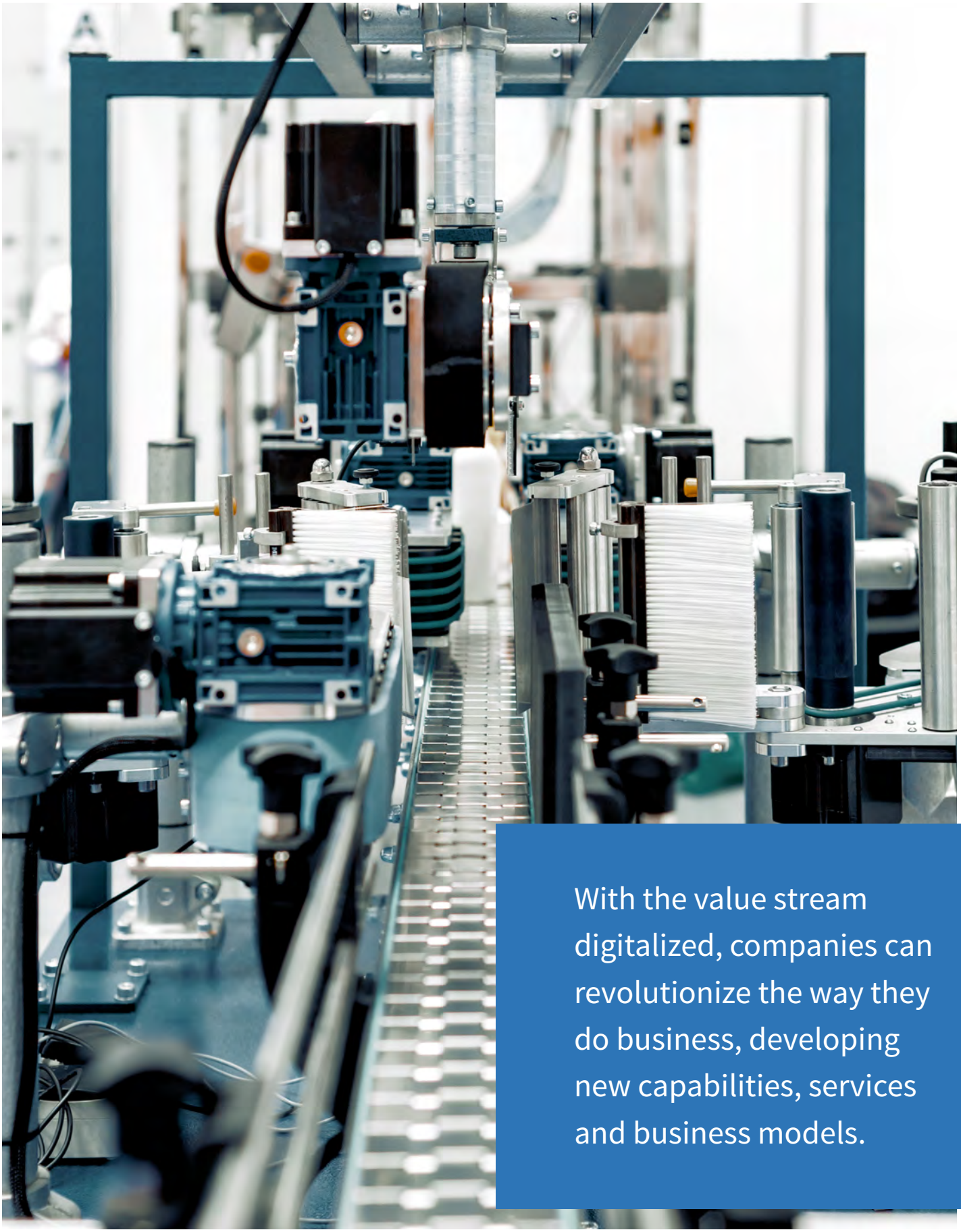
Initial security concerns and questions about data ownership caused manufacturers to be wary of linking machine data to the internet or using a third-party platform. Sending data from their 24/7, mission-critical systems to the relatively unstable internet seemed a preposterous idea. Also, they wondered if sharing detailed operations data would result in the loss of control. However, new solutions have assuaged these fears. Modern-day IoT solutions provide security during data acquisition in the field, and during transmission and storage in the cloud. In most IoT system solutions, customers own their respective data, which is treated with maximum confidentiality. With full control of access and authorization, access protection, tenant segmentation and encrypted

communications, manufacturers can be confident that their data remains confidential and protected from manipulation by unauthorized external parties.

Digitalizing and Transforming

Soon after integrating legacy equipment into the industrial IoT system, opportunities arise to extend the return on investment (ROI) of connecting systems beyond the plant floor. With data in one location, manufacturers can build analytical models and gain new insights from integrated data sets and analytic tools, which will allow them to implement automated predictive and prescriptive processes on the plant floor, as well as create new business models, such as product as a service, commonly referred to as anything as a service (XaaS).

The best third-party solutions offer application programming interfaces (APIs) to further automate enterprise management and decision-making. APIs simplify the programming needed to execute specific actions, such as collecting data from a machine and making it available to, say, a human machine interface (HMI) dashboard for immediate use, or to a data analytics tool to track trends. In many IoT-based third-party solutions, APIs that execute specific actions, such as signal validation or anomaly detection, are included in the solution or are available as modules that can be added to the system. In some cases, third-party solutions offer open-source application development capabilities, which allows manufacturers to easily and quickly create new applications. The latter two capabilities allow manufacturers to customize their implementation.



With the value stream digitalized, companies can revolutionize the way they do business, developing new capabilities, services and business models.

By seamlessly integrating applications with operational data throughout the value chain, companies can leverage data at all points from product ideation, realization to utilization lifecycle stages. That means, for example, that product lifecycle management (PLM) services can be integrated into the platform, providing real-time and accumulated data on performance, thus creating digital twins of the product, production and performance. With the value stream digitalized, companies can revolutionize the way they do business, developing new capabilities, services and business models.

An industrial IoT system also empowers the integration of other powerful, new technologies, such as augmented reality (AR), collaborative and connected robotics and machine learning to adapt to a continually changing business environment as quickly as possible. The most innovative companies will not only reduce cycle times, increase yields and create new business opportunities, they will also dramatically improve their bottom line by implementing technology to improve their product throughout its entire lifecycle with insights gained using closed-loop digital twins from design through production and back again.

Reaping the Rewards with a Fully Transparent Factory

By seamlessly connecting legacy equipment and new machinery, uniting outputs from a multitude of sensors, and normalizing their communications methods, you can operate your entire enterprise as a single unit with detailed oversight and control. Such seamless integration of operational data throughout the value chain not only drives greater operational transparency and performance, but also

enables comparisons of simulation and test results with real-world observations to boost performance, sharpen your competitive advantage and help you realize much more profitability.

With an industrial IoT system that connects new and old assets, you can implement proactive maintenance strategies, such as condition monitoring, predictive maintenance and prescriptive maintenance to service assets at the right time and frequency—before downtime occurs. This capability enables you to maximize asset availability and productivity, prolong asset life by reducing mechanical failure and eliminate costs incurred from inefficient maintenance practices.

Also, by gaining real-time visibility with the IoT, you can optimize the performance of your entire factory with key performance indicators (KPIs), identifying precise performance thresholds and quickly diagnosing deviations, which is especially critical to extending legacy equipment's productive life. You will be able to continuously improve asset performance based on redefined KPI baselines, rapidly identify and service assets that are performing sub-optimally, and utilize assets at their peak production rates without incurring downtime.

Additionally, you can increase process efficiency through in-depth, real-time transparency into your factory processes. You can identify unnecessary or excessive steps and resource use to reduce waste and accelerate production. The IoT system will allow you to simulate processes to ensure efficiency under a variety of conditions, better understand and control energy consumption, and automate manual tasks to lower costs and deliver more consistent results.

Third-party, cloud-based IoT operating systems deliver quick, flexible, secure and cost-effective connectivity solutions to leverage your existing infrastructure. Once connected to the cloud, you can create a big-picture view of your operations and pave the way for new digital service offerings.

With an IoT solution, you will quickly and easily be able to:

- Connect disparate systems and machines across the shop floor and across plants.
- Minimize investment while maximizing connectivity.
- Transmit data from the entire shop floor and immediately start monitoring assets.
- Unlock the full potential of legacy equipment.

By connecting legacy equipment with a cloud-based, IoT system, you will accelerate your digitalization journey with little disruptive risk.

This content was developed together with Siemens Digital Industries Software.

To learn more about the industrial IoT and how you can modernize your aging assets, visit **www.siemens.com/mindsphere.**

1. Digital Twins And Data Insight Enhance Benefits For Firms At All IoT Maturity Levels: Closing the Loop Between Product, Production, And Performance, Forrester Consulting, May 2019.